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UNITED NATIONS ENVIRONMENT PROGRAMME

CHEMICALS BRANCH, DTIE

Study on the possible effects on Human Health and the Environment in Asia and the Pacific of the trade of products containing Lead, Cadmium and Mercury

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Special contributions were received from Lee Bell and his team and Björn Beeler.

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[1] MT = metric tonnes

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Executive Summary

UNEP Governing Council through its Decision 25/5 II taken in February 2009 noted that the import and export of new and used products containing lead, cadmium and mercury, remains a challenge for developing countries and countries with economies in transition which lack the capacity to manage and dispose of the substances in products in an environmentally sound manner. This study reaffirms the concerns of the Governing Council and can confirm that developing countries in the Asia and Pacific region remain challenged by the management and disposal of products containing lead, cadmium and mercury. Even developed countries in the region are grappling with policy and technology solutions to the problems presented by products containing these metals.

The international community has focused on the potential impact of these toxic heavy metals because of their widespread use, global distribution, and broad population exposure and potential impacts. These concerns are underscored by a recent Blacksmith Institute study of the world's worst pollution problems which conclude that lead and mercury represent the greatest toxic threats to humans out of all possible pollution sources. Ten million people are at risk from identified sites of lead pollution and up to twenty two million people are estimated to be at risk globally from lead contamination. Identified sites of mercury contamination are estimated to directly affect 8.6 million people with potential for secondary impacts on up to 19 million people globally. The number of people at risk is expected to rise as the Blacksmith institute continues to assess a growing list of polluted sites.

The global trade in products containing these metals is dominated by the Asian region with China featuring prominently as the primary importer of metal bearing articles and exporter of products. China dominates product flows including lead mining and exports of lead containing products although Australia is also a major exporter of lead to Asia followed by the Republic of Korea. China leads regional imports of products containing lead followed by the Republic of Korea, Japan and India. The products containing lead that are most commonly imported into Asian countries are lead ores and concentrates followed by lead vehicle batteries and then computers. The products containing lead that are most commonly exported in the Asia and Pacific region are unwrought lead followed by computers and lead acid batteries.

China continues to lead global cadmium refinery production followed by the Republic of Korea, Japan and Kazakhstan. China's exports of products containing cadmium exceed exports of all other countries of Asia and the Pacific by a factor of at least fifty. Indonesia is a leading importer of cadmium bearing products followed by Malaysia, Papua New Guinea, Bangladesh, Iran, Australia and Japan (these imports are mainly fertilisers). China is the highest importer of plastics additives while the Republic of Korea and Indonesia import the majority of NiCd batteries. Fertilizers make up around 80 percent of all exports of products containing cadmium in Asia and the Pacific followed by anti-oxidisers and stabilisers for plastics and then nickel-cadmium batteries.

Global mercury production continues to be dominated by China (73%), Kyrgyzstan (13%) and Peru (7%) with total global mine production estimated at 1920 MT in 2009. Export of mercury bearing products is led by the Republic of Korea, and then China, Japan, Hong Kong and Malaysia. The leading importers of mercury containing products are Hong Kong, then Republic of Korea, China, Japan, Singapore, Malaysia and India. The major imported products bearing mercury are electric switch relay circuits, then data processing machines, thermionic and cold cathode valves and tubes and TV's. The major exported products are electric switch relay circuits, thermionic and cold cathode valves and tubes, data processing machines, TV's and fluorescent lamps. Hong Kong is only listed separately to China for trade statistical purposes to assist in tracking ports of transit, import and export of shipped goods and its contribution to trade flows should be regarded as a subset of China's overall trade.

While the scope of this study is to investigate and report upon trade in products containing lead, cadmium and mercury and their potential to impact health and the environment in the Asia and Pacific region, it is clear that certain processes contribute to human and environmental exposure to these heavy metals. Some of these processes release lead, cadmium and mercury as an unintentional by-product such as mercury from coal burning or gas extraction. Other processes cause releases and directly involve products bearing these metals such as waste incineration, used-lead acid battery recycling, e-waste recycling and artisanal gold mining using elemental mercury as a product for amalgamation. All of these products and processes require prompt global attention and action to prevent further human exposure and environmental impact.

Exposure to lead, cadmium and mercury from the products that contain them in Asia and the Pacific region occurs from use of and direct contact with certain products (lead in paint and jewellery, mercury in artisanal gold mining and dental amalgam) but also from the disposal phase of these and other products. The recycling of certain articles such as used lead acid batteries and electronic waste by the informal sector in developing countries has been demonstrated to lead to high exposure rates for humans and significant environmental impacts. The methods by which precious metals are extracted (breaking, smelting and acid reaction) from these products lead to heavy exposure among workers and their families who do not used protective equipment. Occupational exposure in the formal recycling sector of many countries also requires higher standards and regulation to prevent health impacts among workers. The same issues apply to workers engaged in mining and refining of lead, cadmium and mercury and the manufacture of products containing these metals. Burning of products containing lead, cadmium and mercury in their disposal phase is also a major source of exposure. Open burning of remnants from e-waste recycling, discarded products containing heavy metals and municipal waste is a significant source of human exposure to lead, cadmium and mercury. Open burning of wastes is a common practice in Pacific Island countries. Incineration of wastes and disposal phase products bearing lead, cadmium and mercury in the formal sector has also been identified as a significant source of heavy metals releases – particularly mercury. Controlling airborne mercury emissions from waste incineration with improved flue gas cleaning does not resolve the problem as the mercury is transferred to ash and is disposed of to the environment.

The illegal trade in products containing lead, cadmium and mercury is largely limited to used products and products at the disposal phase. The illegal trade in these materials is growing despite international efforts to detect and prevent illegal shipments with up to 1.5 million containers of illegal waste shipped annually. Common materials shipped illegally include used lead acid batteries and electronic waste shipped under the guise of used products for refurbishment. Development of pre-export inspections and tighter reporting and tracking requirements for cargo may reduce the illegal shipments over time.

Releases of lead, mercury and cadmium from the products which contain them represent a major source of environmental contamination that requires a concerted international effort to overcome. Many initiatives have been developed and implemented in countries around the world to reduce releases and exposure to these metals and to seek alternative processes that do not have such releases. However, many countries do not have the resources to manage these products in their waste phase and are unlikely to have that capacity in the foreseeable future. Under these circumstances the most effective way to reduce releases of these metals from products is to substitute lead, cadmium and mercury in the products with alternative non-hazardous materials. There are very positive signs in some sectors (such as mercury in medical settings) that uptakes of alternative materials are taking place and releases and exposures are reduced commensurately. The industrial design phase of products is critical to the implementation of alternatives and has proven responsive to international regulation and control of hazardous substances in the past. Substitution of lead, cadmium and mercury at the design phase of products should be a priority for action.

Where alternatives cannot be found and widespread use of certain products containing lead, cadmium and mercury continue, the life cycle of these products requires a much higher degree of scrutiny. Such products require a more sophisticated tracking system, meaningful extended producer responsibility and high rates of environmentally sound recycling to reduce the human exposure, environmental contamination and extraction of virgin metals that generate subsequent releases. The complexity of the tasks involved in managing such products from manufacturing, shipping, use, recycling and disposal in both formal and informal sectors on a global scale may require concerted international action.

While this study examines products containing lead, cadmium and mercury in the Asia and Pacific region a great deal of the focus is on Asia where the trade flows are concentrated. the Pacific Island countries are not major contributors to this trade but clearly have challenges associated with the recycling and disposal phase of such products. Products that become e-waste are rapidly accumulating in the Pacific Island Countries (PICs) who are remote and have extremely limited land space and infrastructure to manage these wastes. There is a valuable opportunity for the international community to assist PICs to manage these materials with take-back programs, infrastructure assistance and technology transfer before the scale of the challenge becomes unmanageable and this should be prioritised.

It is important when interpreting the trade statistics in this study to be aware that product statistics are recorded by weight and value. This does not correspond with the total weight of lead, cadmium and mercury in the products being traded. As an example, total lead acid battery weight is mostly refined lead where the lead in a laptop computer is a relatively small fraction of its total weight. It would add significant value to this study and similar studies to conduct further research into the average weight of lead, cadmium and mercury in the products studied to develop an approximation of the total tonnage of lead, cadmium and mercury that is present in the trade flows of these products across the globe.

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND

UNEP is the principal driving force in the United Nations system for international activities related to the responsible management of chemicals. The aim is to promote chemical safety and provide countries access to information about toxic chemicals. UNEP promotes chemical safety through policy advice, technical guidance and capacity building in developing countries and countries with economies in transition, including activities on chemicals related to the implementation of the Strategic Approach to International Chemicals Management (SAICM).

The Governing Council of UNEP (United Nations Environment Program) through its Decision 25/5 II, adopted in February 2009, noted that the export of new and used products containing lead and cadmium is still a challenge for developing countries and countries with economies in transition, which lack the capacity to manage and dispose of substances in products in an environmentally sound manner. It also brings together efforts of governments and others to reduce risks to human health and the environment imposed by lead and cadmium throughout their life cycle and adopt measures to promote the use of appropriate lead and cadmium free alternatives.

At the request of the UNEP Governing Council from its 23rd through its 25th sessions, UNEP developed reviews of scientific information on lead and cadmium; which is currently being updated with the latest data available. The final reviews of scientific information will be presented to the Governing Council of UNEP at its 26th session on February 2011 with a view to informing discussions on the need for global action in relation to lead and cadmium.

The second session of the International Conference on Chemicals Management (ICCM2) in May 2009, examined four emerging policy issues in order to establish cooperative action. Resolution II/4 contains the measures agreed upon regarding lead in paint, among others, currently realized through the GAELP (Global Alliance for Elimination of Lead in Paint).

A previous study to the current study was carried out in Africa i.e. "*Study on the possible effects on human health and the environment in Africa of the trade of products containing cadmium, lead and mercury"* (completed in December 2008 and presented at the Informal Workshop on Stakeholders' Information Needs on Chemicals in Items/Products, in Geneva, Switzerland of 9-12 February, 2009). This study has been replicated in Latin America and the Caribbean and the report "*Analysis of trade flow and review of environmentally sound management practices related to products containing cadmium, lead, and mercury in Latin America and the Caribbean*" which can be accessed at the UNEP Website.[2]

The African study analyzed the global flow of products containing cadmium, lead and mercury to and from Africa. In order to do this it was necessary to identify the databases related to trade statistics, investigate current initiatives in African countries that address negative impacts of products containing cadmium, lead and mercury, as well as case studies of good waste management and the effects of heavy metal trade to humans and the environment. The initial study of Africa, is being replicated in both Latin America and the Caribbean as well as in Asia and the Pacific, therefore the results obtained would contribute to the overall management of products containing cadmium, lead and mercury including their waste, and support decision making of the Governing Council of UNEP.

This study on the possible effects on human health and the environment in Asia and the Pacific of the trade of products containing lead, cadmium and mercury has been prepared with support by the Nordic Council of Ministers and the assistance of the International POPs Elimination Network (IPEN).

1.2 AIM OF THE STUDY

The main objective of this study is to address the data gaps identified in the UNEP Draft Final Review of Scientific Information on Lead and the UNEP Draft Final Review of Scientific Information on Cadmium where they relate to the trade in *products* that contain lead and cadmium. This study also investigates trade flows for products that contain mercury. In particular the study seeks to address the global trade flows of these products in and out of the Asia and the Pacific region in accordance with decisions 24/3 and 25/5 II of the Governing Council of the UNEP.

The other major objective of the study is to supplement existing knowledge and consolidate the available information on global trade and flow of products containing lead, cadmium and mercury with the intention of providing a basis for further measures to address the impacts of these heavy metals in the Asia and the Pacific region. The analysis of trade, management systems and national initiatives to address mercury, lead and cadmium in products across the Asia and the Pacific region highlights areas of concern where possible environmental and human health impacts from these metals can be identified and strategies developed to address them.

1.3 SCOPE AND ORGANISATION OF THE STUDY

The study has a primary focus on data analysis of the trade, use and disposal (waste phase) of products containing lead, cadmium and mercury in the Asia and the Pacific region to identify the possible human health and environmental impacts arising from the release of these toxic elements from the products that contain them. While it is not within the scope of this study to assess *processes* that use and emit lead, cadmium and mercury some processes are discussed briefly due to their role as sources of emissions. Examples of processes include coal fired power generation, chemical production and artisanal small-scale gold mining. Extensive research and literature is available on these processes and the reader is directed to those sources.

[2] http://www.unep.org

This study identifies;

a) databases related to trade statistics for products containing heavy metals

b) initiatives, policies and strategies to mitigate the potential human health effects of products containing these toxic heavy metals

c) case studies related to management of these products and initiatives that progress that management toward an environmentally sound basis to reduce negative effects on humans and the environment.

The study is divided into seven chapters dealing with various aspects of the trade in products containing lead, cadmium and mercury. Chapter 1 describes the background, aims, scope and methodology of the study. Chapter 2 provides an overview of lead, cadmium and mercury including their incorporation into a variety of products while Chapter 3 describes the known and potential toxic effects of these metals on human health and environmental receptors. Chapter 4 details the main organisations and databases that provide trade statistics that are utilised in this study. Chapter 5 provides an analysis of the product types and volumes of trade in products containing lead, cadmium and mercury as well as major trade routes, importers and exporters within the Asia and Pacific regions for the period 2000-2009.

Chapter 6 comprises two significant sub-sections. Firstly, it provides an overview of the major international, national and regional environmental initiatives in Asia and the Pacific regions to manage and regulate trade in products (and waste) containing the three heavy metals as well as criteria to restrict emissions of lead, cadmium and mercury and assess or control contamination levels of various media (soil, water, air, foodstuffs). Secondly, Chapter 6 examines the scale of the illegal (and legal) trade in products and wastes (end of life products) primarily in the form of e-waste in Asia and the Pacific region. This section also considers examples of good management practices and improved policies and regulations across the region to manage the most damaging aspects of this trade.

Chapter 7 provides case studies from Samoa, India, the Cook Islands, Sri Lanka, and Nepal examining management practices for products containing lead, cadmium and mercury and their potential effects on human health and the environment in those countries. Products include Used Lead Acid Batteries (ULABs), e-waste, leaded paint, children’s jewellery and medical equipment utilising mercury and includes laboratory analysis of the heavy metal content of selected products.

1.4 METHODOLOGY OF THE STUDY AND SOURCES OF INFORMATION.

This study provides an analysis of the trade flows of products containing lead, cadmium and mercury throughout Asia and the Pacific region. The primary source of information to assess trade flows and trends is the United Nations Comtrade database. The database contains statistics on products which are classified by harmonised international codes (each product or product type has a unique code) and records the annual export, re-export, import and re-import of each product between trading partners.

For the purposes of this study trade data for the products identified at Tables 4-1, 4-2 and 4-3 has been extracted from the database and imports and exports of these products from the Asia and Pacific regions has been analysed. Many countries have been aware of the human health and environmental impacts of products containing lead, cadmium and mercury for some time and have developed a range of initiatives to prevent, restrict or mitigate these impacts. A range of national and international initiatives relating to these impacts have been identified and reported in Chapter 6 where they relate to the scope of the study.

Chapter 6 also includes a section that addresses the issue of illegal imports and exports of products containing lead, cadmium and mercury and international initiatives to prevent this trade. Electronic waste (e-waste) has featured prominently among international illegal shipments, especially in Asia. The management of e-waste in Asia and the Pacific region is documented in some detail for selected countries and includes initiatives for good management of e-waste that are emerging in many countries.

Case studies from the Asia and Pacific region have also been included in Chapter 7 to highlight the diversity of product-related impacts as well as management measures undertaken to address the problems. Some of the case studies include laboratory analysis of the products of concern and measures being undertaken to ensure future management of the products is environmentally sound.

A number of databases were considered in the development of the analysis of trade flows of products containing lead, cadmium and mercury. While the primary data source was the UN Comtrade database, other trade databases were also consulted and data included in this study if it added value to the analysis. Other databases examined include

- the *Interactive Tariff and Trade DataWeb* of the United States International Trade Commission (USITC)[3],
- *Eurostat* which is the statistical database of the European Commission[4]
- World Trade Organisation[5] *International Trade Statistics*
- World Customs Organisation Commodity database[6]

In addition to trade databases information on the implications of trade in products containing lead, mercury and cadmium has been sourced from the UN Scientific reviews of lead and cadmium, the UNEP Global Mercury Assessment and a wide variety of publications from academics, IGO’s, NGO’s national governments and other organisations concerned with the human health and environmental impacts of lead cadmium and mercury.

[3] http://dataweb.usitc.gov/
[4] http://epp.eurostat.ec.europa.eu/
[5] http://www.wto.org/english/res_e/statis_e/its2010_e/its10_toc_e.htm
[6] http://www.wcoomd.org/

This study also draws upon the work of the International Lead and Zinc Study Group (ILZSG)[7] and The International Cadmium Association[8]. Where relevant, information arising from international forums, conferences and presentations has been incorporated in the study. Sources include meeting proceedings, publications and statements by the Basel Convention, SAICM, and the Intergovernmental Negotiating Committee of UNEP (particularly the work of INC 1).

Due to structural limitations in some of the other databases consulted, we primarily drew upon the UN Comtrade database as the primary source of import and export flow data for products containing lead, cadmium and mercury. These data relating to these products was extracted from the database according to their specific codes and analysed for the period between 2000-2009 for Asia and the Pacific regions including trade with partners outside of these regions. The data relating to these trade flows is presented in graphs and tables and subject to analysis in Chapter 5 of this study.

The study period of 2000-2009 provides sufficient scope to analyse the trends developing in relation to particular products which, in turn, permits a more accurate focus on priorities for the development of measures to ensure the environmentally sound management of certain products. Substitution of lead, cadmium and mercury in products for less harmful materials may also have a bearing on demand for the products containing the harmful metals and in some cases this can be observed in trends derived from the Comtrade database.

1.5 REGION OF STUDY – ASIA AND THE PACIFIC.

The population distribution of the region under study is presented in the table below. Asia accounts for approximately 99% of the population under study and this is reflected in the trade data where the Pacific has a small population and relatively low trade volumes. There are some exceptions in the Pacific such as Australia (which is not a PIC) which plays a major role in global supply of lead.

[7] http://www.ilzsg.org/static/home.aspx
[8] http://www.cadmium.org/

Table: 1-1 Asia and Pacific Region Population

Asia	Population[9] (000's)	Pacific (the Pacific)	Population (000's)
Afghanistan	29,117	American Samoa	69
Bangladesh	164,425	Australia	21,512
Bhutan	708	Christmas Islands	1.3
Brunei Darussalam	407	Cocos Islands	0.62
Cambodia	15,053	Cook Islands	20
China	1,354,146	Fiji	854
China Hong Kong SAR	7,069	French Polynesia	272
China, Macao SAR	548	Guam	180
Dem. People's Rep. of Korea	23,991	Heard Island and McDonald Islands	No resident population
India	1,214,464	Kiribati	100
Indonesia	232,517	Marshall Islands	63
Iran	75,078	Micronesia	177
Japan	126,995	Nauru	10
Kazakhstan	15,753	New Caledonia	254
Kyrgyzstan	5,550	New Zealand	4,303
Lao People's Dem. Rep	6,436	Niue	1
Malaysia	27,914	Norfolk Islands	2
Maldives	314	N. Mariana Islands	88
Mongolia	2,701	Papua New Guinea	6,888
Myanmar	50,496	Pitcairn	0.045
Nepal	29,853	Samoa	179
Pakistan	184,753	Solomon Islands	536
Philippines	93,617	Tokelau	1
Rep. of Korea	48 501	Tonga	104
Singapore	4,837	Tuvalu	10
Sri Lanka	20,410	Vanuatu	246
Tajikistan	7,075	Wallis and Futuna Islands	15
Thailand	68,139		
Timor-Leste	1,171		
Turkmenistan	5,177		
Uzbekistan	27,794		
Vietnam	89,029		
Total	**4,083,000**	**Total**	**35,886**

[9] *Source*: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, *World Population Prospects: The 2008 Revision*, http://esa.un.org/unpp

CHAPTER 2
BRIEF OVERVIEW OF LEAD, CADMIUM AND MERCURY AND PRODUCTS CONTAINING LEAD, CADMIUM AND MERCURY

2.1 BRIEF OVERVIEW OF LEAD (PB)

2.1.1 Lead

Lead in its pure form is a silvery-white metal that oxidizes to a blue-grey colour when exposed to air. It is a metallic element belonging to group IV A of the Periodic table with atomic number 82 and a relative atomic mass of 207.2. Lead has a range of properties that for centuries has made it a popular material for use by humans. Lead is very dense, malleable and can be fused easily. It can easily be worked due to its softness, low melting point, low strength and ease of casting. In the industrial age lead has been in high demand due to its acid resistance, chemical stability in air, water or earth and its ability to attenuate sound waves, ionising radiation and mechanical vibration. It can also be hardened through alloying with small quantities of copper, arsenic, antimony and other metals[10]. These alloys are used widely in lead containing products.

The three chemical forms of lead are metallic lead, inorganic lead compounds and organic lead compounds which contain carbon. Metallic lead does exist in nature but is relatively rare making up only about 0.0013 percent of the Earth's crust. The most commonly mined form of lead is a sulphide ore known as galena (PbS) and generally occurs in combination with elements such as zinc, copper and silver. The most common use of organo-lead compounds has been as an anti-knock additive for petrol. Large-scale commercial use of two of these compounds (tetramethyl-lead and tetraethyl-lead) has gradually been phased out around the globe due to health concerns and only a small number of countries still use leaded fuel.

When exposed to environmental sources of sulphuric acid, metallic lead becomes impervious to corrosion due to the formation of a protective coating of lead sulphate ($PbSO_4$) resulting from the reaction of exposure to H_2SO_4. This property of lead has made it popular for applications such as roofing, containing corrosive liquids as well as pipe-work and fittings for water supply purposes although recognition of lead health impacts has curtailed many of these applications.

In the atmosphere lead exists primarily in particulate form. Anthropogenic sources include automobile exhausts (historical) and industrial emissions. Most industrial lead emission particles are <PM10 with the smallest particles arising from high temperature combustion (<PM1)[11]. The impact of small particles is of serious concern due to their ability to travel thousands of kilometres and penetrate deeply into human lungs which can potentially contribute to a range of health effects. Large lead particles from emission sources tend to deposit to earth within a short distance from the source.

In aquatic environments lead can exist in the following forms[12];

- ionic form (highly mobile and bioavailable)
- organic complexes with dissolved humus materials (strongly bound limited bioavailability)
- attached to colloidal particles such as iron oxide (strongly bound less readily mobile)
- attached to solid clay particles (very limited mobility and availability)

The tendency of lead to adsorb tightly to soil particles means that groundwater is not at high risk from lead infiltration through topsoil although heavily contaminated sites may pollute localised groundwater especially in acidified conditions. In the aquatic environment this tendency is expressed through the movement of lead into the benthic habitat where it concentrates in sediments. The lead in sediments can be re-mobilized due to alterations in water chemistry (particularly reduced pH or changes in ionic composition) potentially increasing bioavailability to aquatic organisms. Dredging of sediments in estuarine environments where contamination is present (such as harbours and ports) can also lead to the liberation of bioavailable lead.

Lead is relatively immobile in soils due to its tendency to adsorb to particles such as clay, iron and manganese oxides. However, human exposure to soils contaminated with lead can lead to ingestion and inhalation of dust particles contaminated with lead which in turn can lead to potentially serious health consequences due to lead intoxication. The lead content in uncontaminated soils of remote areas is generally within the range of 10-30 mg Pb/kg. Lead concentration in soil beside roadways and in towns is reported to be up to several thousand mg Pb/kg, whereas soils adjacent to smelters and lead battery factories are reported at up to 60,000 mg Pb/kg[13].

2.1.2 Sources of lead and products containing lead

China is currently the largest producer of lead from mining in the world with 2009 data[14] indicating production of 1,690,000 metric tonnes, followed by Australia (516,000 MT) and the US (400,000 MT). Chinese lead mines account for 43 percent of total global mine production. Australia produces 13 percent and the US around 10 percent of global mine production. Chinese production as a

[10] UNEP (2008e) *Draft final review of scientific information on lead.* Chemicals Branch DTIE November 2008.p.36-7
[11] U.S. ATSDR (2005): *Toxicological profile for lead*. (Draft for Public Comment). U.S. Department of Health and Human Services. Public Health Service. Agency for Toxic Substances and Disease Registry, Atlanta, U.S.A.
[12] OECD (1993): Risk Reduction Monograph No.1: Lead. OECD Environment Monograph Series No. 65. OECD Environment Directorate, Paris, France.
[13]op cit. UNEP (2008e) p.39
[14] USGS (2010) *Mineral commodity summaries. Lead* U.S. Geological Survey. U.S.A. http://minerals.er.usgs.gov/minerals/pubs/commodity/lead/mcs-2010-lead.pdf

percentage of world total mining production has risen from 30 percent to 43 percent since 2006[15].The sharp rise in Chinese production has been linked to a 25 percent increase in Chinese lead consumption due to strong growth in the automobile and electric bicycle markets[16]. Up to 40 other countries also mine lead but the major global exporters of raw lead products (ores and concentrates) are Australia and South America.

Global mined lead production has declined slightly over the last three decades from 3.6 million tonnes in 1975 to 3.1 million tonnes in 2004. Global lead consumption and refined lead production has increased from 4.7 to 7.1 million tonnes during the same period. The discrepancy is due to the recycling of lead which accounted for up to 45 percent of global lead supply in 2003[17]. The International Lead and Zinc Study Group (ILZSG) estimated that secondary (recycled) lead production represented about 53% of total refined lead production worldwide in 2008 demonstrating a clear rise in the recycled lead globally from 2003 levels. Most recycled lead originates from automotive lead batteries which are scrapped and smelted.

Due to the specific properties of lead described earlier, there are over 50 areas of application for lead in products. The major end-use of refined lead is for lead batteries (also known as lead-acid batteries and lead-acid electric accumulators) which accounted for 78 percent of global reported consumption in 2003. Other prominent applications include lead sheeting, ammunition, alloys and cable sheathing although combined they account for only 10 percent of total consumption.

Lead compounds accounted for 10 percent of global consumption of lead between the years 1970-2003. This included the use of compounds in cathode ray tubes (CRTs) and plastic additives in the electronics industry. Lead pigments in paint and ceramics has decreased significantly in developed countries due to regulatory pressure over health impacts. However, lead in elevated concentrations is still commonly used in paints in developing countries in the Asia and Pacific regions. For further details on this application see case studies at Chapter 7.

Due to the persistence of lead in the environment from soil adsorption one of the most significant lead contamination sources from a ‘product’ has been the addition of lead compounds such as tetraethyl-lead to petroleum for use in vehicles. The historical global use of this product and its geographic distribution means that lead contamination from atmospheric deposition of vehicle exhaust emissions is widespread. Regulations and voluntary actions in most countries of the world have seen leaded petrol phased out. However, it is still used in aircraft and off-road vehicles. In 1979 vehicles released 94.6 million kilograms of lead into the atmosphere in the US alone[18]. Global consumption of lead for petrol additives is estimated to have declined by 95 percent from 1970 levels with 14,400 tonnes consumed globally for this purpose in 2003.[19]

Estimates vary considerably for natural releases of lead. Atmospheric emissions of lead attributed to volcanoes were estimated in 2001 at 1000-10,000 tonnes[20]. The major natural sources of emissions to atmosphere are volcanoes, airborne soil particles, sea spray, biogenic material and forest fires. There is considerable debate around the issue of lead releases from forest fires as there is evidence to suggest it may be re-mobilized lead from anthropogenic origins that has contaminated forests through atmospheric deposition. According to UNEP estimates of total natural emissions of lead to atmosphere vary widely. A 1989 study of total 1983 natural emissions estimated 970-23,000 tonnes/year and a current study estimates 220,000 -4,900,000 tonnes/year. The vast disparity is due to different approaches in estimating lead released from the movement of soil particles. Total anthropogenic emissions to atmosphere were estimated in the mid 1990’s at 120,000 tonnes per annum of which 89,000 tonnes was attributed to leaded petrol emissions.[21] A recent study of snow and ice in the Canadian Arctic indicates that about 95-99 percent of recent lead deposited is anthropogenic.

Although lead is released by similar geological processes to mercury and cadmium (erosion, weathering, volcanic activity etc) current elevated ambient levels of lead in the environment have largely been contributed by the industrial and domestic uses of lead in the latter half of last century when leaded fuel use peaked.[22] Recent data indicates that atmospheric lead and deposition has decreased significantly since the widespread use of leaded fuel has been phased out.

Anthropogenic releases of lead to land contribute significantly to the global lead cycle. It is estimated that in 2004 an estimated 3.15 million tonnes of lead was extracted by humans and brought into general circulation. In addition lead as a by-product of the extraction of other metals accounted for significant releases to land with an estimated 0.4-1 million tonnes of lead mobilised from mining waste, base metal production and coal use.[23]

The 1983 study estimates of land releases were 600,000 -1,660,000 tonnes annually with an additional 200,000 to 260,000 tonnes from atmospheric deposition. Land releases were attributed to loss of waste/commercial products (mainly hunting ammunition), mine tailings and smelter slag/wastes. The global contribution of lost ammunition to soil was estimated at 120,000 tonnes of lead in 2003.[24]

Products containing lead, such as batteries and electronic articles, contribute to soil contamination through disposal to landfill and to atmosphere through incineration (and depending on the final use of ash, soil can also become contaminated with lead residues). Poor management of recycling operations involving lead containing products such as batteries and electronic components can also lead to localised soil contamination and impacts on the health of recycling workers as well as atmospheric contamination. While the products themselves may not cause lead exposure, the processes used to produce, recycle and dispose of them can cause exposure, emissions and contamination. Lead smelters are also known to cause localised atmospheric and soil contamination

[15] op cit. UNEP (2008e)
[16] USGS (2010a) *U.S. Geological Survey* 2008 Minerals Yearbook Lead [Advance Release] Feb 2010
[17] op cit. UNEP 2008e
[18] US Agency for Toxic Substances and Disease Registry. (2007) Public Health Statement. Lead. http://www.atsdr.cdc.gov/es/phs/es_phs13.html
[19] op cit. UNEP (2008e)
[20] ibid at 14
[21] ibid at 15
[22] ibid at 15
[23] ibid at 15
[24] ibid at 15

resulting in human health impacts (there is also considerable evidence of transboundary movement of atmospheric lead)[25]. A number of lead smelters in China have been closed in 2010 due to the health impacts of their emissions and Australia smelters[26] have also been reported to be responsible for elevated lead levels in the children of local communities.

Products contributing lead to the terrestrial environment include leaded paint, lead balancing weights for vehicles, lead sheathing of cable in the ground, and lead batteries. Landfills act as a concentrator of lead lost to soil and studies from Denmark and the Netherlands indicate about 10 percent of the total flow of lead in products is ending up in landfill. Lead compounds account for 10 percent of global lead consumption and virtually all of this ends in landfill. UNEP estimates that up to 1 million tonnes of lead incorporated into disposed products finds its way into landfills annually. Mining, industrial wastes and contaminated soils containing lead also contribute to the total lead volumes disposed of to landfill.

Total releases to the aquatic environment were estimated in 1983 at 87,000 -113,000 tonnes from atmospheric deposition (likely to be much lower now due to the phase out of leaded petrol) and 10,000 – 67,000 tonnes from all other sources. The major industrial sources of release to the aquatic environment are mining and non-ferrous metal production. Lead from fishing and diving equipment may also be a significant contributor with lead loss from angling in the EU estimated at 2,000 to 8,000 tonnes per annum.[27]

2.2 BRIEF OVERVIEW OF CADMIUM (CD)

2.2.1 Cadmium

Cadmium is a metallic element of Group 2b of the Periodic Table with atomic number 48 and a relative atomic mass of 112.41. In its pure form it is a sliver-white metal that is relatively soft. Cadmium is most often present in nature as complex oxides, sulphides, and carbonates in zinc, lead, and copper ores and is very rarely present in its elemental form. Though it is widely distributed in the earth's crust it is a relatively rare element with an average concentration of 0.1-0.2 mg/kg Cd.[28] There is no dedicated primary production of cadmium though it is derived as a by-product of mining and processing zinc, lead and copper ores where it occurs in much higher concentrations than the global average.

The lifetime of cadmium in the atmosphere is relatively short compared to mercury. Most airborne cadmium is bound to very small particulate matter (PM<1). Releases from anthropogenic sources are as elemental cadmium, cadmium oxide and to a lesser extent cadmium sulphide or chloride.[29] Cadmium and its compounds have relatively low vapour pressure and are not particularly volatile however cadmium may be released as a metal vapour from anthropogenic high temperature combustion sources but upon cooling it rapidly binds with particulate matter.[30] Deposition of this particulate ultimately returns the cadmium compounds to soil and surface water bodies.

In aquatic environments elemental cadmium, cadmium oxide and cadmium sulphide are almost insoluble. In the marine environment cadmium exists almost entirely as chloride species and these chloride complexes greatly increase the bioavailability of the cadmium and hence its toxicity to marine organisms. However, environments with elevated salinity tend to reduce the bioavailability of the cadmium chloride complexes.

In soils the availability and mobility of cadmium is largely dependent on pH levels. General trends indicate that lower soil pH (or a reduction in organic matter in the soil) increases the bioavailability of the cadmium component of the soil and therefore the overall toxicity of the soil. This is of significant concern as cadmium levels in soils (particularly agricultural soils) have become elevated in many countries due to the cadmium content of phosphatic fertilizers. Cadmium is readily taken up by plants and if the soil contains elevated levels of cadmium through atmospheric deposition and application of fertilizers then it can be expected that the cadmium levels in the food produced on such land will be higher, leading to greater exposure for humans who consume that food. This exposure scenario is important from a human health perspective as 90 percent of human exposure (non-smokers) to cadmium is dietary.[31]

The global cycling of cadmium operates on a number of key factors originating from natural and anthropogenic processes. Cadmium is released by similar natural processes to mercury (weathering of rock, erosion etc) which allows the metal to be transported via rivers to the marine environment. This process alone accounts for large movements of cadmium to the ocean environment with an estimated annual gross input of 15 000 tonnes[32]. This process is accelerated by anthropogenic acidic emissions. Erosion of agricultural topsoil with elevated cadmium into rivers also plays a role in this form of environmental transport.

The other major source of cadmium release is from atmospheric deposition to aquatic environments. The deposition occurs as a result of both natural releases to atmosphere and anthropogenic emissions. It is estimated that deposition to aquatic environments accounts for between 900 and 3600 tonnes of cadmium annually.

Anthropogenic airborne emissions were estimated in the mid 1990's to be around 2 983 tonnes of which much is returned to soil and aquatic environments through deposition.[33] The key sources of anthropogenic airborne emissions are fossil fuel combustion

[25] ibid at 107
[26] Queensland Health Department (2010) Mount Isa Community Lead screening Programme 2006-7 http://www.health.qld.gov.au/ph/documents/tphn/mtisa_leadrpt_sum.pdf
[27] op cit. UNEP (2008e) at 17
[28] EC (2001) Ambient *Air Pollution by As, Cd and Ni Compounds. Position paper*. Working Group on Arsenic, Cadmium and Nickel Compounds. European Commission, Directorate-General Environment.
[29] ibid EC
[30] UNEP (2008d) *Draft final review of scientific information on cadmium*. Chemicals Branch DTIE
[31] ibid at 7
[32] ibid at 5
[33] ibid at 4

and non-ferrous metal production. Other notable sources include iron and steel production, waste incineration and cement production.

A significant anthropogenic cadmium emission to land and aquatic environments is mining of non-ferrous metals. Significant releases of cadmium to the environment occur from mining activities that lead to tailings leaks, mine drainage, waste water release, storm water runoff and in some cases direct disposal of mine waste and tailings sludge to the aquatic environment.

2.2.2 Sources of cadmium and products containing cadmium

Cadmium is not mined and produced independently but is generated as a by-product of mining, smelting and refining of zinc (and to a lesser extent lead and copper). Global production of cadmium therefore tends to be a function of zinc production rather than global demand for cadmium. Global cadmium production has remained constant since 1990 at around 20,000 tonnes per annum.[34] European production has decreased significantly in recent decades while Asian cadmium production has increased sharply. Primary cadmium production is predominantly from China, Japan and Korea as well as Canada and Mexico with only a small contribution from Australia and Europe.[35]

While cadmium production has dropped significantly in Europe due to the restrictions imposed by the European Union (EU) End-of-Life Vehicle Directive and its Restriction of Hazardous Substances in Electrical and Electronic Equipment Directive, production in Asia (particularly Korea) has risen.

The transition from pyrometallurgical processes to hydrometallurgical process over the decades (the latter now accounting for over 80% of all cadmium production) has resulted in substantial reductions in atmospheric releases of cadmium over the same period. Notably, recycled cadmium from products accounts for around 18% of global supply. Outside of Europe and the US both Japan and the Republic of Korea are noted for their effective collection and recycling initiatives for cadmium. Clearly there are opportunities to further reduce global production and use of cadmium through extended initiatives in cadmium recycling.

The most significant products by volume containing refined cadmium include pigments for plastics, ceramics and enamels; stabilizers for plastics; plating on iron and steel; and as an alloying element of some lead, copper and tin alloys[36]. By far the greatest consumption of refined cadmium is for production of NiCd batteries which accounted for 81% of total refined cadmium use in 2004. The trend for refined cadmium in products other than NiCd batteries has steadily decreased since 1990.

In Japan the leading producers of cadmium are Mitsui Mining & Smelting, Nippon Mining & Metals and Toho Zinc and all of these companies run recycling operations for NiCd batteries. The main Chinese producers are Zhuzhou, Huludao, Shaoguan and Baiyin and in Korea it is primarily Korea Zinc.[37]

The three major global recycling operations for collection and recycling of NiCd batteries are Rechargeable Battery Recycling Corporation (RBRC) in the United States and Canada, Battery Association of Japan (BAJ) in Japan, and RECHARGE (formerly CollectNiCad) in Europe. The recyclers are estimated to produce 3, 500 MT of secondary cadmium annually and levels continue to increase.[38]

Many developed countries have an increasing awareness of the health and environmental impacts of cadmium releases and have introduced waste management schemes to reduce the amount of cadmium-contaminated products disposed of to the environment. That being said, a large volume of products containing cadmium still enter the waste stream to be disposed of at landfill or incinerated. Many electronic products such as laptops and cell phones have moved away from NiCd to NiMH or Lithium-ion batteries in recent years and over time a corresponding decline in the amount of cadmium in the waste stream may be seen.

Acid leachate within landfills breaks down these products and potentially allows the cadmium to be released into groundwater with any leachate seepage through the base of the landfill. Incineration of cadmium containing products (as waste) results in transfer of cadmium in gas phase or particulate form to atmosphere. Fly ash and bottom ash from the incineration process is also contaminated with metals including cadmium and POPs that can re-enter the environment depending on the final use or disposal option for the ash. In fact, the more efficient the air pollution control equipment installed in the incinerator, the more heavy metals and POPs are captured in the ash through bag house filters and electrostatic precipitator mechanisms.

Developing countries may not have the same degree of awareness or the necessary resources to segregate cadmium containing articles from the general waste stream and recycle the metals. This often leads to open burning of the waste, indiscriminate dumping or disposal to unlined landfills. All of these disposal scenarios increase the risk of release of cadmium to the environment and may lead to high local or regional exposures depending on the proximity of inhabitants to the waste disposal areas.

In the Pacific Island Countries (PICs) waste disposal and recycling of modern products (particularly e-waste) is a very difficult issue. Critically limited land space and traditional ownership patterns combined with very limited potable groundwater supplies make the establishment of landfills difficult. Even when landfills are established, segregation of wastes for recycling prior to landfill is hampered by lack of financial resources, community awareness and the remote locations of many villages for the purposes of collection and recycling.

Traditional waste disposal by burning rubbish in the garden in the Pacific region also hampers efforts to reduce exposure to toxic fumes from plastics and metals including cadmium. In addition many islands including Fiji, Samoa and the Cook Islands have experienced a surge in imports of electronic goods such as mobile phones, computers and battery powered hand tools in recent years with the former products heavily promoted by major manufacturers with products sold inexpensively or free[39]. Community

[34] ibid at 5
[35] ICdA (2005) *Cadmium Markets and Trends*. Hugh Morrow, International Cadmium Association September 2005.
[36] op cit UNEP (2008d) p.5
[37] op cit ICdA (2005) at 3
[38] ibid
[39] ISACI-NTN (2008) *E-Waste in the Pacific: The Rising Tide in Fiji and Samoa* Report on Scoping Visits on E-Waste to Fiji and Samoa.

ownership rates of these products have risen sharply but the opportunities for recycling or product stewardship schemes has been very limited or non-existent.

Importantly a number of the PICs have developed initiatives for e-waste recycling and negotiations between national governments in Samoa and the Cook Islands, NGO's, product manufacturers and major recycling companies are positive and ongoing.

2.3 BRIEF OVERVIEW OF MERCURY (Hg)

2.3.1 Mercury

The metallic element mercury has a high density, with a specific gravity of 13,456, an atomic weight of 200.59 and also has a high vapour pressure value of 0.16 Pa (0.0012 mm Hg) at room temperature which leads it to volatilise easily at room temperature and above. Under the Chemical Abstract System (CAS) it holds registration number 7439-97-6.

Mercury is a naturally occurring element which exists in the environment in a wide range of forms. Its pure form is *elemental* or *metallic* mercury and is expressed as Hg (0) or Hg^0. The pure liquid metal is rarely found in nature but occurs within compounds and inorganic salts. Mercury can be bound in a monovalent (Hg(I)) or divalent (Hg(II)) form to other compounds. Many different mercury compounds can be derived from Hg(II). Mercury occurs as a shiny silver-white metal that is liquid at room temperature. Unless it is contained liquid mercury will evaporate and form mercury vapours and being temperature sensitive it will give off more vapours as temperature increases. Vapours double for every additional 18 degrees Fahrenheit in temperature. While the vapours are not visible and are odourless they can be seen with the addition of UV light[40].

Mercury occurs in both organic and inorganic forms. Inorganic (or ionic) mercury compounds include a group identified as mercury salts such as mercuric sulphide (HgS), mercuric oxide (HgO) and mercuric chloride ($HgCl_2$). Inorganic mercury compounds are white salts or crystals with the exception of mercuric sulphide which is red unless exposed to light where it turns black. Inorganic mercury compounds (also known as ionic) have rapid rate of deposition from atmosphere due to a much higher chemical reactivity and water solubility that elemental mercury gas.

The organic form of mercury occurs when mercury combines with carbon (also known as organomercurials). While there are many forms of organic mercury the most common compound found in the environment is methylmercury. Organic mercury such as phenylmercury and methylmercury also exist most commonly as salts with pure methylmercury forming a white crystalline solid. Dimethylmercury forms a colourless liquid.

A number of forms of mercury occur naturally in the environment including metallic mercury, mercuric sulphide, mercuric chloride and methylmercury. Most importantly, these forms can change when subject to natural processes and the actions of micro-organisms. Methylmercury is of particular concern as the most toxic compound generated by micro-organisms and natural processes. As a highly bioavailable compound it is toxic, bioaccumulative and biomagnifies[41]. This property is most notable in freshwater and marine mammal and fish species.

As an element mercury cannot be broken down or reduced to other substances that are harmless to humans and the environment. Despite its ability to change into different compounds and species as it cycles through the Earth's natural processes, its simplest form is elemental mercury which is harmful to both humans and the environment. Once mercury is released from relative immobility below the earth's surface through mining and use of ores, fossil fuels or volcanic activity, it rapidly enters the biosphere and cycles between the earth's surface and atmosphere. Evidence suggests that the most common eventual sinks for this mercury are surface soils, water bodies and their bottom sediments.

2.3.2 Sources of mercury and products containing mercury.

Sources of mercury in the environment can be divided into anthropogenic and natural processes. Natural processes include weathering of rock containing mercury compounds, volcanic activity and natural mobilisation of mercury through the earth's crust due to geological activities.

Global estimates of naturally emitted mercury are difficult to calculate due to re-mobilization of former historical anthropogenic sources adding complexity to the analysis. Despite these limitations global natural emissions have been estimated at between 1400 metric tons/year[42] and 2400 metric tonnes/year.[43]

Anthropogenic releases of mercury account for up to two thirds of all mercury in the environment[44] and arise from three main sources:

- Mobilization of mercury as an incidental act during the extraction and use of fossil fuels such as coal, oil and gas and a range of other minerals during their production and even recycling.
- Mobilization of mercury during current manufacture processes or breakage, use and disposal or incineration of products intentionally containing mercury.

[40] See mercury vapour experiment by Bowling Green State University and the Ohio EPA at http://michigan.gov/mdch/0,1607,7-132-2945_5105_47868-181553--,00.html

[41] This can result in mercury levels in the flesh of fish and mammals rising to magnitudes of order higher than in the surrounding water bodies they inhabit.

[42] Lamborg, C. H., Fitzgerald, W. F., O'Donnell, J. and Torgersen, T. (2002) A non-steady-state compartmental model of global-scale mercury biogeochemistry with interhemispheric atmospheric gradients. *Geochimica et Cosmochimica Acta* 66 (7), 1105-1118.

[43] Bergan, T. and Rohde, H. (2001) Oxidation of elemental mercury in the atmosphere; constraints imposed by global scale modelling. *Journal of Atmospheric Chemistry* 40, 191-212.

[44] U.S. Department of Health and Human Services. *Toxicological Profile for Mercury.* Georgia: Agency for Toxic Substances and Disease Registry, 1999.

- Re-mobilization of anthropogenic mercury releases historically deposited in soils, sediments, water bodies, landfills, tailings dams and waste dumps.

Other than through remobilization, anthropogenic mercury releases arise through processes (i.e. metal and gas production, power generation, chlor-alkali production, vinyl chloride monomer production, artisanal gold mining) or in products (i.e thermometers, light bulbs) when they reach the end of their useful life. When the discarded product is landfilled, broken up for recycling or incinerated mercury is released into the environment. Up to 50 percent of global annual mercury production is incorporated in products.

The main sources of air emissions from anthropogenic mercury release currently occurring are from fossil fuel combustion for energy production (such as coal) and use of mercury in gold production - particularly through wide-spread but small-scale artisanal gold mining and production. The next major contributions are from the production of metals and cement. Some analysts believe that between 500-1000 tonnes of mercury are consumed annually by the artisanal mining community with the majority of the mercury being lost to the environment[45]. One study of small-scale gold mining in Peru estimated that 1-2 grams of mercury were released into the environment for every gram of gold produced.[46]

Global stationary sources of power production (mostly coal fired) were estimated to release 1470 tonnes of mercury annually[47]. Estimates have been made of total global mercury emissions from major anthropogenic sources including non-ferrous metal production, stationary power sources, pig iron and steel production, cement production, waste disposal and artisanal gold production. The 1995 estimates from all of these sources combined were around 2200 tonnes per annum. On the basis of these estimates coal-fired power stations are clearly a major contributor to total global emissions of mercury from anthropogenic sources. Ash from coal fired power stations has also been identified as a source of mercury and as air pollution control regulations tighten heavy metals once emitted to atmosphere will be transferred to the ash fraction of emissions and disposed of to land.

Mining and production (primary production) of elemental mercury has decreased slightly in recent decades with global primary production down from 2600-2800 tonnes in 1996 to 1800 tonnes in 2000[48]. This is despite global demand for mercury dropping 50% from 1980 levels up until 2000. Historically the main suppliers of mercury from primary production have been Spain, China, Kyrgyzstan and Algeria. In recent years only China and Kyrgyzstan have engaged in mercury mining with China's supplies directed to its domestic market. Kyrgyzstan is believed to have the only operating mercury mine in the world which continues to export to other countries. Against historical market trends the price of mercury has jumped sharply in the last two years due to the high price of gold and the role of mercury in its production.

Historically mercury has been mined as a mercuric sulphide (cinnabar ore) which is the primary source for pure metallic mercury. The ore must be heated to at least 540°C to drive off the mercury in vapour form which is then captured, cooled and condensed into liquid mercury. The second major source of mercury from mining is as a by-product of mining other minerals such as zinc, gold and silver and to a lesser extent from gas production. Mercury stripped from natural gas production globally was estimated in 2005 at 30- 40 metric tonnes.[49]

In terms of market demand, primary production of mercury must also compete with a number of other sources. These include government stockpiles, private stockpiles from chlor-alkali production facilities, mercury extracted from reprocessed historical tailings dumps and mercury recovered from recycled products or industrial wastes containing mercury. Recent developments in the mercury market have seen a dramatic rise in the price of mercury from $US 600 per flask in 2008 to $US 1800 in 2010 due to demand from artisanal gold mining sector on the back of strong gold prices. This is likely to have a significant upward influence on the release of surplus mercury stockpiles on to the global market. The Kyrgyzstan government operates the last known dedicated mercury mine in the world and has been debating whether to shut the mine and remediate the locality of Khaidarkan where it is based. The sharp price rise may affect this decision with the Kyrgyzstan government now also considering privatization of the mine and an increase in production from the 250 MT of mercury mined in 2009.

Demand for mercury in products often relates directly to the physical characteristics of the metal. Being liquid at room temperature, being a good electrical conductor, having very high density and high surface tension, expanding/contracting uniformly over its entire liquid range in response to changes in pressure and temperature, and being toxic to micro-organisms (including pathogenic organisms) and other pests has made it an attractive component of many products – particularly in electrical devices and historically, pesticides and fungicides. Australia still uses the mercuric fungicide *Shirtan* for pineapple disease in sugarcane.[50]

Mercury has principally been used in two modes, firstly as a metal and secondly as a chemical compound. Common uses of mercury for its metal characteristics are gold and silver extraction, vinyl chloride monomer / PVC production, a chlor-alkali production catalyst, in manometers for measuring and controlling pressure, in thermometers, electrical and electronic switches, fluorescent lamps and dental amalgam fillings.

As a chemical compound, mercury has been used in batteries, as a biocide, as an antiseptic pharmaceutical, laboratory reactant, and historically for pigments, dyes and explosives and felting. Mercury has also been reported to be used in some cosmetics,

[45] MMSD (2002) *Breaking New Ground: Mining, Minerals, and Sustainable Development*. International Institute for Environment and Development, 2002.

[46] Earth Report. (2004) *Slum at the Summit.* Television Trust for the Environment. Available at http://www.tve.org/earthreport/archive/doc.cfm?aid=1623

[47] Pirrone, N., Pacyna, J.M. and Barth, H. (Guest Editors) (2001a): Atmospheric Mercury Research in Europe, *Special Issue of Atmospheric Environment* Vol. 35 / 17 Elsevier Science (Publisher), Amsterdam, Netherlands.

[48] Hylander, L.D. and Meili, M., (2002) *500 years of mercury production: global annual inventory by region until 2000 and associated emissions*. Science of the Total Environment, cited in Global Mercury Assessment, published by UNEP – Chemicals Branch in Geneva, Switzerland in 2002, under the IOMC Agency Agenda for the Sound Management of Chemicals. A cooperative agreement among UNEP, ILO, FAO, WHO, UNIDO, UNITAR and OECD. P.118

[49] UNEP (2006) *Summary of Supply, Trade and Demand Information on Mercury.* UNEP Chemicals Branch, DTIE Requested by UNEP Governing Council decision 23/9 IV. Geneva November 2006.

[50] APVMA (2010) cited in National Toxics Network - Australia (2010) *NTN Briefing: Mercury in Australia.* see also www.apvma.gov.au

traditional medicines and ritualistic practices. Mercury use in products is mainly in appliances in the domestic and commercial sector and in switches, pressure and temperature control devices in the industrial sector. The US Agency for Toxic Substances and Disease Registry estimates that up to two thirds of global demand for mercury in products is in the domestic/commercial sector and around a third is consumed in products for the industrial sector[51].

While stockpiles, use and production of mercury are relatively small in the Pacific there are sizeable stockpiles and processes that contribute to a significant mercury problem in Asia. In China mercury is used extensively in VCM/PVC production and to an unknown but significant extent in chlor-alkali production. The rest of Asia still has many chlor-alkali plants in operation based on the mercury catalyst although these are scheduled to be phased out in coming decades. This may create a large surplus in mercury stocks in Asia. The question of how to address surplus mercury, its storage and management is currently the subject of international debate. The EU and the US have already banned the export of their surplus mercury stockpiles that have arisen from old chlor-alkali plant shut-downs and US military sources.

Table: 2-1 Estimated mercury consumption in Asia, including products for export, 2005 (MT)

	China		East and Southeast Asia, excl. China		South Asia	
	min.	max.	min.	max.	min.	max.
Small-scale gold mining	120	240	288	384	3	12
VCM/PVC production	700	800	0	0	0	0
Chlor-alkali production	n.r.	n.r.	4	8	35	40
Batteries	150	250	50	70	30	50
Dental applications	45	55	25	31	22	32
Measuring and control devices	280	310	20	30	40	50
Lamps	60	70	20	25	20	25
Electrical and electronic equipment	30	40	15	20	25	30
Other*	40	80	30	40	20	30
Totals	**1,425**	**1,845**	**452**	**608**	**195**	**269**

* "Other" applications include uses of mercury in pesticides, fungicides, catalysts, paints, chemical intermediates, laboratory and clinical applications, research and testing equipment, pharmaceuticals, cosmetics, traditional medicine, cultural and ritual uses, etc.
n.r. – Not Reported

Sources: UNEP 2006; NRDC 2006; CRC 2007a; consultant estimates.

Table: 2-2 Asian "sources" of elemental mercury, 2005 (MT)

	CHINA	East And Southeast Asia, excl. China	South Asia
Mercury mining (formal)	1,094	0	0
Mercury mining (informal)*	0 - 200	0	0
Decommissioned chlor-alkali		(current capacity 1252)	
By-product mercury	0	67	0
Recycled Hg from VCM	350	0	0
Recycled Hg from products	18 - 24	10 - 15	
Inventory (not a "source"):			
Mercury Stocks	500 - 1000	500 - 1000	

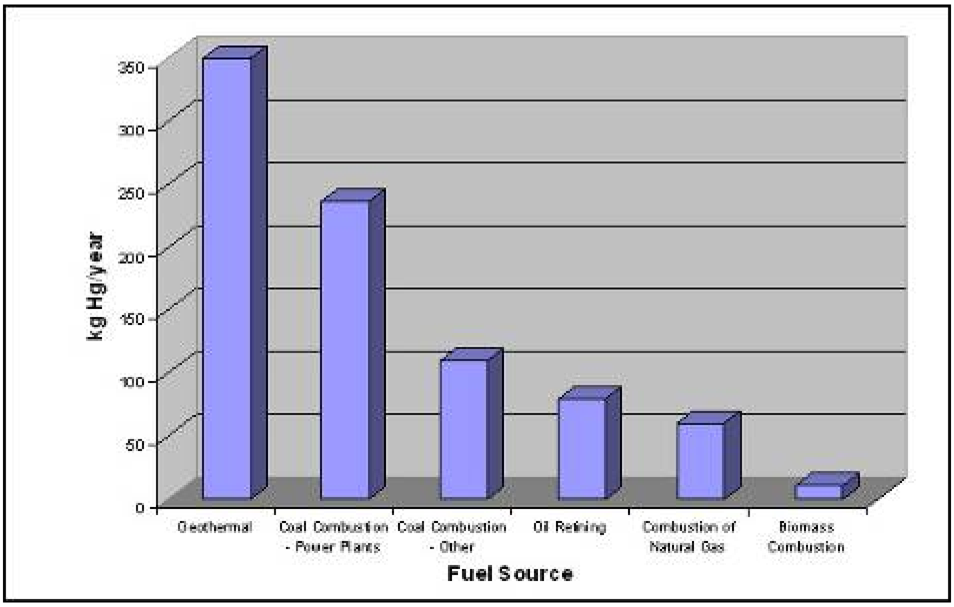
* Informal or artisanal mining is typically carried out by individuals or small groups outside the normal commercial and legal system; as such, it is very difficult to obtain good information on the extent of these activities.

Sources: Derived from NRDC (2006), CRC (2006) and personal communications.

[51] http://www.atsdr.cdc.gov/es/toxfaqs/es_mercmetal5.html

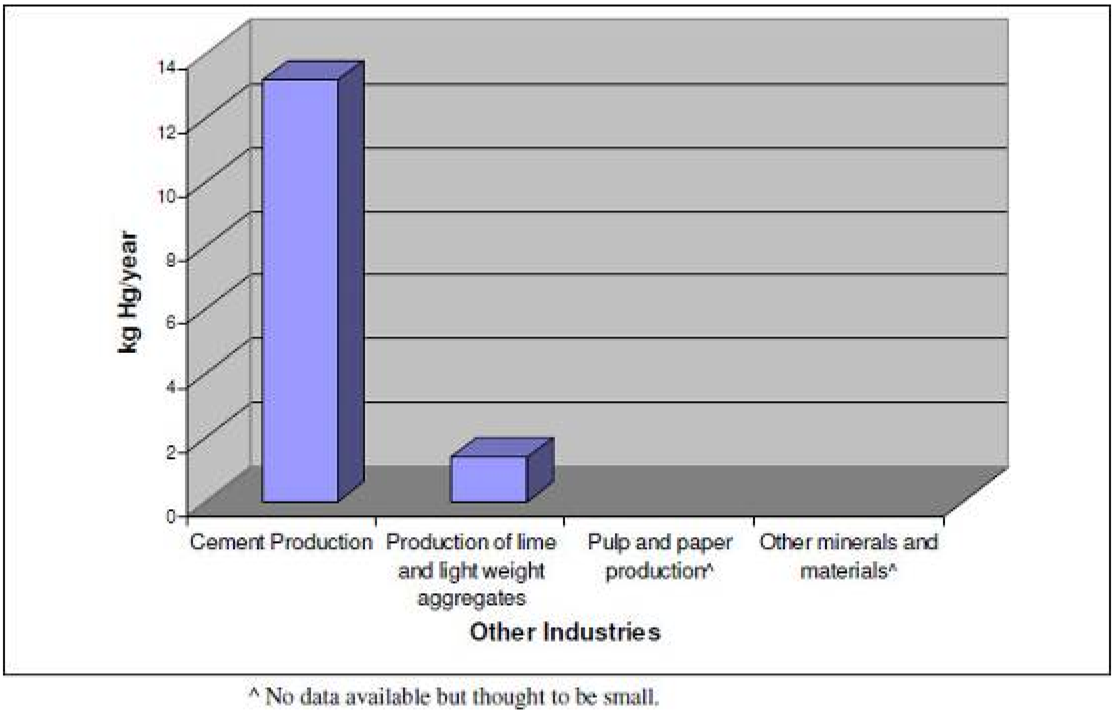
An example of the relative contributions from natural sources of mercury and mercury from anthropogenic sources in the Pacific region is provided by the New Zealand government who have estimated releases from natural sources, industrial process and products containing mercury (Figure 2-1 to 2-3.)

Figure 2-1 Contribution from extraction and use of fuels/energy sources



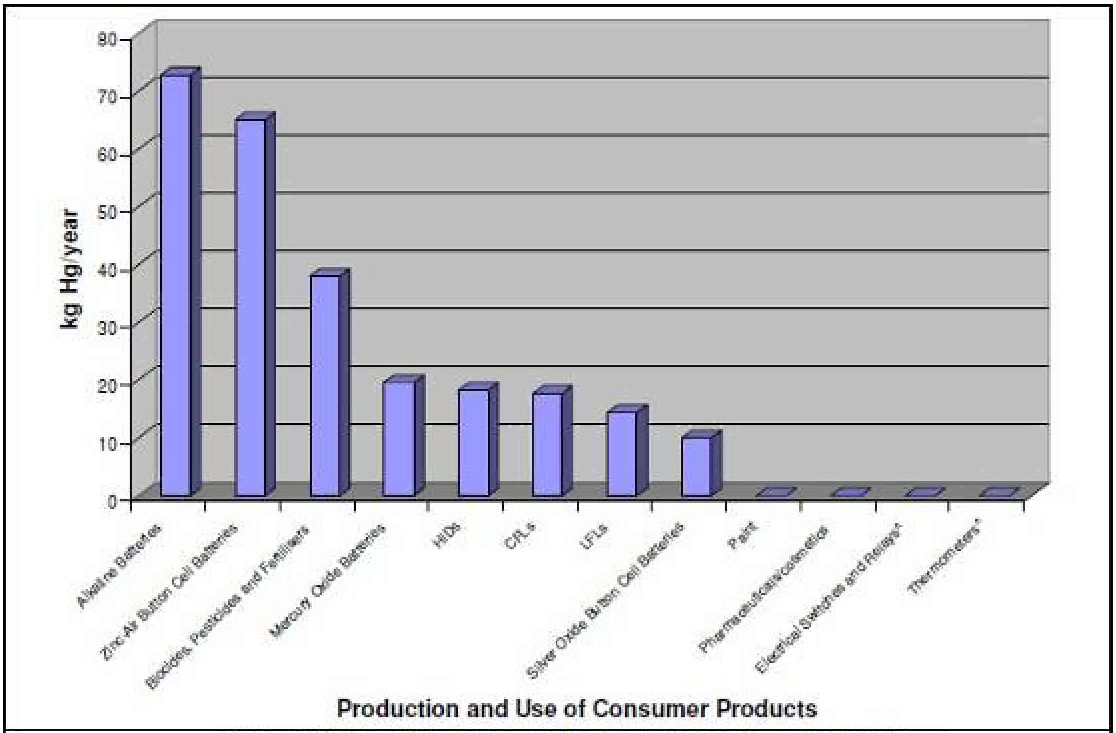
Sources: Ministry for the Environment New Zealand/Manatū Mō Te Taiao

Figure 2-2 Contribution of production of other minerals and materials with mercury impurities



Sources: Ministry for the Environment New Zealand/Manatū Mō Te Taiao

Figure 2-3 Contribution from consumer products with intentional use of mercury



^ Data unavailable in New Zealand, and therefore emissions have not been calculated.

Sources: Ministry for the Environment New Zealand/Manatū Mō Te Taiao

The widespread recognition of the persistent global health threat posed by mercury production and releases has been the primary driver behind UNEP's efforts to strengthen the global movement to reduce, replace or eliminate current uses of mercury and reduce human and environmental exposures to its toxic characteristics. Growing awareness of the diversity of mercury containing products and their global distribution has accelerated UNEP's global partnership activities to reduce mercury exposure and increase the initiatives that strategically target mercury containing products throughout their life-cycle.

A key factor in the release of mercury from products is the management of products containing mercury at their *end of life* stage. While a few products have dedicated recycling options that include mercury recovery –most do not. The most common fate of discarded products containing mercury is open combustion, incineration or burial. In many developing countries and countries in economic transition secure landfills are scarce or nonexistent. This leads to above ground waste dumps that are often burnt deliberately to increase capacity for additional waste or spontaneously combust due to the nature of the wastes disposed at the site. Poor management of products containing mercury in its waste phase has been a significant cause for concern due to the mercury release that can be expected from these practices.

As an example, open combustion of waste is a common practice in many countries and a daily domestic activity in many islands in the Pacific. While this practice may have been relatively harmless when most local products were derived from natural fibres and organic matter – modern products such as plastics and mercury-containing discards are also burnt in the same manner without a general awareness of the risks that this presents to human health and the environment. Children are often tasked with burning of the day's waste greatly increasing their exposure to pollutants from the smoke and fumes of the fire they attend and from the scattering of the ashes and residues of incomplete combustion.

Landfilling of products containing mercury has been reported to lead to emissions of mercury vapour from the landfill and contamination of landfill leachate and eventually the groundwater beneath the sites. Many products containing a small amount of mercury can lead to a significant local contamination problem. Incineration of mercury containing products also leads to atmospheric mercury emissions and secondary contamination issues with fly ash and bottom ash depending on where it is dumped or re-used as products such as road base (all of which leads to greater distribution of mercury in the environment).

Estimates of mercury released to atmosphere from burning of end of life products containing mercury in waste have been calculated in a number of studies. In 2005 estimates of global mercury release from medical waste, municipal and hazardous waste incineration was around 50 tonnes per annum.[52] A 2008 study[53] estimated that in 2007 up to 70 tonnes or mercury was released globally from the same sources. A study[54] released in 2009 took into account the same incineration processes but in addition

[52] Swain *et al.* (2007) EB Swain, PM Jakus, G Rice, F Lupi, PA Maxson, JM Pacyna, A Penn, SJ Spiegel and MM Veiga, 'Socioeconomic consequences of mercury use and pollution.' *Ambio 36:* 45-63.
[53] UNEP (2008a) – *Mercury Fate and Transport in the Global Atmosphere: Measurements, Models and Policy Implications*, N Pirrone and R Mason (eds.), UNEP Mercury Air Transport and Fate Research partnership, July 2008, Italy.
[54] Mercury Policy Project (2009), *'Mercury Rising: reducing Global Emissions from Burning Mercury-added Products.'* A collaboration between the Zero Mercury Working Group, BAN Toxics! and Global Alliance for Incinerator Alternatives.

considered incineration of municipal wastewater sludge as well as landfill fires and open burning of wastes containing mercury. This report estimated that global releases from all these forms of burning mercury containing products to be 141 tonnes per annum. The contribution of open burning and landfill burning was estimated to be between 45 and 100 tonnes.

Open burning and landfill fires are a key source of mercury exposure to the population of the Asia and Pacific regions. While power generation and other industrial sources may release more mercury in total direct exposure to human receptors may be less as a result of plume distribution through stacks. Open burning and landfill fires create ground level exposure to mercury fume inhalation and may result in greater localised impacts on human health. Open burning and landfill fires have the greatest impacts in South Asia, East Asia and Southeast Asia where they are estimated to have released up to 45 tonnes of mercury in 2005.[55]

The focus of this study is primarily upon products rather than processes that lead to lead, cadmium and mercury releases. For further information on mercury use in artisanal gold mining and human exposure see the references provided.[56] [57] [58] [59] [60]

[55] ibid
[56] Blacksmith Institute (2010) *World's Worst Pollution Problems Report 2010. Top Six Toxics Threats*. Produced in collaboration with Green Cross Switzerland.
[57] UNEP (2002*) Global Mercury Assessment* Chemicals Branch DTIE. Geneva 2002
[58]op cit UNEP (2006)
[59] Maxson, P., (2009) *Assessment of Excess Mercury in Asia*, *2010-2050.*
[60] Weinberg. J., (2010) *An NGO Introduction to Mercury Pollution*. Prepared for the International POPs Elimination Network (IPEN), 2010.

CHAPTER 3
BRIEF OVERVIEW OF POSSIBLE EFFECTS ON HUMAN HEALTH AND THE ENVIRONMENT OF PRODUCTS CONTAINING LEAD, CADMIUM AND MERCURY

3.1 MAIN EFFECTS OF LEAD ON HUMAN HEALTH AND THE ENVIRONMENT

3.1.1 Effects on human health

Lead is a toxic heavy metal even at very low levels of exposure in humans. Its effect on the human body can be both acute and chronic depending on dose and exposure scenarios. Lead targets multiple organs in the body due to its systemic toxicity which can cause neurological, cardiovascular, renal, gastro-intestinal, haematological and reproductive effects. Human exposure to lead is usually tested through blood sampling. However this approach does not always accurately reflect the intoxication level of the individual as lead moves from the vascular system and is deposited in the bones of the human body. Blood tests do not assess historic exposure to lead which is stored in bones at the time of the blood test. The lead stored in the bones can emerge as a remobilised form of lead exposure late in the life of the individual.[61]

Exposure occurs primarily through inhalation of dust particles, air contaminated with lead and ingestion of foodstuffs, water and dust. Inhalation is an important exposure pathway for people in the vicinity of point sources such as lead contaminated sites, countries where leaded fuel is still used and areas where waste from products containing lead is burnt as well as secondary lead recovery operations. Apart from ingestion of lead on foodstuffs and in drinking water a major exposure source is leaded paint. Dust in homes containing leaded paint can be inhaled by adults and children and ingested by children through pica behaviour. Leaded paint are still commonly marketed and used in Asia (see case studies Chapter 7) and many other countries although initiatives are underway to reduce this form of exposure.

One of the critical human health impacts of lead is neuro-developmental effects in children. Very low levels of lead exposure to children aged between 0-5 years can lead to developmental impacts and subsequent lowering of IQ. The activities and behaviour of children (particularly 'pica' behaviour where small children deliberately or incidentally ingest significant quantities of soil) can magnify the exposure of children beyond an adult exposure in the same setting. Children playing in a garden with lead contaminated soil and ingesting that soil may have a greater relative exposure than an adult occupying the same garden space. For children, exposure begins in-utero due to lead passing the placental barrier and therefore exposure of pregnant women is also a key concern.[62]

Epidemiological studies have consistently found adverse health effects in children at blood lead levels above 10µg/dL. However recent studies[63] suggest that lead -induced IQ decrements in children are occurring below a level of 10ug/dl[64]. The 3rd US National Health and Nutrition Examination Survey (NHANES 3) found that despite blood lead levels in Americans having dropped considerably since the 1970's, lower blood lead levels were still associated with increased risk of death or disease. An early survey conducted in the period 1976-1980 indicated a higher risk of death with a blood lead level higher than 20µg/dL. The third survey from 1988-1994 reported that even low blood lead levels (5-9 µg/dL) carry an increased risk of death. The current NHANES survey with data from 1999-2002 suggested an elevated risk of peripheral arterial disease, hypertension, and renal dysfunction in a population with blood lead levels averaging approximately 2 µg/dL.

No threshold levels for the effects of lead have been determined. Studies suggest that early exposure to lead may lead to behavioural deficits and lower functional skills during childhood and adulthood. High exposures may occur in a variety of occupational exposures such as lead mines, lead battery recycling facilities (particularly informal recycling without appropriate occupational hygiene protection for workers), and manufacture of fishing sinkers and even indoor shooting ranges where lead ammunition is used.[65]

Data indicates that global lead exposure levels have dropped in recent decades and this is largely believed to be due to the elimination of lead from petrol products. However, toxicity and risk assessments continue to generate findings that indicate lead has significant adverse health effects in humans well below what are currently considered to be acceptable levels. There are many areas in the world where significant exposure to lead still occurs among some segments of the population in both developed and developing countries. Potential for lead exposure remains high in those jurisdictions where there are significant lead emissions and sources (mines, smelters, recyclers), lead contaminated water and where individuals are exposed to lead in paint (either historical or contemporary products).[66]

For a more detailed assessment of the impacts of lead on human health refer to Chapter 3 of UNEP (2008) Draft final review of scientific information on lead. Chemicals Branch DTIE November 2008.

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[61] op cit UNEP (2008e)
[62] ibid
[63] Lanphear BP, Dietrich K, Auinger P, Cox C. (2000) 'Cognitive Deficits Associated with Blood Lead Concentrations <10 microg/dL in US Children and Adolescents' *Public Health Rep*. 2000;115:521–529,
[64] Susan E. Schober, Lisa B. Mirel, Barry I. Graubard, Debra J. Brody, Katherine M. Flegal (2006) *Blood Lead Levels and Death from All Causes, Cardiovascular Disease, and Cancer: Results from the NHANES III Mortality Study* in Environmental Health Perspectives Online 6th July 2006, The National Institute of Environmental Health Sciences, National Institutes of Health, U.S. Department of Health and Human Services, 1st Oct 2006
[65] Centre for Disease Control. (2005*) Lead Exposure from Indoor Firing Ranges Among Students on Shooting Teams. Alaska, 2002-2004*. June 17, 2005 / 54(23);577-579
[66] U.S. EPA (2006) *Air quality criteria for lead*. United States Environmental Protection Agency, Office of Research and Development (EPA/600/R-05/144aB).

3.1.2 Effects on the environment

Lead has a tendency to exist in a particle bound form in the environment with relatively low mobility and bioavailability though highly soluble forms do exist in the marine environment. While lead does bioaccumulate in most organisms biomagnification is not a feature of lead. All experimental assessments of lead toxicity to animals demonstrate that lead causes adverse effects to organs and organ systems. Target systems include the blood system, central nervous system, the reproductive system and immune system as well as the kidneys.[67]

Exposure for environmental biota is greatest near points sources such as smelters and from concentrations of lead shot (used for hunting water fowl) and fishing sinkers (in both freshwater and marine environments). In general lead concentrations in the aquatic environment are below known effect levels while in Europe lead concentrations in soil (at distance from point sources) is elevated above threshold levels and a cause for concern.

The most obvious adverse impact to the environment from lead in products is the primary poisoning of waterfowl by lead shot and sinkers and then secondary poisoning of their predators. Lead toxicity to fish varies according to availability and uptake of the lead ion which depends on a range of factors such as water hardness (presence of divalent anions), pH, salinity, and organic matter. Laboratory experiments indicate that the toxicity of organic lead may be 10 to 100 times higher than that of inorganic lead to fish. However, long-term exposure of adult fish to inorganic lead induces sub-lethal effects on morphology, amino levulinic acid dehydratase (delta-ALAD) and other enzyme activities, and avoidance behaviour at available lead concentrations of 10-100 mg/litre.[68] Juveniles are more sensitive than either adult fish or eggs which exclude lead from the embryo.

Amphibians such as frogs and toads are also affected by lead which can accumulate in fresh water systems as a result of effluent releases and the presence of lead sinkers. Experiments indicate that there is evidence that frog and toad eggs are sensitive to nominal lead concentrations of less than 1.0 mg/litre in standing water and 0.04 mg/litre in flow-through systems; arrested development and delayed hatching have been observed.[69]

In the Asia and Pacific region a number of cases of environmental contamination have arisen in recent times that have has potential and actual environmental impacts. In 2006 the export of bulk lead carbonate (lead ore concentrate) from Western Australia resulted in widespread contamination of the coastal town of Esperance where the lead was loaded at the local port. The first indication that the powdered lead was leaking from the rail shipments was the death of some 9,500 native birds which literally dropped from the sky[70]. Subsequent isotopic testing confirmed the lead was from the export of lead carbonate and that the contamination had spread to soil, sediment and water supplies for the town. While exports were halted temporarily and a clean-up of the town has been ongoing exports were re-commenced through a different Western Australian port (Fremantle). Atmospheric lead sulphide contamination was also identified in ore exports through another Western Australian port (Geraldton) in late 2010 and investigations are ongoing.

Further detailed information on environmental impacts of lead and can be sourced from the IPCS[71] Environmental Health Criteria 85 and the UNEP (2008) Draft final review of scientific information on lead.

3.2 MAIN EFFECTS OF CADMIUM ON HUMAN HEALTH AND THE ENVIRONMENT

3.2.1 Effects on human health

Humans are exposed to cadmium by inhalation and ingestion although the main health impacts recorded in the literature are through dietary exposure (kidney and bone damage) and inhalation from smoking tobacco and occupational exposure (lung damage). Dietary intake accounts for 90% of all exposure in non-smokers. Cadmium in the environment is toxic to plants and animals and many micro-organisms. Cadmium does not degrade in the environment to less toxic products which contributes to its bioaccumulation in the kidneys and liver of vertebrates and invertebrates.

Cadmium enters the environment from a variety of anthropogenic sources. Wastewater is key source of environmental cadmium contamination and diffuse pollution occurs through industrial air emissions and widespread use of fertilizers on agricultural soils. Plants (including rice and tobacco) that are grown in contaminated soils take up cadmium and lead to human dietary (and inhalation) exposures. However, human exposure also occurs when cadmium contaminated soils are disturbed and the dust is inhaled. Diets high in meat (especially liver and kidneys) or products from marine mammals may result in a particularly high intake of cadmium.[72]

Cadmium is not considered essential for biological function in humans. The main human organ impacted by cadmium exposure is the kidney in both the general population and the occupationally exposed. Tobacco smokers are considered to be at particular risk as are people with low iron levels. A secondary critical effect is skeletal damage as a secondary response to kidney damage or direct action on the bone cells by the cadmium. WHO[73] has reported an increased level of lung cancer by inhalation among occupationally exposed workers though this does not apply to the ingestion route of exposure.

However, ingestion and inhalation of low levels of cadmium of many years can lead to an accumulation of cadmium in the kidneys. If the cadmium levels in the kidney are high enough then this can lead to kidney damage and bone fragility[74]. This condition was

[67] op cit UNEP (2008d) @ 14
[68] IPCS (1989) International Programme on Chemical Safety. *Environmental Health Criteria 85. Lead* – Environmental Aspects
[69] ibid
[70] Parliament of Western Australia (2007) Legislative Council Education and Heath Standing Committee. *Inquiry into the Cause and Extent of Lead Pollution in the Esperance Area*. Report No. 8 of the 37th Parliament.
[71] op cit IPCS @ http://www.inchem.org/documents/ehc/ehc/ehc85.htm#SubSectionNumber:7.3.2
[72] op cit UNEP (2008d) at 38
[73] WHO Chemical Fact Sheets (2006). Available at: http://www.who.int/water_sanitation_health/dwq/en/gdwq3_12.pdf
[74] ATSDR (1999): *Toxicological profile for cadmium.* U.S. Department of Health and Human Services. Public Health Service. Agency for Toxic Substances and Disease Registry.

highlighted in Japan after the Second World War when patients presented with a bone disease that came to be known as *itai-itai disease*[75]. The condition featured proteinuria, bone fractures and severe pain that is associated with cadmium exposure and a low calcium diet. The cadmium exposure was linked to cadmium contaminated water which was used to irrigate the rice fields.

In the 1990's sub-groups of the Chinese population exposed to cadmium in rice were studied and skeletal, renal and reproductive toxicity effects were identified[76]. Proximal tubular disease arising from high cadmium absorption has been reported in many Asian countries[77] where rice is grown in cadmium contaminated soils[78]. Many plants including rice readily uptake cadmium from soils.

Cadmium accumulates primarily in the kidneys and has a long biological half-life in humans of 10–35 years. There is evidence that cadmium is carcinogenic by the inhalation route, and IARC has classified cadmium and cadmium compounds in Group 2A. However, there is no evidence of carcinogenicity by the oral route and no clear evidence for the genotoxicity of cadmium. The kidney is the main target organ for cadmium toxicity. The critical cadmium concentration in the renal cortex that would produce a 10 percent prevalence of low-molecular-weight proteinuria in the general population is about 200 mg/kg and would be reached after a daily dietary intake of about 175 mg per person for 50 years.[79]

WHO have set a PTWI of 7 mg/kg of body weight, on the basis that if levels of cadmium in the renal cortex are not to exceed 50 mg/kg, total intake of cadmium (assuming an absorption rate for dietary cadmium of 5 percent and a daily excretion rate of 0.005 percent of body burden) should not exceed 1 mg/kg of body weight per day.[80]

In terms of exposure from products containing cadmium (other than tobacco) workers are exposed to cadmium in the zinc, copper and steel industries, in the manufacture of nickel-cadmium batteries, solar cells, jewellery, metal plating, the production of plastics, fertilisers and a range of other industrial activities[81]. This provides an indication that consumers or recycling workers who regularly handle such products may have exposures to cadmium that can potentially have health effects.

3.2.2 Effects on the environment

Key sources of cadmium releases to the biosphere include;

i) natural sources such as mobilisation through volcanic processes and weathering of rocks
ii) Current anthropogenic releases from mobilization of cadmium impurities in raw materials such as phosphate minerals, fossil fuels and other extracted and processed materials such as zinc and copper.
iii) Current anthropogenic releases from cadmium used intentionally in products through manufacturing, use, disposal or incineration of products.
iv) Remobilisation of cadmium from historical anthropogenic releases that have been deposited in soil, waste dumps, sediments and landfills.[82]

Cadmium is not an essential element for animal or plant life[83] and in most cases is toxic to biota. Many organisms readily accumulate cadmium, particularly micro-organisms and molluscs where bioaccumulation factors are in the order of thousands. Soil invertebrates share a similar propensity to accumulate cadmium.[84] This effect is found at all levels of the food chain with cadmium accumulation found in grasses, food crops, earthworms, poultry, cattle, horses and wildlife. In plants cadmium accumulates in the leaves.

Cadmium mainly accumulates in the liver and kidneys of vertebrates and chronic exposure can produce a wide variety of acute and chronic effects in mammals similar to those in humans. The primary effect of cadmium is kidney damage. Some marine vertebrates contain high cadmium concentrations in the kidney which has been linked to signs of kidney damage in the biota[85] (although the cadmium source was naturally occurring).

Kidney damage has been reported in wild pelagic seabirds with kidney concentrations of 60-480 µg/g[86]. Cadmium levels have been found at high enough levels to cause kidney damage in some Canadian moose and caribou as well as some seabirds and marine mammals from northwest Greenland and the Faroe Islands. However, pathological examinations of ringed seal, beluga and bowhead whales with highly elevated kidney concentrations of cadmium did not exhibit cadmium related effects.[87]

[75] Godt, J., Scheidig, S., Grosse-Siestrup, C., Esche, V., Brandenburg, P., Reich, A. and Groneberg. D.A. (2006) 'The toxicity of cadmium and resulting hazards for human health*'. Journal of Occupational Medicine and Toxicology*, 1: 22, 2006.
[76] Nordberg, G.F. (2004) 'Cadmium and health in the 21st century--historical remarks and trends for the future.*' Biometals*, 17(5): 485-489.
[77] Cheng, W.D., Zhang, G.P., Yao, H.G., Wu, W. and Xu, M. (2006) 'Genotypic and environmental variation in cadmium, chromium, arsenic, nickel, and lead concentrations in rice grains'. *Univ Sci B*., 2006 Jul; 7(7): 565-571
[78] Tsukahara, T., Ezaki, T., Moriguchi, J., Furuki, K., Shimbo, S., Matsuda-Inoguchi, N., Ikeda M. (2003) 'Rice as the most influential source of cadmium intake among general Japanese population.' *Sci Total Environ*, 305(1-3): 41-51.
[79] WHO Chemical Fact Sheets (2006). Available at: http://www.who.int/water_sanitation_health/dwq/en/gdwq3_12.pdf
[80] ibid
[81] op cit UNEP (2008d) at 40
[82] ibid
[83] Except for certain ocean phytoplankton under element depleted conditions
[84] ibid UNEP (2008d) at 49
[85] IPCS (1992a) *Cadmium. Environmental Health Criteria 134*. The International Programme on Chemical Safety (IPCS), a joint venture of the United Nations Environment Programme, the International Labour Organisation, and the World Health Organization, Geneva, Switzerland.
[86] IPCS (1992b) *Cadmium - environmental aspects*. *Environmental Health Criteria 135*. International Programme on Chemical Safety (IPCS), a joint venture of the United Nations Environment Programme, the International Labour Organisation, and the World Health Organization, Geneva, Switzerland.
[87] AMAP (2005) *AMAP Assessment 2002: Heavy Metals in the Arctic*. Arctic Monitoring and Assessment Programme (AMAP), Oslo, 2005.

The risk of secondary poisoning is considered very significant in the food chain system that operates between soil, worm, bird and mammals with accumulation of cadmium occurring among the higher trophic feeders.[88] Laboratory experiments indicate that cadmium is toxic to a wide range of micro-organisms but that this toxicity is reduced by sediment, high concentrations of dissolved salts or organic matter. The main toxic impacts are on growth and reproduction. Fungi are especially sensitive to cadmium toxicity. Experimental studies have also found that cadmium interferes with the growth of plants where it accumulates in the roots and leaves.[89]

In aquatic environments organisms can directly absorb cadmium in its free ionic form from the water.[90] Cadmium interacts with the calcium metabolism, and in fish it causes abnormally low calcium levels (hypocalcaemia), probably by inhibiting calcium uptake from the water. However, high calcium concentrations in the water protect fish from cadmium uptake by competing at uptake sites. Effects of long-term exposure can include larval mortality and temporary reduction in growth.[91]

For aquatic invertebrates the presence of zinc increases the toxicity of cadmium and sub-lethal effects on growth and reproduction have been reported. The toxicity of cadmium to fish varies with salmonoids being especially susceptible. The most vulnerable life-stages for fish are at the embryo and early larva stages with malformation of the spine the main reported sub-lethal effect.[92] The EU risk assessment of cadmium (ECB, 2005) found that for fish and amphibians the lowest effect concentrations for cadmium were at 0.8 µg/L, with reproduction being the most sensitive endpoint. Primary aquatic consumers (invertebrates) can be affected in the µg /L range and below with reproduction found to be the most sensitive endpoint. Primary producers such as algae are affected by cadmium in the 1-10 µg/L range but with no toxicity below 1 µg/L.

3.3 MAIN EFFECTS OF MERCURY ON HUMAN HEALTH AND THE ENVIRONMENT

3.3.1 Effects on human health

Toxicity of mercury is dependent on whether it takes the form of elemental mercury, inorganic mercury or organic mercury compounds (particularly alkylmercury compounds such as methylmercury and ethylmethyl salts and dimethylmercury). Accordingly, the exposure scenario varies considerably for these different forms of mercury and complicates toxicity assessment. In terms of methylmercury, dietary ingestion is the major source of human exposure, especially for seafood and fish.[93] Debate continues as to the degree of toxicity of mercury (especially methylmercury) with recent findings suggesting that it may be toxic at much lower levels than those previously considered.

Elemental mercury vapour is encountered by most humans in the form of dental amalgam although some occupational settings may result in much higher exposures (see case study on medical settings in Nepal at Chapter 7). Around 80% of inhaled elementary mercury vapour is retained in the tissue of the lungs where it goes on to penetrate the blood-brain barrier where neurological effects take place. Ingestion of elementary mercury does not always lead to high levels of absorption but deaths have been reported. Inhalation of elementary mercury vapour has been observed to lead to symptoms including tremors, emotional lability, insomnia, memory loss, neuromuscular changes, and headaches as well effects on the kidney and thyroid. High exposures have led to death but the critical effects are neurotoxic and renal.[94]

The main route of exposure to inorganic mercury for humans is dietary although for some sub-sections of the population products such as skin-lightening creams, soaps and the use in traditional medicine and/ritualistic practices can result in significant exposures to both inorganic an elemental mercury.[95]

Methylmercury is a well known potent neurotoxin which causes adverse impacts on the developing human brain. It passes readily through the placental barrier and the blood-brain barrier making any exposure during pregnancy of great concern. Methylmercury is considered possibly carcinogenic by the International Agency for Research on Cancer[96] (IARC) and classed as group 2B.

Methylmercury is the focus of international research and concerns due to its widespread presence in fish and marine mammals consumed by humans. It is formed naturally from anthropogenically and naturally released mercury in the aquatic environment due to biological activity. It biomagnifies in the food chain causing high concentrations in higher order predatory fish (shark, swordfish, large tuna) and mammals (seals and whales) which in turn may be consumed by humans.

The long range atmospheric transport of mercury emissions, from local and regional sources, results in mercury contamination of the environment far from the emission source. This has been a particular problem for local populations dependent on marine diets such as the Inuits of the Antarctic who are placed at significant risk of methylmercury exposure[97] and Pacific Island people who have a diet rich in fish[98]. The food webs of the aquatic environment tend to have more levels than terrestrial food webs and land-based predators tend not to feed on each other. This factor leads to higher biomagnification in biota of aquatic settings.[99]

[88] ECB (2005) *Risk Assessment: Cadmium metal/Cadmium oxide*. Final, but not adopted version of Dec 2005. European Chemicals Bureau, Ispra, Italy.
[89] op cit UNEP (2008d)
[90] AMAP (1998): *Assessment report: Arctic pollution issues*. Arctic Monitoring and Assessment Programme, Oslo.
[91] ibid
[92] op cit IPCS (1992b)
[93] op cit UNEP (2002)
[94] ibid at 36
[95] ibid at 35
[96] IARC (1993) *IARC monographs on the evaluation of carcinogenic risks to humans.* Vol 58. Beryllium, cadmium, mercury, and exposures in the glass manufacturing industry. Lyon, 1993. International Agency for Research on Cancer
[97] op cit UNEP (2002) at 38
[98] Aarlsberg, B., Kumar, M., and Mosley L., (2003) *Mercury levels in Fijian Seafoods and Potential health Implications*. A Study for the WHO. Institute of Applied Sciences. University of the South Pacific. Suva Fiji.
[99] Pirrone et al. (2001), U.S. EPA (1997), presentation of the Government of Canada of information for UNEP (sub42gov) and the presentation of the Nordic Council of Ministers (sub84gov).

The toxic effects of methylmercury are not limited to the principal target tissue of the nervous system. Early effects of methylmercury exposure include paresthesia, malaise, and blurred vision. Increasing exposure leads to concentric constriction of the visual field, deafness, dysarthria, ataxia, and ultimately coma and death.[100]

One of the highest profile cases of methylmercury poisoning occurred from the 1950s to the 1970s in Japan's Minamata Bay. Discharges of mercury contaminated wastewater from a local chemical company manufacturing acetaldehyde were disposed of into the bay. It is estimated that up to 150 metric tonnes of mercury may have been discharged to the bay over a number of decades. A range of methylmercury symptoms started to become evident in the local population and the condition was dubbed 'Minamata Disease'.

The disease was prevalent among those local people who consumed large quantities of fish and shellfish from Minamata Bay. The population groups affected could be divided into two distinct categories, those who were directly exposed to the methylmercury diet and those offspring born to parents who were exposed. For those directly exposed through diet symptoms were paresthesia, ataxia, sensory disturbances, tremors, impairment of hearing and difficulty in walking. Among the 78 patients who died from exposure an examination of their brains found high levels of atrophy (up to 55 percent of normal brain weight and volume) with cystic cavities and spongy foci and entire regions devoid of neurons, granular cells in the cerebellum, Golgi cells and Purkinje cells.[101]

The children born of exposed parents (congenital cases) showed a higher level of symptoms than the parents. Symptoms included severe disturbance of nervous functions and highly delayed developmental skills. Common symptoms of the disease include sensory disorders in hands and feet, ataxia, narrowing field of vision, hearing impairment, balance impairment, speech impediment, trembling in hands and feet and disorders in ocular movement.[102]

3.3.2 Effects on the environment

Mercury is present in the environment from both natural and anthropogenic sources and researchers have found it difficult to calculate the exact contribution of each source due to the confounding effect of remobilization of historical anthropogenic sources from sources that appear to be 'natural'. One such example is forest fires where mercury is released. Some sources refer to mercury releases from forest fires as 'natural' whereas US researchers[103] note that a considerable portion of mercury releases from forest fires are actually of anthropological origin and are simply being remobilised as a result of the action of the fire.

In spite of these complexities it has been demonstrated that mercury is released naturally from weathering of rocks, volcanoes, evaporation from the surface of soils and water bodies and forest fires. The specific partition between truly natural and anthropogenic contributions of mercury (from sources such as soil and water evaporation) remain very difficult to determine. European data exists on soil and water mercury re-mobilisation but the total is aggregated due to the difficulty in separating anthropogenic sources.[104] Recent estimates suggest that the total anthropogenic contribution to air releases is about 50-70 percent annually of the total releases[105]. Current estimates of natural releases are between 1400[106] and 2400[107] metric tonnes per year.

Mercury is present in trace form in soils, fossil fuels and other minerals processed by humans. Anthropogenic sources of mercury are created largely as a result of the exploitation of these resources. Coal fired power production is the largest single source of atmospheric mercury emissions due to increasing global power demand and a reduction in other uses of mercury.[108]

The beneficiation and processing of a range of other minerals such as zinc, copper and gold also leads to the release of mercury to air, land and water. In particular the use of mercury to extract gold in small-scale artisanal mining is a significant source of releases to the environment as most of the mercury is heated from the amalgam with a blowtorch or similar heat source and emitted to atmosphere. The disposal and use of products containing mercury may also be a significant source of releases of mercury to the environment depending on the efficacy of recycling processes, landfill disposal or incineration practices.

As noted earlier methylmercury is generally the most toxic form of mercury due to its ability to build up in organisms in the food chain. Fish are particularly susceptible to the bioaccumulation of methylmercury where in fish tissue it is covalently bound to protein sulfhydryl groups. This results in a long half-life to elimination of around two years[109]. Predators of fish, including mammals (both marine and terrestrial), birds, humans and other fish are therefore susceptible to the toxic effects of the concentrated methylmercury.

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[100] Harada, M. (1995) 'Minamata disease: methylmercury poisoning in Japan caused by environmental pollution'*. CRC Critical Reviews in Toxicology* 1995; 25: 1-24.
[101] op cit UNEP (2002)
[102] Minamata City (2000): *Minamata disease – Its history and lessons – 2000*. Minamata City Planning Division, December 2000.
[103] USA (2002) comm-24-gov cited in Global Mercury Assessment, published by UNEP - Chemicals in Geneva, Switzerland in 2002, under the IOMC AGENCY AGENDA FOR THE SOUND MANAGEMENT OF CHEMICALS A cooperative agreement among UNEP, ILO, FAO, WHO, UNIDO , UNITAR and OECD
[104] op cit Pirrone et al. (2001)
[105] US EPA (1997) *Mercury study report to congress*. US EPA, Dec. 1997.
[106] Lamborg, C. H., Fitzgerald, W. F., O'Donnell, J. and Torgersen, T. (2002). *A non-steady-state compartmental model of global-scale mercury biogeochemistry with interhemispheric atmospheric gradients.* Geochimica et Cosmochimica Acta 66 (7), 1105-1118.
[107] op cit Bergan et al (2001)
[108] Pacyna, J.M. and Pacyna, E.G. (2000) *Assessment of emissions/discharges of mercury reaching the Arctic environment.* The Norwegian Institute for Air Research, NILU Report OR 7/2000, Kjeller, Norway.
[109] Wiener, J.G. and Spry, D.J., (1996) *Toxicological significance of mercury in freshwater fish. In: Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations*. Beyer, W.N., Heinz, G.H.and Redman-Norwood, A.W. (Eds.), Special Publication of the Society of Environmental Toxicology and Chemistry, Lewis Publishers, Boca Raton, FL, USA. pp. 297-339.

Lethal or harmful effects in mammals are reported when mercury concentrations exceed 25 to 60 mg/kg wet weight in kidneys and liver. Inorganic mercury targets the kidneys while methylmercury acts as a central nervous system toxin. Methylmercury also poses a significant reproductive risk to mammals due to its ability to cross the placental barrier.[110]

The use of mercury as a seed dressing in the 1950's and 1960's led to severe poisoning of wildlife in Scandinavia and North America with populations of pheasants and other seed eating birds as well as predatory birds (hawks and eagles) drastically reduced in some regions.[111] Acutely poisoned birds have whole body residues >20 mg/kg wet weight.[112] Toxicity of mercury to birds is species specific (and mediated by dietary exposure pathways) making it difficult to assign generic exposure thresholds however, adverse effects on reproduction can occur at egg concentrations as low as 0.5 to 2.0 mg/kg wet weight[113]

Although fish do accumulate methylmercury, direct waterborne exposure to mercury is not considered a serious concern for adult fish. However, there is recent evidence to suggest exposure to mercury in the early life stages of fish can affect growth, development and hormonal status. Indirect exposure via dietary uptake and maternal transfer of methylmercury to eggs is of concern (embryo mortality in lake trout eggs occurring at 0.07 - 0.10 µg/g w.w. versus toxicity in adults at 10-30 µg/g). Acute toxicity (96 hour LC_{50}) ranges from 33-400 µg/l for freshwater fish while ocean fish are less sensitive.[114]

Mercury is toxic to micro-organisms which is one reason that mercury has been used as an anti-bacterial ingredient in some topical pharmaceutical applications, for seed dressing and to inhibit bacteria in laboratory experiments. Inorganic mercury has effects on cultures of micro-organisms at 5 µg/l and organic mercury has effects at a magnitude of order below that level[115]. Recent research indicates impacts on soil microbial life across large parts of Europe from ambient mercury levels and there is potential for the same impacts in similar soil types across the globe.[116]

An international expert group operating under the UN ECE Convention on Long-Range Transboundary Air Pollution has developed preliminary critical limits to prevent ecological effects from mercury in organic soils. The limit has been set at 0.07-0.3 mg/kg total mercury in soil[117]. The bioavailability of mercury in soil is critical to toxicity levels. In this respect it is mainly the water-dissolved fraction of the mercury that determined the toxicity to microbial life in soil.

[110] op cit AMAP (1998)

[111] Ramel, C. (1974) *The mercury problem – A trigger for environmental pollution control.* Mutation Research 26, 341-348.

[112] op cit US EPA (1997)

[113] Burgess, N.M. and Braune, B.M. (2001) *Increasing trends in mercury concentrations in Atlantic and Arctic seabird eggs in Canada*. Poster presentation, SETAC Europe, 2001.

[114] WHO/IPCS (1989) *Mercury – Environmental aspects. Environmental Health Criteria No 86*, World Health Organisation, International Programme on Chemical Safety (IPCS), Geneva, Switzerland, 1989.

[115] WHO/IPCS (1991) *Inorganic mercury. Environmental Health Criteria No 118*, World Health Organisation, International Programme on Chemical Safety (IPCS), Geneva, Switzerland, 1991.

[116] Johansson, K., Bergbäck, B. and Tyler, G. (2001) *Impact of atmospheric long range transport of lead, mercury and cadmium on the Swedish forest environment*. Water, Air and Soil Pollution: Focus 1: 279-297, 2001.

[117] Curlic, J., Sefcik, P. and Viechova, Z. (edts) (2000) *Proceedings from meeting of the ad hoc international expert group on effect-based critical limits for heavy metals*. Report from Soil Science and Conservation Research Institute, Bratislava.

CHAPTER 4
DATABASES AND MAJOR ORGANISATIONS DEALING WITH TRADE STATISTICS OF PRODUCTS CONTAINING LEAD, CADMIUM AND MERCURY

4.0 INTRODUCTION

This study draws upon a wide range of trade statistics, research literature and publications of international governmental organisations, national governments, industry associations and non-government organisations. The main sources of information relating to the trade in products containing lead, cadmium and mercury are searchable statistical databases relating to global trade in these articles. The United States Geological Survey (USGS) also provide relevant statistics and analysis of trade flows for lead, cadmium and mercury ores and some products containing these elements. Contextual industry-based information has also been sourced from the International Lead and Zinc Study Group and the International Cadmium Association.

The main organisations that maintain databases of trade statistics include the United States (U.S.) International Trade Commission, Eurostat, UNCTAD Trade Analysis and Information System (TRAINS), Inter-American Development Bank (IDB / CTS) and the Comtrade database operated by the United Nations. This study primarily draws upon the UN Comtrade database due to its global coverage and incorporation of standardized commodity classifications. The codes utilised in this report and in the Comtrade database are the Standard international Trade Classification (SITC) codes and the Harmonised Commodity Description and Coding System (HS).

4.1 UN COMTRADE DATABASE AND CLASSIFICATION OF COMMODITIES FOR PRODUCTS CONTAINING LEAD, CADMIUM, AND MERCURY.

UN Comtrade is the acronym for “United Nations Commodity Trade Statistics Database” which is maintained by the United Nations Statistical Division (UNSD). On an annual basis over 140 countries provide the International Trade Statistics Branch of the United Nations Statistics Division with their annual international trade statistics including over 160 trade partners countries with details of commodities and trading partners. Commodities are classified according to SITC (Rev. 1from 1962, Rev. 2 from 1976 and Rev. 3 from 1988) and the Harmonized System (HS from 1988 with revisions in 1996 and 2002). Current data is reported in HS-2002 and automatically converted into the other classifications.[118]

The selected products and their codes are listed in Table 4-1 to 4-3 below. There are a number of instances where the data extracted from the Comtrade database did not contain net weight data or was recorded as zero. Therefore, the net weight data presented in Chapter 5 will be limited by the availability of the data in the database.

There were three commodity codes where no data existed in the COMTRADE database. These commodity codes (SITC-1-71421 - Electronic Computers, SITC-2-51551 and SITC-1-51283 – Organo-mercury Compounds) were not subject to any further analysis.

The net weight of items does not represent the net weight of lead, cadmium, or mercury but rather the net weight of the items. It does not account for varying percentages of lead, cadmium, or mercury inherently present in the items. Where an item was recorded as a weight, the data was generally more complete. In the instances where the quantity code was unknown or as the number of item, it was much more likely for the net weight to be blank or recorded as zero. For this reason, the value of the trade in $US was included as one of the parameters for comparison, as in all instances, a value in $US was recorded.

Re-imports and Re-exports are included in the import and export data that is extracted from the Comtrade Database. Re-exports and re-imports are recorded separately for analytical purposes, but have not been analysed separately in this report. Re-exports are the export of a foreign good in the same state as it was imported, and similarly, re-imports are a good that is imported in the same state as it was previously exported. Normally the volumes of re-imports are a relatively small part of the overall imports, in the order of 0.5 – 1.2% for some of the higher re-importing countries. China, for all trade, has a relatively high re-import proportion, in the range of 8% of its total imports. Comtrade attributed this to the trade between China and Hong Kong, SAR of China. This can be observed in some of the trading partner data where China is listed as one of its own major trading partners.

This study focuses on the Asia and Pacific region in terms of trade in products containing lead, cadmium and mercury. As a result the Eurostat database and the US International Trade Commission database have limited applicability due to limitations in recording trade statistics in their respective regions rather than global statistics. Eurostat’s trade statistics directly relate to the trade between European Union Member States and non-European Union countries but they do not cover trade between non-European Union countries which has been reported to represent up to two-thirds of the global mercury trade.

[118] op cit UNEP (2006)

Table: 4-1 Lead and lead – containing products by commodity code

CODE	DESCRIPTION OF THE PRODUCT
HS-92-850710	Lead-acid electric accumulators (vehicle)
HS-92-850720	Lead-acid electric accumulators except for vehicles
HS-96-260700	Lead ore and concentrates
HS-96-262020	Ash or residues containing mainly lead
HS-92-2824	Lead oxides, red lead and orange lead
HS-92-282410	Lead monoxide (litharge, massicot)
HS-96-381111	Anti-knock preparations based on lead compounds
HS-96-7801	Unwrought lead
HS-96-7802	Lead waste or scrap
HS-96-7803	Lead bars, rods, profiles and wire
HS-96-7804	Lead plates, sheets, strip, foil, powders and flakes
HS-96-7805	Lead tubes, pipes and fittings
HS-96-7806	Articles of lead nes
SITC-3-6852	Lead, lead alloys, worked
SITC-3-52375	Lead carbonates
SITC-1-71421	Electronic Computers
HS-02-8471	Automatic data processing machines and units thereof (computers)

Table: 4-2 Cadmium and cadmium – containing products by commodity code

CODE	DESCRIPTION OF THE PRODUCT
HS-02-283030	Cadmium sulphide
SITC-3-53313	Pigments and preparations based on cadmium compounds
HS-92-850730	Nickel-cadmium electric accumulators
SITC-3-68982	Cadmium, unwrought; cadmium waste and scrap; powders
HS-96-381230	Anti-oxidisers and stabilisers or plastics
SITC-4-5622	Mineral or chemical fertilizers, phosphatic
SITC-1-5612	Phosphatic fertilizers and materials
HS-07-262091	Ash & residues (excl. From the manufacture of iron/steel) containing antimony/beryllium/cadmium/chromium/their mixtures

Table: 4-3 Mercury and mercury containing products by commodity code

CODE	DESCRIPTION OF THE PRODUCT
HS-92-853931	Fluorescent lamps, hot cathode
HS-92-9025	Hydrometers, thermometers, barometers, etc
HS-02-853932	Electric discharge lamps (excl. Ultra-violet lamps), mercury/sodium vapour lamps; metal halides
HS-02-850630	Primary cells & batteries, mercuric oxide
SITC-3-772	Elec.Switch.Relay.Circuit
HS-02-847160	Input/output units (of auto. Data processing machines), whether or not containing storage units in the same housing
HS-92-8525	Radio and TV transmitters, television cameras
HS-02-854012	Cathode-ray television picture tubes, incl. Video monitor cathode-ray tubes, black and white / other, monochrome
HS-96-8540	Thermionic and cold cathode valves and tubes
SITC-2-51551	Organo-mercury compounds
SITC-1-51283	Organo-mercury compounds
SITC-4-776	Thermionic, cold cathode or photo-cathode valves and tubes (e.g., vacuum or vapour or gas-filled valves and tubes, mercury arc rectifying valves and tubes, cathode-ray tubes, television camera tubes); diodes, transistors and similar semiconductor devices
HS-02-262060	Ash & residues (excl. from the mfr. of iron/steel) cont. mainly arsenic/mercury/thallium/ their mixtures
HS-96-280540	Mercury
HS-07-2852	Compounds, inorganic or organic, of mercury, excluding amalgams.

CHAPTER 5
PRODUCTION AND TRADE OF PRODUCTS CONTAINING LEAD, CADMIUM, AND MERCURY IN THE ASIA AND PACIFIC REGION

5.1 PRODUCTION AND TRADE OF PRODUCTS CONTAINING LEAD

5.1.1 Products containing lead[119]

5.1.1.1 Batteries

In 2003, batteries or lead-acid accumulators accounted for 75% of the total lead consumption. Lead is present in the batteries in both metallic and chemicals form. The major application of lead-acid batteries is starter batteries in motor vehicles, followed by batteries for electric vehicles and back-up power supplies.

5.1.1.2 Cathode ray tubes (CRT) and crystal glass

In 2001, cathode ray tubes accounted for 38% of the consumption of lead compounds. The use of the lead glass for radiation shielding in CRT's will become a historical application as the technology moves towards the more modern flat panel plasma and LCD technologies. Crystal glass accounted for 15 percent of the lead compound consumption.

5.1.1.3 PVC Stabilisers

Lead compounds used as heat and UV stabilisers in PVC are regarded as the second most important market of lead compounds and accounted for 24 percent of the 2001 lead compound consumption.

5.1.1.4 Pigments

The use of lead in pigments has largely been a historical application where lead oxides were used as pigments and anti-corrosive agents in paints. Their usage has declined from 14% of lead compounds to 5% in the period from 1975 to 2001.

5.1.2 World Production of lead and trade of products containing lead

5.1.2.1 World production of lead in refineries in MT [120]

Worldwide lead mine production increased in 2008 by 165,000 tonnes or approximately 4% over 2007 production. China was the leading producer with approximately 39% of the world mine production, followed by Australia (17%), and the United States (11%). World production of refined lead was lead by China (37%), United States (15%) and Germany (5%). The leading refined lead consuming countries were China (37%), the United States (18%), and Germany (4%).

It is also noted that the recycled portion of the refined lead production, or secondary lead production, accounted for 53% of the total refined lead production in 2008.

5.1.3 Production and trade of lead and products containing lead in Asia and the Pacific

The data contained in this section is derived from the United Nations COMTRADE database. It analyses the trade flows of lead containing products in the Asia and the Pacific region. These products, which are listed in Table 5-2, were identified as products that contain, or may contain lead. During the course of this study, there has been no attempt to quantify the amounts of lead contained within these products, which in some cases may be the majority of the weight present in the identified item, but in other items, may be fractions of a percent of the total weight. This should be taken into consideration when using this data for decision making, or further information should be sought on particular commodity code to determine the actual lead contents of particular items.

There were also a number of instances where the data extracted from the COMTRADE database did not contain net weight data or was recorded as zero. Therefore, the net weight data tabulated in this section will be limited by the availability of the data in the database. Where an item was recorded as a weight, the data was generally more complete. In the instances where the quantity code was unknown or as the number of item, it was much more likely for the net weight to be blank or recorded as zero.

Re-imports and Re-exports are included in the import and export data that is extracted from the COMTRADE Database. Re-exports and re-imports are recorded separately for analytical purposes, but have not been analysed separately in this section. Re-exports are the export of a foreign good in the same state as it was imported, and similarly, re-imports are a good that is imported in the same state as it was previously exported. Normally the volumes of re-imports are a relatively small part of the overall imports, in the order of 0.5 – 1.2% for some of the higher re-importing countries. China, for all trade, has a relatively high re-import proportion of its trade in the range of 8% of its total imports. COMTRADE attributed this to the trade between China and Hong Kong, SAR of China. This can be observed in some of the trading partner data where China is listed as one of its own major trading partners.

The period of data extracted from the COMTRADE database spanned the period of 2000 to 2009. The countries that data was extracted for are listed in Table 1-1.

[119] op cit UNEP (2008e)
[120] op cit USGS (2010a)

Table: 5-1 World lead mine production (MT)

Country	2004		2005		2006		2007		2008	
Argentina	9,551	0.3%	10,683	0.3%	12,064	0.3%	17,045	0.5%	16,000	0.4%
Australia	674,000	21.4%	767,000	22.0%	686,000	19.1%	641,000	17.4%	645,000	16.8%
Bolivia	10,267	0.3%	11,231	0.3%	11,955	0.3%	22,798	0.6%	81,602	2.1%
Bosnia and Herzegovina	850	0.0%	1,100	0.0%	600	0.0%	2,300	0.1%	2,300	0.1%
Brazil	14,734	0.5%	23,616	0.7%	15,764	0.4%	24,574	0.7%	24,600	0.6%
Bulgaria	19,000	0.6%	22,000	0.6%	18,000	0.5%	16,400	0.4%	16,400	0.4%
Burma	2,000	0.1%	2,000	0.1%	2,000	0.1%	2,000	0.1%	2,000	0.1%
Canada	76,730	2.4%	79,254	2.3%	83,096	2.3%	75,135	2.0%	98,974	2.6%
Chile	2,286	0.1%	878	0.0%	672	0.0%	1,305	0.0%	3,985	0.1%
China	998,000	31.7%	1,140,000	32.8%	1,330,000	36.9%	1,410,000	38.3%	1,500,000	39.1%
Georgia	400	0.0%	400	0.0%	400	0.0%	400	0.0%	400	0.0%
Greece	--	0.0%	1,500	0.0%	10,500	0.3%	15,000	0.4%	16,000	0.4%
Guatemala	47	0.0%	23	0.0%	28	0.0%	363	0.0%	380	0.0%
Honduras	8,877	0.3%	10,488	0.3%	11,775	0.3%	10,215	0.3%	10,000	0.3%
India	51,300	1.6%	60,400	1.7%	69,200	1.9%	77,500	2.1%	87,300	2.3%
Iran	22,000	0.7%	23,000	0.7%	24,000	0.7%	25,000	0.7%	20,000	0.5%
Ireland	65,915	2.1%	63,800	1.8%	62,000	1.7%	54,100	1.5%	54,100	1.4%
Italy	600	0.0%	800	0.0%	800	0.0%	800	0.0%	800	0.0%
Japan	5,512	0.2%	3,437	0.1%	777	0.0%	--	0.0%	--	0.0%
Kazakhstan	33,000	1.0%	31,000	0.9%	48,100	1.3%	40,200	1.1%	39,000	1.0%
Korea, North	20,000	0.6%	20,000	0.6%	20,000	0.6%	20,000	0.5%	20,000	0.5%
Korea, Republic of	40	0.0%	50	0.0%	17	0.0%	12	0.0%	12	0.0%
Macedonia	--	0.0%	--	0.0%	15,600	0.4%	32,000	0.9%	32,000	0.8%
Mexico	118,484	3.8%	134,388	3.9%	120,450	3.3%	120,000	3.3%	100,725	2.6%
Morocco	31,300	1.0%	45,800	1.3%	53,000	1.5%	44,800	1.2%	40,000	1.0%
Namibia	14,338	0.5%	14,320	0.4%	11,830	0.3%	11,900	0.3%	12,000	0.3%
Peru	306,211	9.7%	319,345	9.2%	313,325	8.7%	329,154	8.9%	345,109	9.0%
Poland	60,200	1.9%	75,100	2.2%	58,500	1.6%	59,900	1.6%	62,200	1.6%
Romania	18,297	0.6%	11,610	0.3%	6,269	0.2%	784	0.0%	800	0.0%
Russia	23,000	0.7%	36,000	1.0%	36,000	1.0%	50,000	1.4%	60,000	1.6%
Saudi Arabia	30	0.0%	--	0.0%	--	0.0%	--	0.0%	--	0.0%
Serbia	1,000	0.0%	1,000	0.0%	1,000	0.0%	1,000	0.0%	1,000	0.0%
South Africa	37,485	1.2%	42,159	1.2%	48,273	1.3%	41,857	1.1%	46,440	1.2%
Sweden	55,000	1.7%	61,000	1.8%	76,800	2.1%	62,100	1.7%	60,000	1.6%
Tajikistan	800	0.0%	800	0.0%	800	0.0%	800	0.0%	800	0.0%
Tunisia	5,470	0.2%	8,708	0.3%	--	0.0%	--	0.0%	--	0.0%
Turkey	17,000	0.5%	19,000	0.5%	15,000	0.4%	20,000	0.5%	30,000	0.8%
United Kingdom	500	0.0%	500	0.0%	500	0.0%	500	0.0%	500	0.0%
United States	445,000	14.1%	437,000	12.6%	429,000	11.9%	444,000	12.1%	410,000	10.7%
Vietnam	2,750	0.1%	3,300	0.1%	3,500	0.1%	3,500	0.1%	3,500	0.1%
Total	**3,150,000**	**100%**	**3,480,000**	**100%**	**3,600,000**	**100%**	**3,680,000**	**100%**	**3,840,000**	**100%**

Source: USGS

Table: 5-2 Lead and lead – containing products by commodity code

CODE	DESCRIPTION OF THE PRODUCT
HS-92-850710	Lead-acid electric accumulators (vehicle)
HS-92-850720	Lead-acid electric accumulators except for vehicles
HS-96-260700	Lead ore and concentrates
HS-96-262020	Ash or residues containing mainly lead
HS-92-2824	Lead oxides, red lead and orange lead
HS-92-282410	Lead monoxide (litharge, massicot)
HS-96-381111	Anti-knock preparations based on lead compounds
HS-96-7801	Unwrought lead
HS-96-7802	Lead waste or scrap
HS-96-7803	Lead bars, rods, profiles and wire
HS-96-7804	Lead plates, sheets, strip, foil, powders and flakes
HS-96-7805	Lead tubes, pipes and fittings
HS-96-7806	Articles of lead nes*
SITC-3-6852	Lead, lead alloys, worked
SITC-3-52375	Lead carbonates
SITC-1-71421	Electronic Computers
HS-02-8471	Automatic data processing machines and units thereof (computers)

*nes – not elsewhere specified

Table: 5-3 Import and export of products containing cadmium in Asia and the Pacific, in MT and in thousands of $US, 2000 – 2009 period

Code	Description	Import (MT)	Value of Import (thousands $US)	Export (MT)	Value of Export (thousands $US)
HS-92-850710	Lead-acid electric accumulators (vehicle)	1,545,562	3,545,066	5,359,095	9,944,384
HS-92-850720	Lead-acid electric accumulators except for vehicles	1,324,226	5,305,744	2,437,984	9,496,105
HS-96-260700	Lead ore and concentrates	14,099,163	12,696,075	6,652,257	4,570,047
HS-96-262020	Ash or residues containing mainly lead	455,145	119,619	84,535	52,415
HS-92-2824	Lead oxides, red lead and orange lead	567,212	607,760	626,645	505,530
HS-92-282410	Lead monoxide (litharge, massicot)	451,482	474,714	504,566	356,383
HS-96-381111	Anti-knock preparations based on lead compounds	19,335	130,423	4,132	22,199
HS-96-7801	Unwrought lead	7,061,391	8,571,783	10,516,400	11,493,392
HS-96-7802	Lead waste or scrap	488,230	320,749	232,940	153,162
HS-96-7803	Lead bars, rods, profiles and wire	170,070	389,905	48,084	103,471
HS-96-7804	Lead plates, sheets, strip, foil, powders and flakes	457,212	360,763	369,076	626,737
HS-96-7805	Lead tubes, pipes and fittings	8,783	20,912	4,610	13,953
HS-96-7806	Articles of lead nes	112,761	422,260	121,180	423,427
SITC-3-6852	Lead, lead alloys, worked	624,636	772,102	416,981	744,161
SITC-3-52375	Lead carbonates	973	2,651	2,938	8,920
HS-02-8471	Automatic data processing machines and units thereof (computers)	3,579,397	509,660,377	7,554,612	1,129,514,972
Totals		**30,965,577**	**543,400,904**	**34,936,036**	**1,168,029,258**

Table: 5-4 Annual import and export of all products containing lead in Asia and the Pacific, in MT and thousands of $US 2000 – 2009 period

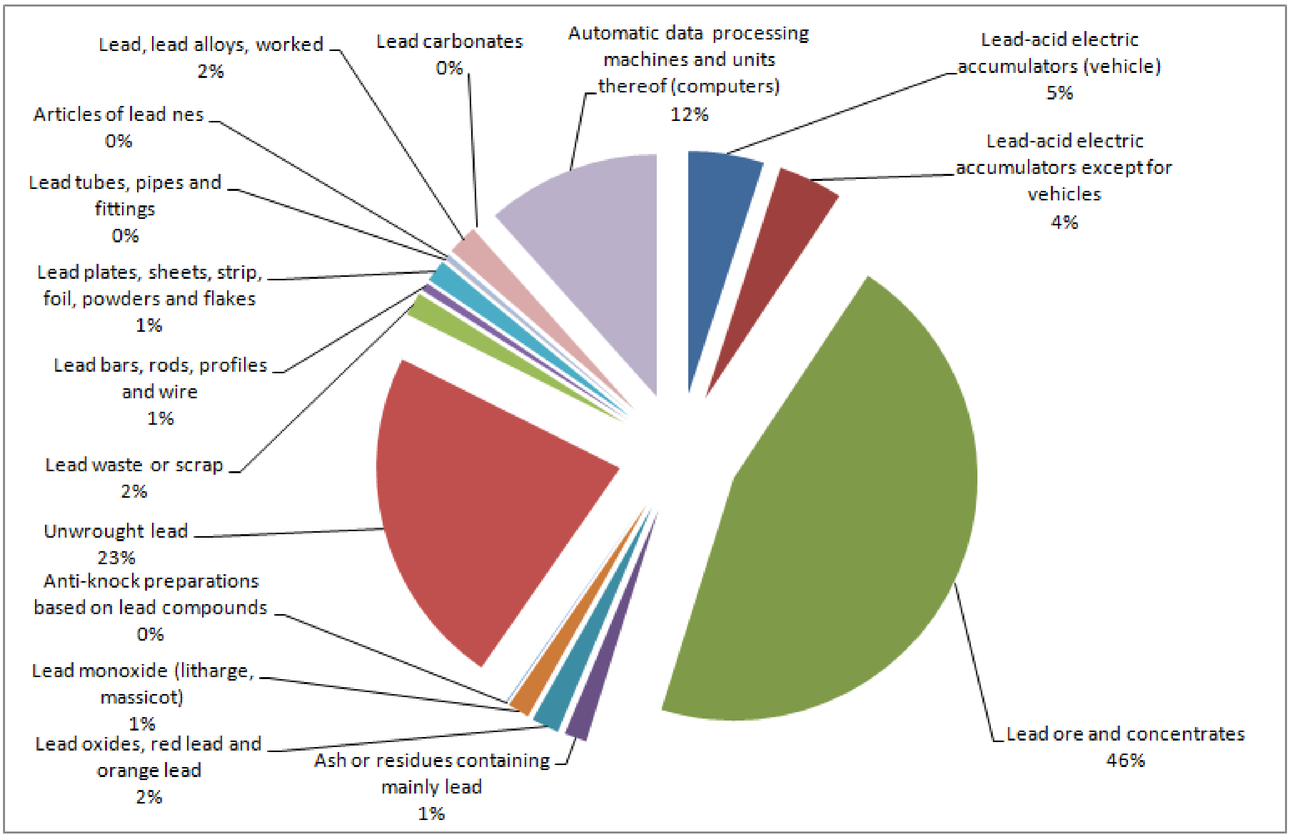
Year	Import (MT)	Value of Imports (Thousands US$)	Export (MT)	Value of exports (Thousands of US$)
2000	1,884,211.45	1,421,630.96	2,088,020.00	1,681,852.56
2001	1,962,430.43	1,426,966.03	2,421,702.37	1,782,226.71
2002	2,316,757.21	43,447,101.04	2,715,867.77	74,492,820.70
2003	2,781,415.67	52,523,368.79	2,726,575.82	96,864,864.50
2004	3,196,982.64	62,255,760.95	3,015,004.27	122,407,296.33
2005	3,970,180.44	71,309,018.77	4,564,901.27	144,688,604.00
2006	4,223,921.74	77,681,940.63	4,935,779.84	166,116,523.29
2007	3,296,614.24	76,461,974.27	4,397,349.93	191,343,337.47
2008	3,812,590.20	83,693,492.32	4,507,870.88	198,083,866.48
2009	3,520,473.46	73,179,650.21	3,562,963.41	170,567,866.35
Totals	**30,965,577.48**	**543,400,903.95**	**34,936,035.57**	**1,168,029,258.39**

Table: 5-5 Import of products containing lead by commodity code in Asia and the Pacific, in MT, 2000 – 2009 period

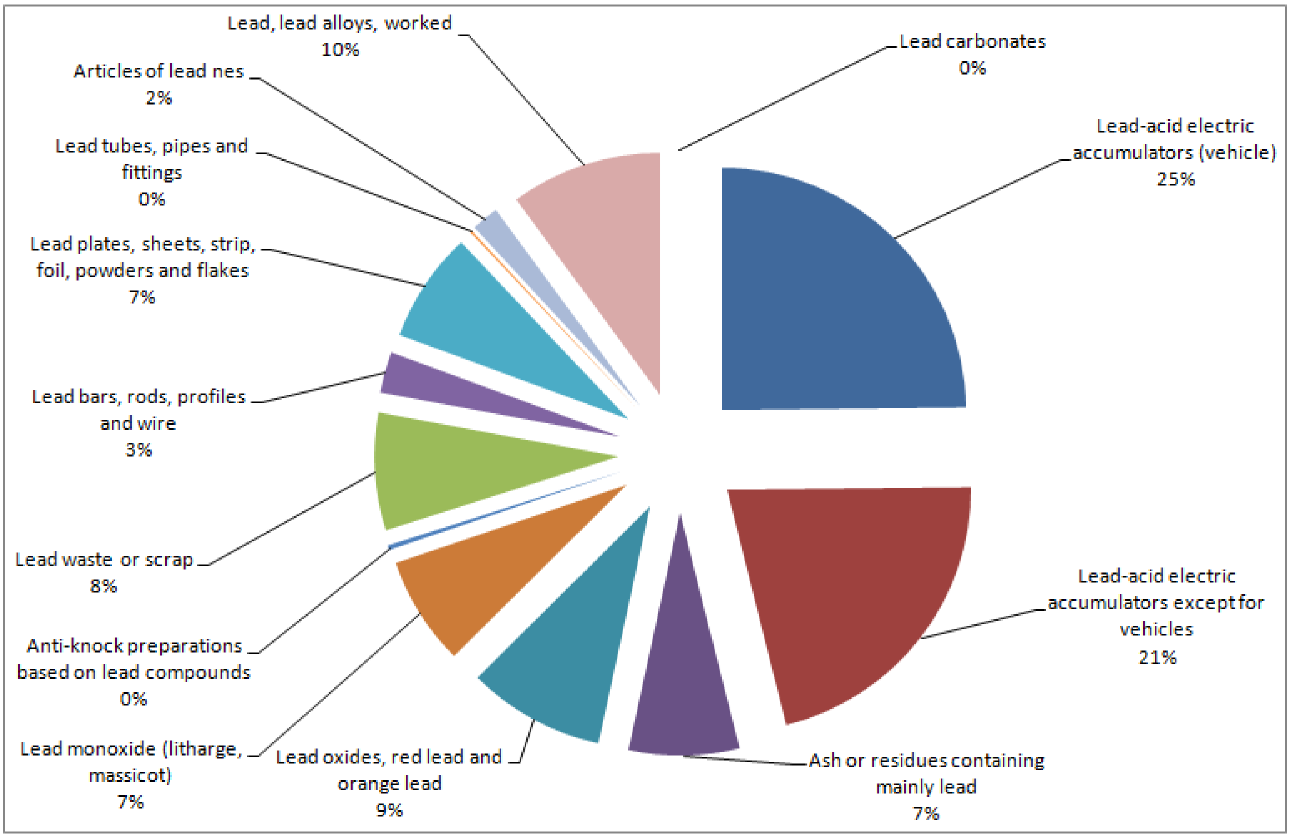
Year	HS-92-850710	HS-92-850720	HS-96-260700	HS-96-262020	HS-92-2824	HS-92-282410	HS-96-381111	HS-96-7801	HS-96-7802	HS-96-7803	HS-96-7804	HS-96-7805	HS-96-7806	SITC-3-6852	SITC-3-52375	HS-02-8471	Totals
2000	87,219.1	65,603.1	893,281.7	14,604.0	80,210.4	72,060.6	7,313.2	563,846.9	37,638.9	10,785.0	14,535.0	1,094.1	9,295.0	26,605.2	119.1	-	1,884,211
2001	94,742.6	70,407.4	934,798.3	22,454.6	74,266.6	60,047.2	4,581.7	582,263.9	57,382.2	14,760.2	11,602.0	992.2	5,982.7	27,564.5	584.2	-	1,962,430
2002	106,447.0	69,087.6	847,418.2	31,200.0	61,590.4	50,368.4	701.7	687,243.0	64,040.3	16,877.1	12,227.3	690.7	9,842.1	29,859.3	89.7	329,074.6	2,316,757
2003	113,694.0	89,847.3	1,177,447.5	70,666.2	73,488.8	55,506.9	986.3	649,644.4	61,466.2	14,361.7	14,924.4	305.7	9,068.9	29,622.8	54.8	420,329.7	2,781,416
2004	142,803.1	114,321.0	1,318,571.7	75,092.8	78,216.8	66,041.4	1,850.5	760,210.6	58,834.3	17,689.3	14,378.7	1,394.2	11,272.7	33,632.5	40.5	502,632.4	3,196,983
2005	176,478.0	165,090.8	1,542,378.1	63,039.6	61,862.2	51,136.1	1,525.5	701,636.0	65,024.2	20,899.9	21,003.8	905.0	10,023.7	42,845.9	45.8	1,046,285.8	3,970,180
2006	211,637.8	192,571.7	1,627,280.5	57,298.3	53,329.4	37,565.9	638.1	834,374.5	34,741.2	34,530.6	84,001.2	1,151.6	20,395.3	119,857.0	34.6	914,513.9	4,223,922
2007	246,787.1	212,524.6	1,725,280.4	93,714.4	41,073.4	34,322.1	615.9	711,647.9	31,526.7	36,361.4	16,747.8	1,615.3	9,858.8	39,125.3	0.9	95,412.1	3,296,614
2008	207,158.7	207,370.7	1,910,694.6	23,438.1	31,652.6	17,945.1	716.1	724,694.7	34,315.6	1,868.9	237,288.0	506.9	16,567.3	242,956.3	1.2	155,415.3	3,812,590
2009	158,594.8	137,402.0	2,122,012.0	3,637.0	11,521.7	6,488.0	405.7	845,828.9	43,260.3	1,935.4	30,503.8	127.5	10,454.2	32,566.7	2.1	115,733.3	3,520,473
Totals	**1,545,562**	**1,324,226**	**14,099,163**	**455,145**	**567,212**	**451,481**	**19,334**	**7,061,390**	**488,230**	**170,069**	**457,212**	**8,783**	**112,760**	**624,635**	**973**	**3,579,397**	**30,965,577**

Table: 5-6 Import of products containing lead by commodity code in Asia and the Pacific, in thousands $US, 2000 – 2009 period

Year	HS-92-850710	HS-92-850720	HS-96-260700	HS-96-262020	HS-92-2824	HS-92-282410	HS-96-381111	HS-96-7801	HS-96-7802	HS-96-7803	HS-96-7804	HS-96-7805	HS-96-7806	SITC-3-6852	SITC-3-52375	HS-02-8471	Totals
2000	208,620.6	358,956.2	252,497.5	1,820.2	50,970.5	44,111.8	52,155.6	295,261.9	11,156.4	30,976.1	25,313.0	1,868.2	29,229.8	58,432.5	260.6	-	1,421,631
2001	205,751.6	382,358.4	278,442.6	1,510.4	44,746.8	36,420.2	31,073.6	311,673.5	16,076.7	28,660.2	17,469.3	1,113.2	22,843.6	47,377.4	1,448.6	-	1,426,966
2002	192,209.6	346,865.2	280,050.5	2,268.4	40,346.2	30,387.7	3,640.4	341,611.5	15,730.3	32,336.9	17,019.2	1,448.8	26,116.5	50,893.7	175.6	42,066,000.6	43,447,101
2003	229,620.6	419,337.4	462,153.2	4,210.3	55,140.4	35,812.7	4,126.8	358,182.1	19,317.9	31,541.3	23,609.0	1,031.7	35,008.5	56,186.2	199.9	50,787,890.6	52,523,369
2004	274,928.4	478,724.0	836,040.7	5,700.2	84,352.4	70,278.2	5,464.7	676,995.9	15,909.4	50,203.7	29,086.5	2,342.1	40,438.6	81,645.8	124.4	59,603,525.9	62,255,761
2005	332,552.4	501,799.9	1,064,717.3	4,963.6	73,094.2	59,294.1	6,721.7	730,293.2	32,397.8	44,541.1	33,580.1	1,727.5	35,866.2	79,850.7	148.1	68,307,470.9	71,309,019
2006	405,678.9	593,641.3	1,531,455.5	13,409.1	70,934.6	51,933.0	7,150.3	1,036,059.4	28,006.3	59,118.1	32,220.9	7,064.6	42,212.0	98,406.1	126.1	73,704,524.4	77,681,941
2007	536,565.4	732,351.4	2,675,643.6	56,365.5	100,688.4	83,699.9	6,513.0	1,650,816.0	43,877.3	103,244.5	59,822.2	2,935.9	56,555.4	166,003.5	7.0	70,186,885.2	76,461,974
2008	654,965.1	849,985.8	2,547,073.1	27,475.8	65,929.1	49,645.5	7,894.7	1,688,643.5	69,703.5	5,843.6	74,226.0	1,060.0	85,467.3	81,130.3	116.0	77,484,333.0	83,693,492
2009	504,173.9	641,724.7	2,768,000.7	1,895.9	21,557.6	13,130.4	5,682.4	1,482,246.3	68,573.8	3,439.0	48,417.0	319.6	48,522.4	52,175.6	44.3	67,519,746.8	73,179,650
Totals	**3,545,066**	**5,305,744**	**12,696,075**	**119,619**	**607,760**	**474,714**	**130,423**	**8,571,783**	**320,749**	**389,905**	**360,763**	**20,912**	**422,260**	**772,102**	**2,651**	**509,660,377**	**543,400,904**



Graph: 5-1 Import of products containing lead into Asia and the Pacific, in MT, 2000 – 2009 period



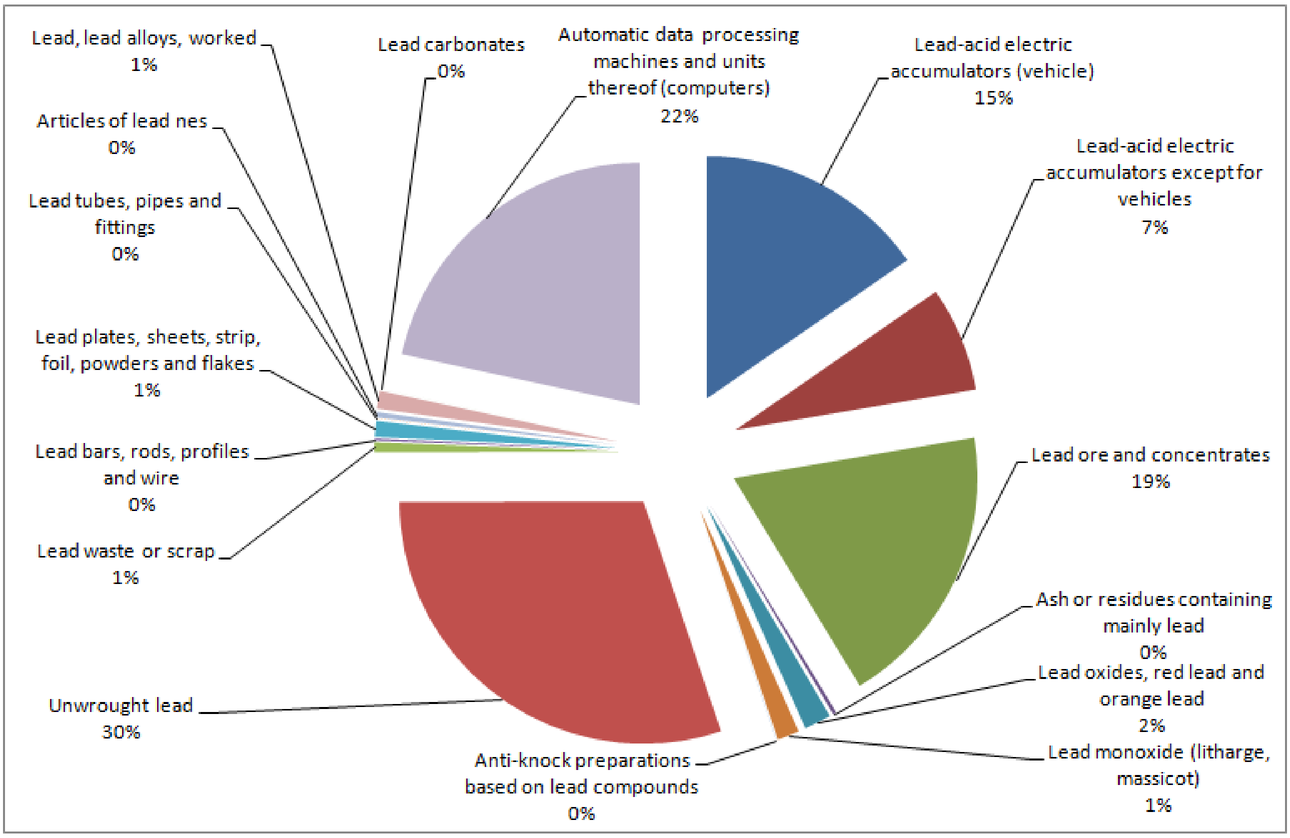
Graph: 5-2 Import of products containing lead into Asia and the Pacific, excluding lead ore and concentrates, unwrought lead and electronic data machines, in MT, 2000 – 2009 period

Table: 5-7 Export of products containing lead by commodity code in Asia and the Pacific, in MT, (2000 – 2009) period

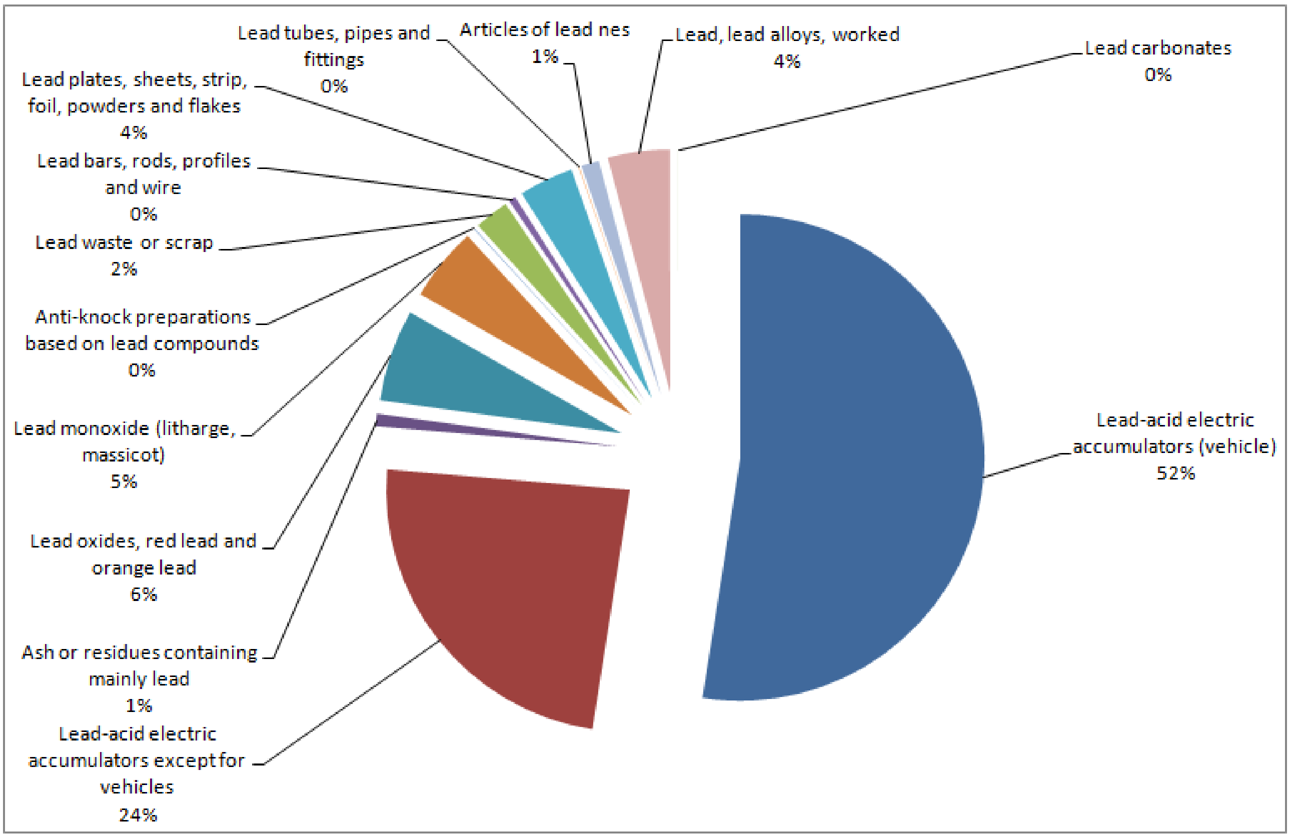
Year	HS-92-850710	HS-92-850720	HS-96-260700	HS-96-262020	HS-92-2824	HS-92-282410	HS-96-381111	HS-96-7801	HS-96-7802	HS-96-7803	HS-96-7804	HS-96-7805	HS-96-7806	SITC-3-6852	SITC-3-52375	HS-02-8471	Totals
2000	295,742.5	82,067.8	450,549.7	16,071.0	58,289.3	49,223.8	888.1	1,088,955.1	17,934.6	4,939.5	6,802.8	1,003.7	2,653.1	12,746.0	152.8	-	2,088,020
2001	321,709.7	98,887.8	534,140.3	21,080.4	129,107.7	118,547.1	587.1	1,146,845.8	16,919.6	5,446.6	7,914.5	943.8	5,144.5	14,305.1	122.4	-	2,421,702
2002	370,147.2	111,348.1	439,642.7	10,382.2	47,890.5	39,609.5	532.0	1,158,862.2	20,585.9	14,064.2	17,473.6	467.6	6,725.1	32,005.4	140.9	445,991	2,715,868
2003	420,758.5	126,108.9	440,420.7	26.4	66,711.8	49,195.2	534.1	1,109,862.2	24,662.6	4,730.6	27,556.0	351.5	17,720.6	32,655.0	65.9	405,216	2,726,576
2004	469,152.7	176,018.5	545,809.8	4,738.0	66,989.3	53,543.0	189.4	1,088,911.8	31,733.8	6,530.7	23,204.1	401.5	12,566.4	29,617.1	70.1	505,528	3,015,004
2005	631,618.9	281,928.7	700,464.3	9,046.7	45,499.1	31,902.7	146.3	1,162,756.9	16,104.9	4,300.4	21,276.0	490.6	11,087.8	24,984.1	2,307.7	1,620,986	4,564,901
2006	672,834.0	371,625.9	746,240.7	5,819.4	52,175.6	31,231.0	425.9	1,247,662.1	18,549.9	5,513.4	71,728.5	534.0	20,080.9	74,571.8	77.2	1,616,710	4,935,780
2007	810,653.8	464,668.5	1,698,407.5	5,496.7	40,008.4	30,069.0	392.1	963,710.3	28,157.5	2,040.9	33,953.2	264.2	16,374.4	36,258.3	1.1	266,894	4,397,350
2008	722,613.7	499,397.1	561,384.3	6,434.9	103,635.4	93,388.1	265.0	748,260.7	28,324.1	478.1	104,756.8	6.3	16,701.1	105,241.2	0.0	1,516,984	4,507,871
2009	643,864.2	225,933.1	535,197.1	5,439.3	16,337.7	7,856.6	172.0	800,573.2	29,967.3	40.0	54,410.3	146.7	12,126.0	54,597.0	0.0	1,176,303	3,562,963
Totals	5,359,095	2,437,984	6,652,257	84,535	626,645	504,566	4,132	10,516,400	232,940	48,084	369,076	4,610	121,180	416,981	2,938	7,554,612	34,936,036

Table: 5-8 Export of products containing lead by commodity code in Asia and the Pacific, in thousands $US, (2000 – 2009) period

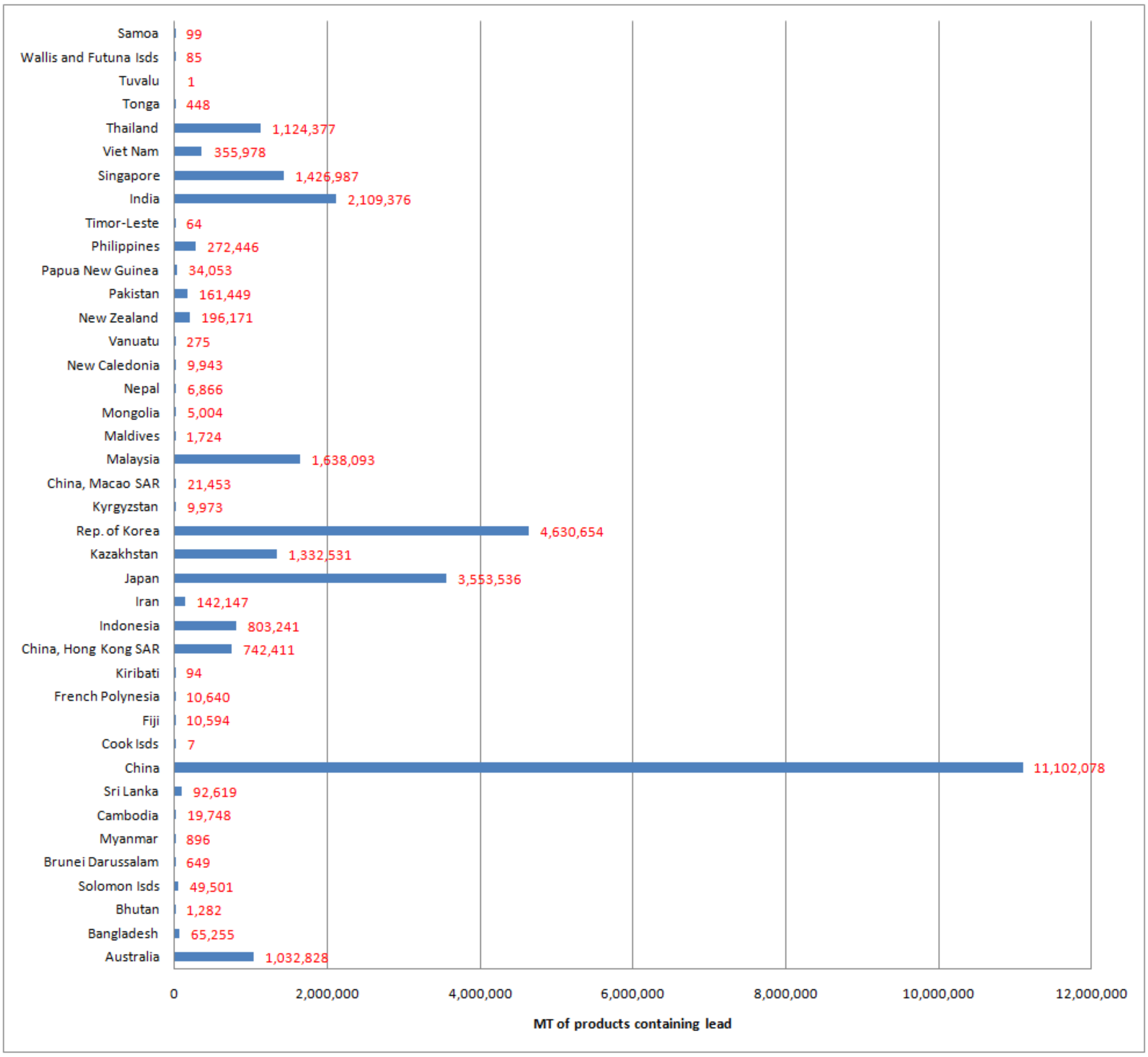
Year	HS-92-850710	HS-92-850720	HS-96-260700	HS-96-262020	HS-92-2824	HS-92-282410	HS-96-381111	HS-96-7801	HS-96-7802	HS-96-7803	HS-96-7804	HS-96-7805	HS-96-7806	SITC-3-6852	SITC-3-52375	HS-02-8471	Totals
2000	474,363.9	339,757.5	167,750.3	2,370.0	35,639.2	27,864.1	2,008.6	530,757.4	8,029.3	10,405.5	23,440.8	1,041.5	23,249.5	34,887.7	287.3	-	1,681,853
2001	487,850.0	361,556.5	183,983.5	1,538.2	33,884.4	27,057.7	1,286.5	586,005.5	9,462.1	11,301.0	22,860.1	885.0	19,302.4	35,046.0	207.8	-	1,782,227
2002	523,468.1	399,930.8	173,915.0	1,132.9	27,838.7	21,960.9	1,085.3	591,952.2	7,715.2	14,980.7	22,541.6	873.8	30,738.8	38,396.1	294.7	72,635,995.9	74,492,821
2003	633,003.6	500,988.2	203,239.2	481.9	40,792.5	29,621.5	1,549.8	594,437.6	6,890.6	12,281.0	25,946.0	1,327.0	37,198.9	39,553.9	217.3	94,737,335.7	96,864,864
2004	713,931.4	679,371.4	354,045.2	2,356.5	68,945.8	54,764.7	794.8	952,788.1	11,901.9	16,821.9	36,700.3	1,231.0	40,584.5	54,753.2	7,035.9	119,411,269.7	122,407,296
2005	921,946.4	925,861.5	505,341.2	8,166.5	48,187.3	35,520.2	1,438.0	1,170,152.3	7,690.6	14,536.1	40,311.6	1,778.4	34,820.2	56,626.1	519.4	140,915,708.1	144,688,604
2006	1,065,884.0	1,195,800.6	614,139.7	6,484.1	63,727.1	41,012.3	4,007.3	1,599,597.7	9,926.7	16,123.4	44,035.6	3,798.4	49,300.3	63,957.4	357.4	161,338,371.4	166,116,523
2007	1,641,831.6	1,700,941.4	978,375.1	9,890.6	94,703.9	67,671.6	5,602.4	2,308,399.6	27,187.7	5,573.8	119,230.9	2,940.6	65,852.3	127,745.2	0.7	184,187,389.9	191,343,337
2008	1,997,751.5	2,160,960.2	677,392.3	9,980.9	63,886.0	36,668.6	3,515.1	1,814,242.0	37,550.5	1,200.8	188,571.6	48.3	66,195.0	189,820.7	0.0	190,836,082.8	198,083,866
2009	1,484,353.1	1,230,937.2	711,865.8	10,013.2	27,924.9	14,241.5	910.7	1,345,059.8	26,807.2	246.6	103,098.5	29.6	56,185.4	103,374.7	0.0	165,452,818.4	170,567,866
Totals	9,944,384	9,496,105	4,570,047	52,415	505,530	356,383	22,199	11,493,392	153,162	103,471	626,737	13,953	423,427	744,161	8,920	1,129,514,972	1,168,029,258



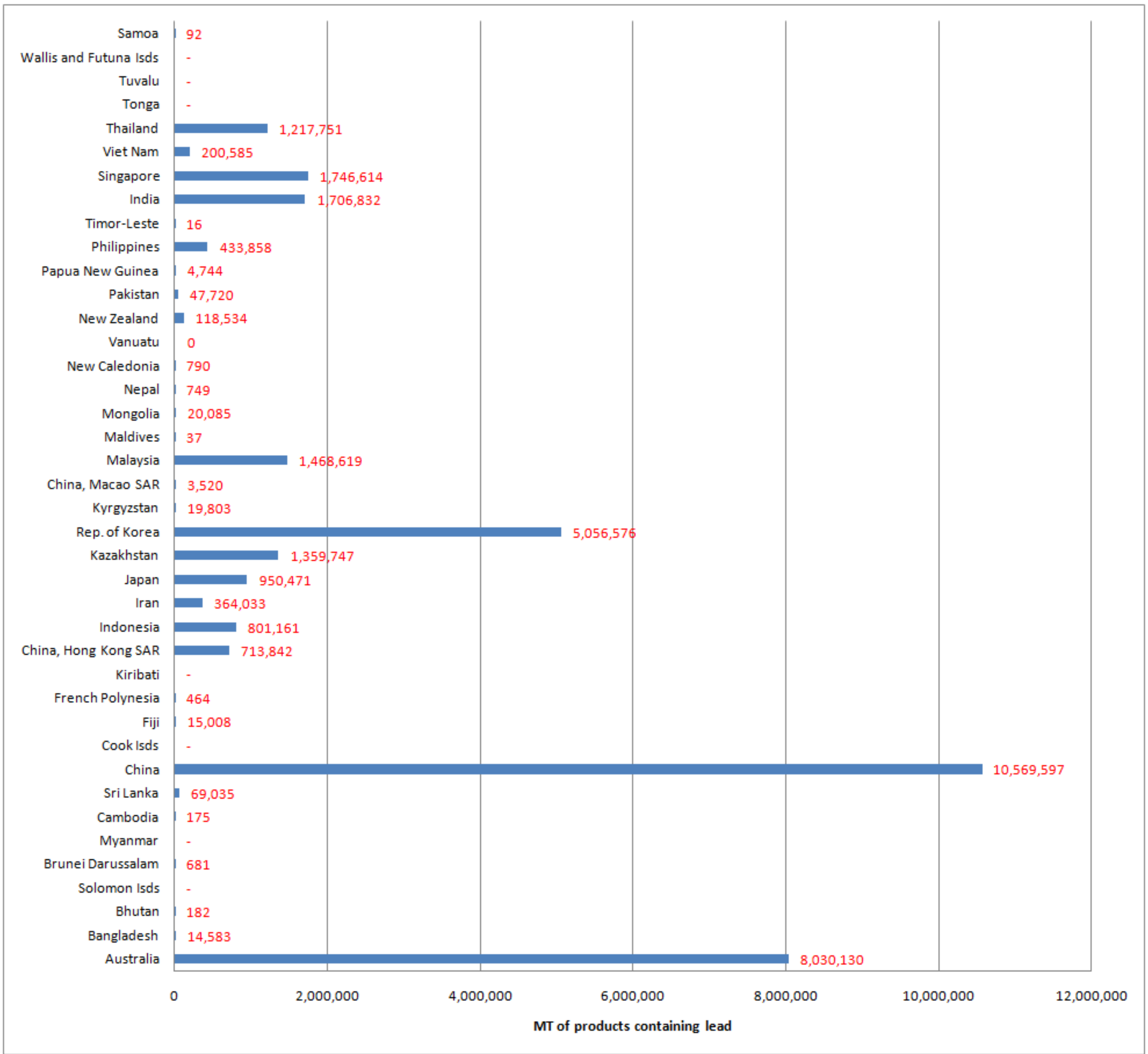
Graph: 5-3 Export of products containing lead into Asia and the Pacific, in MT, 2000 – 2009 period



Graph: 5-4 Export of products containing lead into Asia and the Pacific, excluding lead ore and concentrates, unwrought lead and electronic data machines, in MT, 2000 – 2009 period



Graph: 5-5 Imports of products containing lead into Asia and the Pacific, in MT, 2000 – 2009 period



Graph: 5-6 Exports of products containing lead into Asia and the Pacific, in MT, 2000 – 2009 period

Table: 5-9 Principal importing countries of Asia and the Pacific of products containing lead and their principal trading partners, 2000 – 2009 period

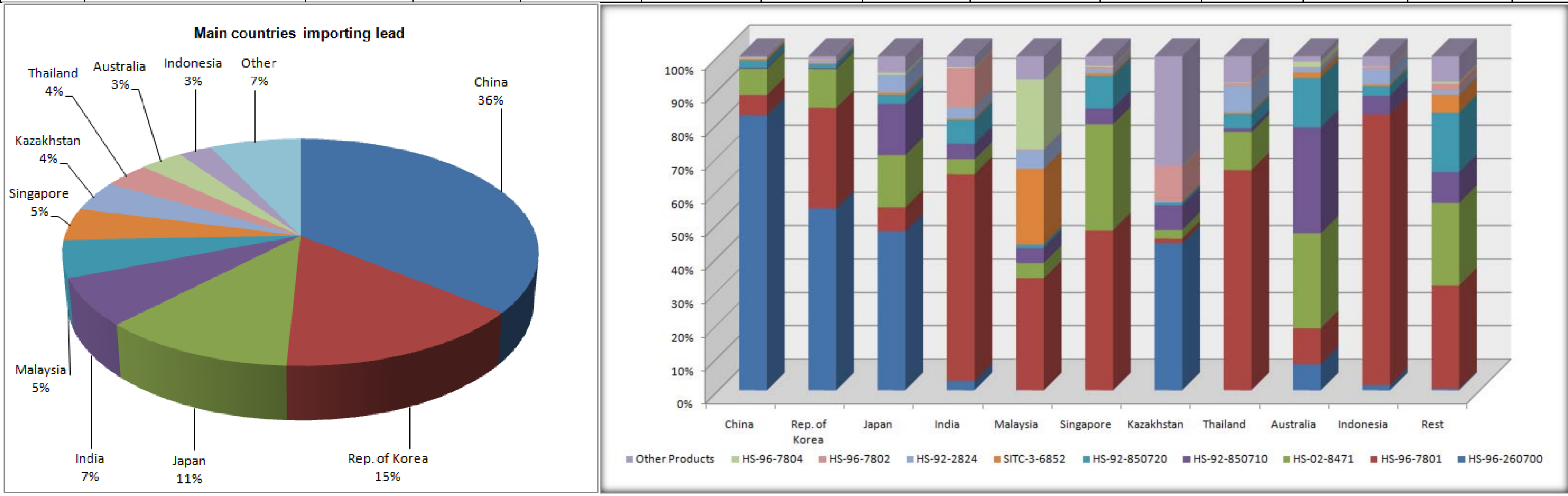
No	Code	Name of Product	Amount (Tonnes)	%	Main Importer Code	Main Importer Country	Main Importer %	Main Supplier Code	Main Supplier Country	Main Supplier %
1	HS-96-260700	Lead ore and concentrates	14,099,163.2	45.5%	156	China	64.8%	842	USA	17.1
								604	Peru	17.1
								36	Australia	15.3
								643	Russian Federation	4.3
					410	Rep. of Korea	17.9%	36	Australia	49.7
								604	Peru	18.0
								842	USA	13.2
								710	South Africa	3.9
					392	Japan	12.0%	842	USA	42.7
								36	Australia	33.8
								604	Peru	9.4
								68	Bolivia	7.4
					398	Kazakhstan	4.2%	604	Peru	36.0
								56	Belgium	10.4
								643	Russian Federation	10.2
								757	Switzerland	9.5
					36	Australia	0.6%	152	Chile	50.8
								604	Peru	22.2
								699	India	14.5
								842	USA	12.3
						Rest	0.6%			
2	HS-96-7801	Unwrought lead	7,061,390.9	22.8%	410	Rep. of Korea	19.8%	156	China	56.8
								36	Australia	25.9
								842	USA	4.4
								484	Mexico	2.5
					699	India	18.5%	36	Australia	24.0
								156	China	19.9
								410	Rep. of Korea	12.5
								784	United Arab Emirates	3.9
					764	Thailand	10.5%	156	China	52.8
								36	Australia	24.7
								410	Rep. of Korea	6.1
								490	Other Asia, nes	2.5
					702	Singapore	9.7%	156	China	73.4
								36	Australia	11.0
								410	Rep. of Korea	4.6
								490	Other Asia, nes	3.1
					156	China	9.5%	36	Australia	29.0
								392	Japan	16.4
								410	Rep. of Korea	11.5
								398	Kazakhstan	7.3
						Rest	32.1%			
3	HS-02-8471	Automatic data processing machines and units thereof (computers)	3,579,397.1	11.6%	156	China	24.1%	156	China	28.4
								764	Thailand	10.6
								608	Philippines	9.4
								842	USA	8.6
					392	Japan	15.5%	156	China	58.0
								764	Thailand	7.3
								842	USA	6.9
								410	Rep. of Korea	4.4
					410	Rep. of Korea	15.0%	156	China	66.1
								458	Malaysia	6.5
								702	Singapore	4.1
								392	Japan	4.1
					702	Singapore	12.7%	156	China	32.8
								458	Malaysia	21.2
								360	Indonesia	8.0
								764	Thailand	7.8
					344	China, Hong Kong SAR	8.8%	156	China	65.3
								764	Thailand	9.0
								702	Singapore	5.0
								842	USA	3.5
						Rest	23.9%			
4	HS-92-850710	Lead-acid electric accumulators (vehicle)	1,545,562.3	5.0%	392	Japan	35.3%	410	Rep. of Korea	61.9
								156	China	17.0
								276	Germany	4.8
								842	USA	3.4
					36	Australia	21.2%	410	Rep. of Korea	31.2
								608	Philippines	18.3
								156	China	14.1
								842	USA	10.6
					699	India	6.5%	156	China	67.7
								50	Bangladesh	8.5
								410	Rep. of Korea	3.9
								344	China, Hong Kong SAR	3.6
					398	Kazakhstan	6.4%	643	Russian Federation	53.4
								804	Ukraine	26.8
								792	Turkey	6.0
								410	Rep. of Korea	4.2
					458	Malaysia	4.8%	360	Indonesia	32.9
								608	Philippines	22.0
								764	Thailand	13.6
								156	China	7.4
						Rest	25.9%			

No	Code	Name of Product	Amount (Tonnes)	%	Main Importer			Main Supplier		
					Code	Country	%	Code	Country	%
5	HS-92-850720	Lead-acid electric accumulators except for vehicles	1,324,226.0	4.28%	156	China	17.7%	156	China	40.8
								276	Germany	17.0
								490	Other Asia, nes	7.8
								842	USA	7.0
					344	China, Hong Kong SAR	13.3%	156	China	34.1
								842	USA	19.3
								826	United Kingdom	7.3
								276	Germany	6.5
					36	Australia	11.6%	156	China	34.1
								842	USA	19.3
								826	United Kingdom	7.3
								276	Germany	6.5
					699	India	11.4%	156	China	73.7
								410	Rep. of Korea	5.0
								704	Viet Nam	4.9
								764	Thailand	4.4
					702	Singapore	10.6%	156	China	41.4
								276	Germany	11.8
								842	USA	10.2
								381	Italy	7.8
						Rest	35.4%			
6	SITC-3-6852	Lead, lead alloys, worked	624,635.5	2.02%	458	Malaysia	59.1%	392	Japan	80.7
								156	China	10.5
								344	China, Hong Kong SAR	3.3
								764	Thailand	1.3
					704	Viet Nam	10.4%	490	Other Asia, nes	27.1
								36	Australia	21.3
								344	China, Hong Kong SAR	15.5
								156	China	10.6
					156	China	9.0%	410	Rep. of Korea	28.8
								156	China	22.4
								490	Other Asia, nes	20.9
								392	Japan	5.4
					392	Japan	4.0%	156	China	57.8
								251	France	27.2
								276	Germany	5.5
								826	United Kingdom	3.9
					90	Solomon Isds	3.9%	156	China	52.9
								36	Australia	21.9
								702	Singapore	11.1
								381	Italy	9.5
						Rest	13.5%			
7	HS-92-2824	Lead oxides, red lead and orange lead	567,212.5	1.83%	392	Japan	33.1%	156	China	50.4
								490	Other Asia, nes	29.5
								360	Indonesia	10.0
								484	Mexico	4.7
					458	Malaysia	16.1%	458	Malaysia	50.7
								490	Other Asia, nes	14.9
								764	Thailand	10.3
								392	Japan	8.6
					764	Thailand	15.8%	490	Other Asia, nes	34.2
								156	China	23.5
								360	Indonesia	22.3
								458	Malaysia	9.0
					699	India	12.0%	156	China	37.3
								144	Sri Lanka	25.4
								410	Rep. of Korea	17.6
								458	Malaysia	12.7
					360	Indonesia	6.5%	490	Other Asia, nes	24.8
								458	Malaysia	22.5
								156	China	13.5
								579	Norway	11.5
						Rest	16.5%			
8	HS-96-7802	Lead waste or scrap	488,230.0	1.58%	699	India	51.0%	826	United Kingdom	22.0
								36	Australia	15.9
								842	USA	13.2
								784	United Arab Emirates	8.0
					398	Kazakhstan	29.1%	643	Russian Federation	94.9
								860	Uzbekistan	5.0
								417	Kyrgyzstan	0.1
								792	Turkey	0.0
					410	Rep. of Korea	5.0%	392	Japan	33.7
								784	United Arab Emirates	17.1
								36	Australia	15.1
								710	South Africa	11.3
					554	New Zealand	4.3%	36	Australia	96.2
								540	New Caledonia	1.7
								899	Areas, nes	0.6
								242	Fiji	0.5
					764	Thailand	1.8%	36	Australia	87.7
								392	Japan	2.8
								490	Other Asia, nes	2.8
								642	Romania	1.6
						Rest	8.8%			

No	Code	Name of Product	Amount (Tonnes)	%	Main Importer			Main Supplier		
					Code	Country	%	Code	Country	%
9	HS-96-7804	Lead plates, sheets, strip, foil, powders and flakes	457,212.2	1.48%	458	Malaysia	75.0%	392	Japan	85.2
								156	China	7.9
								344	China, Hong Kong SAR	3.5
								842	USA	0.8
					156	China	7.8%	410	Rep. of Korea	28.6
								156	China	27.7
								490	Other Asia, nes	8.6
								608	Philippines	6.9
					392	Japan	5.4%	156	China	58.4
								251	France	27.7
								276	Germany	4.8
								826	United Kingdom	3.9
					36	Australia	3.6%	826	United Kingdom	92.7
								156	China	1.9
								842	USA	1.6
								276	Germany	1.6
					410	Rep. of Korea	1.6%	566	Nigeria	43.2
								156	China	26.7
								276	Germany	18.1
								842	USA	4.4
						Rest	6.6%			
10	HS-96-262020	Ash or residues containing mainly lead	455,145.0	1.47%						
11	HS-92-282410	Lead monoxide (litharge, massicot)	451,481.8	1.46%						
12	HS-96-7803	Lead bars, rods, profiles and wire	170,069.5	0.55%						
13	HS-96-7806	Articles of lead nes	112,760.6	0.36%						
14	HS-96-381111	Anti-knock preparations based on lead compounds	19,334.9	0.06%						
15	HS-96-7805	Lead tubes, pipes and fittings	8,783.2	0.03%						
16	SITC-3-52375	Lead carbonates	972.8	0.00%						
	Total		**30,965,577**							

Table: 5-10 Main lead and lead containing products, by product code, and their principal importing countries, MT, 2000 – 2009 period

Code	Description	China	Rep. of Korea	Japan	India	Malaysia	Singapore	Kazakhstan	Thailand	Australia	Indonesia	Rest	Totals
HS-96-260700	Lead ore and concentrates	9,137,452	2,519,861	1,690,283	59,499	1,013	582	586,974	135	80,585	12,368	10,412	14,099,163
HS-96-7801	Unwrought lead	672,009	1,394,756	254,771	1,305,000	547,724	682,283	18,369	740,944	111,037	650,940	683,558	7,061,391
HS-02-8471	Automatic data processing machines and units thereof (computers)	863,658	535,343	556,022	92,895	75,155	453,366	34,058	127,894	293,485	-	547,521	3,579,397
HS-92-850710	Lead-acid electric accumulators (vehicle)	51,560	19,230	544,844	99,796	73,893	67,700	98,255	13,232	328,197	44,615	204,239	1,545,562
HS-92-850720	Lead-acid electric accumulators except for vehicles	234,851	56,766	96,580	151,415	17,832	139,700	11,556	47,742	152,959	23,048	391,777	1,324,226
SITC-3-6852	Lead, lead alloys, worked	56,328	7,572	25,036	8,729	369,437	11,453	459	4,891	17,079	4,159	119,492	624,636
HS-92-2824	Lead oxides, red lead and orange lead	3,245	24,975	187,490	68,145	91,510	17,953	3,256	89,668	14,710	36,693	29,568	567,212
HS-96-7802	Lead waste or scrap	2,840	24,221	7	248,751	4,389	7,668	141,867	8,999	1,530	5,152	42,807	488,230
HS-96-7804	Lead plates, sheets, strip, foil, powders and flakes	35,567	7,187	24,575	6,696	342,971	5,995	247	1,430	16,682	1,660	14,203	457,212
	Other Products	44,567	40,743	173,928	68,451	114,170	40,286	437,490	89,444	16,564	24,605	168,301	1,218,548
Totals		**11,102,078**	**4,630,654**	**3,553,536**	**2,109,376**	**1,638,093**	**1,426,987**	**1,332,531**	**1,124,377**	**1,032,828**	**803,241**	**2,211,877**	**30,965,577**



Graph: 5-7 Main lead importing countries by total imports, in MT, and the percentage of imports by product code for the principal importers, 2000 – 2009 period

Table: 5-11 Principal exporting countries of Asia and the Pacific of products containing lead and their principal trading partners, 2000 – 2009 period

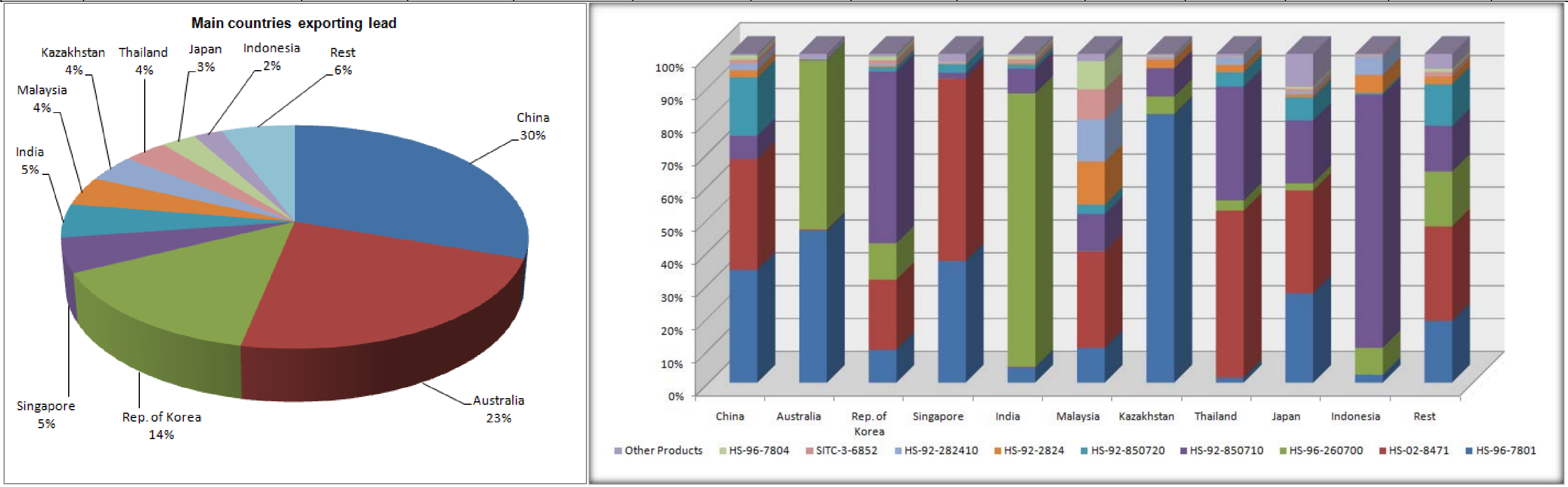
No	Code	Name of Product	Amount (Tonnes)	%	Main Exporter			Main Buyer		
					Code	Country	%	Code	Country	%
1	HS-96-7801	Unwrought lead	10,516,400.4	30.1%	36	Australia	35.4%	826	United Kingdom	37.7
								410	Rep. of Korea	9.7
								699	India	7.6
								490	Other Asia, nes	5.2
					156	China	34.5%	410	Rep. of Korea	21.2
								490	Other Asia, nes	13.4
								702	Singapore	12.8
								764	Thailand	9.4
					398	Kazakhstan	10.6%	643	Russian Federation	24.9
								757	Switzerland	16.8
								724	Spain	11.9
								528	Netherlands	11.9
					702	Singapore	6.2%	699	India	31.8
								458	Malaysia	15.6
								490	Other Asia, nes	9.8
								360	Indonesia	9.4
					410	Rep. of Korea	4.8%	699	India	29.6
								490	Other Asia, nes	18.1
								156	China	13.5
								764	Thailand	8.5
						Rest	8.7%			
2	HS-02-8471	Automatic data processing machines and units thereof (computers)	7,554,611.5	21.6%	156	China	47.1%	842	USA	30.2
								344	China, Hong Kong SAR	15.3
								528	Netherlands	14.1
								392	Japan	7.1
					410	Rep. of Korea	14.2%	156	China	19.8
								842	USA	15.9
								344	China, Hong Kong SAR	12.0
								528	Netherlands	6.4
					702	Singapore	12.8%	842	USA	26.8
								156	China	7.5
								528	Netherlands	7.0
								392	Japan	6.7
					764	Thailand	8.2%	842	USA	23.8
								156	China	14.9
								528	Netherlands	11.2
								392	Japan	9.0
					458	Malaysia	5.7%	842	USA	38.1
								528	Netherlands	14.6
								36	Australia	4.8
								251	France	4.6
						Rest	12.0%			
3	HS-96-260700	Lead ore and concentrates	6,652,257.0	19.0%	36	Australia	62.1%	410	Rep. of Korea	32.5
								156	China	32.2
								56	Belgium	15.1
								392	Japan	14.1
					699	India	21.4%	156	China	96.3
								528	Netherlands	1.8
								842	USA	1.0
								36	Australia	0.8
					410	Rep. of Korea	8.5%	156	China	100.0
					364	Iran	4.1%	156	China	92.4
								398	Kazakhstan	5.4
								699	India	0.7
								643	Russian Federation	0.4
					398	Kazakhstan	1.1%	156	China	95.8
								642	Romania	4.2
						Rest	2.9%			
4	HS-92-850710	Lead-acid electric accumulators (vehicle)	5,359,095.2	15.34%	410	Rep. of Korea	49.3%	392	Japan	13.1
								842	USA	13.1
								784	United Arab Emirates	8.3
								36	Australia	5.2
					156	China	14.1%	392	Japan	13.3
								842	USA	11.4
								826	United Kingdom	6.9
								36	Australia	6.3
					360	Indonesia	11.5%	826	United Kingdom	14.2
								784	United Arab Emirates	13.5
								458	Malaysia	8.0
								736	Sudan	5.8
					764	Thailand	7.9%	104	Myanmar	17.6
								784	United Arab Emirates	16.3
								116	Cambodia	10.9
								392	Japan	3.4
					392	Japan	3.4%	704	Viet Nam	31.5
								344	China, Hong Kong SAR	22.9
								682	Saudi Arabia	8.1
								842	USA	5.6
						Rest	13.9%			

No	Code	Name of Product	Amount (Tonnes)	%	Main Exporter Code	Main Exporter Country	Main Exporter %	Main Buyer Code	Main Buyer Country	Main Buyer %
5	HS-92-850720	Lead-acid electric accumulators except for vehicles	2,437,984.4	6.98%	156	China	76.9%	842	USA	16.4
								699	India	11.2
								344	China, Hong Kong SAR	10.0
								608	Philippines	6.2
					344	China, Hong Kong SAR	6.9%	156	China	44.1
								699	India	13.6
								842	USA	12.8
								608	Philippines	3.2
					704	Viet Nam	3.4%	490	Other Asia, nes	34.3
								608	Philippines	21.3
								842	USA	10.3
								699	India	9.7
					410	Rep. of Korea	2.8%	699	India	19.5
								842	USA	9.4
								76	Brazil	8.9
								392	Japan	7.5
					392	Japan	2.7%	842	USA	17.6
								490	Other Asia, nes	12.8
								156	China	6.4
								702	Singapore	6.2
						Rest	7.3%			
6	HS-92-2824	Lead oxides, red lead and orange lead	626,644.8	1.79%	156	China	36.4%	392	Japan	40.5
								699	India	11.9
								764	Thailand	10.0
								410	Rep. of Korea	9.7
					458	Malaysia	30.6%	702	Singapore	55.1
								764	Thailand	13.4
								710	South Africa	10.4
								360	Indonesia	7.9
					360	Indonesia	7.0%	764	Thailand	50.9
								392	Japan	42.7
								702	Singapore	4.2
								36	Australia	1.8
					398	Kazakhstan	5.8%	643	Russian Federation	79.5
								112	Belarus	15.1
								860	Uzbekistan	4.8
								804	Ukraine	0.4
					144	Sri Lanka	4.7%	699	India	66.3
								792	Turkey	12.5
								784	United Arab Emirates	4.2
								364	Iran	3.8
						Rest	15.3%			
7	HS-92-282410	Lead monoxide (litharge, massicot)	504,565.9	1.44%	156	China	39.5%	392	Japan	45.2
								699	India	12.6
								410	Rep. of Korea	10.7
								764	Thailand	9.2
					458	Malaysia	37.3%	702	Singapore	55.9
								764	Thailand	13.6
								710	South Africa	10.6
								360	Indonesia	8.1
					360	Indonesia	8.7%	764	Thailand	51.0
								392	Japan	42.9
								702	Singapore	4.1
								36	Australia	1.7
					764	Thailand	5.3%	458	Malaysia	78.1
								360	Indonesia	10.2
								36	Australia	9.8
								702	Singapore	0.8
					410	Rep. of Korea	4.6%	699	India	56.9
								608	Philippines	21.7
								458	Malaysia	19.3
								392	Japan	1.0
						Rest	4.6%			
8	SITC-3-6852	Lead, lead alloys, worked	416,981.0	1.19%	156	China	35.7%	490	Other Asia, nes	46.0
								392	Japan	10.8
								704	Viet Nam	8.8
								344	China, Hong Kong SAR	7.8
					458	Malaysia	32.4%	490	Other Asia, nes	76.1
								156	China	8.6
								608	Philippines	5.9
								699	India	3.4
					410	Rep. of Korea	14.5%	156	China	59.7
								344	China, Hong Kong SAR	34.3
								704	Viet Nam	3.1
								392	Japan	1.1
					699	India	3.7%	842	USA	33.5
								826	United Kingdom	9.8
								528	Netherlands	9.1
								381	Italy	7.5
					344	China, Hong Kong SAR	3.3%	156	China	99.4
								328	Guyana	0.2
								446	China, Macao SAR	0.1
								740	Suriname	0.1
						Rest	10.4%			

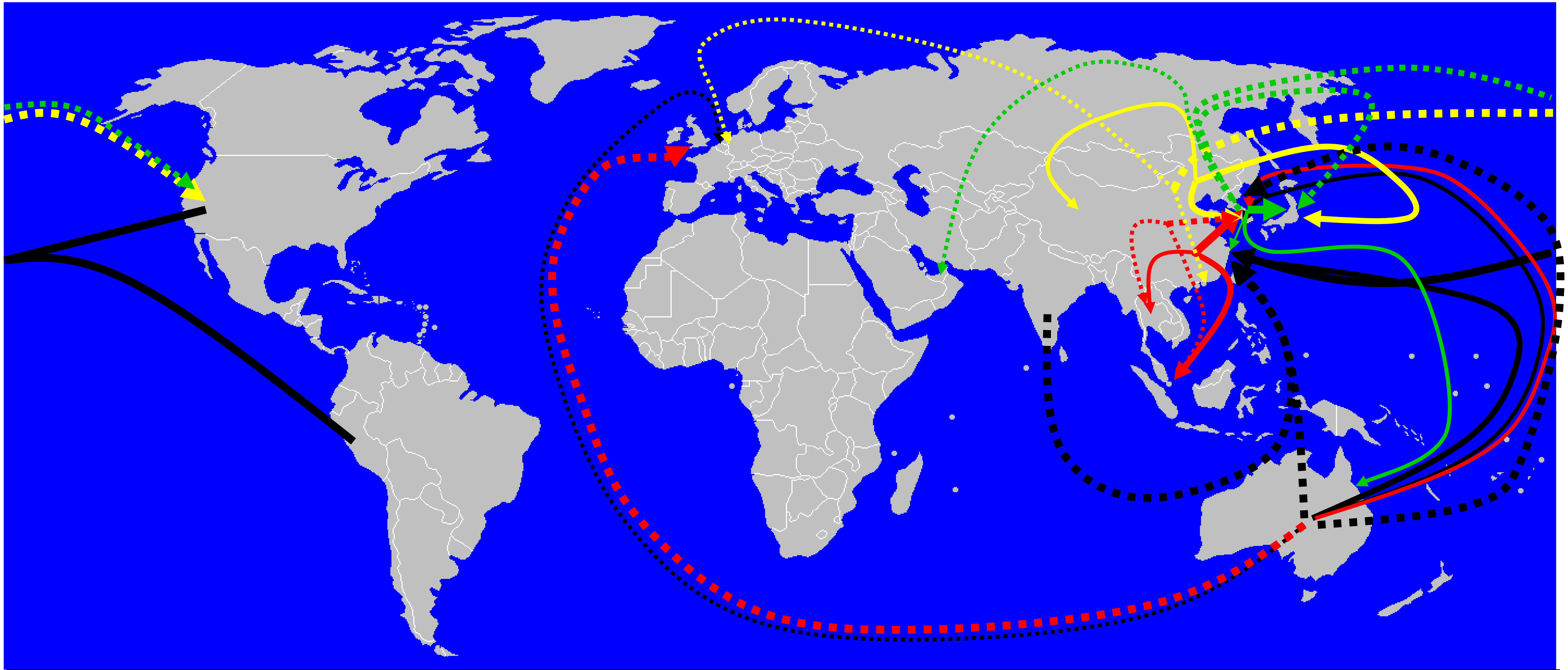
No	Code	Name of Product	Amount (Tonnes)	%	Main Exporter			Main Buyer		
					Code	Country	%	Code	Country	%
9	HS-96-7804	Lead plates, sheets, strip, foil, powders and flakes	369,075.7	1.06%	458	Malaysia	34.1%	490	Other Asia, nes	81.08
								156	China	8.53
								608	Philippines	6.26
								344	China, Hong Kong SAR	0.91
					156	China	34.0%	490	Other Asia, nes	52.79
								392	Japan	11.81
								704	Viet Nam	10.32
								344	China, Hong Kong SAR	7.23
					410	Rep. of Korea	15.9%	156	China	59.90
								344	China, Hong Kong SAR	35.28
								704	Viet Nam	3.12
								392	Japan	1.09
					699	India	4.7%	842	USA	30.40
								784	United Arab Emirates	17.41
								528	Netherlands	12.23
								826	United Kingdom	8.82
					344	China, Hong Kong SAR	3.2%	156	China	99.43
								328	Guyana	0.29
								446	China, Macao SAR	0.14
								740	Suriname	0.14
						Rest	8.0%			
10	HS-96-7802	Lead waste or scrap	232,940.3	0.67%						
11	HS-96-7806	Articles of lead nes	121,180.0	0.35%						
12	HS-96-262020	Ash or residues containing mainly lead	84,535.0	0.24%						
13	HS-96-7803	Lead bars, rods, profiles and wire	48,084.3	0.14%						
14	HS-96-7805	Lead tubes, pipes and fittings	4,609.8	0.01%						
15	HS-96-381111	Anti-knock preparations based on lead compounds	4,132.1	0.01%						
16	SITC-3-52375	Lead carbonates	2,938.0	0.01%						
	Total		**34,936,035.6**							

Table: 5-12 Main lead and lead containing products, by product code, and their principal exporting countries, MT, 2000 – 2009 period

Code	Description	China	Australia	Rep. of Korea	Singapore	India	Malaysia	Kazakhstan	Thailand	Japan	Indonesia	Rest	Totals
HS-96-7801	Unwrought lead	3,625,219	3,717,895	505,937	646,736	78,423	155,259	1,110,368	18,244	258,111	19,163	381,044	10,516,400
HS-02-8471	Automatic data processing machines and units thereof (computers)	3,557,016	21,053	1,075,788	966,977	3,215	430,102	531	619,274	297,794	-	582,862	7,554,612
HS-96-260700	Lead ore and concentrates	3,102	4,129,240	563,105	550	1,420,271	984	72,844	37,842	20,327	65,584	338,408	6,652,257
HS-92-850710	Lead-acid electric accumulators (vehicle)	754,944	15,490	2,640,108	32,106	128,529	166,927	116,787	421,917	182,119	617,035	283,131	5,359,095
HS-92-850720	Lead-acid electric accumulators except for vehicles	1,874,499	8,944	67,464	44,718	20,755	41,926	600	52,733	66,720	3,995	255,630	2,437,984
HS-92-2824	Lead oxides, red lead and orange lead	228,157	8,627	23,858	1,122	8,647	192,020	36,634	26,912	9,410	44,016	47,242	626,645
HS-92-282410	Lead monoxide (litharge, massicot)	199,538	2,126	23,127	740	3,914	188,349	7,648	26,655	7,452	43,863	1,156	504,566
SITC-3-6852	Lead, lead alloys, worked	148,893	7,008	60,634	7,124	15,483	135,078	3,503	1,689	7,687	2,896	26,984	416,981
HS-96-7804	Lead plates, sheets, strip, foil, powders and flakes	125,508	5,084	58,776	3,712	17,290	126,028	3,351	1,625	5,970	1,111	20,623	369,076
	Other Products	52,720	114,664	37,779	42,829	10,305	31,945	7,482	10,860	94,881	3,498	91,457	498,420
Totals		**10,569,597**	**8,030,130**	**5,056,576**	**1,746,614**	**1,706,832**	**1,468,619**	**1,359,747**	**1,217,751**	**950,471**	**801,161**	**2,028,537**	**34,936,036**



Graph: 5-8 Main lead exporting countries by total exports, in MT, and the percentage of exports by product code for the principal exporters, 2000 – 2009 period



CODE	DESCRIPTION	MT	IMPORTER	FLOW	MT	SUPPLIER		MT	EXPORTER	FLOW	MT	BUYER
HS-96-260700	Lead ore and concentrates	9,137,452	China		1,561,591	USA		4,129,240	Australia		1,341,182	Republic of Korea
					1,560,677	Peru					1,331,272	China
					1,398,944	Australia					625,582	Belgium
		2,519,861	Republic of Korea		1,253,127	Australia		1,420,271	India		1,367,849	China
HS-96-7801	Unwrought lead	1,394,756	Republic of Korea		791,524	China		3,717,895	Australia		1,195,804	United Kingdom
					360,684	Australia		3,625,219	China		769,271	Republic of Korea
		682,283	Singapore		501,000	China					466,203	Singapore
		740,944	Thailand		391,070	China					339,320	Thailand
HS-02-8471	Automatic data processing machines and units thereof (computers)	863,658	China		245,103	China		3,557,016	China		1,074,218	USA
		556,022	Japan		322,326	China					545,681	Hong Kong
		535,343	Republic of Korea		353,862	China					503,744	Netherlands
HS-92-850710	Lead-acid electric accumulators (vehicle)	544,844	Japan		337,476	Republic of Korea		2,640,108	Republic of Korea		346,910	Japan
					92,841	China					345,854	USA
		328,197	Australia		102,496	Republic of Korea					220,185	United Arab Emirates

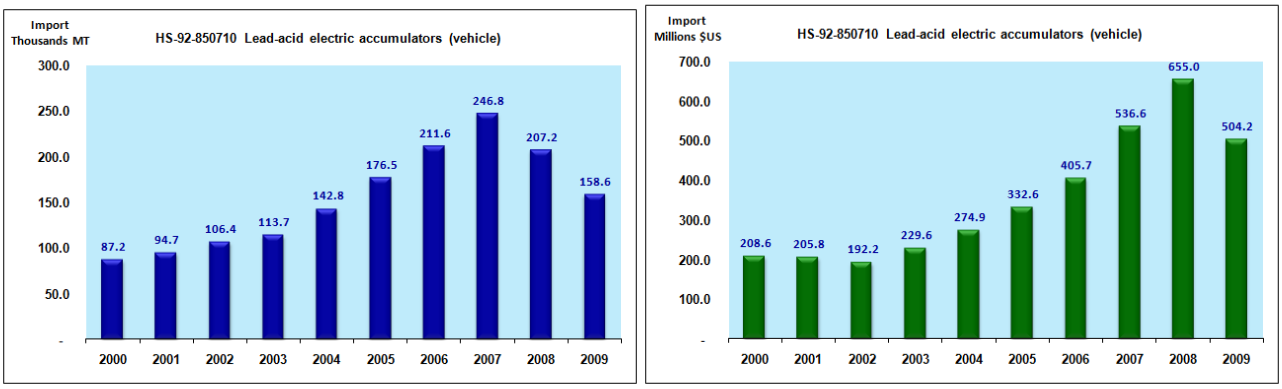
Figure 5-1 Trade flows of products containing lead to and from the Asia and Pacific region, 2000 - 2009 period

5.1.4 Analysis of trade in Asia and the Pacific of products containing Lead, 2000 – 2009 period

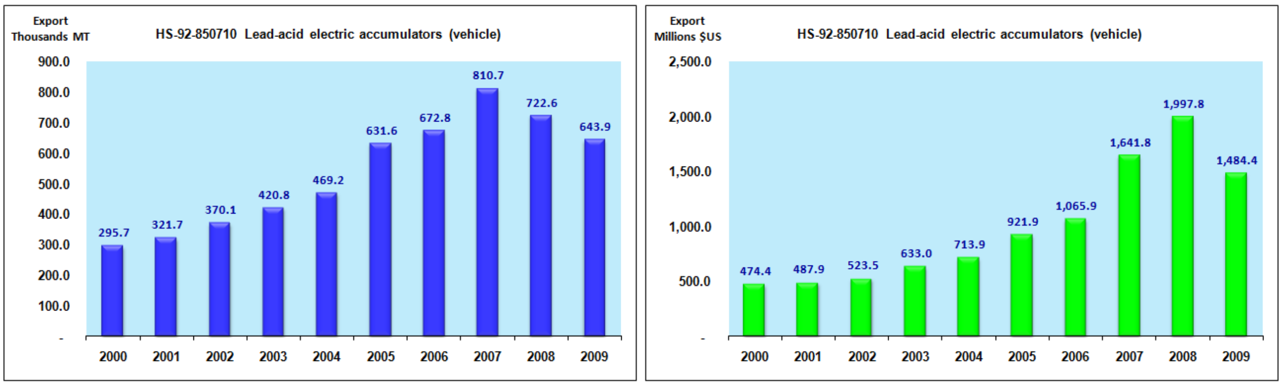
5.1.4.1 Lead-acid electric accumulators (vehicle) (HS-92-850710)

The import volumes of lead-acid electric accumulators, which are commonly referred to as vehicle 'batteries' have approximately doubled over the 2000 – 2009 period and accounted for 5% of the trade volumes studied. They peaked in 2007 at approximately three times the 2000 volume, prior to declining in recent years to their current levels. The costs of the imports showed a similar trend, although the peak trade flow in $US occurred one year later than the volume based measure. The exports of lead-acid electric accumulators (vehicles) showed an identical trend to that of the imports, the volumes of trade were approximately three to four times that of the imports.

The main importing countries are Japan (35.3%) and Australia (21.2%). These imports were predominantly sourced from the Republic of Korea, China, and The Phillippines. The main exporting countries were mainly the Republic of Korea (49.3%) followed by China (14.1%) and Indonesia (11.5%). The main destination for the products are Japan, the USA, and Australia.



Graph: 5-9 Import of Lead-acid electric accumulators (vehicle), in thousands of MT and millions of $US, 2000 - 2009

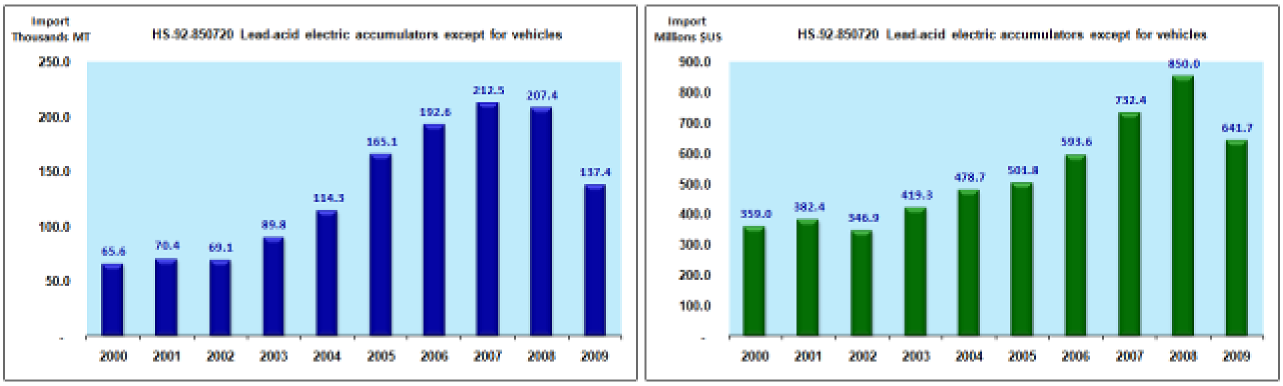


Graph: 5-10 Export of Lead-acid electric accumulators (vehicle), in thousands of MT and millions of $US, 2000 - 2009

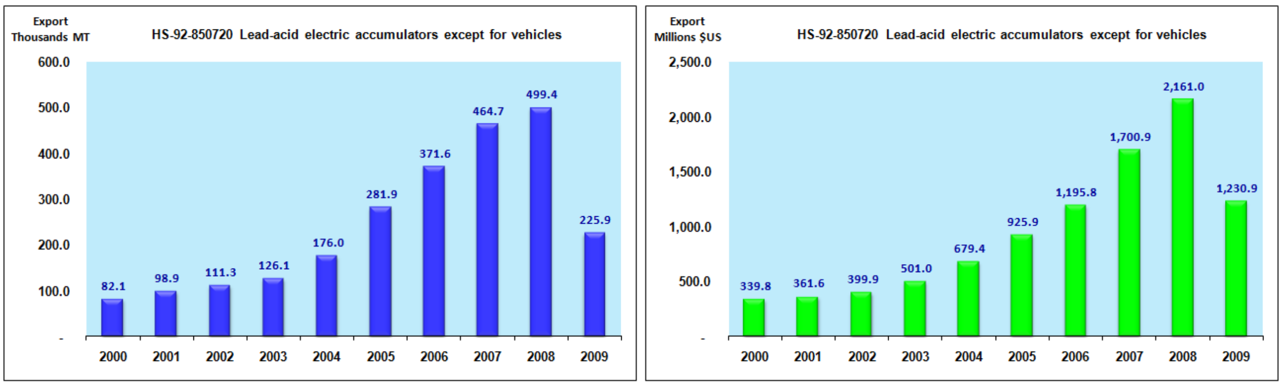
5.1.4.2 Lead-acid electric accumulators except for vehicles (HS-92-850720)

The import volumes of lead-acid electric accumulators (non-vehicle) have approximately doubled over the study period and account for 4.3% of the total lead products imported. The import volumes peaked in 2007, approximately three times the 2000 import volume, and then declined approximately 40% to the 2009 import volumes. The value of the imports steadily increased from 2000 to 2008, prior to declining 25% to its 2009 value. The exports which represented approximately 7% of the total trade volume, demonstrated a similar trend to the imports, although the export volume increased sixfold from 2000 – 2008 before dropping approximately 50% in 2009.

The main importers of lead-acid accumulators (non-vehicle) were China and China - Hong Kong SAR (31.0%), Australia (11.6%) and India (11.4%). The dominant source of the imports was China. This instance illustrated the issues that surround accounting for imports and re-imports and the movement of product between China and China – Hong Kong SAR. The imports to China of lead acid accumulators (non-vehicle) were listed as 40.8% sourced from China, and China – Hong Kong SAR sourced 34.1% of its imports of this product from China. It is concievable that some of these products have been double counted. Other suppliers of these products to China and China – Hong Kong SAR include Germany and the USA. The main supplier of these products to Australia and India was China. The main exporting countries was China (76.9%) and China – Hong Kong SAR (6.9%) with the main destination being the USA and India. There was also a proportion of trade between China and China – Hong Kong SAR, with almost 10% of the exports from China going to China – Hong Kong SAR and 44.1% of the exports from China – Hong Kong SAR going to China.



Graph: 5-11 Import of Lead-acid electric accumulators except for vehicles, in thousands of MT and millions of $US, 2000 - 2009

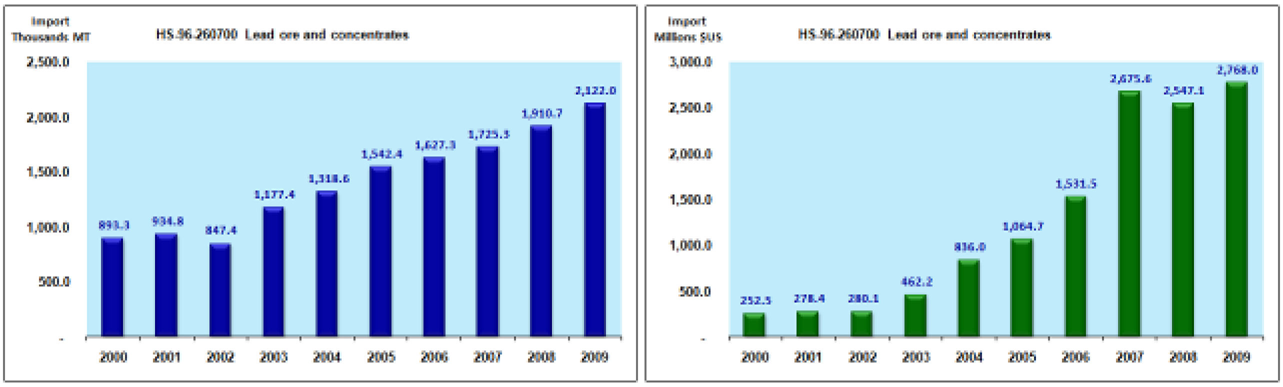


Graph: 5-12 Export of Lead-acid electric accumulators except for vehicles, in thousands of MT and millions of $US, 2000 - 2009

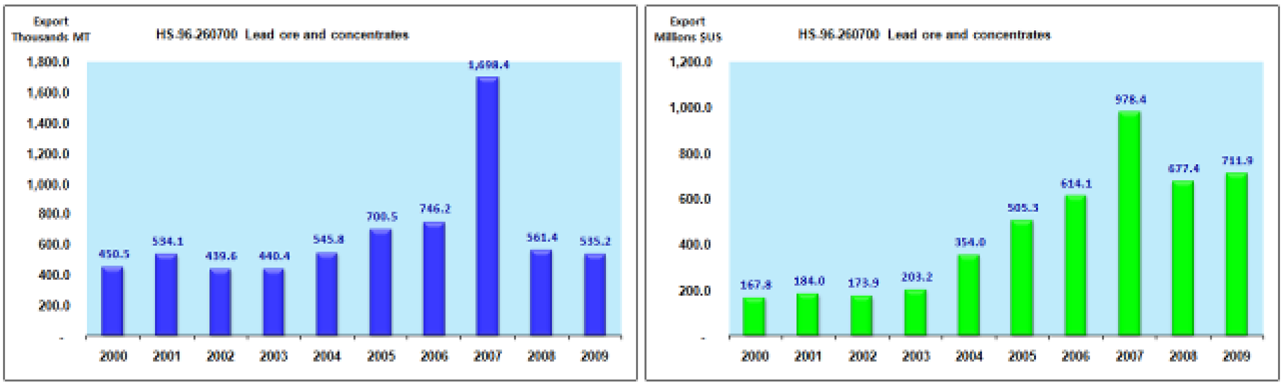
5.1.4.3 Lead ore and concentrates (HS-96-260700)

The imports of lead ore and concentrates, which accounted for 45.5% of the import volumes, has increased by a factor of 2.4 over the study period and has demonstrated a relatively constant growth. The value of these imports has increased more dramatically with the 2009 import value being almost 11 times the 2000 import value. The volume of exports over the study period, which accounted for 19% of the total trade volumes, has remained relatively constant apart from a peak in 2007 where it approximately doubled prior to falling back to previous values. The value of exports has demonstrated a general rise to 2009 to be approximately 4 times the value of the 2000 export trade. This also demonstrated a peak in 2007 where value jumped 50% prior to returning to the longer term trend.

The main importer of lead ore and concentrates was China (64.8%), Republic of Korea (17.9%), and Japan (12.0%). Collectively their major suppliers were Australia, USA, and Peru. The largest exporter of lead ore and concentrates was Australia (62.1) and India (21.4) with the major destinations being China and the Republic of Korea.



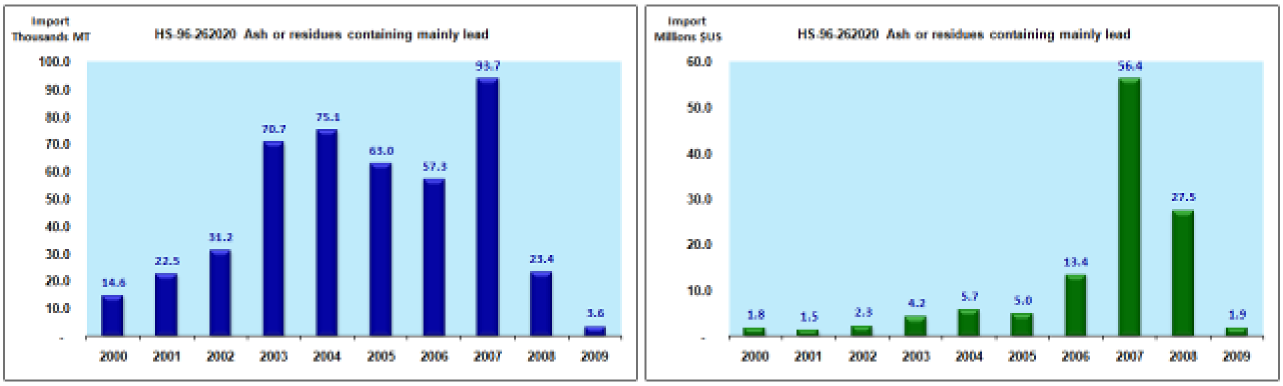
Graph: 5-13 Import of Lead ore and concentrates, in thousands of MT and millions of $US, 2000 – 2009



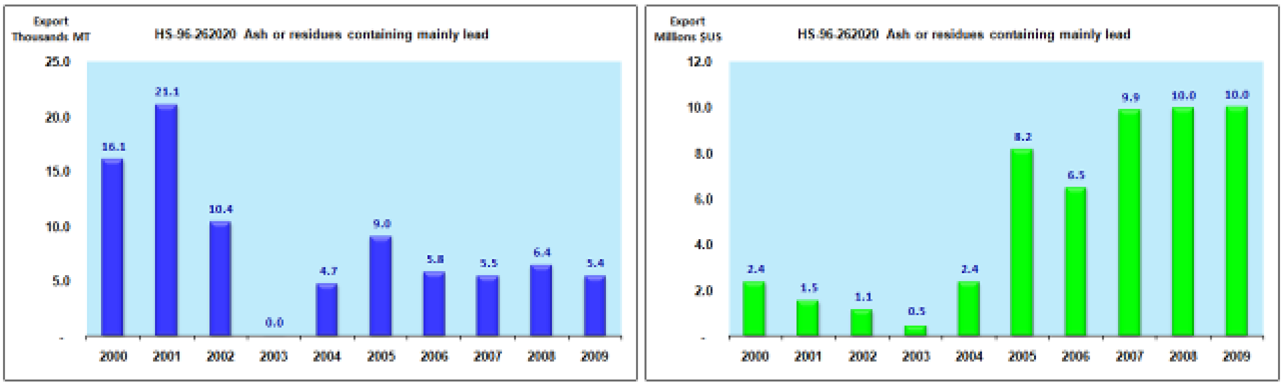
Graph: 5-14 Export of Lead ore and concentrates, in thousands of MT and millions of $US, 2000 - 2009

5.1.4.5 Ash or residues containing mainly lead (HS-96-262020)

Ash or residues containg mainly lead account for 1.47% of the import product volumes and 0.24% of the export trade volumes in lead containing products. The volumes and value of imports peaked in 2007 prior to dropping to close to zero in 2009. The export volumes have levelled off in the later years of the study as has the export value of the product.



Graph: 5-15 Import of Ash or residues containing mainly lead, in thousands of MT and millions of $US, 2000 – 2009

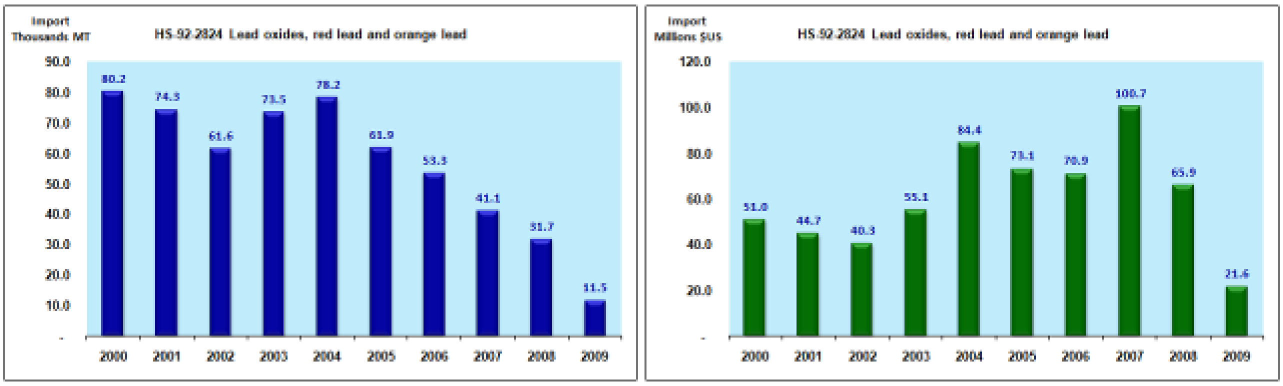


Graph: 5-16 Export of Ash or residues containing mainly lead, in thousands of MT and millions of $US, 2000 - 2009

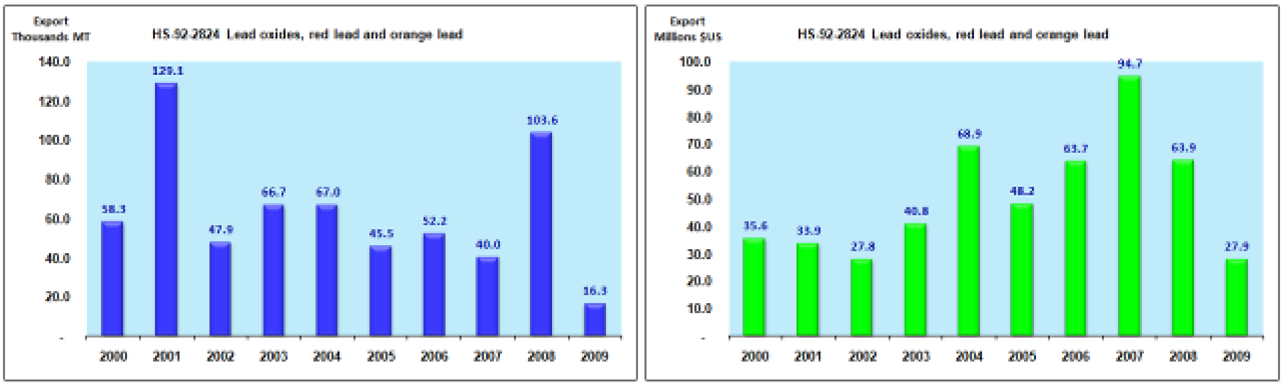
5.1.4.6 Lead oxides, red lead and orange lead (HS-92-2824)

Lead oxides (red and orange lead) account for approximately 1.8% of the import and export trade volumes. The import volumes have declined over the study period and the import value was relatively steady until 2009 where it had dropped to less than half the 2000 import value.Exports have declined over the study period to less than a third of the 2000 volumes, but did demonstrate some peak export trades in 2001 and 2008. The value of the exports had declined approximately 20% since 2000, but demonstrated some increased in 2004 – 2008 where the values approximately doubled prior to the decline in 2009.

The main importing countries include Japan (33.1%), Malaysia (16.1%), and Thailand (15.8%) who sourced the majority of the materials from China, Malaysia, Indonesia and Other Asia (nes). The main exporters in the region were China and Malaysia who exprted to their main partners of Japan, Singapore, Thailand, and India.



Graph: 5-17 Import of Lead oxides, red lead and orange lead, in thousands of MT and millions of $US, 2000 – 2009

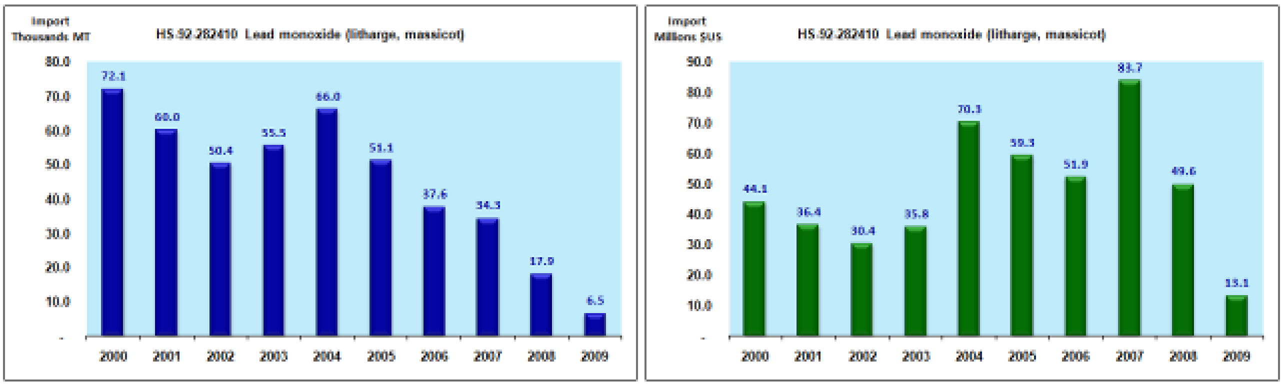


Graph: 5-18 Export of Lead oxides, red lead and orange lead, in thousands of MT and millions of $US, 2000 - 2009

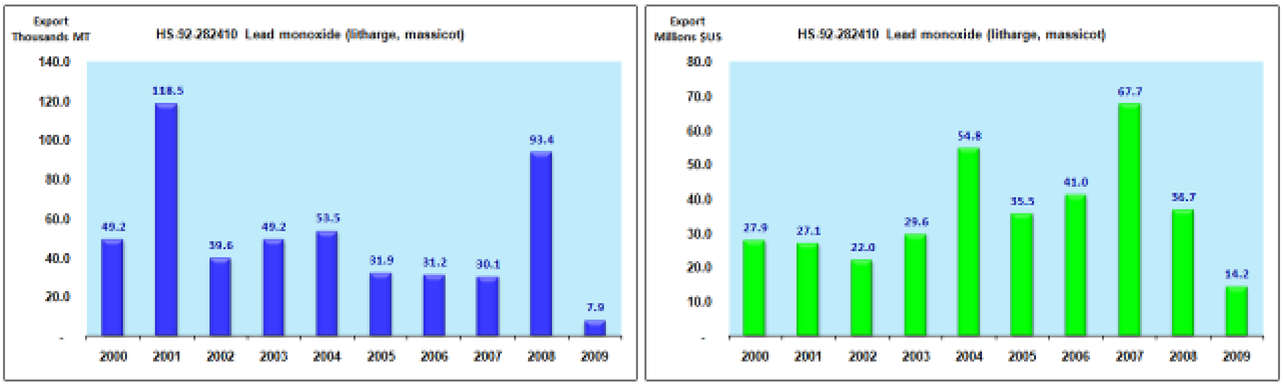
5.1.4.7 Lead monoxide (litharge, massicot) (HS-92-282410)

The import volumes of lead monoxide (litharge, massicot), which accounted for 1.46% of the import trade volumes, declined steadily over the study period to less than 10% of the 200 trade volumes. The value of the import trade approximately doubled from 2000 to 2007 prior to declining to approximately a quarter of the 2000 value by 2009. The export trade volumes, which accounted for 1.44% of the export trade volumes, declined over the study period to approximate 16% of the 2000 trade volume by 2009. This was despite the approximate doubling of the 2000 export trade volumes in 2001 and 2008. The export value peaked in 2008 at a level approximately double the 2000 trade value prior to dropping to a value approximately half the 2000 export trade volume in 2009.

The main importers of lead monoxide (litharge, massicot) were not seggregated. The main exporters of the product were China (39.5%) and Malaysia (37.3%) who exported the product to Japan, Singapore, and Thailand.



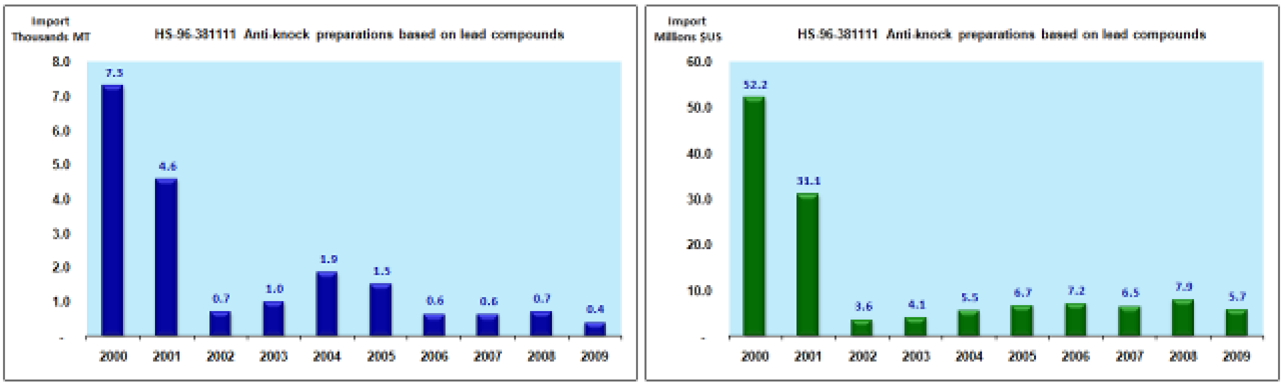
Graph: 5-19 Import of Lead monoxide (litharge, massicot), in thousands of MT and millions of $US, 2000 – 2009



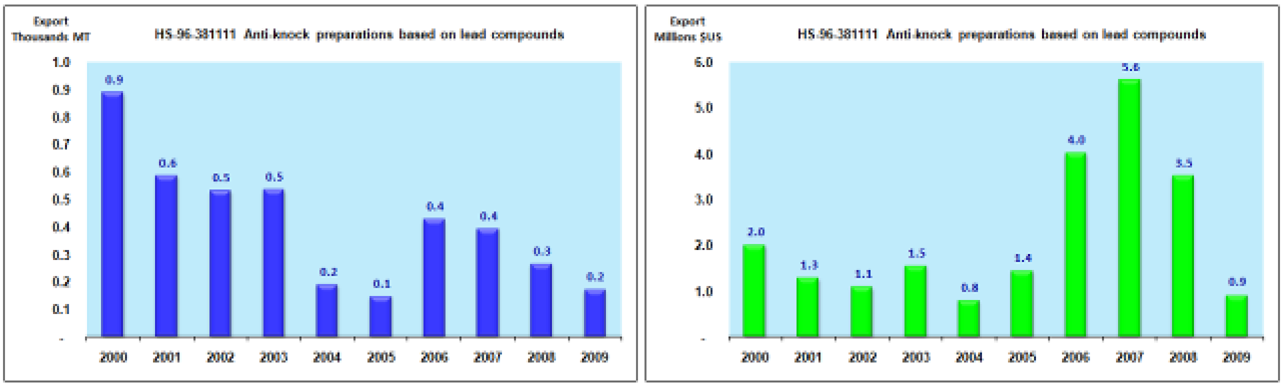
Graph: 5-20 Export of Lead monoxide (litharge, massicot), in thousands of MT and millions of $US, 2000 - 2009

5.1.4.8 Anti-knock preparations based on lead compounds (HS-96-381111)

The imports of anti-knock preparations based on lead compounds declined significantly over the study period in terms of both volume and value. They account for 0.06% of the total import trade volume and 0.01% of export trade volumes of lead products. Their import value had declined significantly over the study period to approximately 10% of its 2000 value. The export value has also decreased, but not to the same extent as the import values.



Graph: 5-21 Import of Anti-knock preparations based on lead compounds, in thousands of MT and millions of $US, 2000 – 2009

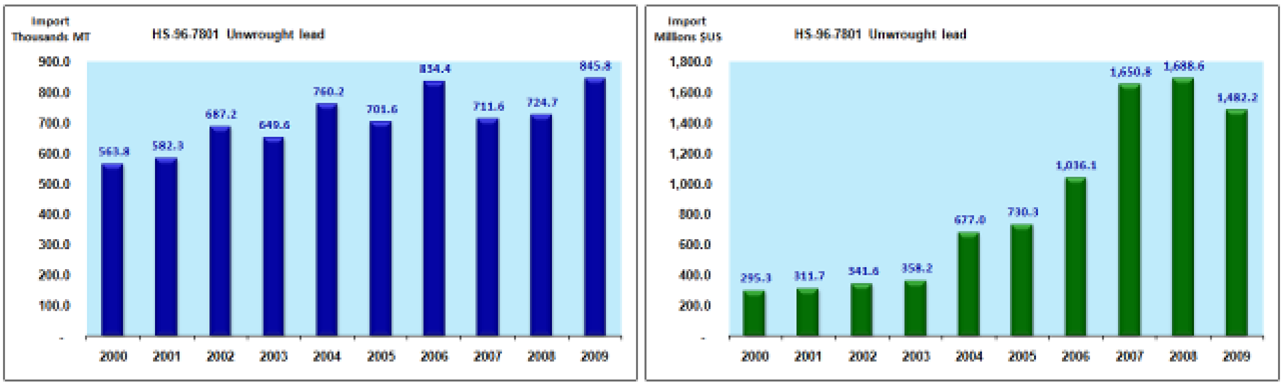


Graph: 5-22 Export of Anti-knock preparations based on lead compounds, in thousands of MT and millions of $US, 2000 - 2009

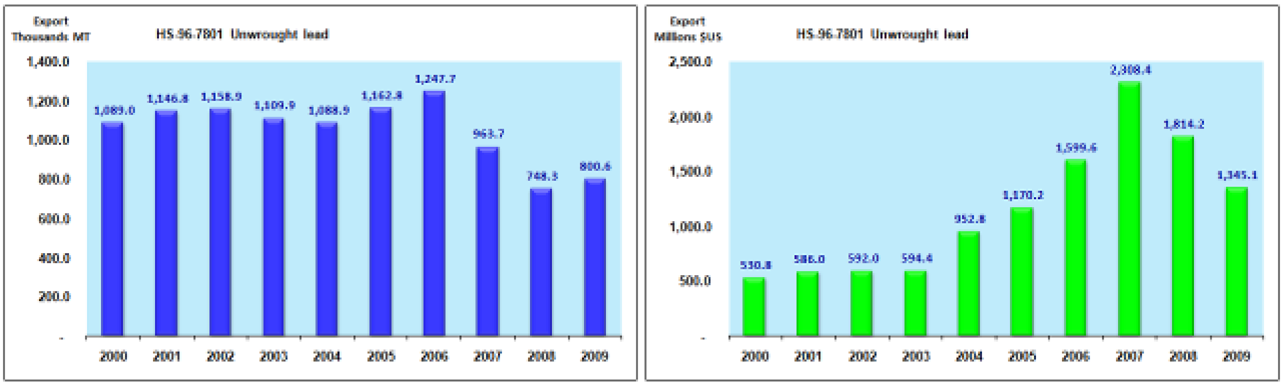
5.1.4.9 Unwrought lead (HS-96-7801)

The trade volumes of unwrought lead, which account for 22.8% of the total import trade volumes of lead products, have steadily increased over the study period by approximately 50%. Their trade value over the same period has increased approximately 5 fold. The export trade volumes, which account for 30.1% of the exported lead products, remained steady until 2007 when they declined by approximately a third to 2009. Their export value has, however, increased over the study period to more than double its value by 2009. This includes a peak export value in 2007 where the value approached 4.5 times the 2000 value prior to declining to its 2009 position.

The main importers of unwrought lead products are the Republic of Korea (19.8%), India (18.5%) and Thailand (10.5%) who sourced their products from mainly China and Australia. The main exporters of unwrought lead were Australia (35.4%) and China (34.5%) who exported mainly to the United Kingdom and the Republic of Korea.



Graph: 5-23 Import of Unwrought lead, in thousands of MT and millions of $US, 2000 – 2009

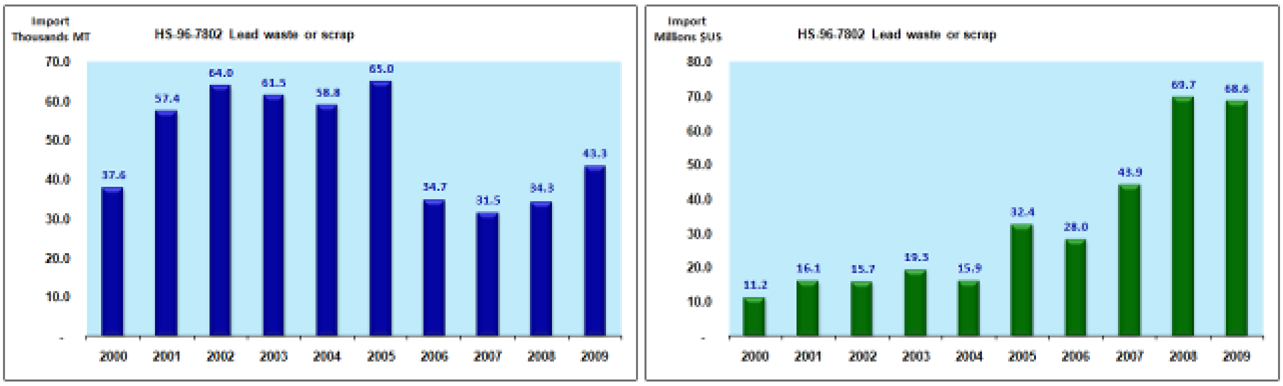


Graph: 5-24 Export of Unwrought lead, in thousands of MT and millions of $US, 2000 - 2009

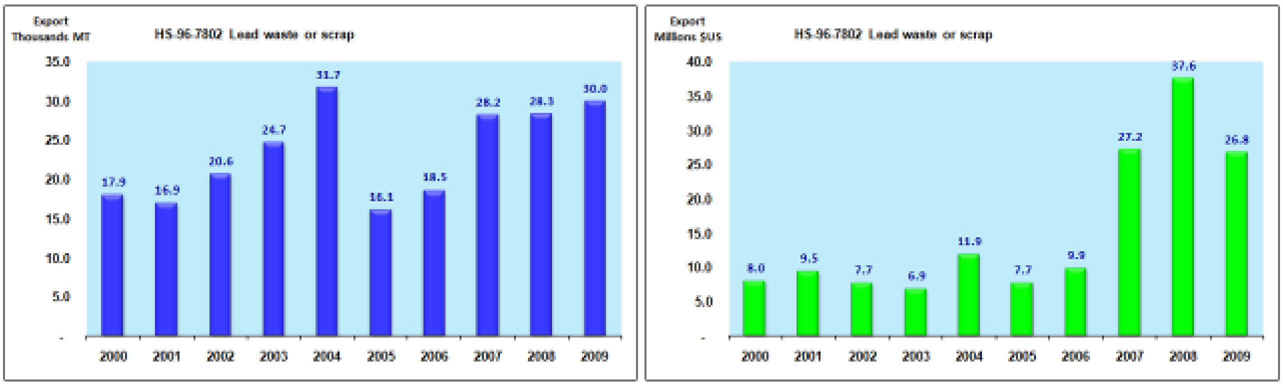
5.1.4.10 Lead waste or scrap (HS-96-7802)

The trade volume of lead waste or scrap accounted for 1.58% of the import trade volumes and 0.67% of the export trade volumes of lead containing products. The import trade volumes have increased slightly over the study period, but did demonstrate good growth until 2005 prior to declining to present values that were similar to the 2000 reference point. The value of the imports, however, has increased to more than six times the value of the 2000 trade. The export volumes have almost doubled their initial trade volume, with a peak in 2004 and a minimum in 2005. The export value was steady from 2000 to 2006 before it increased by a factor of three in 2009.

The major importers of lead waste or scrap were India (51.0%) and Kazakstan (29.1%). India sourced the majority of their imports from the United Kingdom and Australia, whereas Kazakstan sourced its imports predominantly from the Russian Federation. The exports were not seggregated.



Graph: 5-25 Import of Lead waste or scrap, in thousands of MT and millions of $US, 2000 – 2009

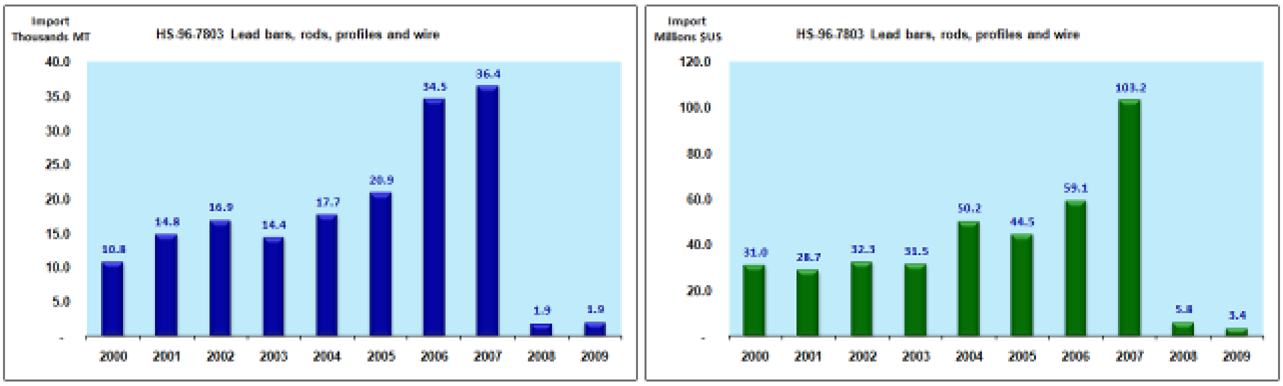


Graph: 5-26 Export of Lead waste or scrap, in thousands of MT and millions of $US, 2000 - 2009

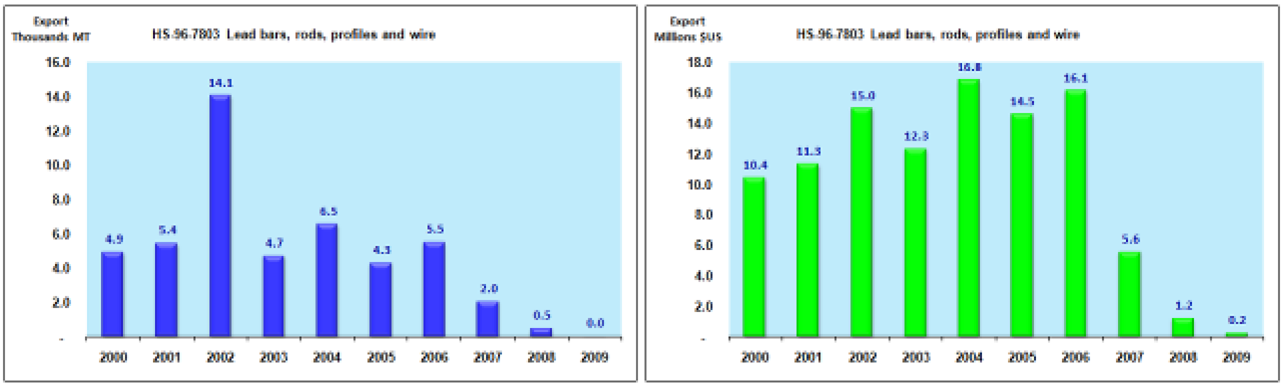
5.1.4.11 Lead bars, rods, profiles and wire (HS-96-7803)

Lead bars, rods, profiles and wire account for 0.55% of the import and 0.14% of the export trade volumes over the study period. The import volumes and values have increased from 2000 – 2007 prior to declining dramatically in the two subsequent years.The export volume and values follwed a similar decline from 2007, but their levels did not increase to the same extent in the years leading up to 2007.

The major trading partners were not extracted from the data for this product code due to its relatively low trade volumes.



Graph: 5-27 Import of Lead bars, rods, profiles and wire, in thousands of MT and millions of $US, 2000 - 2009

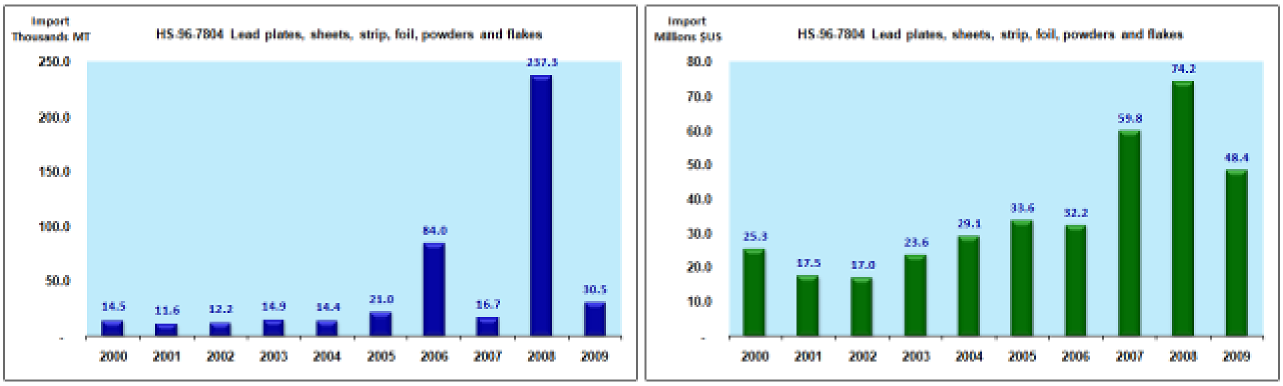


Graph: 5-28 Export of Lead bars, rods, profiles and wire, in thousands of MT and millions of $US, 2000 - 2009

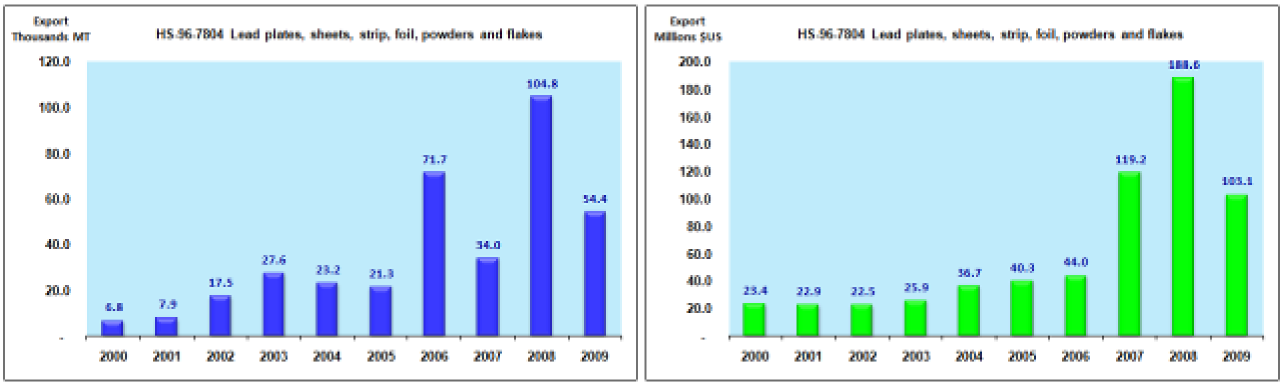
5.1.4.12 Lead plates, sheets, strip, foil, powders and flakes (HS-96-7804)

Lead plates, sheet, strip, foil, powder, and flakes account for 1.48% of the import and 1.06% of the export trade volumes over the study period. The import volumes peaked in 2008 prior to declining dramatically in 2009, although overall the import volume doubled over this period. The import value has risen over the period to almost double the 2000 reference value, having risen to a peak in 2008 prior to declining by a third to it 2009 value.Export volume and values rose steadily to 2005 prior to increasing by a factor of approximately 4 to a peak in 2008, prior to declining approximately 50% in 2009.

The major importing countries were Malaysia (75.0%), China (7.8%) , and Japan (5.4%) with the majority of the imports being sourced from Japan. The major exporting countries were Malaysia (34.1%), China (34.0%) and the Republic of Korea (15.9%) who exported their products to Other Asia nes, with lesser exports to China and Japan.



Graph: 5-29 Import of Lead plates, sheets, strip, foil, powders and flakes, in thousands of MT and millions of $US, 2000 – 2009

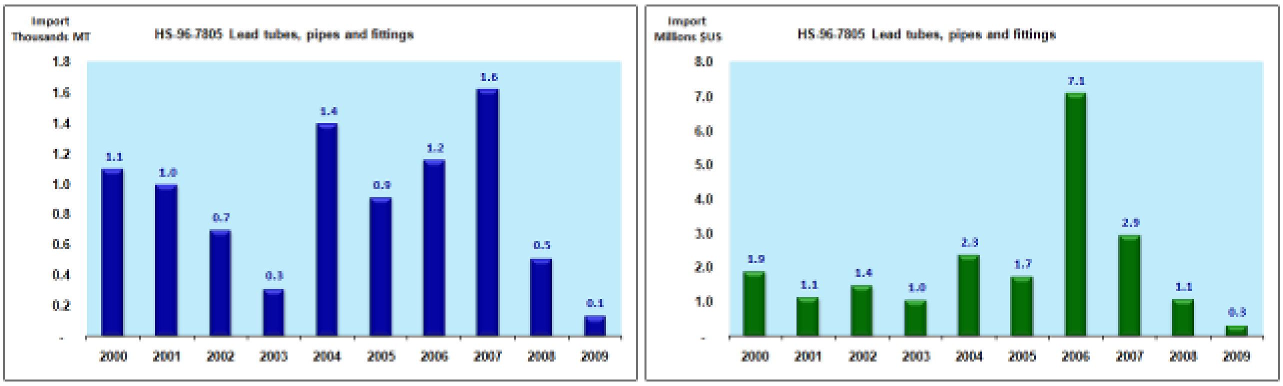


Graph: 5-30 Export of Lead plates, sheets, strip, foil, powders and flakes, in thousands of MT and millions of $US, 2000 - 2009

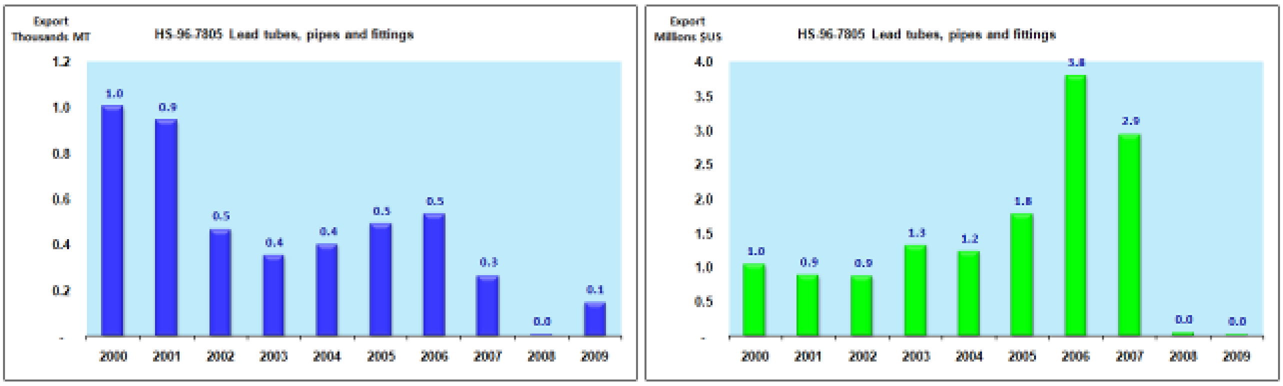
5.1.4.13 Lead tubes, pipes and fittings (HS-96-7805)

Lead tube, pipes and fittings account for 0.03% of the import volumes and 0.01% of the export volumes of lead products. Import volumes have declined overall, as have the import values. Exports volumes have gradually dropped to almost zero levels, whereas the export values increased in value to peak in 2006, prior to declining to near zero levels in 2009.

Major regional importers and exporters were not determined for this product code due to low import and export trade volumes.



Graph: 5-31 Import of Lead tubes, pipes and fittings, in thousands of MT and millions of $US, 2000 – 2009

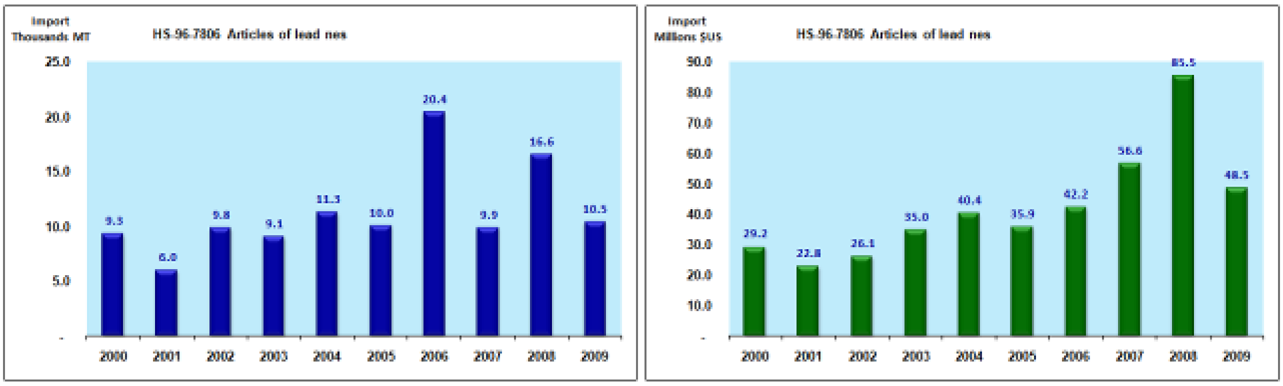


Graph: 5-32 Export of Lead tubes, pipes and fittings, in thousands of MT and millions of $US, 2000 - 2009

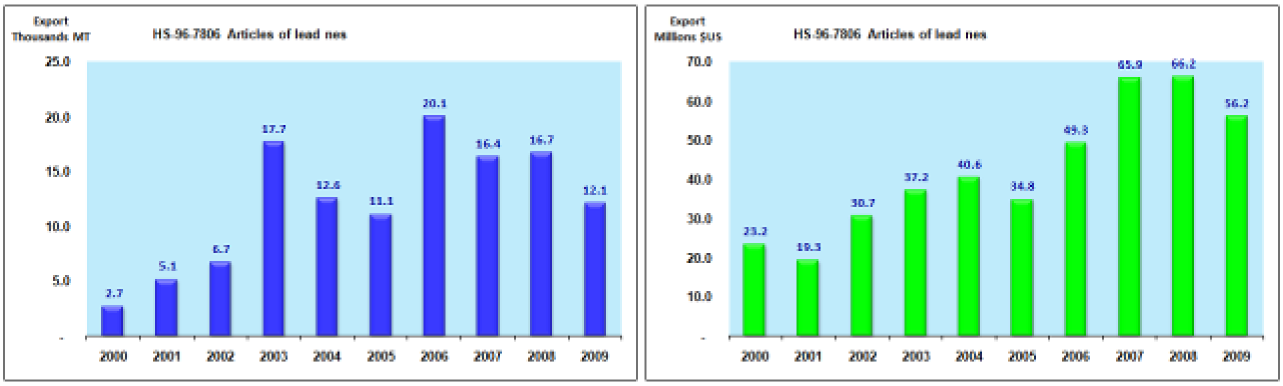
5.1.4.14 Articles of lead nes (HS-96-7806)

Articles of lead nes account for 0.36% of the import volumes and 0.35% of the export volumes for the study period. Import volumes and values have increased slightly over 2000 levels, with import value peaking in 2008. Export volumes and values have increased significantly, with export volumes increasing four fold and export values more than doubling over the study period.

Major regional importers and exporters were not determined for this product code due to low import and export trade volumes.



Graph: 5-33 Import of Articles of lead nes, in thousands of MT and millions of $US, 2000 – 2009

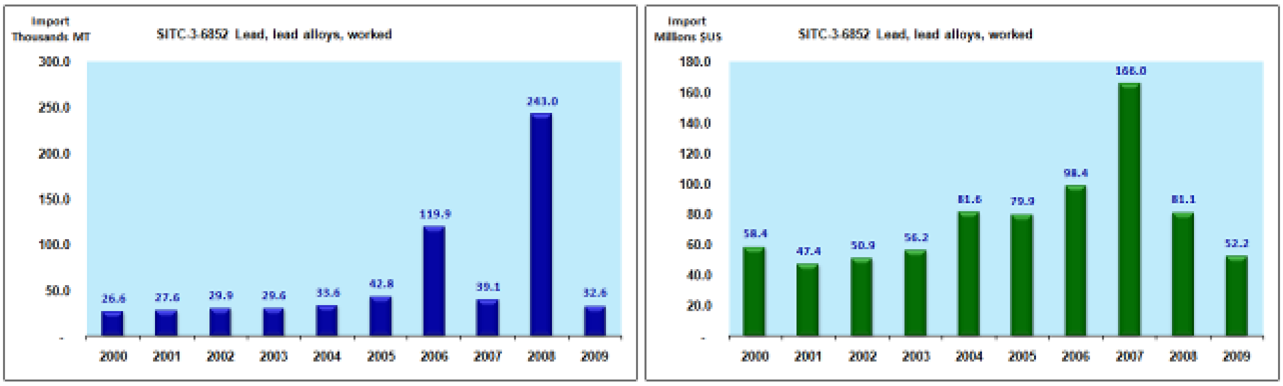


Graph: 5-34 Export of Articles of lead nes, in thousands of MT and millions of $US, 2000 - 2009

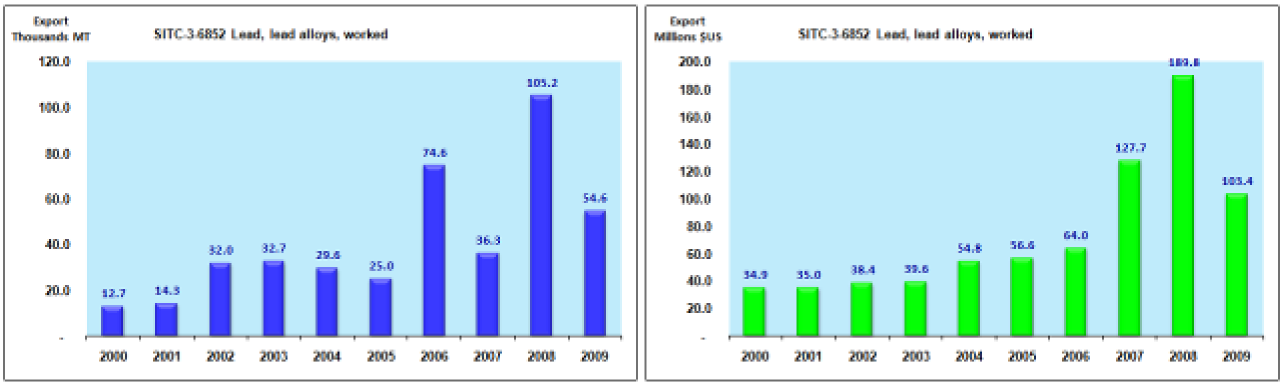
5.1.4.15 Lead, lead alloys, worked (SITC-3-6852)

Lead lead alloys, worked account for 2.02% of the import and 1.19% of the export trade volumes over the study period. The import volumes peaked in 2008 at almost ten times the 2000 value before declining dramatically in 2009 to levels slightly above 2000 levels. The import value trebled to 2007 before declining to just below 2000 levels in 2009. Both export volume and values approximately trebled over the study period, peaking in 2008 and declining approximately 50% to their 2009 values.

The major importing countries were Malaysia (59.1%), Viet Nam (10.4%) , and China (9.0%) with the majority of the imports being sourced from Japan and China. The major exporting countries were China (35.7%), Malaysia (32.4%) and the Republic of Korea (14.5%) who exported their products to Other Asia nes and China.



Graph: 5-35 Import of Lead, lead alloys, worked, in thousands of MT and millions of $US, 2000 – 2009

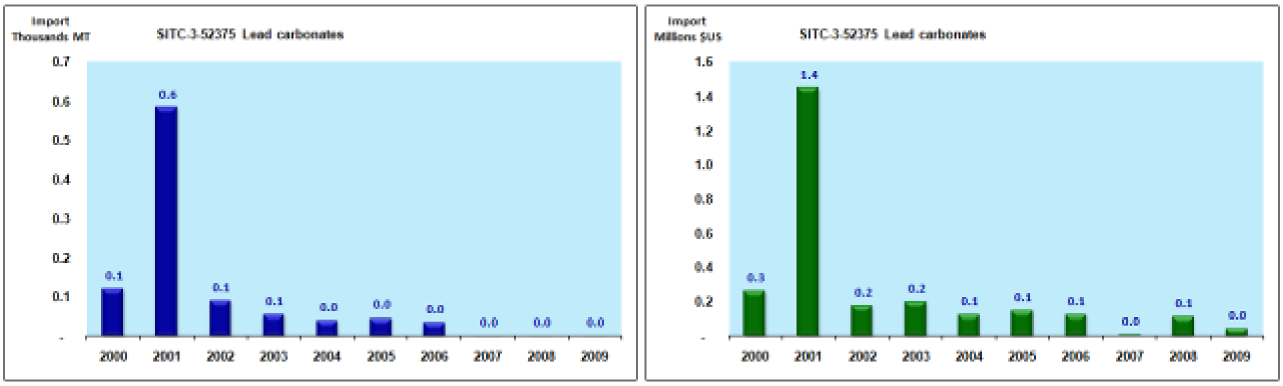


Graph: 5-36 Export of Lead, lead alloys, worked, in thousands of MT and millions of $US, 2000 - 2009

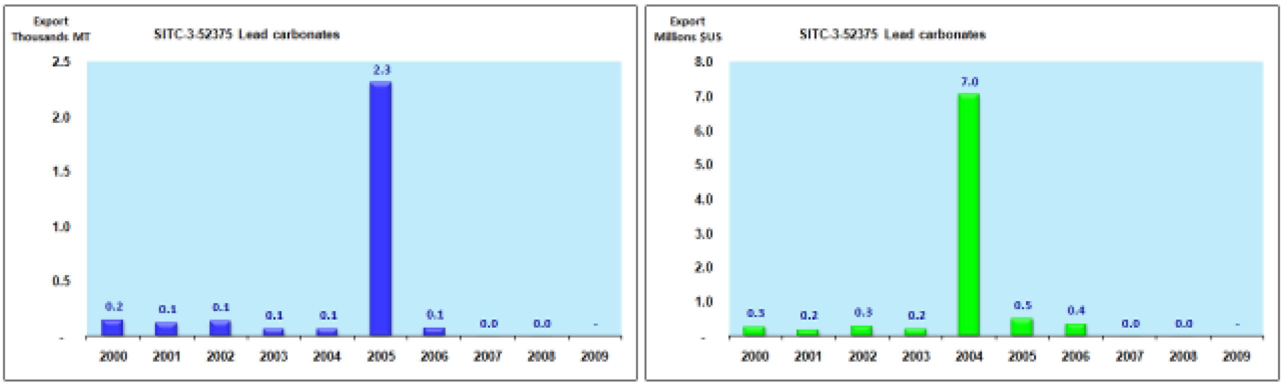
5.1.4.16 Lead carbonates (SITC-3-52375)

Lead carbonates were the lowest imported and exported product containing lead. Import and export volumes and values were generally flat over the study period with occasional spikes in 2001 for imports and 2005-2006 for exports.

Due to low trading volumes, major regional importers and exporters were not determined for this product code.



Graph: 5-37 Import of Lead carbonates, in thousands of MT and millions of $US, 2000 – 2009

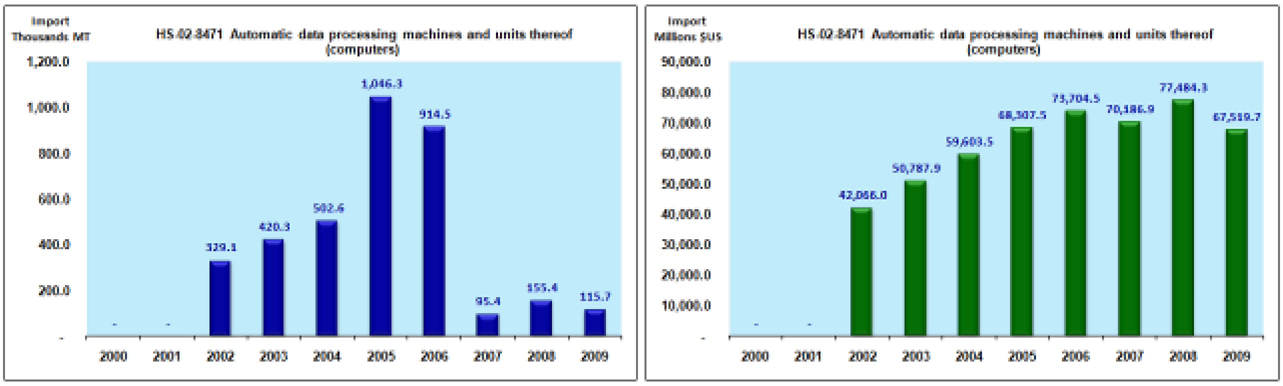


Graph: 5-38 Export of Lead carbonates, in thousands of MT and millions of $US, 2000 - 2009

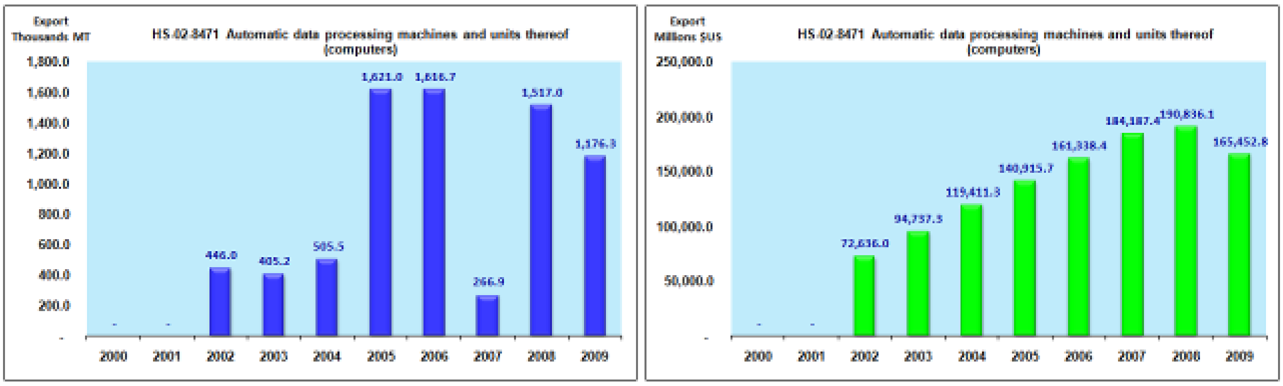
5.1.4.17 Automatic data processing machines and units thereof (computers) (HS-02-8471)

Automatic data processing machines and units thereof (computers) account for 11.6% of the import volumes and 21.6% of the export volumes over the study period. Import volumes increased threefold from 2002 to 2006 prior to declining to levels approximately a third of the 2002 levels. The import values, however, have steadily increased from 2002 to 2009 to a value approximately 50% higher than 2002 levels. The export values followed a similar trend to the import values, although the value more than doubled. The export volumes increased by a factor of approximately 3.5 from 2002 to 2006, which then declined significantly in 2007, prior to recovering in 2008.

The major importing countries were China (24.1%), Japan (15.5%), and the Republic of Korea (15.0%) and their major importing partners were China and Thailand. The major exporters were China (47.1%), the Republic of Korea (14.2%), and Singapore (12.8%).



Graph: 5-39 Import of Automatic data processing machines and units thereof (computers), in thousands of MT and millions of $US, 2000 – 2009



Graph: 5-40 Export of Automatic data processing machines and units thereof (computers), in thousands of MT and millions of $US, 2000 – 2009

5.2 Production and Trade of products containing cadmium

5.2.1 Products containing cadmium[121]

5.2.1.1 Coatings and electroplating

Cadmium coatings and electroplating can be applied to certain metals to improve their resistance to corrosion. The amount of cadmium used for this purpose has decreased in recent years as alternatives have been found in motor vehicle applications. Cadmium, however, is still used in specialist applications where alternatives do not provide the same level of corrosion protection and can compromise operational safety (aerospace and military applications).

5.2.1.2 Nickel – Cadmium Batteries (NiCd)

NiCd batteries have been popular as a rechargeable battery for consumer devices due to their low cost, high number of charge and discharge cycles, high rate of discharge, and wide operating temperature. NiCd battery use in consumer electronics is seen to be declining in recent years with the advent of Nickel Metal Hydride (NiMH) and Lithium Ion (Li-ion) rechargeable batteries, although they still have applications in low cost devices where they have a price advantage over the newer technologies. World production of NiCd batteries is lead by manufacturing facilities in China and Japan.

5.2.1.3 Pigments

Cadmium pigments are generally used to colour plastics that are processed at higher temperatures as they do not degrade at these higher temperatures in the same way as other pigments. Cadmium sulfide, which is golden yellow in colour, is used in conjunction with other sulfur compounds of zinc, mercury and selenium to produce a range of colours from bright yellow to maroon.

5.2.1.4 Solar Cells

Cadmium Telluride (CdTe) flexible thin film solar cells are one of the alternatives for the traditional crystalline silicon solar cells. They are seen as a viable alternative for commercial and large scale installations and are highlighted as one of the important areas of future photovoltaic power generation. It is estimated that the average content of cadmium in a CdTe thin film cell is 7 grams per m2, which is said to be contained within the cell during operation and is recyclable at the end of its life.

5.2.1.5 Recycling

From the major uses of cadmium, the only item that is immediately suited to recycling are NiCd batteries. There are a number of programs in the US, Japan and Europe that promote the collection and return of NiCd batteries for recycling.

5.2.2 World Production of Cadmium and trade in products containing cadmium

5.2.2.1 World production of cadmium in refineries in MT[122]

The global production of cadmium from primary sources increased to 19,600 MT in 2008, with the majority of the world's primary cadmium being produced in the Asian region, more specifically in China, Japan, and the Republic of Korea. Approximately 20 percent of the global production of cadmium metal was the result of secondary production via the recycling of NiCd batteries.

Data published by the World Bureau of Metal Statistics indicates that the production of refined cadmium increased 3 percent in 2008 over 2007 levels. The main consumers of refined cadmium are currently China (32%), Belgium (30%), and Japan (12%). The main end use of cadmium is the production of nickel cadmium (NiCd) batteries and is said to represent most global cadmium consumption. The other end uses of note include alloys, corrosion resistant coatings, pigments, stabilizers for poly vinyl chloride (PVC), and semiconducting compounds in solar cells. The trends in the end use of cadmium are towards higher consumption in the production of NiCd Batteries and lower consumption in the other major uses for cadmium and cadmium compounds.

[121] USGS (2009a) *U.S. Geological Survey 2008 Minerals Yearbook – Cadmium [Advance Release]* Feb 2010.
[122] ibid

Table: 5-13 World cadmium refinery production (MT)

	2004		2005		2006		2007		2008	
Argentina	39	0.2%	3	0.0%	6	0.0%	6	0.0%	6	0.0%
Australia	347	1.9%	358	1.8%	329	1.7%	351	1.8%	330	1.7%
Brazil	187	1.0%	200	1.0%	141	0.7%	200	1.0%	200	1.0%
Bulgaria	356	1.9%	319	1.6%	363	1.8%	459	2.4%	460	2.3%
Canada	1,880	10.1%	1,727	8.6%	2,090	10.5%	1,388	7.2%	1,300	6.6%
China	2,800	15.0%	4,080	20.3%	3,790	19.0%	4,210	21.7%	4,300	21.9%
Germany	640	3.4%	640	3.2%	640	3.2%	400	2.1%	400	2.0%
India	489	2.6%	409	2.0%	457	2.3%	583	3.0%	599	3.1%
Italy	10	0.1%	10	0.0%	10	0.1%	10	0.1%	10	0.1%
Japan	2,233	12.0%	2,297	11.4%	2,287	11.5%	1,933	10.0%	2,113	10.8%
Kazakhstan	1,900	10.2%	2,000	9.9%	2,000	10.0%	2,100	10.8%	2,100	10.7%
Korea, North	200	1.1%	200	1.0%	200	1.0%	200	1.0%	200	1.0%
Korea, South	2,362	12.7%	2,582	12.8%	3,320	16.7%	2,846	14.7%	2,900	14.8%
Mexico	1,615	8.7%	1,653	8.2%	1,401	7.0%	1,617	8.3%	1,605	8.2%
Netherlands	493	2.6%	494	2.5%	524	2.6%	495	2.6%	530	2.7%
Norway	141	0.8%	153	0.8%	125	0.6%	269	1.4%	178	0.9%
Peru	532	2.9%	481	2.4%	416	2.1%	347	1.8%	371	1.9%
Poland	356	1.9%	408	2.0%	373	1.9%	421	2.2%	420	2.1%
Russia	532	2.9%	621	3.1%	690	3.5%	810	4.2%	800	4.1%
Ukraine	25	0.1%	25	0.1%	25	0.1%	25	0.1%	25	0.1%
United States	1,480	7.9%	1,470	7.3%	723	3.6%	735	3.8%	777	4.0%
	18,617	**100%**	**20,130**	**100%**	**19,910**	**100%**	**19,405**	**100%**	**19,624**	**100%**

5.2.3 Production and trade of cadmium and products containing cadmium in Asia and the Pacific

The data contained in this section is derived from the United Nations COMTRADE database. It analyses the trade flows of cadmium containing products in the Asia and the Pacific region. These products, which are listed in Table 5-14, were identified as products that contain, or may contain cadmium. During the course of this study, there has been no attempt to quantify the amounts of cadmium contained within these products, which in some cases may be the majority of the weight present in the identified item, but in other items, may be fractions of a percent of the total weight. This should be taken into consideration when using this data for decision making, or further information should be sought on particular commodity code to determine the actual cadmium contents of particular items.

There were also a number of instances where the data extracted from the COMTRADE database did not contain net weight data or was recorded as zero. Therefore, the net weight data tabulated in this section will be limited by the availability of the data in the database. Where an item was recorded as a weight, the data was generally more complete. In the instances where the quantity code was unknown or as the number of item, it was much more likely for the net weight to be blank or recorded as zero.

Re-imports and Re-exports are included in the import and export data that is extracted from the COMTRADE Database. Re-exports and re-imports are recorded separately for analytical purposes, but have not been analysed separately in this section. Re-exports are the export of a foreign good in the same state as it was imported, and similarly, re-imports are a good that is imported in the same state as it was previously exported. Normally the volumes of re-imports are a relatively small part of the overall imports, in the order of 0.5 – 1.2% for some of the higher re-importing countries. China, for all trade, has a relatively high re-import proportion of its trade in the range of 8% of its total imports. COMTRADE attributed this to the trade between China and Hong Kong, SAR of China. This can be observed in some of the trading partner data where China is listed as one of its own major trading partners.

The period of data extracted from the COMTRADE database spanned the period of 2000 to 2009. The countries that data was extracted for are listed in Table 1-1.

Table: 5-14 Cadmium and cadmium – containing products by commodity code

CODE	DESCRIPTION OF THE PRODUCT
HS-02-283030	Cadmium sulphide
SITC-3-53313	Pigments and preparations based on cadmium compounds
HS-92-850730	Nickel-cadmium electric accumulators
SITC-3-68982	Cadmium, unwrought; cadmium waste and scrap; powders
HS-96-381230	Anti-oxidisers and stabilisers or plastics
SITC-4-5622	Mineral or chemical fertilizers, phosphatic
SITC-1-5612	Phosphatic fertilizers and materials
HS-07-262091	Ash & residues (excl. From the manufacture of iron/steel) containing antimony/beryllium/cadmium/chromium/their mixtures

Table: 5-15 Import and export of products containing cadmium in Asia and the Pacific, in MT and in thousands of $US, 2000 – 2009 period

Code	Description	Import (MT)	Value of Import (thousands $US)	Export (MT)	Value of Export (thousands $US)
HS-02-283030	Cadmium sulphide	639.3	941.5	2,655.4	2,007.9
SITC-3-53313	Pigments and preparations based on cadmium compounds	22,608.9	114,563.9	8,542.7	34,981.6
HS-92-850730	Nickel-cadmium electric accumulators	885,842.9	8,866,318.3	337,197.1	11,420,579.7
SITC-3-68982	Cadmium, unwrought; cadmium waste and scrap; powders	90,168.3	195,871.2	51,879.6	130,433.3
HS-96-381230	Anti-oxidisers and stabilisers or plastics	2,336,604.0	6,581,167.0	1,320,437.1	3,547,870.7
SITC-4-5622	Mineral or chemical fertilizers, phosphatic	1,685,110.4	657,198.9	4,309,594.4	1,403,715.3
SITC-1-5612	Phosphatic fertilizers and materials	24,378,848.9	3,648,743.0	10,195,966.8	2,220,411.0
HS-07-262091	Ash & residues containing cadmium	1,848.4	156.7	2,345.9	93.0
Totals		**29,401,671.2**	**20,064,960.5**	**16,228,619.1**	**18,760,092.4**

Table: 5-16 Annual import and export of all products containing cadmium in Asia and The pacific, in MT and thousands of $US (2000 – 2009) period

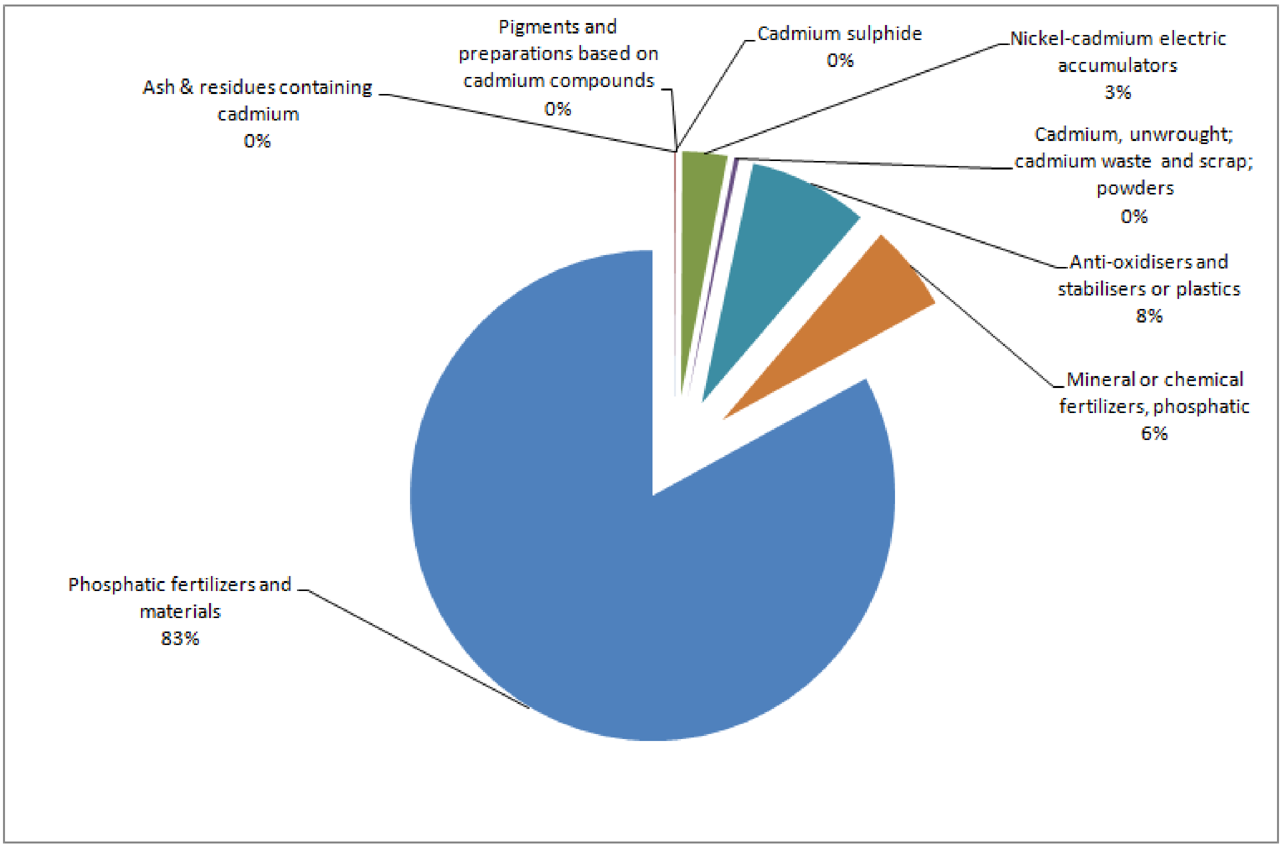
Year	Import (MT)	Value of Imports (Thousands US$)	Export (MT)	Value of exports (Thousands of US$)
2000	1,908,809.35	1,479,344.79	571,108.11	1,568,939.40
2001	1,952,306.71	1,388,735.91	536,067.32	1,319,506.51
2002	2,062,385.38	1,544,070.43	901,727.35	1,486,506.05
2003	2,210,835.41	1,660,099.56	1,029,372.50	1,416,972.49
2004	5,874,243.46	1,966,099.94	1,309,662.26	1,634,354.99
2005	3,230,382.88	2,095,992.59	1,250,753.86	1,710,526.73
2006	2,784,685.42	1,965,886.71	1,258,787.08	1,661,277.88
2007	2,660,273.95	2,411,559.54	3,628,553.36	2,545,598.95
2008	4,484,179.28	3,688,260.30	3,000,228.30	3,572,935.74
2009	2,233,569.32	1,864,910.71	2,742,358.97	1,843,473.71
Totals	**29,401,671.16**	**20,064,960.48**	**16,228,619.10**	**18,760,092.44**

Table: 5-17 Import of products containing cadmium by commodity code in Asia and The pacific, in MT, 2000 – 2009 period

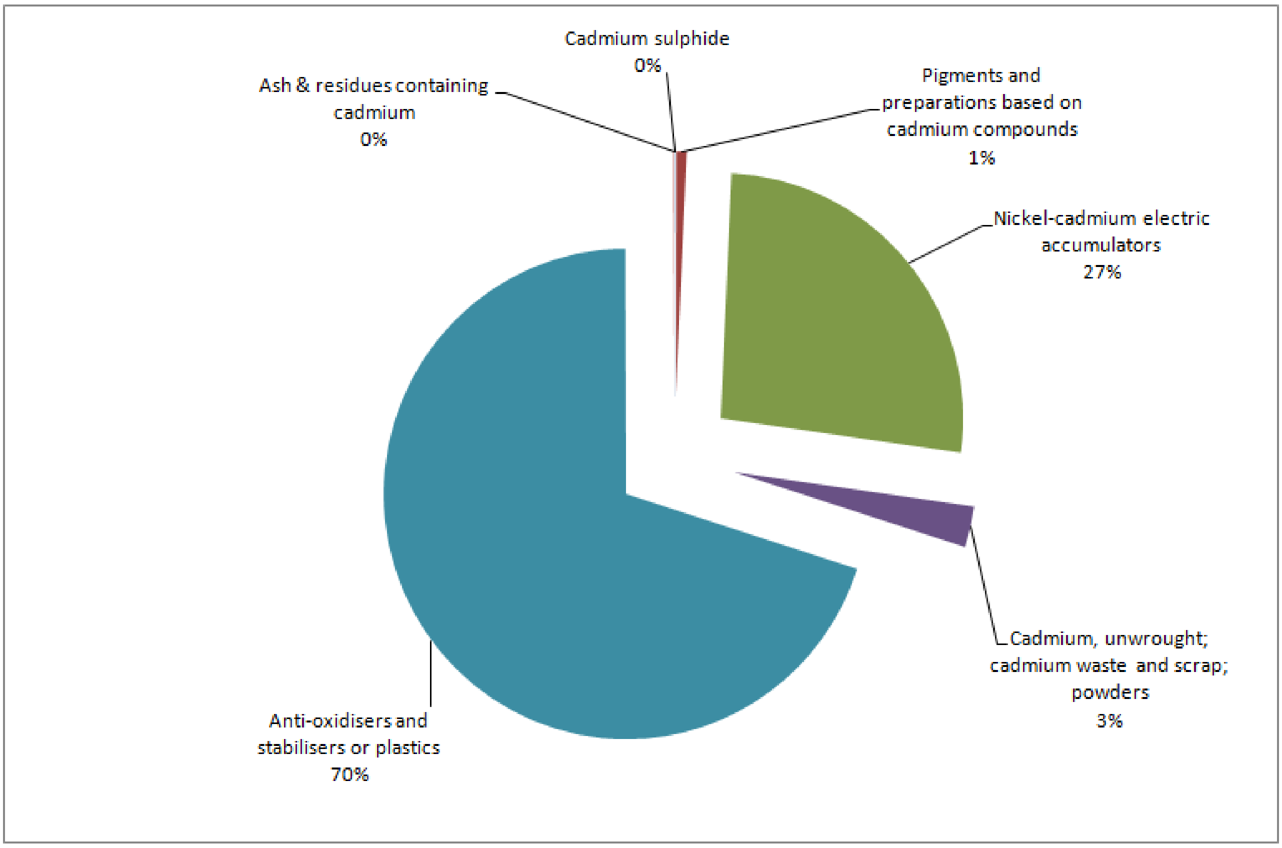
Year	HS-02-283030	SITC-3-53313	HS-92-850730	SITC-3-68982	HS-96-381230	SITC-4-5622	SITC-1-5612	HS-07-262091	Totals
2000	0.0	1,882.8	102,747.2	8,347.9	161,747.3	0.0	1,634,084.2	0.0	1,908,809.35
2001	0.0	1,962.1	101,609.9	6,844.4	167,790.4	0.0	1,674,100.0	0.0	1,952,306.71
2002	5.1	1,788.9	118,436.8	8,518.9	230,382.7	0.0	1,703,253.0	0.0	2,062,385.38
2003	34.6	2,096.5	95,954.0	10,448.3	237,641.3	0.0	1,864,660.7	0.0	2,210,835.41
2004	25.6	2,429.0	105,540.3	10,110.8	265,651.2	0.0	5,490,486.6	0.0	5,874,243.46
2005	440.3	1,342.9	114,425.3	10,057.0	260,680.2	0.0	2,843,437.1	0.0	3,230,382.88
2006	33.7	1,103.5	137,824.0	11,237.0	268,502.4	0.0	2,365,984.9	0.0	2,784,685.42
2007	100.0	2,994.5	34,500.1	6,413.4	268,360.0	414,022.7	1,933,189.7	693.5	2,660,273.95
2008	0.0	4,188.1	56,535.9	5,366.0	251,691.7	613,796.9	3,551,451.5	1,149.2	4,484,179.28
2009	0.0	2,820.6	18,269.6	12,824.7	224,156.8	657,290.8	1,318,201.1	5.8	2,233,569.32
Totals	**639.3**	**22,608.9**	**885,842.9**	**90,168.3**	**2,336,604.0**	**1,685,110.4**	**24,378,848.9**	**1,848.4**	**29,401,671.16**

Table: 5-18 Import of products containing cadmium by commodity code in Asia and the Pacific, in thousands $US, 2000 – 2009 period

Year	HS-02-283030	SITC-3-53313	HS-92-850730	SITC-3-68982	HS-96-381230	SITC-4-5622	SITC-1-5612	HS-07-262091	Totals
2000	0.0	8,965.3	801,896.2	4,092.6	447,208.6	0.0	217,182.0	0.0	1,479,344.8
2001	0.0	9,851.6	721,550.6	4,932.1	439,841.4	0.0	212,560.2	0.0	1,388,735.9
2002	81.4	10,080.3	816,746.1	6,378.0	525,414.2	0.0	185,370.3	0.0	1,544,070.4
2003	115.0	11,580.7	841,475.0	12,558.5	548,581.9	0.0	245,788.5	0.0	1,660,099.6
2004	224.8	12,726.8	954,893.3	10,884.9	637,180.7	0.0	350,189.5	0.0	1,966,099.9
2005	309.6	9,365.2	884,958.0	22,877.9	725,914.4	0.0	452,567.5	0.0	2,095,992.6
2006	150.3	9,057.9	836,688.4	32,339.6	747,305.9	0.0	340,344.7	0.0	1,965,886.7
2007	60.4	12,166.8	1,092,960.6	38,653.7	822,390.7	102,294.9	342,948.8	83.6	2,411,559.5
2008	0.0	17,735.9	1,348,731.2	29,105.5	929,028.7	365,420.1	998,176.5	62.4	3,688,260.3
2009	0.0	13,033.4	566,418.9	34,048.4	758,300.5	189,483.9	303,615.0	10.7	1,864,910.7
Total	**941.5**	**114,563.9**	**8,866,318.3**	**195,871.2**	**6,581,167.0**	**657,198.9**	**3,648,743.0**	**156.7**	**20,064,960.5**



Graph: 5-41 Import of products containing cadmium into Asia and the Pacific, in MT, 2000 – 2009 period



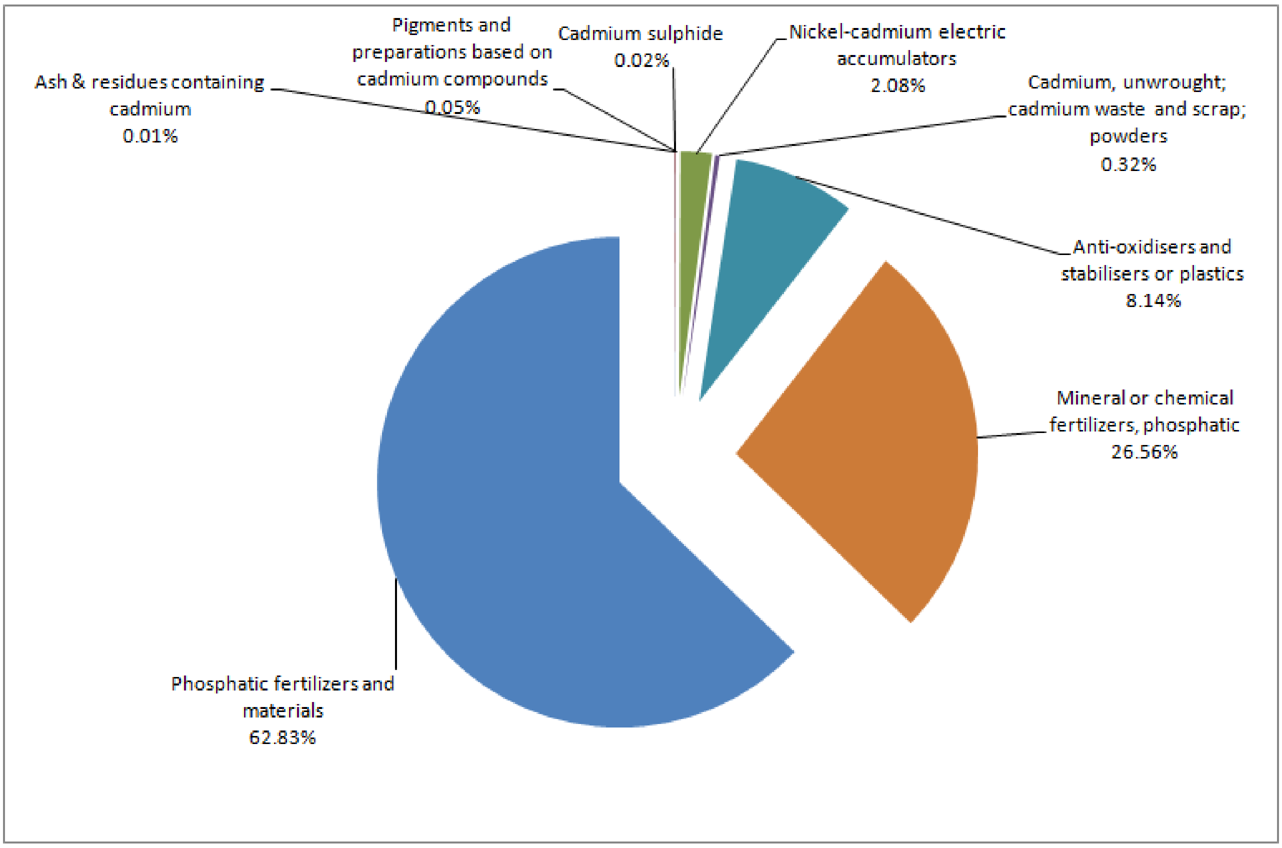
Graph: 5-42 Import of products containing cadmium into Asia and the Pacific, excluding fertilisers, in MT, 2000 – 2009 period

Table: 5-19 Export of products containing cadmium by commodity code from Asia and the Pacific, in MT, 2000 – 2009 period

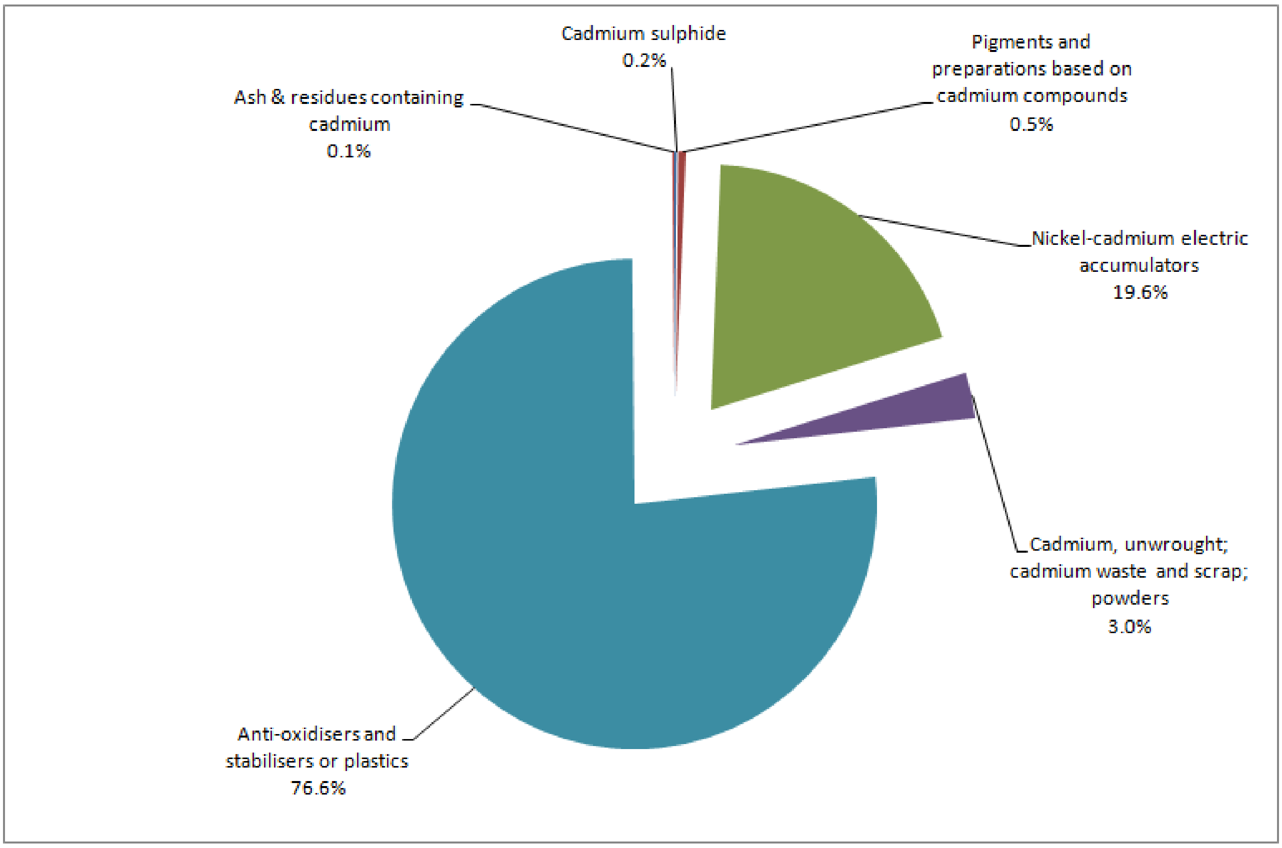
Year	HS-02-283030	SITC-3-53313	HS-92-850730	SITC-3-68982	HS-96-381230	SITC-4-5622	SITC-1-5612	HS-07-262091	Totals
2000	0.0	1,355.4	47,634.4	3,054.0	49,812.9	0	469,251.4	0	571,108.1
2001	0.0	1,088.4	44,130.1	4,191.3	62,409.2	0	424,248.3	0	536,067.3
2002	1,655.1	890.8	43,540.6	3,350.6	110,488.3	0	741,801.9	0	901,727.4
2003	923.8	1,145.8	41,976.1	4,116.2	116,062.2	0	865,148.3	0	1029,372.5
2004	22.0	984.1	42,369.7	5,967.4	127,552.4	0	1,132,766.6	0	1,309,662.3
2005	22.1	1,008.5	41,265.1	5,693.4	144,852.0	0	1,057,912.9	0	1,250,753.9
2006	29.4	881.5	40,764.8	7,485.7	154,891.1	0	1,054,734.6	0	1,258,787.1
2007	3.0	510.6	17,664.4	5,750.9	184,588.9	1,692,407.6	17,276,253.0	3.1	3,628,553.4
2008	0.0	361.0	12,330.7	4,559.9	194,469.4	1,357,402.2	1,430,133.1	972.0	3,000,228.3
2009	0.0	316.7	5,521.1	7,710.3	175,310.8	1,259,784.6	1,292,344.6	1,370.8	2,742,359.0
Totals	**2,655.4**	**8,542.7**	**337,197.1**	**51,879.6**	**1,320,437.1**	**4,309,594.4**	**10,195,966.8**	**2,345.9**	**16,228,619**

Table: 5-20 Export of products containing cadmium by commodity code from Asia and the Pacific, in thousands $US, 2000 – 2009 period

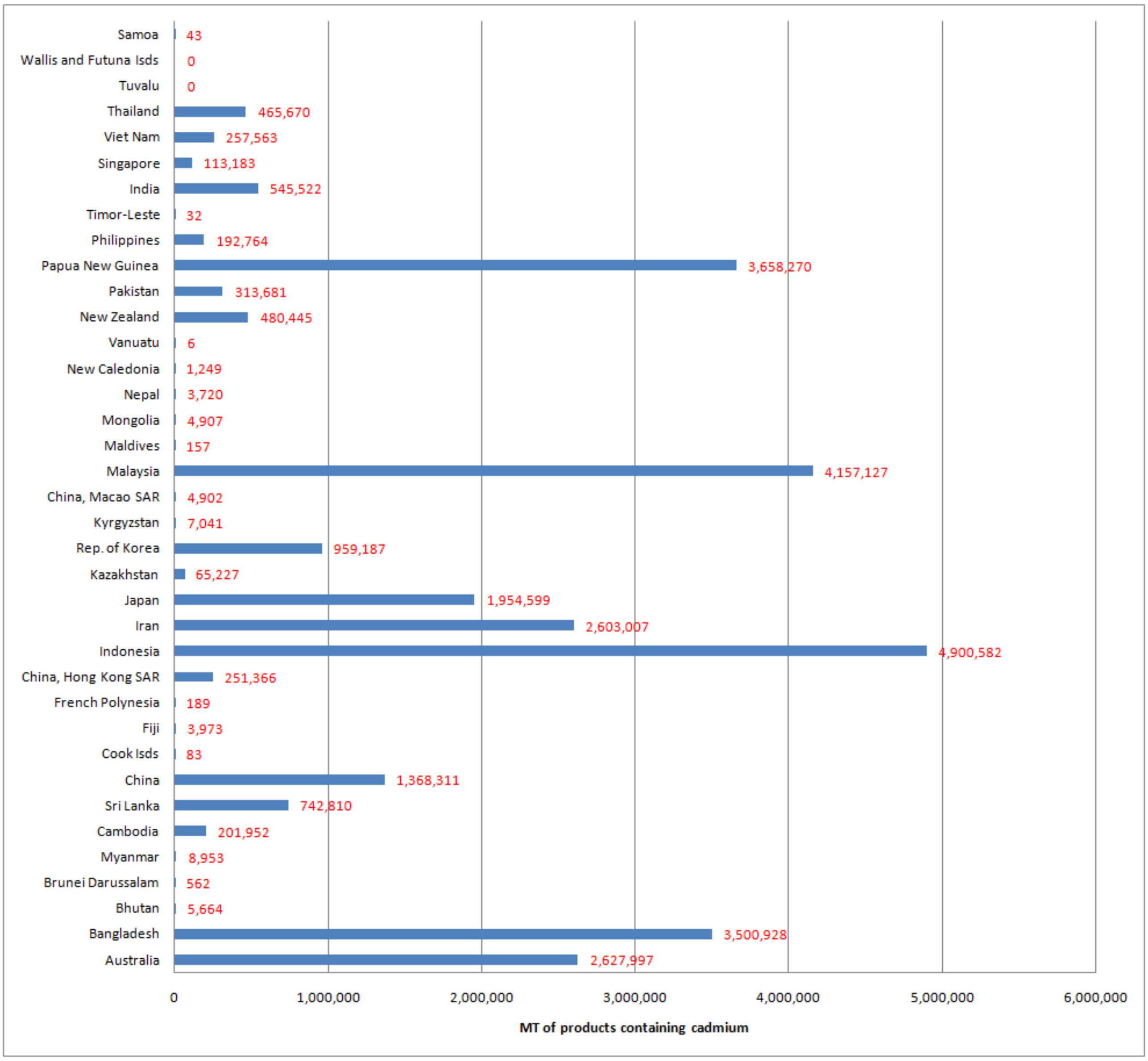
Year	HS-02-283030	SITC-3-53313	HS-92-850730	SITC-3-68982	HS-96-381230	SITC-4-5622	SITC-1-5612	HS-07-262091	Totals
2000	0.0	3,361.2	1,325,218.4	1,346.8	179,320.3	0	59,692.7	0	1,568,939.4
2001	0.0	2,720.0	1,085,070.9	2,452.9	180,042.2	0	49,220.6	0	1,319,506.5
2002	741.2	2,491.0	1,168,009.6	2,287.1	227,370.0	0	85,607.2	0	1,486,506.0
2003	595.8	3,725.5	1,057,771.7	6,223.4	241,961.3	0	106,694.8	0	1,416,972.5
2004	139.7	4,917.3	1,189,186.3	7,224.9	283,585.8	0	149,301.0	0	1,634,355.0
2005	259.4	6,783.0	1,156,755.2	13,819.9	364,818.6	0	168,090.6	0	1,710,526.7
2006	196.9	6,146.1	1,061,199.7	20,994.5	404,417.7	0	168,323.0	0	1,661,277.9
2007	74.9	2,497.4	1,310,707.9	34,211.9	517,066.6	337,940.3	343,095.9	4.13	2,545,599.0
2008	0.0	1,441.6	1,429,516.7	29,068.7	641,419.0	726,883.7	744,566.2	39.65	3,572,935.7
2009	0.0	898.5	637,143.3	12,803.1	507,869.1	338,891.3	345,819.1	49.23	1,843,473.7
Total	**2,007.9**	**34,981.6**	**11,420,579.7**	**130,433.3**	**3,547,870.8**	**1,403,715.3**	**2,220,411.0**	**93.0**	**18,760,092.4**



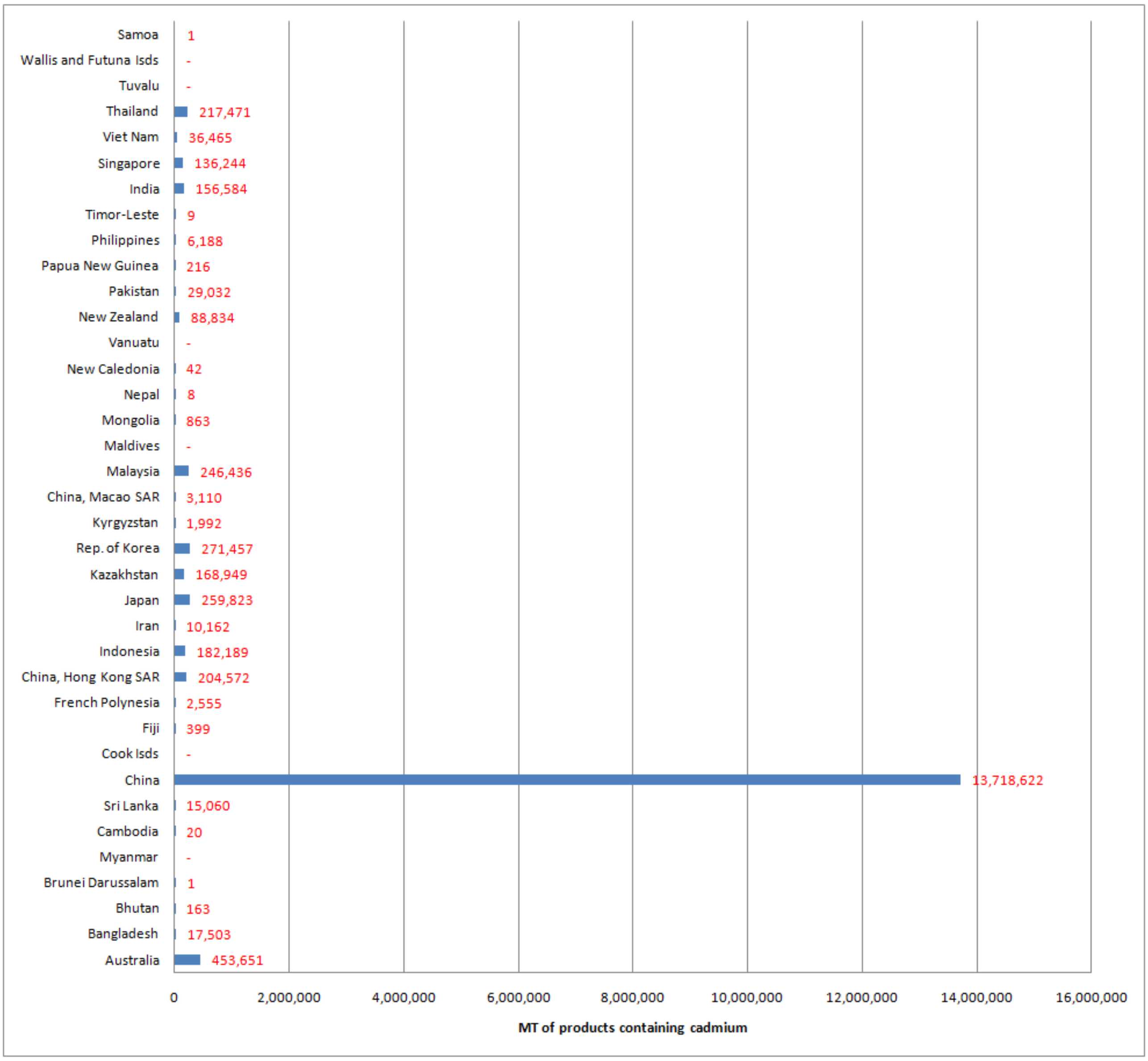
Graph: 5-43 Export of products containing cadmium into Asia and the Pacific, in MT, 2000 – 2009 period



Graph: 5-44 Export of products containing cadmium into Asia and the Pacific, excluding fertilisers, in MT, 2000 – 2009 period



Graph: 5-45 Imports of products containing cadmium into Asia and the Pacific, in MT, 2000 – 2009 period



Graph: 5-46 Exports of products containing cadmium into Asia and the Pacific, in MT, 2000 – 2009 period

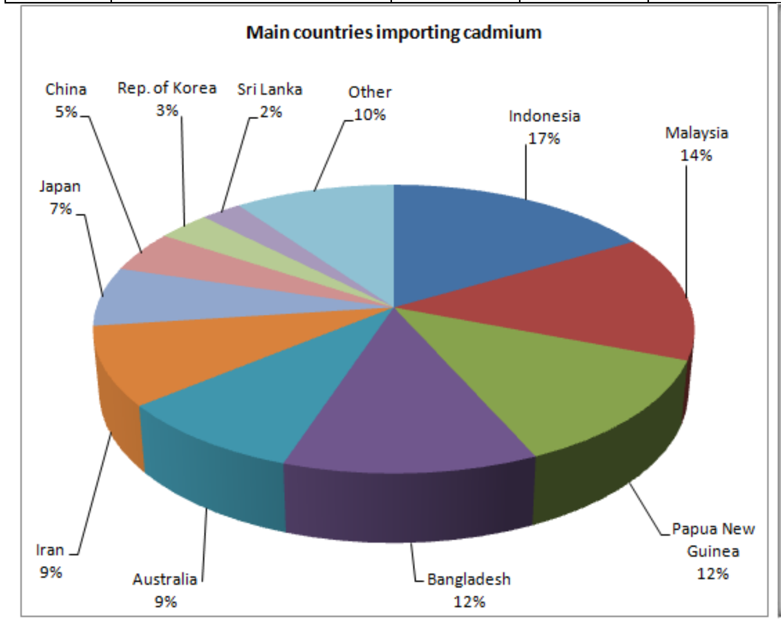
Table: 5-21 Principal importing countries of Asia and the Pacific of products containing cadmium and their principal trading partners, 2000 – 2009 period

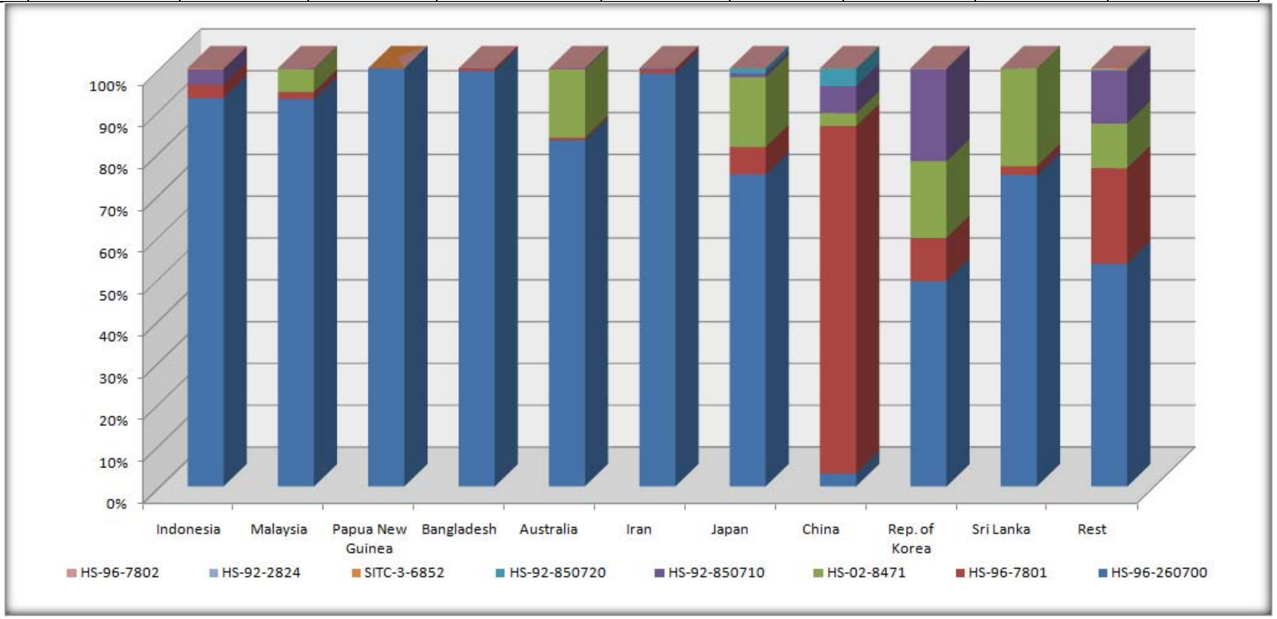
No	Code	Name of Product	Amount (Tonnes)	%	Main Importer			Main Supplier		
					Code	Country	%	Code	Country	%
1	SITC-1-5612	Phosphatic fertilizers and materials	24,378,849	82.9%	360	Indonesia	18.7%	156	China	43.9
								818	Egypt	27.4
								36	Australia	17.4
								788	Tunisia	5.9
					458	Malaysia	15.8%	36	Australia	31.0
								704	Viet Nam	21.0
								818	Egypt	11.8
								764	Thailand	8.9
					598	Papua New Guinea	15.0%	842	USA	47.0
								156	China	28.8
								344	China, Hong Kong SAR	18.8
								36	Australia	4.7
					50	Bangladesh	14.3%	156	China	61.0
								788	Tunisia	19.9
								842	USA	14.3
								504	Morocco	2.1
					364	Iran	10.5%	788	Tunisia	38.1
								504	Morocco	23.0
								422	Lebanon	18.6
								56	Belgium	9.4
						Rest	25.7%			
2	HS-96-381230	Anti-oxidisers and stabilisers or plastics	2,336,604	7.9%	156	China	48.7%	490	Other Asia, nes	40.9
								392	Japan	9.6
								410	Rep. of Korea	9.4
								458	Malaysia	7.3
					344	China, Hong Kong SAR	7.7%	490	Other Asia, nes	31.4
								392	Japan	15.7
								156	China	15.4
								842	USA	7.0
					360	Indonesia	6.7%	490	Other Asia, nes	25.2
								156	China	14.5
								458	Malaysia	8.2
								410	Rep. of Korea	7.6
					699	India	6.4%	156	China	20.5
								410	Rep. of Korea	11.0
								276	Germany	10.3
								842	USA	8.8
					392	Japan	5.5%	702	Singapore	16.1
								156	China	15.9
								842	USA	11.9
								276	Germany	11.7
						Rest	25.1%			
3	SITC-4-5622	Mineral or chemical fertilizers, phosphatic	1,685,110	5.7%	36	Australia	25.4%	376	Israel	49.1
								156	China	16.8
								842	USA	15.6
								554	New Zealand	7.8
					392	Japan	19.3%	156	China	82.9
								504	Morocco	6.6
								376	Israel	3.7
								410	Rep. of Korea	2.9
					458	Malaysia	13.4%	36	Australia	62.0
								818	Egypt	18.9
								156	China	6.8
								643	Russian Fed.	3.4
					410	Rep. of Korea	10.4%	156	China	89.1
								704	Viet Nam	10.4
								276	Germany	0.4
								360	Indonesia	0.1
					144	Sri Lanka	10.3%	156	China	26.8
								818	Egypt	21.0
								702	Singapore	15.9
								792	Turkey	15.0
						Rest	21.1%			
4	HS-92-850730	Nickel-cadmium electric accumulators	885,843	3.03%	410	Rep. of Korea	23.9%	842	USA	31.5
								392	Japan	24.9
								414	Kuwait	13.4
								152	Chile	6.1
					360	Indonesia	20.4%	784	United Arab Emirates	34.6
								702	Singapore	21.2
								144	Sri Lanka	15.0
								414	Kuwait	7.2
					608	Philippines	13.6%	144	Sri Lanka	47.2
								702	Singapore	30.5
								554	New Zealand	15.2
								784	United Arab Emirates	2.5
					156	China	9.9%	156	China	58.1
								392	Japan	28.6
								344	China, Hong Kong SAR	5.3
								484	Mexico	1.5
					344	China, Hong Kong SAR	7.3%	156	China	80.9
								392	Japan	15.8
								251	France	0.9
								702	Singapore	0.5
						Rest	24.8%			

No	Code	Name of Product	Amount (Tonnes)	%	Main Importer			Main Supplier		
					Code	Country	%	Code	Country	%
5	SITC-3-68982	Cadmium, unwrought; cadmium waste and scrap; powders	90,168	0.31%	156	China	64.1%	398	Kazakhstan	18.4
								410	Rep. of Korea	16.8
								484	Mexico	12.5
								842	USA	9.0
					392	Japan	26.7%	410	Rep. of Korea	38.0
								124	Canada	16.7
								276	Germany	11.0
								484	Mexico	8.8
					699	India	4.1%	484	Mexico	23.0
								410	Rep. of Korea	17.6
								124	Canada	8.6
								643	Russian Fed.	7.0
					344	China, Hong Kong SAR	2.7%	124	Canada	70.5
								484	Mexico	9.0
								410	Rep. of Korea	7.9
								842	USA	5.1
					702	Singapore	1.9%	643	Russian Fed.	37.4
								784	United Arab Emirates	25.0
								842	USA	14.7
								156	China	12.2
						Rest	0.5%			
6	SITC-3-53313	Pigments and preparations based on cadmium compounds	22,609	0.077%						
7	HS-07-262091	Ash & residues (excl. From the manufacture of iron/steel) containing antimony/beryllium/cadmium/chromium/their mixtures	1,848	0.006%						
8	HS-02-283030	Cadmium sulphide	639	0.002%						
	Total		**29,401,671**							

Table: 5-22 Main cadmium and cadmium containing products, by product code, and their principal importing countries, MT, 2000 – 2009 period

Code	Description	Indonesia	Malaysia	Papua New Guinea	Bangladesh	Australia	Iran	Japan	China	Rep. of Korea	Sri Lanka	Rest	Totals
SITC-1-5612	Phosphatic fertilizers and materials	4,554,003	3,852,876	3,658,218	3,479,370	2,176,314	2,571,648	1,459,191	42,196	471,088	553,548	1,560,396	24,378,849
HS-96-381230	Anti-oxidisers and stabilisers or plastics	156,040	69,335	47	21,445	16,267	25,312	128,038	137,200	98,976	15,265	668,677	2,336,604
SITC-4-5622	Mineral or chemical fertilizers, phosphatic	0	226,028	0	0	428,558	0	325,623	42,127	176,009	173,855	312,911	1,685,110
HS-92-850730	Nickel-cadmium electric accumulators	180,952	6,976	4	78	6,034	5,698	17,659	88,085	211,745	120	368,491	885,843
SITC-3-68982	Cadmium, unwrought; cadmium waste and scrap; powders	6	103	0	1	1	213	24,055	57,832	3	0	7,954	90,168
SITC-3-53313	Pigments and preparations based on cadmium compounds	9,580	1,334	1	34	822	97	30	866	544	10	9,290	22,609
HS-07-262091	Ash & residues containing cadmium	0	0	0	0	0	0	0	0	712	12	1,125	1,848
HS-02-283030	Cadmium sulphide	0	473	0	0	0	39	3	5	112	0	7	639
Totals		**4,900,582**	**4,157,127**	**3,658,270**	**3,500,928**	**2,627,997**	**2,603,007**	**1,954,599**	**1,368,311**	**959,187**	**742,810**	**2,928,852**	**29,401,671**





Graph: 5-47 Main cadmium importing countries by total imports, in MT, and the percentage of imports by product code for the principal importers, 2000 – 2009 period

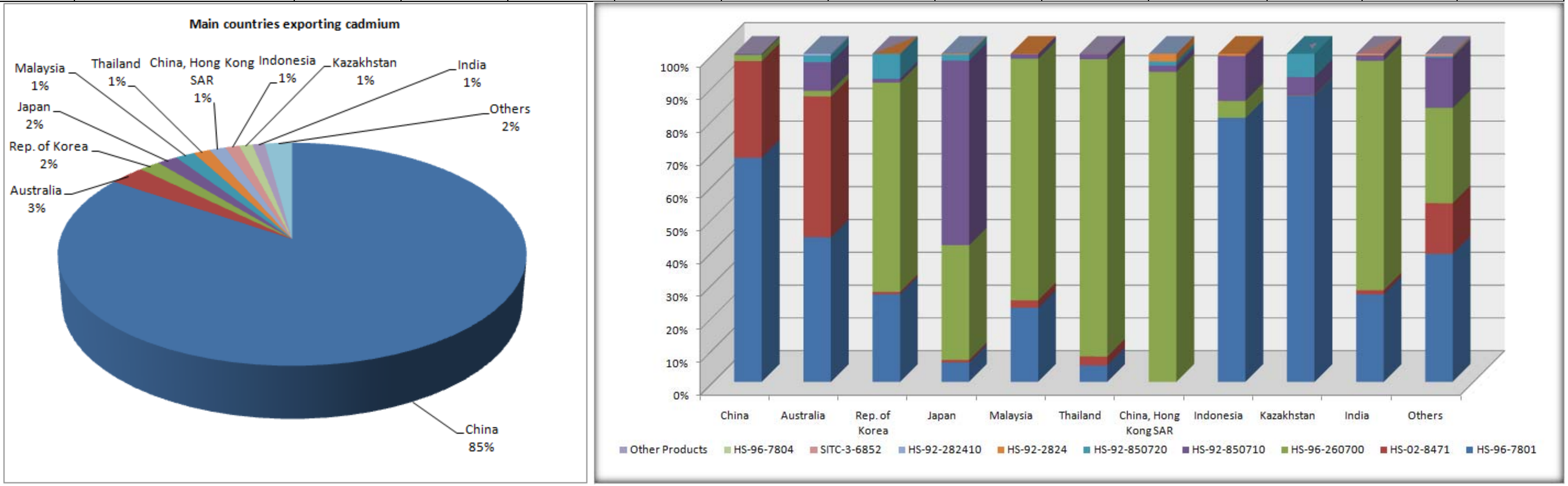
Table: 5-23 Principal exporting countries of Asia and the Pacific of products containing cadmium and their principal trading partners, 2000 – 2009 period

No	Code	Name of Product	Amount Tonnes	%	Main Exporter			Main Buyer		
					Code	Country	%	Code	Country	%
1	SITC-1-5612	Phosphatic fertilizers and materials	10,195,967	62.8%	156	China	91.9%	50	Bangladesh	27.1
								360	Indonesia	21.9
								392	Japan	10.3
								76	Brazil	7.7
					36	Australia	2.0%	76	Brazil	62.4
								32	Argentina	31.2
								554	New Zealand	2.3
								392	Japan	1.5
					398	Kazakhstan	1.4%	762	Tajikistan	84.2
								4	Afghanistan	8.9
								643	Russian Federation	5.1
								784	United Arab Emirates	1.5
					360	Indonesia	1.4%	50	Bangladesh	31.9
								392	Japan	27.8
								458	Malaysia	10.4
								36	Australia	9.0
					410	Rep. of Korea	0.7%	392	Japan	95.2
								156	China	3.1
								36	Australia	1.7
								458	Malaysia	0.0
						Rest	2.5%			
2	SITC-4-5622	Mineral or chemical fertilizers, phosphatic	4,309,594	26.6%	156	China	93.8%	50	Bangladesh	21.6
								360	Indonesia	19.7
								76	Brazil	15.0
								364	Iran	11.9
					36	Australia	4.5%	76	Brazil	64.1
								32	Argentina	32.1
								392	Japan	1.5
								242	Fiji	1.1
					554	New Zealand	0.8%	36	Australia	99.3
								540	New Caledonia	0.3
								242	Fiji	0.2
								258	French Polynesia	0.1
					704	Viet Nam	0.3%	360	Indonesia	27.2
								410	Rep. of Korea	19.8
								418	Lao People's Dem. Rep.	17.2
								36	Australia	14.6
					764	Thailand	0.1%	418	Lao People's Dem. Rep.	39.8
								458	Malaysia	34.7
								116	Cambodia	19.4
								586	Pakistan	4.0
						Rest	0.4%			
3	HS-96-381230	Anti-oxidisers and stabilisers or plastics	1,320,437	8.1%	156	China	19.4%	490	Other Asia, nes	11.8
								344	China, Hong Kong SAR	11.4
								842	USA	9.6
								392	Japan	9.2
					764	Thailand	14.9%	699	India	28.3
								458	Malaysia	15.8
								360	Indonesia	11.0
								156	China	10.8
					344	China, Hong Kong SAR	14.6%	156	China	96.4
								458	Malaysia	0.6
								360	Indonesia	0.6
								704	Viet Nam	0.5
					458	Malaysia	13.7%	156	China	34.8
								704	Viet Nam	9.6
								360	Indonesia	8.0
								392	Japan	6.9
					410	Rep. of Korea	13.1%	156	China	20.9
								490	Other Asia, nes	9.5
								392	Japan	7.8
								842	USA	6.7
						Rest	24.2%			
4	HS-92-850730	Nickel-cadmium electric accumulators	337,197	2.08%	392	Japan	43.3%	484	Mexico	25.5
								344	China, Hong Kong SAR	22.7
								842	USA	11.0
								156	China	8.1
					156	China	14.0%	344	China, Hong Kong SAR	59.5
								392	Japan	15.1
								842	USA	11.7
								124	Canada	2.9
					36	Australia	11.7%	554	New Zealand	89.5
								826	United Kingdom	3.1
								528	Netherlands	2.4
								410	Rep. of Korea	1.2
					702	Singapore	7.6%	608	Philippines	32.1
								458	Malaysia	14.0
								360	Indonesia	12.2
								842	USA	9.3
					360	Indonesia	7.4%	702	Singapore	63.9
								458	Malaysia	8.1
								392	Japan	7.3
								554	New Zealand	5.6
						Rest	16.0%			

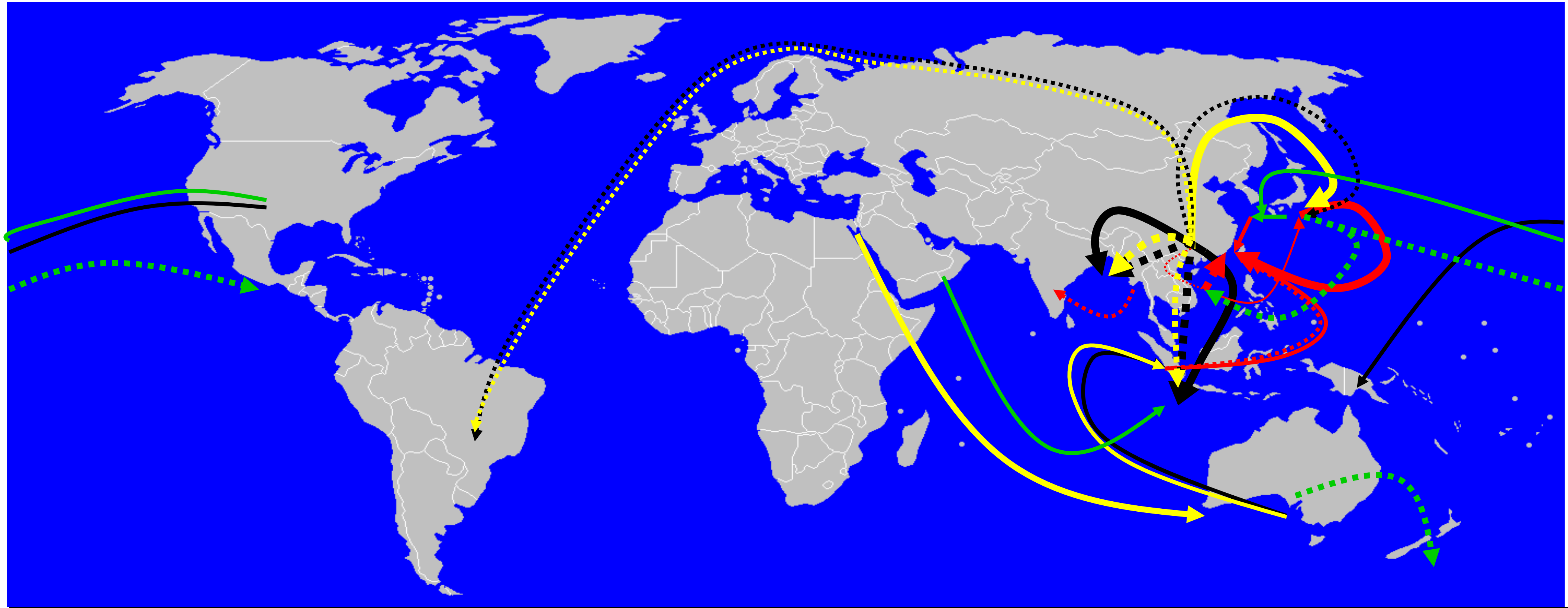
No	Code	Name of Product	Amount Tonnes	%	Main Exporter			Main Buyer		
					Code	Country	%	Code	Country	%
5	SITC-3-68982	Cadmium, unwrought; cadmium waste and scrap; powders	51,880	0.32%	410	Rep. of Korea	39.9%	392	Japan	42.5
								156	China	39.1
								56	Belgium	9.2
								528	Netherlands	5.2
					398	Kazakhstan	23.1%	156	China	75.1
								528	Netherlands	16.0
								643	Russian Federation	6.2
								344	China, Hong Kong SAR	2.0
					36	Australia	17.6%	410	Rep. of Korea	36.5
								156	China	35.7
								344	China, Hong Kong SAR	12.5
								826	United Kingdom	6.5
					392	Japan	9.0%	156	China	89.2
								699	India	7.1
								528	Netherlands	2.4
								344	China, Hong Kong SAR	0.8
					344	China, Hong Kong SAR	5.0%	156	China	89.4
								528	Netherlands	5.4
								392	Japan	4.6
								699	India	0.3
						Rest	5.3%			
6	SITC-3-53313	Pigments and preparations based on cadmium compounds	8,543	0.053%						
7	HS-02-283030	Cadmium sulphide	2,655	0.016%						
8	HS-07-262091	Ash & residues containing cadmium	2,346	0.014%						
	Total		**16,228,619**							

Table: 5-24 Main cadmium and cadmium containing products, by product code, and their principal importing countries, MT, 2000 – 2009 period

Code	Description	China	Australia	Rep. of Korea	Japan	Malaysia	Thailand	China, Hong Kong SAR	Indonesia	Kazakhstan	India	Rest	Totals
SITC-1-5612	Phosphatic fertilizers and materials	9,369,905	200,039	72,413	15,290	55,626	10,830	0	146,661	147,348	41,739	136,115	10,195,967
SITC-4-5622	Mineral or chemical fertilizers, phosphatic	4,043,349	194,694	2,009	2,053	5,576	5,958	0	0	128	1,945	53,881	4,309,594
HS-96-381230	Anti-oxidisers and stabilisers or plastics	256,275	7,690	173,282	90,892	181,523	197,084	193,324	9,373	59	109,592	101,344	1,320,437
HS-92-850730	Nickel-cadmium electric accumulators	47,060	39,548	3,048	146,133	3,476	3,470	3,876	25,064	9,456	2,524	53,543	337,197
SITC-3-68982	Cadmium, unwrought; cadmium waste and scrap; powders	1,455	9,144	20,700	4,688	7	21	2,619	3	11,958	32	1,253	51,880
SITC-3-53313	Pigments and preparations based on cadmium compounds	475	4	6	761	228	108	4,751	1,088	0	399	724	8,543
HS-02-283030	Cadmium sulphide	102	2,532	0	0	0	0	0	0	0	3	11	2,655
HS-07-262091	Ash & residues containing cadmium	0.4	0	0	0	0	0	0	0	0	350	1,996	2,346
Totals		**13,718,622**	**453,651**	**271,457**	**259,823**	**246,436**	**217,471**	**204,572**	**182,189**	**168,949**	**156,584**	**348,866**	**16,228,619**



Graph: 5-48 Main cadmium exporting countries by total exports, in MT, and the percentage of exports by product code for the principal exporters, 2000 – 2009 period



CODE	DESCRIPTION	MT	IMPORTER	FLOW	MT	SUPPLIER		MT	EXPORTER	FLOW	MT	BUYER
SITC-1-5612	Phosphatic fertilizers and materials	4,554,003	Indonesia		2,000,118	China		9,369,905	China		2,542,992	Bangladesh
		3,852,876	Malaysia		1,195,547	Australia					2,050,135	Indonesia
		3,658,218	Papua New Guinea		1,720,094	USA					966,037	Japan
		3,479,370	Bangladesh		2,122,416	China					725,231	Brazil
HS-96-381230	Anti-oxidisers and stabilisers or plastics	1,137,200	China		465,342	Japan		256,275	China		30,343	Hong Kong
					108,830	Republic of Korea		197,084	Thailand		55,676	India
					106,897	Malaysia		193,324	Hong Kong		186,364	China
		178,937	Hong Kong		28,093	Japan		181,523	Malaysia		63,170	China
SITC-4-5622	Mineral or chemical fertilizers, phosphatic	428,558	Australia		210,379	Israel		4,043,349	China		872,150	Bangladesh
		325,623	Japan		269,779	China					796,540	Indonesia
		226,028	Malaysia		140,160	Australia					604,481	Brazil
HS-92-850730	Nickel-cadmium electric accumulators	211,745	Republic of Korea		66,700	USA		146,133	Japan		37,293	Mexico
					52,809	Japan					33,216	Hong Kong
		180,952	Indonesia		62,664	United Arab Emirates		39,548	Australia		35,411	New Zealand

Figure 5-2 Trade flows of products containing cadmium to and from the Asia and Pacific region, 2000 - 2009 period

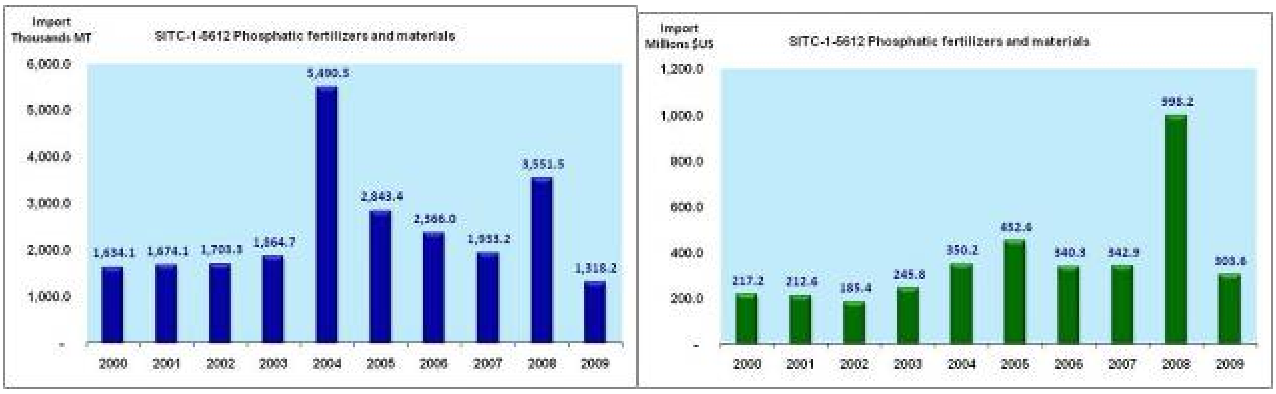
5.2.4 Analysis of trade in Asia and the Pacific of products containing Cadmium, 2000 – 2009 period.

5.2.4.1 Chemical fertilisers, fertilisers and phosphatised materials (SITC-1-5612)

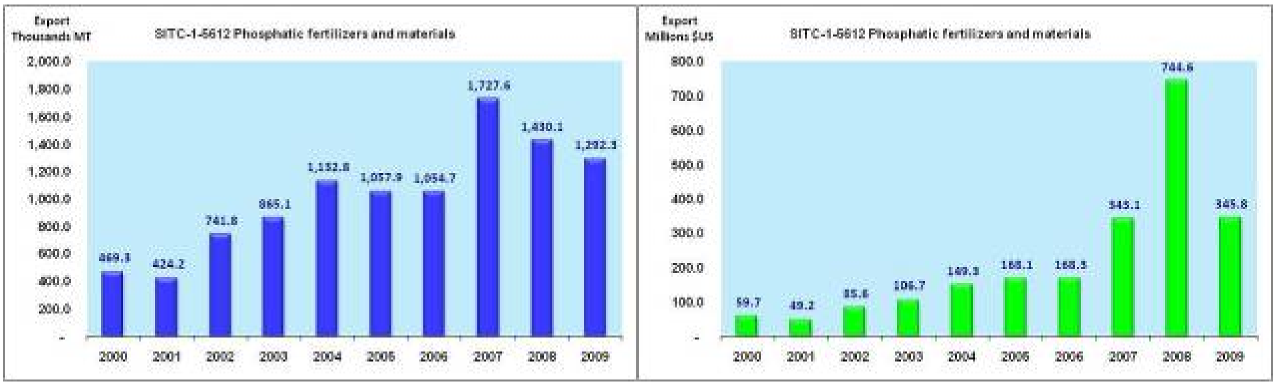
The trade flow of chemical fertilisers, fertilisers and phosphatised materials has generally demonstrated that the import quantities have remained relatively constant over the period of the data, apart from peaks in 2004 and 2008. The increase in imports in 2004, which was approximately 2.5 times the longer term average, did not reflect an increase in the value of goods over the same period. This may reflect changes in the supply and demand dynamic of the commodity, or it may have reflected larger imports of lower value fertilisers then other years. The peak in imports in 2008 did show a corresponding increase in the value of the imports. Fertiliser use can be affected by growing conditions in the region of use, for instance, the increase in use may have corresponded with more ideal growing conditions and vice versa.

The main importers of these products include Indonesia (18.7%), Malaysia (15.8%), Papua New Guinea (15.0%) and Bangladesh (14.3%) and then accounted for 63.8% of the total imports. The major suppliers are China, United States of America, and Australia.

The export quantities of chemical fertilisers, fertilisers and phosphatised materials has more than doubled over the study period, and the value of exports has increased by approximately five fold. The major exporter of this commodity is China, which accounts for more than 90% of the exported materials. The major buyers of these materials are Bangladesh and Indonesia.



Graph: 5-49 Import of Chemical fertilisers, fertilisers and phosphatised materials, in thousands of MT and millions of $US, 2000 - 2009



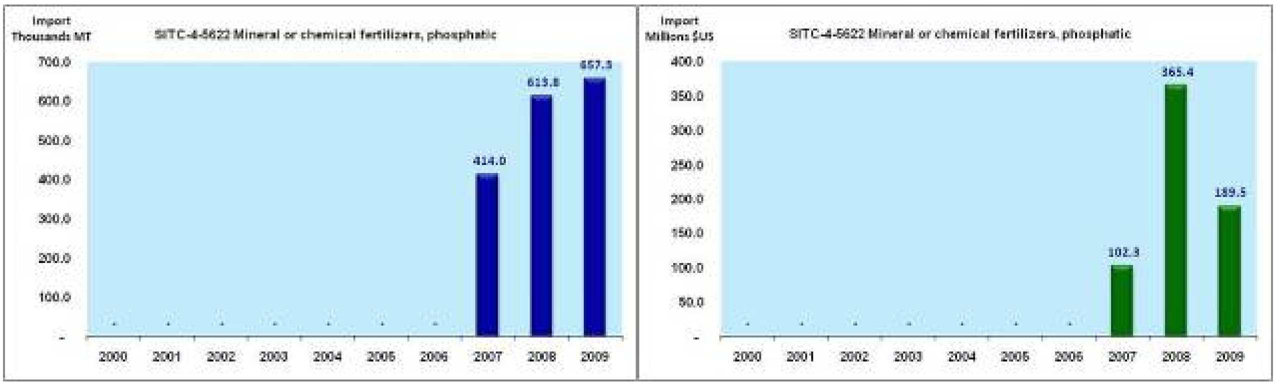
Graph: 5-50 Export of Chemical fertilisers, fertilisers and phosphatised materials, in thousands of MT and millions of $US, 2000 - 2009

5.2.4.2 Mineral or chemical fertilizers, phosphatic (SITC-4-5622)

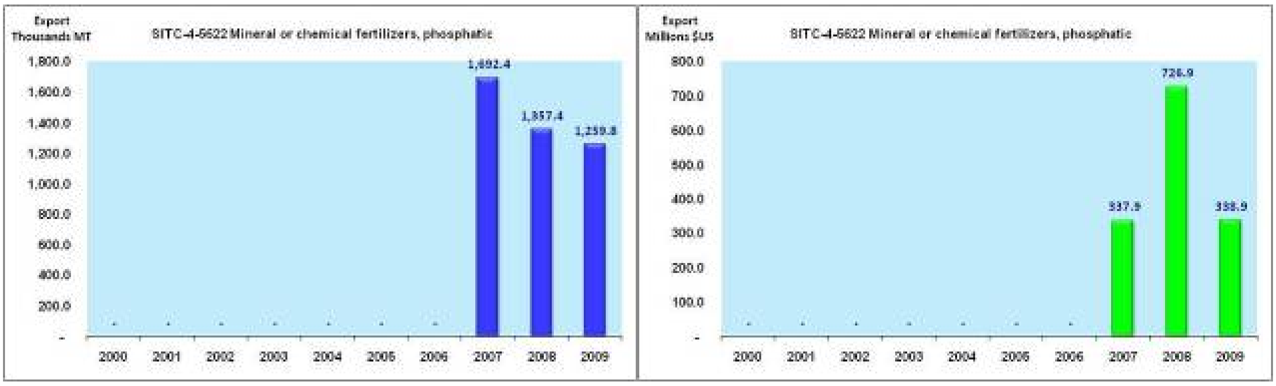
The trade flow of mineral or chemical fertilizers, phosphatic materials has generally demonstrated that the import quantities have increased by approximately 60 percent from 2007 – 2009. The increase in import values has been less consistent, with a threefold increase from 2007 to 2008, and then an approximate 50 percent drop in value from 2008 - 2009. Once again, as fertiliser use can be affected by growing conditions in the region of use, for instance, the increase in use may have corresponded with more ideal growing conditions and vice versa.

The main importers of these products include Australia (25.4%), Japan (19.3%), and Malaysia (13.4%) and then accounted for 58.1% of the total imports. The major suppliers are China, Israel, and Australia.

The export quantities of mineral or chemical fertilizers, phosphatic materials has declined by approximately 25 percent over the period 2007 - 2009, and the value of exports has varied over this time. The value of exports approximately doubled in 2008, but returned to the same approximate value from 2008 in 2009. The major exporter of this commodity is China, which accounts for more than 93 percent of the exported materials. The major buyers of these materials are Bangladesh, Indonesia, and Brazil.



Graph: 5-51 Import of Mineral or chemical fertilizers, phosphatic, in thousands of MT and millions of $US, 2000 – 2009



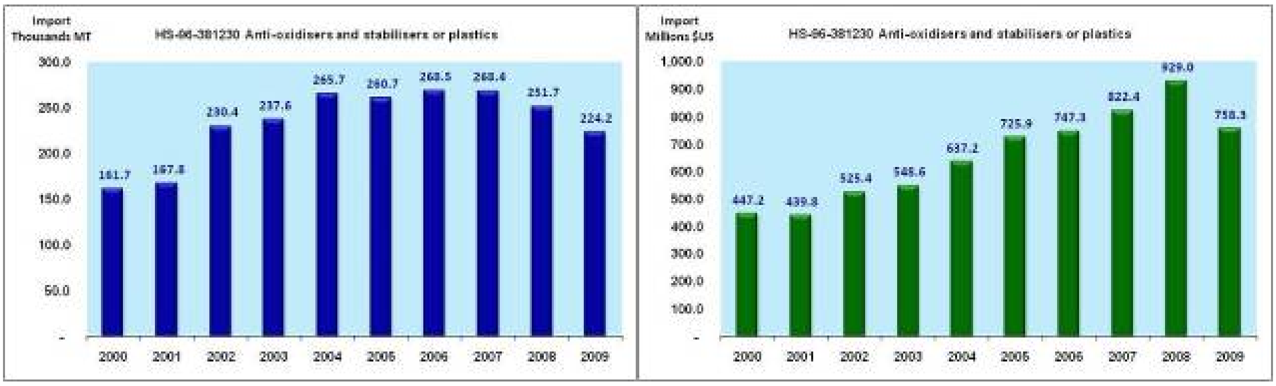
Graph: 5-52 Export of Mineral or chemical fertilizers, phosphatic, in thousands of MT and millions of $US, 2000 - 2009

5.2.4.3 Anti-oxidisers and stabilisers or plastics (HS-96-381230)

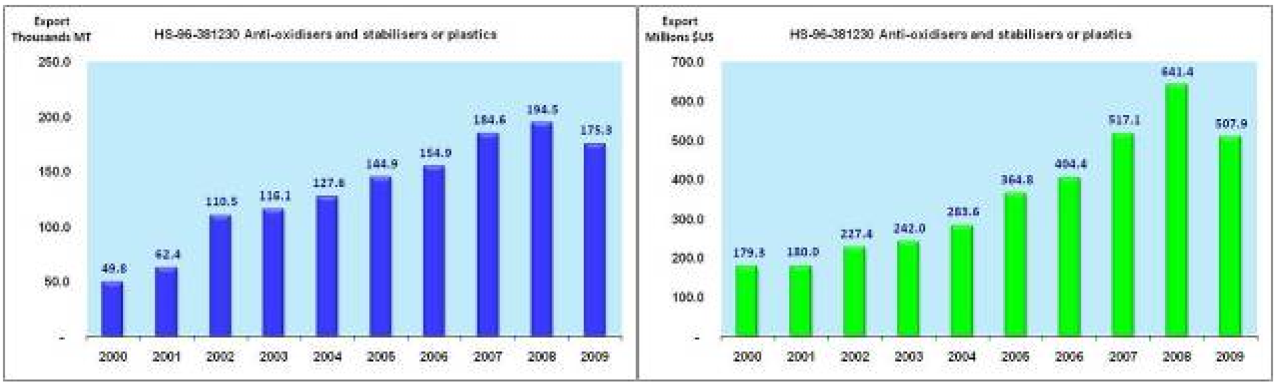
The trade flow of anti-oxidisers and stabilisers or plastics has generally demonstrated that the import quantities have gradually increased from 2000 – 2007, and then slowly decreased. The import values have gradually doubled from 2000 to 2008 prior to declining in 2009.

The main importers of these products include China and China, Hong Kong SAR (56.4%). The major suppliers are listed as Other Asia, nes, Japan and the Republic of Korea.

The export quantities of anti-oxidisers and stabilisers or plastics have gradually increased by approximately 3.5 times 2000 quantities over the period to 2009, and the value of exports has increased gradually over this time to approximately 3 times the 2000 value. The major exporter of this commodity is China and China, Hong Kong SAR (34%), Thailand (14.9%), Malaysia (13.7%) and the Republic of Korea (13.1%). The major buyers of these materials are China and China, Hong Kong SAR.



Graph: 5-53 Import of Anti-oxidisers and stabilisers or plastics, in thousands of MT and millions of $US, 2000 – 2009



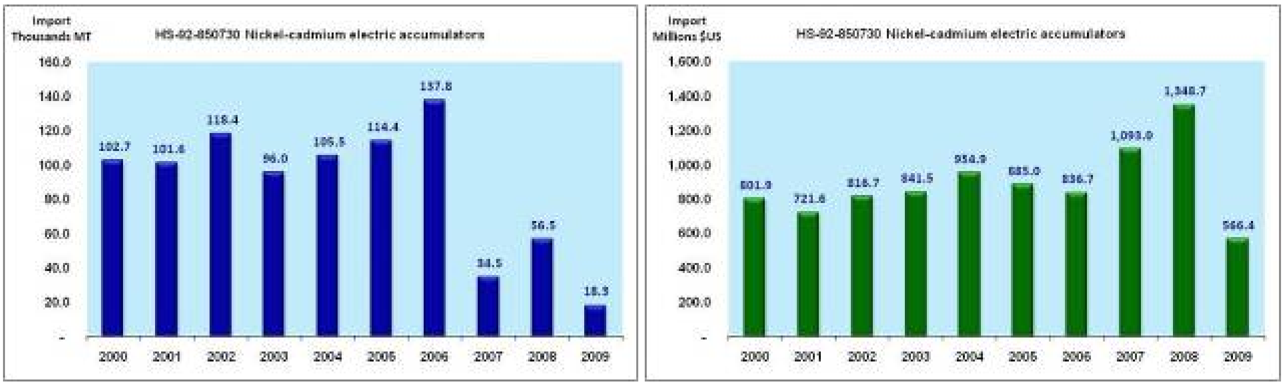
Graph: 5-54 Export of Anti-oxidisers and stabilisers or plastics, in thousands of MT and millions of $US, 2000 - 2009

5.2.4.4 Nickel-cadmium electric accumulators (HS-92-850730)

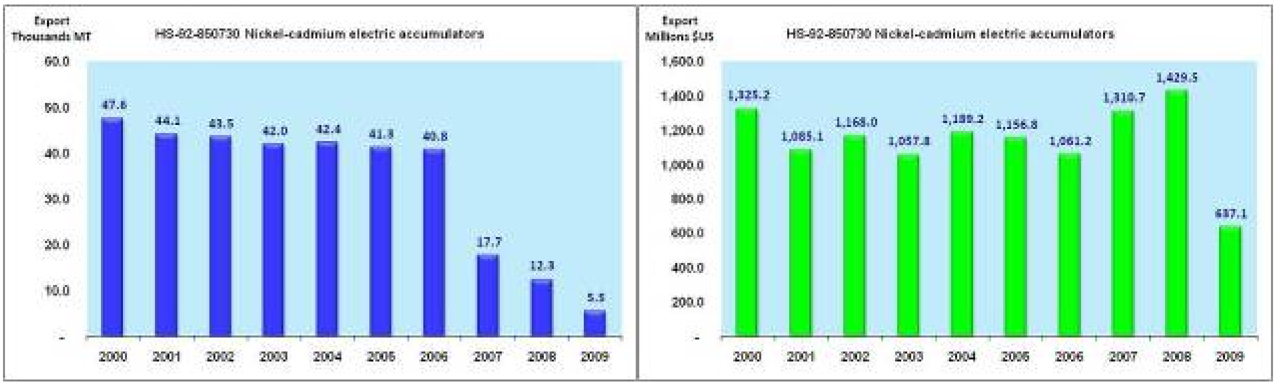
The import flow of nickel-cadmium electric accumulators (NiCd Batteries) had been stable from the period of 2000 – 2006, prior to dropping to less than half for the three subsequent years. The import values were gradually increasing from 2000 to 2008, and then sustain an approximate 50% drop in 2009. It has been suggested that with the increased availability and use of Nickel Metal Hydride (NiMH) and Lithium Ion (Li-Ion) batteries, that the NiCd usage would diminish. This may be reflected in this trend.

The main importers of these products include the Republic of Korea (23.9%), Indonesia (20.4%), and The Philippines (13.6%) and then accounted for 57.9% of the total imports. The major suppliers are China, Japan, and Sri Lanka.

The export quantities of Nickel-cadmium electric accumulators followed a similar trend to the imports over the same period with a relatively constant export until 2006 where the export quantity dropped significantly in 2009 to approximately 15% of the 2006 value. The value of exports were relatively stable until 2008, but dropped to approximately 50% of the 2008 value in 2009. The major exporter of this commodity is Japan, which accounts for 43.3% of the exported materials, followed by China (14.0%) and Australia (11.7%). The major buyers of these materials are China and China, Hong Kong SAR, Mexico, and New Zealand.



Graph: 5-55 Import of Nickel-cadmium electric accumulators, in thousands of MT and millions of $US, 2000 – 2009



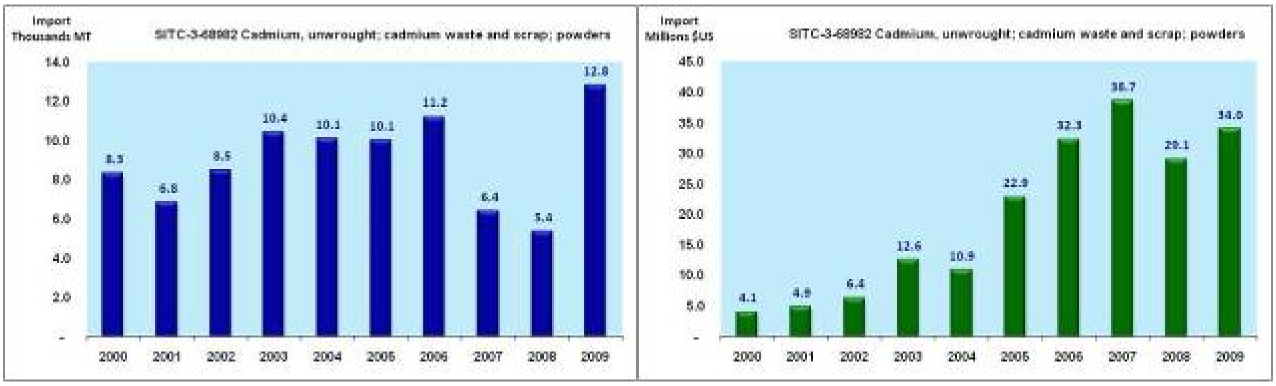
Graph: 5-56 Export of Nickel-cadmium electric accumulators, in thousands of MT and millions of $US, 2000 - 2009

5.2.4.5 Cadmium, unwrought; cadmium waste and scrap; powders (SITC-3-68982)

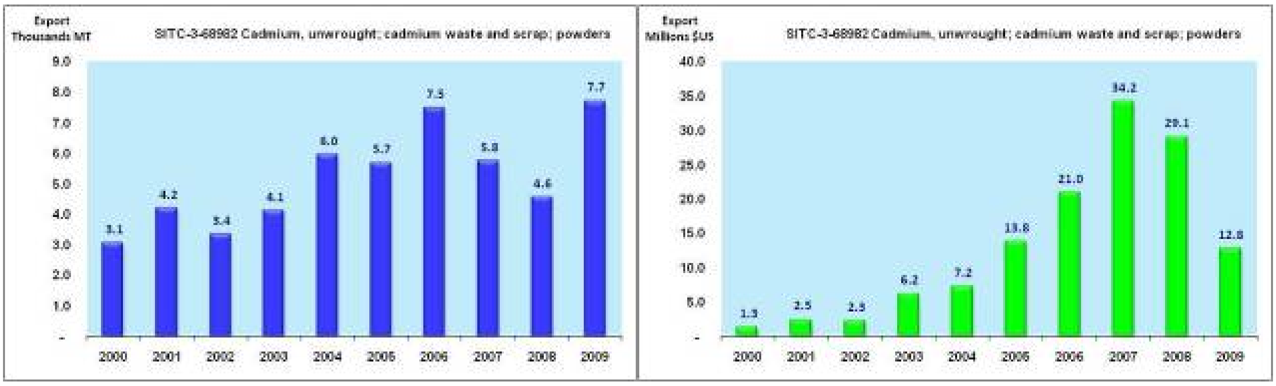
The trade flow for cadmium, unwrought; cadmium waste and scrap; powders have gradually increased over the period of 2000 to 2009 apart from a brief drop in 2007 – 2008. The increase in import values has been strong over this period, with an eightfold increase from 2000 to 2009.

The main importers of these products include China (64.1%) and Japan (26.7%) which accounted for 90.8% of the total imports. The major suppliers are Republic of Korea, Kazakhstan, and Mexico.

The export quantities of cadmium, unwrought; cadmium waste and scrap; powders has approximately doubled over the period 2000 - 2009, and the value of exports has increased tenfold over this time. The value of exports more than doubled from 2005 to 2008, but dropped over the next two years to the same approximate value from 2005 in 2009. The major exporter of this commodity is the Republic of Korea (39.9%), Kazakhstan (23.1%) and Australia (17.6%) which accounts for more than 80% of the exported materials. The major buyers of these materials are China, Japan, and the Republic of Korea.



Graph: 5-57 Import of Cadmium, unwrought; cadmium waste and scrap; powders, in thousands of MT and millions of $US, 2000 – 2009

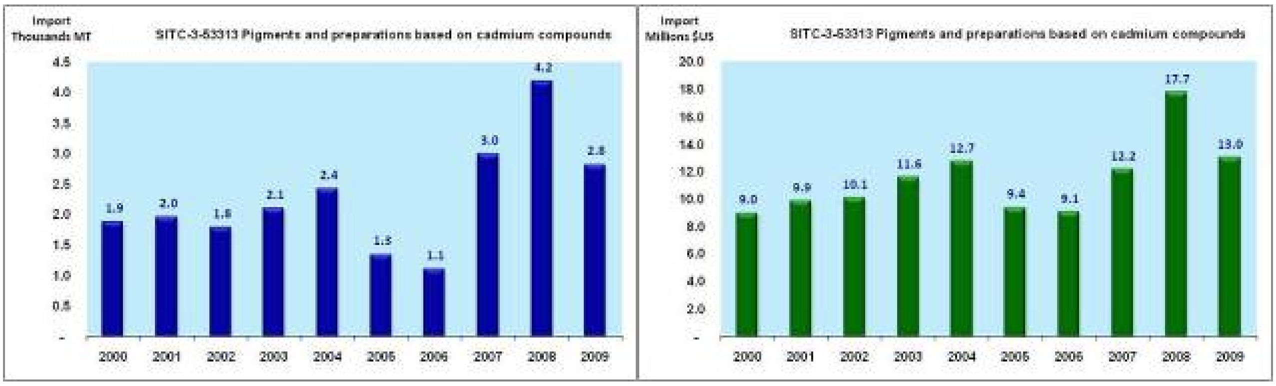


Graph: 5-58 Export of Cadmium, unwrought; cadmium waste and scrap; powders, in thousands of MT and millions of $US, 2000 - 2009

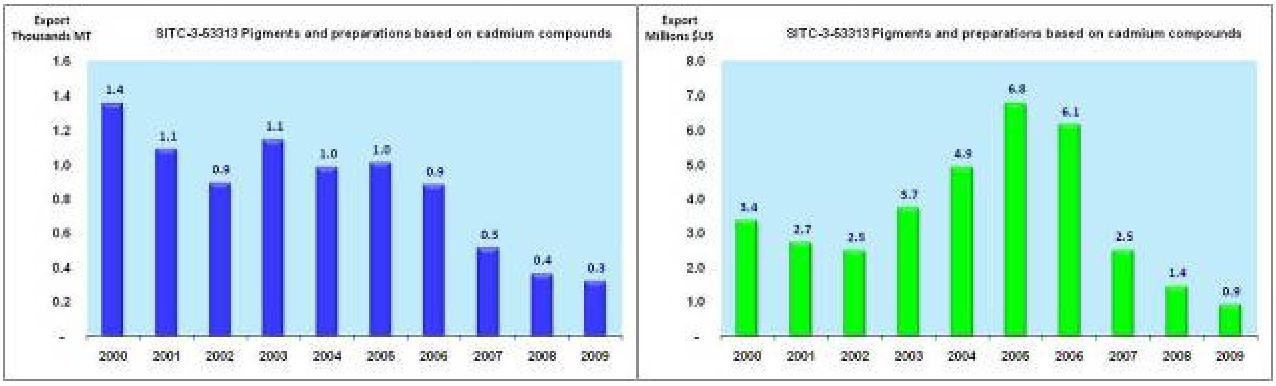
5.2.4.6 Pigments and preparations based on cadmium compounds (SITC-3-53313)

The import flow of pigments and preparations based on cadmium compounds had gradually grown over the period of 2000 – 2009, although it did demonstrate a contraction in 2005 - 2006. The import values has gradually increased from 2000 to 2009, even though it retracted by approximately 25 percent in 2005 – 2006.

The export quantities of pigments and preparations based on cadmium compounds have declined from 2000 to 2009 to approximately 20 percent of the 2000 volume. The value of exports doubled over the period 2000 to 2005, but then dropped to approximately a third of the 2000 value by 2009.



Graph: 5-59 Import of Pigments and preparations based on cadmium compounds, in thousands of MT and millions of $US, 2000 – 2009

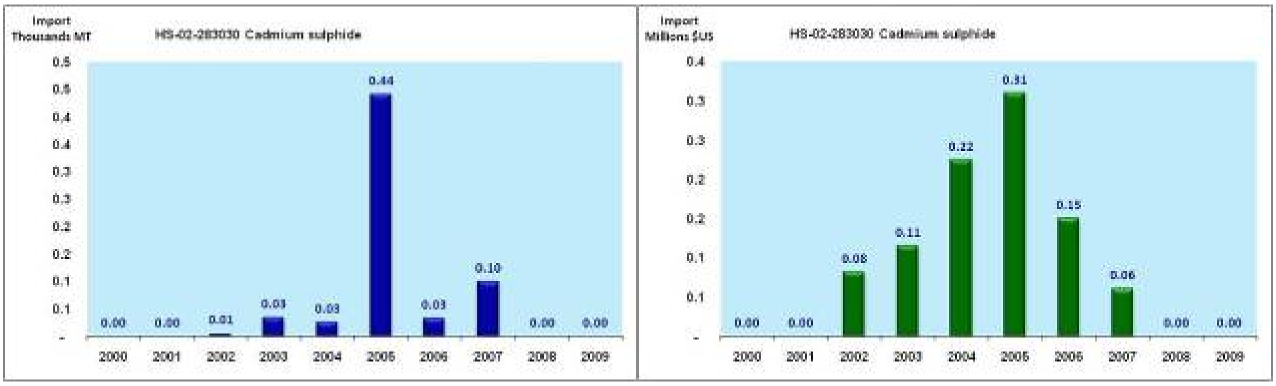


Graph: 5-60 Export of Pigments and preparations based on cadmium compounds, in thousands of MT and millions of $US, 2000 - 2009

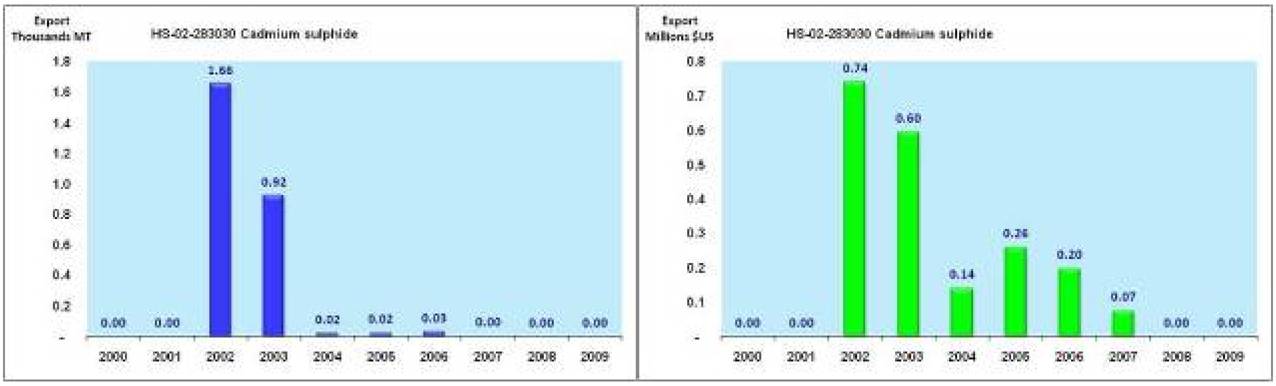
5.2.4.7 Cadmium sulphide (HS-02-283030)

The import flow of cadmium sulphide had been variable over the study period, The import values have also been variable over the study period.

The export quantities and value of cadmium sulphide have also been variable from 2000 to 2009.



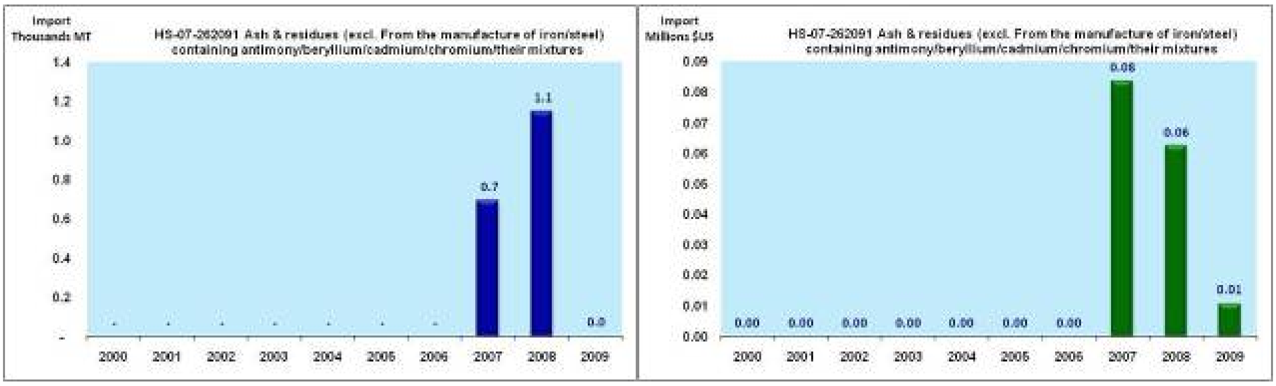
Graph: 5-61 Import of Cadmium sulphide, in thousands of MT and millions of $US, 2000 - 2009



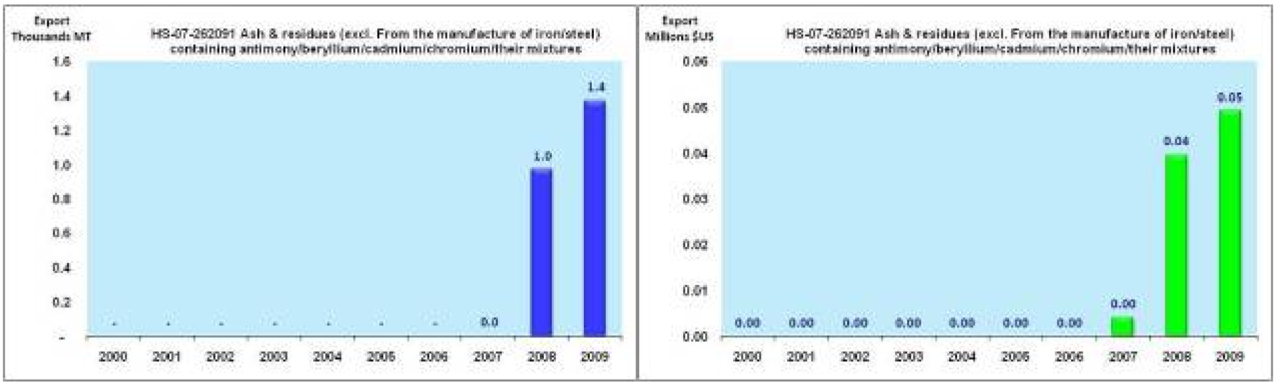
Graph: 5-62 Export of Cadmium sulphide, in thousands of MT and millions of $US, 2000 - 2009

5.2.4.8 Ash & residues (excl. From the manufacture of iron/steel) containing antimony/beryllium/cadmium/chromium/their mixtures (HS-07-262091)

The import flow of ash & residues (excl. from the manufacture of iron/steel) containing antimony/beryllium/cadmium/chromium/their mixtures had been variable over the 2007 - 2009 period, The import values have also been variable over the study period. The export quantities and value for the same trade code have also been variable from 2007 to 2009.



Graph: 5-63 Import of Ash & residues containing cadmium, in thousands of MT and millions of $US, 2000 - 2009



Graph: 5-64 Export of Ash & residues containing cadmium, in thousands of MT and millions of $US, 2000 - 2009

5.3 PRODUCTION AND TRADE OF PRODUCTS CONTAINING MERCURY

5.3.1 Products containing mercury[123]

5.3.1.1 Artisanal and Small Scale Gold Mining

One of the major uses for mercury is by artisanal and small scale gold mining operations, and is the largest global user of mercury. The use of mercury for these purposes is reportedly increasing with the upward movement of gold prices. Currently, it is estimated that 20-30% of world gold production is a result of artisanal and small scale mining, and as it is generally operated in the informal economic sector, often illegally and without organisation, it is responsible for the release of an estimated 650-1000 tonnes per annum of mercury into the environment.

5.3.1.2 Vinyl Chloride Monomer Production

A large and increasing use of mercuric chloride is as a catalyst in the production of vinyl chloride monomer (VCM) which is the precursor for PVC plastics. The consumption of mercuric chloride has increased with the increases in production of PVC to satisfy growing demand in PVC based end products.

5.3.1.3 Chlor-alkali Production

Worldwide, the chlor-alkali industry is the third largest user of mercury. In recent years, governments have worked with industries to phase out the older mercury containing processes and to convert them over to the newer mercury-free membrane processes.

5.3.1.4 Batteries

Mercury is a component of a number of different types of batteries. The recent trend is for manufacturers to switch from the mercury containing battery technologies to the low mercury battery technologies, has been driven by international legislative trends and consumer demand. Despite this trend, button cell batteries can contain up to 2% mercury, and due to their production volume (in the tens of billions) account for a significant quantity of mercury.

5.3.1.5 Dental applications

While the trend in developed countries may show that the use of mercury in dental applications is falling, there are concerns that with better access to dental care in developing nations, the use of mercury in dental applications is increasing.

5.3.1.6 Measuring and control devices

There are a number of devices that utilise the physical properties of mercury as the basis of a measuring or control device. The main usages are in thermometers and sphygmomanometers. Increased awareness of the adverse health effects of mercury has driven the demand for alternative mercury free devices, particularly as they are available for almost all the applications that currently use mercury.

5.3.1.7 Lamps

Energy efficient lighting has relied on mercury containing lamps (fluorescent, compact fluorescent, high-intensity discharge) and despite efforts to reduce the mercury content of these lamps, consumption of mercury for this purpose has grow through increased demand and production of these types of lamps.

5.3.1.8 Electronic Equipment

The use of mercury in electronic equipment (mercury switches, relays, etc) has declined following the implementation of the EU's Restriction on Hazardous Substances (RoHS) Directive, and other similar initiatives in other parts of the world, including Japan, China and the Republic of Korea.

5.3.1.9 Other Uses

There are a number of other uses for mercury or mercury containing products which include uses as pesticides and fungicides, laboratory chemicals, pharmaceuticals, paints, traditional Chinese and Indian medicines, Indian cultural and ritual uses, and in cosmetics. There are also other uses in the production of artificial rubber and in some research and testing devices where its use has only recently been highlighted.

[123] op cit Maxson (2009)

5.3.2 World Production of Mercury and trade of products containing mercury

5.3.2.1 World production of mercury in refineries in MT[124]

The worldwide mine production of mercury is estimated to be 1,920 metric tonnes. It is noted that there is a high degree of uncertainty on the production volumes as most companies and countries do not report primary or secondary production data due to environmental and health concerns. Some of the data is also for by-product production from precious metals processing..

Table: 5-25 World mine production of mercury (MT)

	2005		2006		2007		2008		2009	
China	1,100	72.4%	760	66.1%	800	66.7%	800	60.6%	1,400	72.9%
Finland	20	1.3%	20	1.7%	20	1.7%	20	1.5%	15	0.8%
Kyrgyzstan	200	13.2%	250	21.7%	250	20.8%	250	18.9%	250	13.0%
Mexico	6	0.4%	8	0.7%	8	0.7%	21	1.6%	21	1.1%
Morocco	10	0.7%	10	0.9%	10	0.8%	10	0.8%	10	0.5%
Peru, exports	102	6.7%	22	1.9%	34	2.8%	136	10.3%	140	7.3%
Russia	50	3.3%	50	4.3%	50	4.2%	50	3.8%	50	2.6%
Tajikistan	30	2.0%	30	2.6%	30	2.5%	30	2.3%	30	1.6%
Totals	**1,520**	**100%**	**1,150**	**100%**	**1,200**	**100%**	**1,320**	**100%**	**1,920**	**100%**

5.3.3 Production and trade of mercury and products containing mercury in Asia and the Pacific

The data contained in this section is derived from the United Nations COMTRADE database. It analyses the trade flows of mercury containing products in the Asia and the Pacific region. These products, which are listed in Table 5-26, were identified as products that contain, or may contain mercury. During the course of this study, there has been no attempt to quantify the amounts of mercury contained within these products, which in some cases may be the majority of the weight present in the identified item, but in other items, may be fractions of a percent of the total weight. This should be taken into consideration when using this data for decision making, or further information should be sought on particular commodity code to determine the actual mercury contents of particular items.

There were also a number of instances where the data extracted from the COMTRADE database did not contain net weight data or was recorded as zero. Therefore, the net weight data tabulated in this section will be limited by the availability of the data in the database. Where an item was recorded as a weight, the data was generally more complete. In the instances where the quantity code was unknown or as the number of item, it was much more likely for the net weight to be blank or recorded as zero.

Re-imports and Re-exports are included in the import and export data that is extracted from the COMTRADE Database. Re-exports and re-imports are recorded separately for analytical purposes, but have not been analysed separately in this section. Re-exports are the export of a foreign good in the same state as it was imported, and similarly, re-imports are a good that is imported in the same state as it was previously exported. Normally the volumes of re-imports are a relatively small part of the overall imports, in the order of 0.5 – 1.2% for some of the higher re-importing countries. China, for all trade, has a relatively high re-import proportion of its trade in the range of 8% of its total imports. COMTRADE attributed this to the trade between China and Hong Kong, SAR of China. This can be observed in some of the trading partner data where China is listed as one of its own major trading partners.

The period of data extracted from the COMTRADE database spanned the period of 2000 to 2009. The countries that data was extracted for are listed in Table 5-26

[124] USGS (2010b) *U.S. Geological Survey 2009 Minerals Yearbook Mercury [Advance Release]* Dec 2010

Table: 5-26 Mercury and mercury containing products by commodity code

CODE	DESCRIPTION OF THE PRODUCT
HS-92-853931	Fluorescent lamps, hot cathode
HS-92-9025	Hydrometers, thermometers, barometers, etc
HS-02-853932	Electric discharge lamps (excl. Ultra-violet lamps), mercury/sodium vapour lamps; metal halides
HS-02-850630	Primary cells & batteries, mercuric oxide
SITC-3-772	Elec.Switch.Relay.Circuit
HS-02-847160	Input/output units (of auto. Data processing machines), whether or not containing storage units in the same housing
HS-92-8525	Radio and TV transmitters, television cameras
HS-02-854012	Cathode-ray television picture tubes, incl. Video monitor cathode-ray tubes, black and white / other, monochrome
HS-96-8540	Thermionic and cold cathode valves and tubes
SITC-2-51551	Organo-mercury compounds
SITC-1-51283	Organo-mercury compounds
SITC-4-776	Thermionic, cold cathode or photo-cathode valves and tubes (e.g., vacuum or vapour or gas-filled valves and tubes, mercury arc rectifying valves and tubes, cathode-ray tubes, television camera tubes); diodes, transistors and similar semiconductor devices
HS-02-262060	Ash & residues (excl. from the mfr. of iron/steel) cont. mainly arsenic/mercury/thallium/ their mixtures
HS-96-280540	Mercury
HS-07-2852	Compounds, inorganic or organic, of mercury, excluding amalgams.

Table: 5-27 Import and export of products containing mercury in Asia and the Pacific, in MT and in thousands of $US, (2000 – 2009) period.

Code	Description	Import (MT)	Value of Import (thousands $US)	Export (MT)	Value of Export (thousands $US)
HS-92-853931	Fluorescent lamps, hot cathode	611,672.1	4,653,908.8	1,267,765.7	15,571,030.4
HS-92-9025	Hydrometers, thermometers, barometers, etc	83,001.8	5,470,922.5	63,498.8	6,348,604.7
HS-02-853932	Electric discharge lamps (excl. Ultra-violet lamps), mercury/sodium vapour	43,441.8	3,360,143.7	39,874.7	3,935,380.2
HS-02-850630	Primary cells & batteries, mercuric oxide	1,698.0	28,273.9	1,109.2	30,755.2
SITC-3-772	Elec.Switch.Relay.Circuit	10,620,262.2	497,345,408.5	11,798,373.2	508,680,957.5
HS-02-847160	Input/output units (of auto. Data processing machines)	1,997,902.0	89,088,780.4	5,298,291.9	288,768,517.5
HS-92-8525	Radio and TV transmitters, television cameras	752,768.9	289,832,429.8	1,699,028.1	592,505,025.0
HS-02-854012	Cathode-ray television picture tubes, incl. Video monitor cathode-ray tubes	14,774.1	369,426.2	10,107.1	410,763.8
HS-96-8540	Thermionic and cold cathode valves and tubes	1,700,936.1	51,580,531.2	8,346,381.5	67,059,083.0
SITC-4-776	Thermionic, cold cathode or photo-cathode valves and tubes	423,607.4	969,645,440.0	1,399,779.1	736,447,699.2
HS-02-262060	Ash & residues cont. mainly arsenic/mercury/thallium/ their mixtures	1,070.1	543.6	64,941.5	348.3
HS-96-280540	Mercury	10,269.0	104,444.1	4,987.9	47,711.7
HS-07-2852	Compounds, inorganic or organic, of mercury, excluding amalgams.	33,849.1	37,999.7	5,898.2	44,945.6
Totals		**16,295,252.6**	**1,911,518,252.4**	**30,000,036.7**	**2,219,850,822.1**

Table: 5-28 Annual import and export of all products containing mercury in Asia and the Pacific, in MT and thousands of $US (2000 – 2009) period

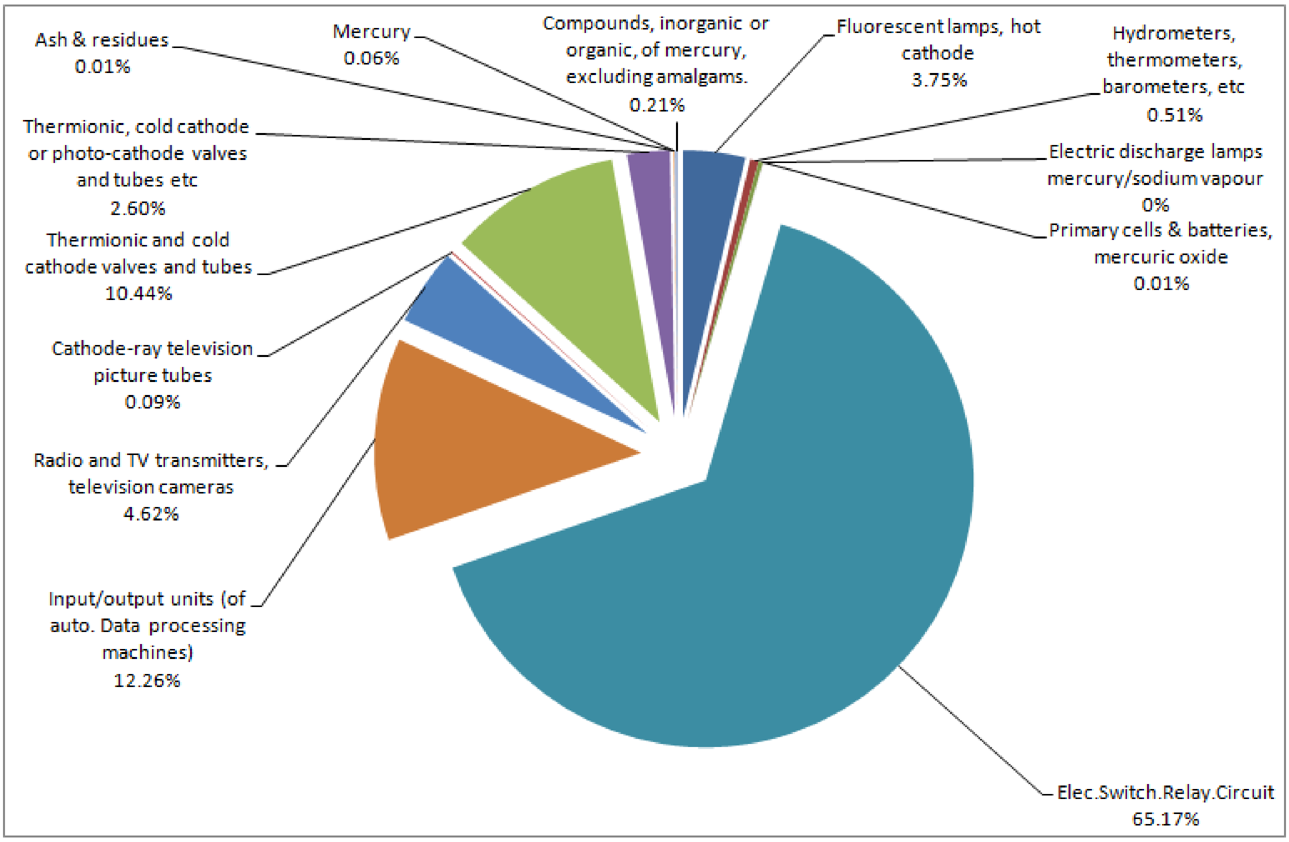
Year	Import (MT)	Value of Imports (Thousands US$)	Export (MT)	Value of exports (Thousands of US$)
2000	690,356.5	49,974,549.6	1,519,519.9	63,706,867.8
2001	554,131.4	46,972,689.8	1,444,110.1	58,804,486.1
2002	1,109,240.1	63,116,053.7	2,373,983.4	92,956,606.1
2003	1,240,760.8	75,029,254.6	2,654,425.7	115,082,888.0
2004	1,499,828.4	91,842,525.6	3,387,776.7	153,299,053.1
2005	2,534,648.1	103,492,056.6	4,350,860.2	170,806,090.2
2006	2,707,748.7	122,110,547.5	4,638,921.3	192,026,945.5
2007	1,855,901.0	455,375,030.0	2,634,391.7	460,224,601.6
2008	1,917,145.7	465,283,174.1	3,602,693.9	471,156,358.9
2009	2,185,491.9	438,322,370.8	3,393,353.9	441,786,924.6
Totals	**16,295,252.6**	**1,911,518,252.4**	**30,000,036.7**	**2,219,850,822.1**

Table: 5-29 Import of products containing mercury by commodity code in Asia and the Pacific, in MT, (2000 – 2009) period

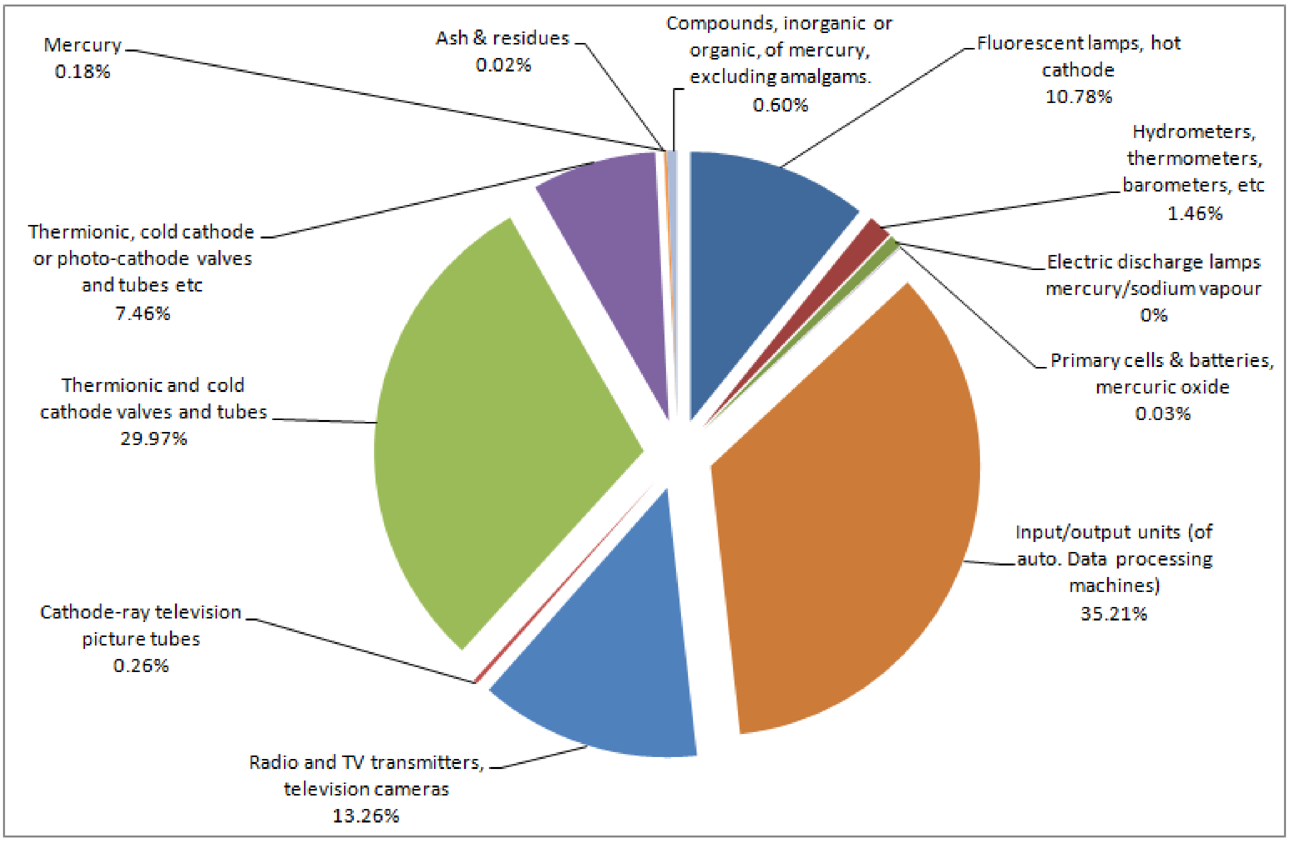
Year	HS-92-853931	HS-92-9025	HS-02-853932	HS-02-850630	SITC-3-772	HS-02-847160	HS-92-8525	HS-02-854012	HS-96-8540	SITC-4-776	HS-02-262060	HS-96-280540	HS-07-2852	Totals
2000	27,047.4	4,313.8	-	-	412,543.5	-	42,215.7	-	202,675.5	-	-	1,560.7	-	690,356.5
2001	26,626.0	4,620.7	-	-	304,402.8	-	29,690.3	-	187,601.1	-	-	1,190.6	-	554,131.4
2002	33,409.3	5,099.4	2,156.4	343.4	632,053.0	194,309.3	31,424.7	1,394.9	207,801.5	-	-	1,248.2	-	1,109,240.1
2003	40,390.7	7,689.6	3,253.9	257.6	696,986.2	222,413.6	72,587.8	4,156.5	191,906.5	-	21.1	1,097.2	-	1,240,760.8
2004	50,551.5	9,017.1	6,991.9	191.7	881,483.2	255,998.0	91,735.4	4,676.4	198,103.5	-	191.4	888.1	-	1,499,828.4
2005	74,707.8	13,547.7	14,003.4	295.7	1,422,436.6	522,517.1	147,700.9	2,557.8	335,659.6	-	87.6	1,133.9	-	2,534,648.1
2006	88,276.0	12,132.0	13,469.5	389.2	1,843,050.8	435,225.5	178,122.2	1,091.8	135,294.7	-	0.1	696.9	-	2,707,748.7
2007	110,234.1	12,014.5	1,185.1	90.6	1,360,007.9	85,302.7	74,083.3	702.7	86,131.8	93,723.7	270.1	782.7	31,371.8	1,855,901.0
2008	92,277.2	7,985.2	1,341.7	107.5	1,211,881.4	171,207.5	50,238.0	72.1	101,444.5	277,824.0	499.8	804.3	1,462.5	1,917,145.7
2009	68,152.0	6,581.7	1,040.0	22.4	1,855,416.8	110,928.1	34,970.7	122.0	54,317.4	52,059.8	0.0	866.3	1,014.8	2,185,491.9
Total	**611,672.1**	**83,001.8**	**43,441.8**	**1,698.0**	**10,620,262.2**	**1,997,902.0**	**752,768.9**	**14,774.1**	**1,700,936.1**	**423,607.4**	**1,070.1**	**10,269.0**	**33,849.1**	**16,295,252.6**

Table: 5-30 Import of products containing mercury by commodity code in Asia and the Pacific, in thousands $US, (2000 – 2009) period

Year	HS-92-853931	HS-92-9025	HS-02-853932	HS-02-850630	SITC-3-772	HS-02-847160	HS-92-8525	HS-02-854012	HS-96-8540	SITC-4-776	HS-02-262060	HS-96-280540	HS-07-2852	Totals
2000	211,207.1	338,457.1	-	-	26,643,401.4	-	12,577,254.1	-	10,196,903.3	-	-	7,326.6	-	49,974,549
2001	208,278.0	335,817.6	-	-	25,331,802.0	-	14,096,049.3	-	6,994,502.5	-	-	6,240.3	-	46,972,689
2002	239,676.8	351,207.2	150,075.1	3,023.0	28,149,141.7	10,085,224.3	17,385,913.3	132,163.0	6,613,855.6	-	-	5,773.6	-	63,116,053
2003	284,785.0	462,758.4	222,309.1	2,039.7	34,693,742.4	11,835,440.8	20,633,637.4	104,518.6	6,782,661.1	-	4.6	7,357.5	-	75,029,254
2004	364,651.7	525,055.8	422,264.6	2,337.0	45,223,609.5	13,376,455.5	25,032,784.2	69,351.7	6,813,998.6	-	10.0	12,006.8	-	91,842,525
2005	502,958.9	565,142.4	474,390.4	1,958.3	53,572,950.0	13,886,743.4	29,669,978.2	31,761.4	4,772,730.2	-	10.2	13,433.2	-	103,492,056
2006	673,477.6	610,687.0	562,228.5	5,196.9	64,295,604.6	13,923,988.6	38,311,258.7	15,269.0	3,700,732.0	-	54.1	12,050.5	-	122,110,547
2007	773,474.4	671,652.5	544,945.3	5,703.6	73,019,326.6	9,185,995.8	46,697,696.1	10,679.9	2,362,967.4	322,061,687.7	34.3	14,089.4	26,776.9	455,375,030
2008	750,302.9	812,755.3	544,365.8	4,824.5	79,326,038.8	9,642,128.9	44,531,162.8	3,291.2	2,049,802.4	327,598,048.0	424.4	13,864.8	6,164.4	465,283,174
2009	645,096.3	797,389.3	439,564.9	3,190.9	67,089,791.4	7,152,803.1	40,896,695.6	2,391.2	1,292,378.0	319,985,704.3	6.0	12,301.4	5,058.5	438,322,370
Total	**4,653,908**	**5,470,922**	**3,360,143**	**28,273**	**497,345,408**	**89,088,780**	**289,832,429**	**369,426**	**51,580,531**	**969,645,440**	**543**	**104,444**	**37,999**	**1,911,518,252**



Graph: 5-65 Import of products containing mercury into Asia and the Pacific, in MT, (2000 – 2009) Period



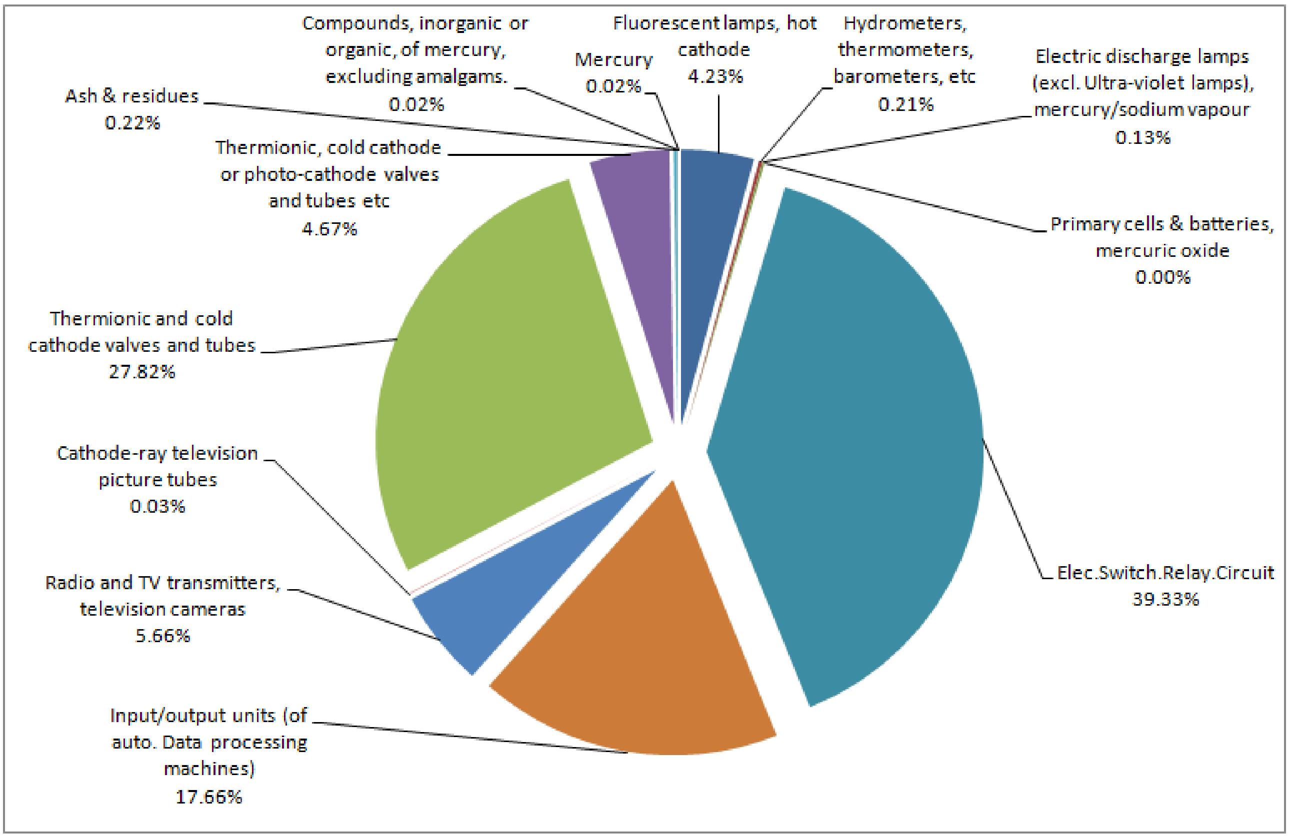
Graph: 5-66 Import of products containing mercury into Asia and the Pacific, excluding elec.switch.relay.circuits, in MT, (2000 – 2009) period

Table: 5-31 Export of products containing mercury by commodity code from Asia and the Pacific, in MT, (2000 – 2009) Period

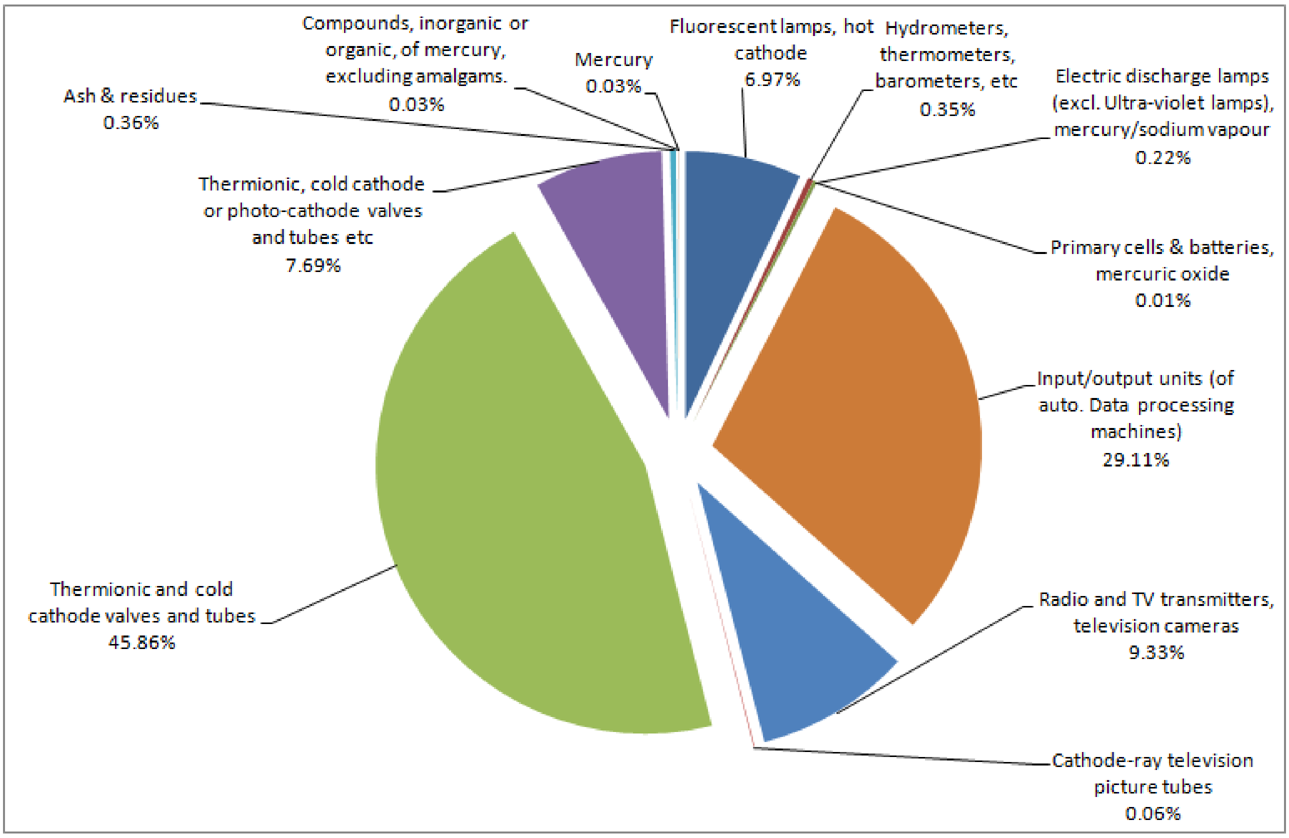
Year	HS-92-853931	HS-92-9025	HS-02-853932	HS-02-850630	SITC-3-772	HS-02-847160	HS-92-8525	HS-02-854012	HS-96-8540	SITC-4-776	HS-02-262060	HS-96-280540	HS-07-2852	Totals
2000	70,040.6	1,785.7	-	-	472,018.5	-	57,001.6	-	917,536.6	-	-	1,137.0	-	1,519,520
2001	111,551.0	1,458.2	-	-	423,090.7	-	70,463.6	-	837,109.9	-	-	436.7	-	1,444,110
2002	81,496.2	1,668.9	1,445.6	15.4	595,046.4	597,607.5	96,371.4	3,397.7	996,446.8	-	232.0	255.4	-	2,373,983
2003	82,987.6	5,093.5	1,609.2	42.3	761,638.7	653,636.5	87,816.1	4,030.7	1,048,225.7	-	9,000.0	345.4	-	2,654,426
2004	114,278.8	6,118.9	2,270.4	78.9	1,053,602.0	773,758.1	143,492.4	1,898.0	1,291,570.2	-	99.4	609.5	-	3,387,777
2005	142,452.0	10,039.9	11,832.7	970.3	1,577,274.7	1,013,925.7	266,551.4	575.4	1,290,834.3	-	36,112.9	290.8	-	4,350,860
2006	211,843.4	10,226.7	10,596.7	1.0	1,955,651.5	944,143.4	322,228.9	173.0	1,165,664.4	-	18,025.3	367.1	-	4,638,921
2007	17,037.6	9,201.4	368.8	0.4	1,175,548.6	233,767.0	110,669.9	19.7	372,335.8	709,569.2	490.4	447.8	4,935.1	2,634,392
2008	245,593.9	9,162.8	11,585.8	0.1	1,663,458.8	689,621.1	486,460.4	8.2	241,522.7	253,384.5	951.5	570.4	373.7	3,602,694
2009	190,484.4	8,742.9	165.5	0.8	2,121,043.1	391,832.8	57,972.4	4.4	185,135.0	436,825.3	30.0	527.9	589.5	3,393,354
Total	**1,267,766**	**63,499**	**39,875**	**1,109**	**11,798,373**	**5,298,292**	**1,699,028**	**10,107**	**8,346,381**	**1,399,779**	**64,941**	**4,988**	**5,898**	**30,000,037**

Table: 5-32 Export of products containing mercury by commodity code from Asia and the Pacific, in thousands $US, (2000 – 2009) period

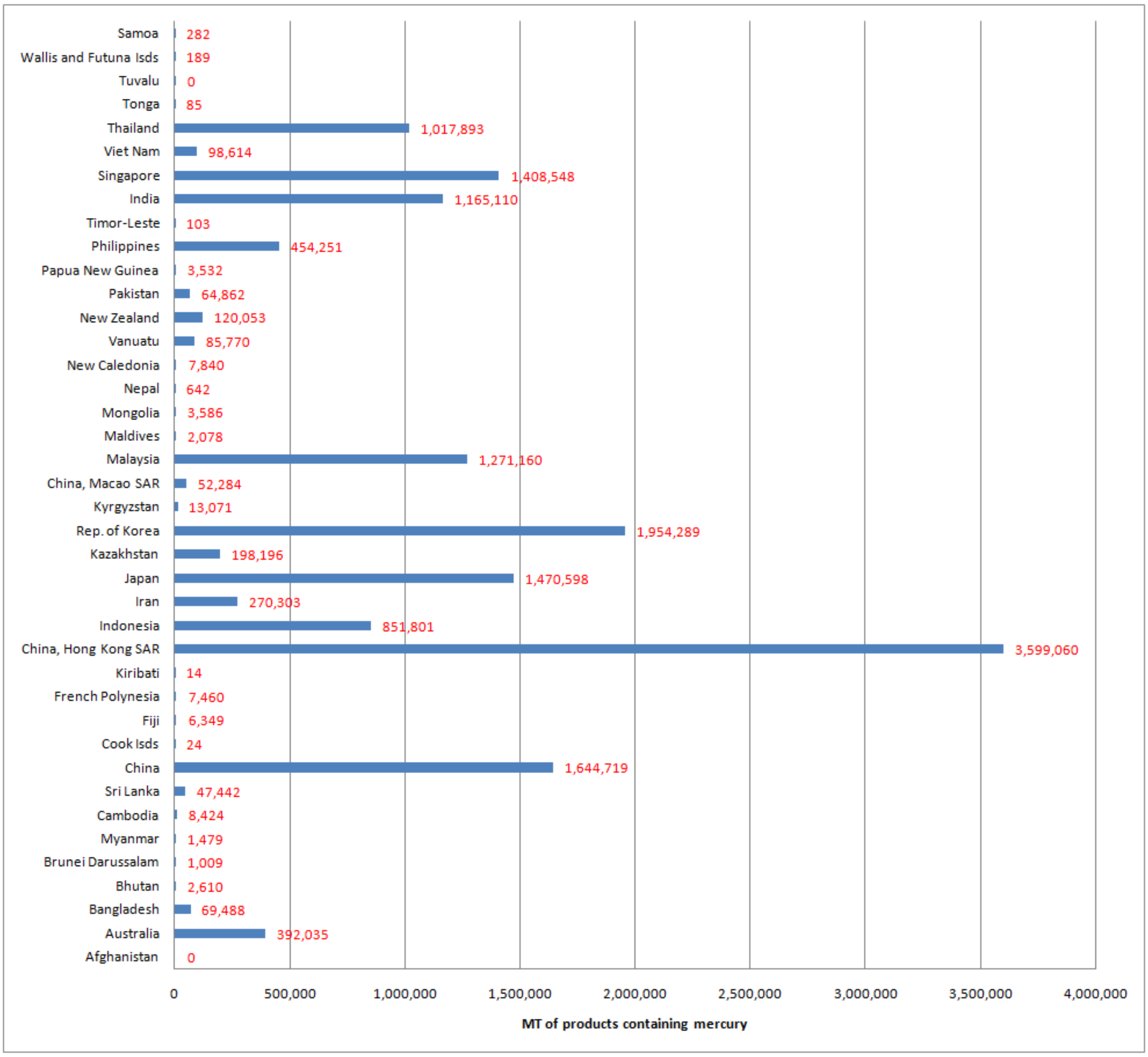
Year	HS-92-853931	HS-92-9025	HS-02-853932	HS-02-850630	SITC-3-772	HS-02-847160	HS-92-8525	HS-02-854012	HS-96-8540	SITC-4-776	HS-02-262060	HS-96-280540	HS-07-2852	Totals
2000	523,661.2	452,244.4	-	-	32,931,649.3	-	17,666,327.4	-	12,129,342.7	-	-	3,642.8	-	63,706,868
2001	768,293.9	438,256.7	-	-	27,725,692.8	-	21,321,226.9	-	8,549,227.1	-	-	1,788.8	-	58,804,486
2002	582,926.6	463,019.5	180,051.1	3,262.6	29,686,607.0	27,306,831.8	26,349,078.7	115,648.3	8,268,206.3	-	13.3	960.8	-	92,956,606
2003	749,391.3	541,255.6	237,917.0	2,795.7	35,767,524.5	34,213,330.1	35,360,229.2	135,847.2	8,072,161.3	-	12.7	2,423.4	-	115,082,888
2004	989,580.2	618,124.9	410,354.1	3,150.2	46,775,011.9	42,696,926.7	52,878,170.7	71,780.0	8,851,486.8	-	0.1	4,467.5	-	153,299,053
2005	1,219,339.3	643,548.1	533,479.2	5,382.4	55,962,951.7	43,540,797.9	61,906,170.9	45,258.2	6,943,990.1	-	73.7	5,098.7	-	170,806,090
2006	1,824,372.6	681,756.2	652,852.2	5,326.3	64,423,495.2	43,220,178.5	75,523,505.8	22,984.9	5,665,378.9	-	68.8	7,026.1	-	192,026,946
2007	2,612,396.2	774,951.2	622,540.5	4,225.1	72,685,649.0	41,318,496.3	99,873,969.4	12,565.7	3,701,765.5	238,589,024.4	103.6	7,086.0	21,828.7	460,224,602
2008	3,290,362.0	854,605.1	678,704.4	5,027.9	77,509,040.6	34,162,730.3	104,718,425.4	4,480.7	2,967,701.3	246,938,037.8	66.1	7,741.5	19,435.6	471,156,359
2009	3,010,707.0	880,842.9	619,481.7	1,585.1	65,213,335.3	22,309,225.8	96,907,920.6	2,198.7	1,909,823.0	250,920,637.0	10.0	7,476.2	3,681.3	441,786,925
Total	**15,571,030**	**6,348,605**	**3,935,380**	**30,755**	**508,680,957**	**288,768,517**	**592,505,025**	**410,764**	**67,059,083**	**736,447,699**	**348**	**47,712**	**44,946**	**2,219,850,822**



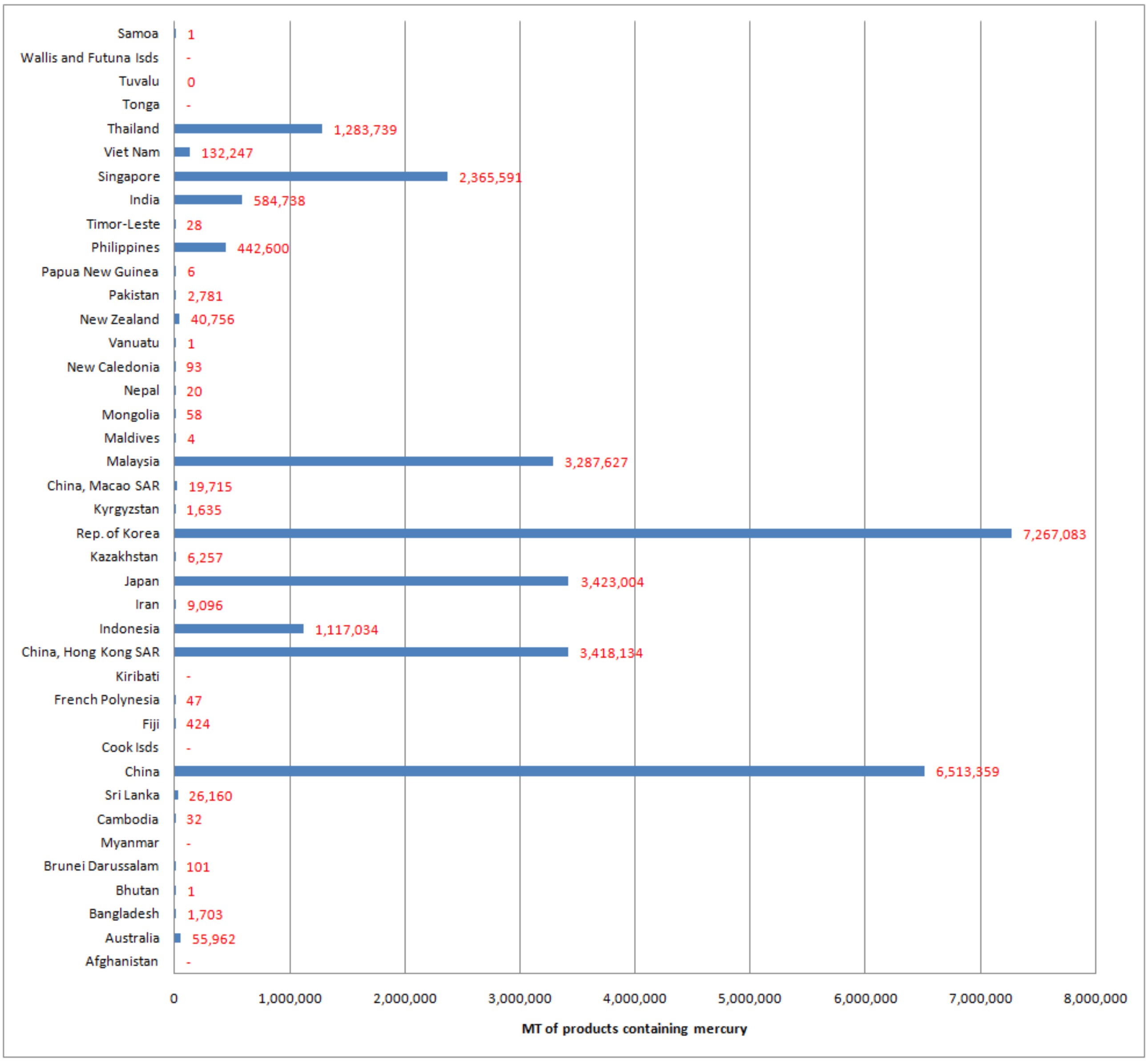
Graph: 5-67 Export of products containing mercury into Asia and the Pacific, in MT, (2000 – 2009) period



Graph: 5-68 Export of products containing mercury into Asia and the Pacific, excluding elec.switch.relay.circuits, in MT, (2000 – 2009) period



Graph: 5-69 Imports of products containing mercury into Asia and the Pacific, in MT, (2000 – 2009) Period



Graph: 5-70 Exports of products containing mercury into Asia and the Pacific, in MT, (2000 – 2009) Period

Table: 5-33 Principal importing countries of Asia and the Pacific of products containing mercury and their principal trading partners, 2000 – 2009 period

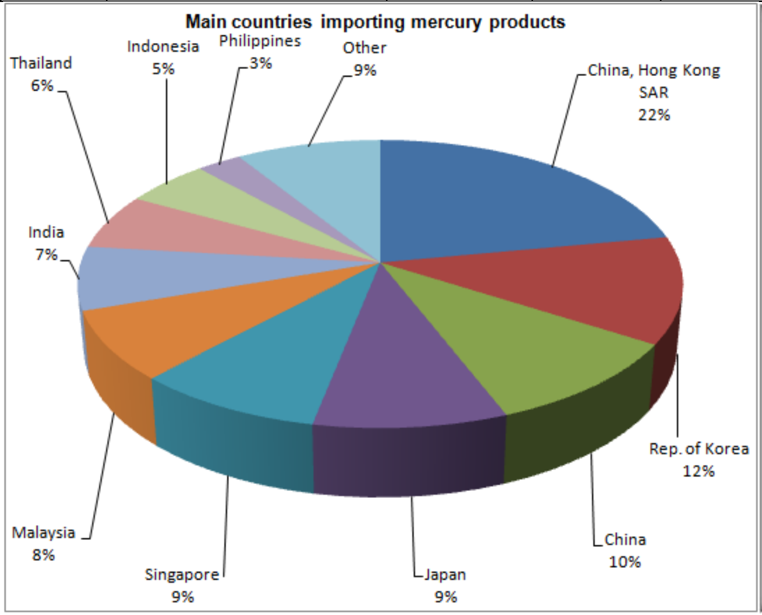
No	Code	Name of Product	Amount (Tonnes)	%	Main Importer Code	Main Importer Country	Main Importer %	Main Supplier Code	Main Supplier Country	Main Supplier %
1	SITC-3-772	Elec.Switch.Relay.Circuit	10,620,262.2	65.2%	344	China, Hong Kong SAR	30.3%	156	China	77.17
								392	Japan	6.63
								490	Other Asia, nes	4.45
								842	USA	1.97
					458	Malaysia	10.7%	392	Japan	38.32
								156	China	14.75
								490	Other Asia, nes	12.20
								360	Indonesia	8.43
					699	India	9.0%	490	Other Asia, nes	17.42
								156	China	16.47
								702	Singapore	13.61
								276	Germany	12.13
					156	China	8.8%	156	China	27.50
								392	Japan	18.60
								490	Other Asia, nes	13.95
								410	Rep. of Korea	9.46
					392	Japan	8.5%	156	China	52.33
								764	Thailand	7.74
								490	Other Asia, nes	0.88
								410	Rep. of Korea	5.61
						Rest	32.8%			
2	HS-02-847160	Input/output units (of auto. Data processing machines), whether or not cont . . .	1,997,902.0	12.3%	156	China	18.2%	156	China	50.53
								392	Japan	9.03
								490	Other Asia, nes	7.81
								410	Rep. of Korea	7.81
					410	Rep. of Korea	17.6%	156	China	72.75
								458	Malaysia	7.20
								392	Japan	4.35
								490	Other Asia, nes	3.18
					392	Japan	16.5%	156	China	70.51
								764	Thailand	7.05
								410	Rep. of Korea	5.70
								490	Other Asia, nes	4.12
					702	Singapore	12.5%	156	China	42.78
								458	Malaysia	22.28
								392	Japan	7.49
								360	Indonesia	6.14
					36	Australia	9.6%	156	China	50.40
								490	Other Asia, nes	7.32
								458	Malaysia	6.91
								392	Japan	6.28
						Rest	25.6%			
3	HS-96-8540	Thermionic and cold cathode valves and tubes	1,700,936.1	10.4%	410	Rep. of Korea	40.0%	156	China	34.42
								458	Malaysia	27.90
								392	Japan	10.78
								360	Indonesia	7.35
					360	Indonesia	16.1%	156	China	30.59
								458	Malaysia	25.91
								410	Rep. of Korea	18.44
								360	Indonesia	11.38
					764	Thailand	11.9%	458	Malaysia	32.14
								410	Rep. of Korea	22.49
								156	China	17.99
								392	Japan	14.16
					364	Iran	7.7%	410	Rep. of Korea	61.27
								784	United Arab Emirates	10.49
								458	Malaysia	7.77
								764	Thailand	7.72
					608	Philippines	4.5%	458	Malaysia	35.40
								360	Indonesia	20.85
								156	China	9.65
								410	Rep. of Korea	8.46
						Rest	19.8%			
4	HS-92-8525	Radio and TV transmitters, television cameras	752,768.9	4.6%	702	Singapore	17.1%	156	China	26.77
								410	Rep. of Korea	22.12
								458	Malaysia	20.16
								344	China, Hong Kong SAR	7.58
					699	India	11.1%	156	China	49.82
								410	Rep. of Korea	21.86
								752	Sweden	5.03
								784	United Arab Emirates	4.01
					156	China	10.6%	410	Rep. of Korea	29.11
								392	Japan	18.26
								156	China	13.54
								490	Other Asia, nes	11.56
					344	China, Hong Kong SAR	10.0%	156	China	50.37
								702	Singapore	9.28
								410	Rep. of Korea	8.14
								458	Malaysia	6.93
					360	Indonesia	9.3%	156	China	38.46
								752	Sweden	15.34
								276	Germany	8.23
								246	Finland	7.25
						Rest	42.0%			

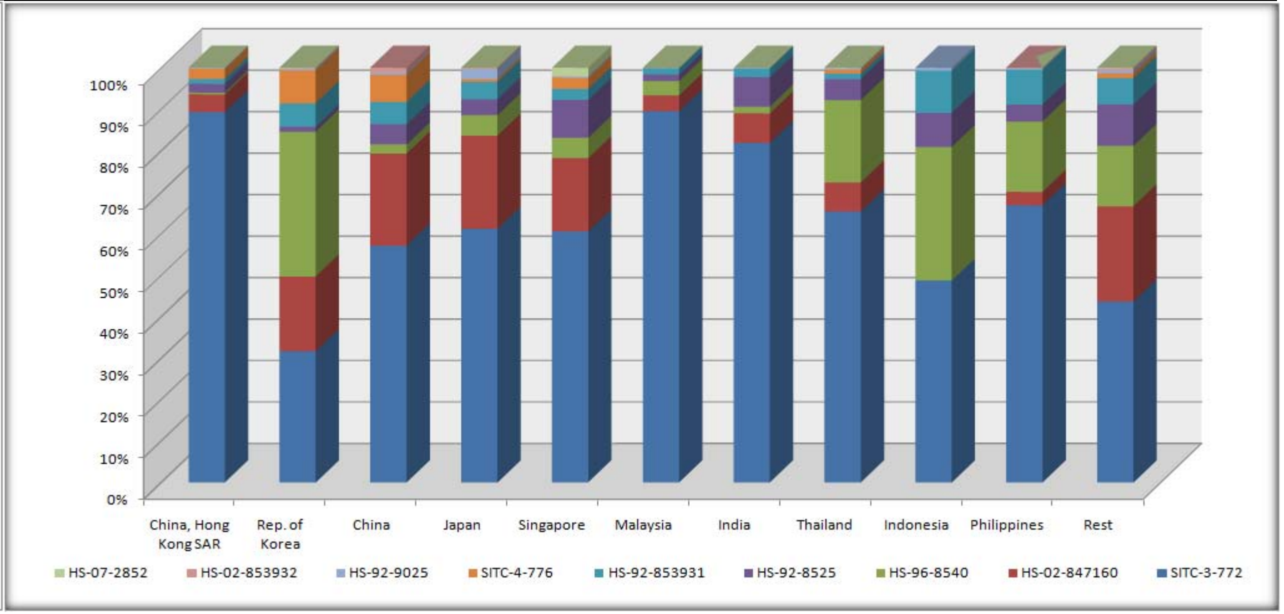
No	Code	Name of Product	Amount (Tonnes)	%	Main Importer			Main Supplier		
					Code	Country	%	Code	Country	%
5	HS-92-853931	Fluorescent lamps, hot cathode	611,672.1	3.75%	410	Rep. of Korea	17.8%	156	China	69.75
								764	Thailand	18.24
								276	Germany	2.73
								616	Poland	1.92
					156	China	14.3%	410	Rep. of Korea	38.13
								392	Japan	24.64
								764	Thailand	10.62
								156	China	7.60
					360	Indonesia	14.2%	156	China	90.02
								764	Thailand	3.42
								344	China, Hong Kong SAR	1.00
								702	Singapore	0.96
					392	Japan	10.0%	156	China	58.61
								360	Indonesia	34.50
								410	Rep. of Korea	2.21
								490	Other Asia, nes	0.99
					36	Australia	7.7%	156	China	51.75
								276	Germany	13.41
								764	Thailand	7.30
								392	Japan	6.27
						Rest	35.9%			
6	SITC-4-776	Thermionic, cold cathode or photo-cathode valves and tubes (e.g., vacuum or vapour or gas-filled valves and tubes, mercury arc rectifying valves and tubes, cathode-ray tubes, television camera tubes); diodes, transistors and similar semiconductor devices	423,607.4	2.60%	410	Rep. of Korea	36.8%	156	China	45.72
								458	Malaysia	13.90
								392	Japan	11.99
								490	Other Asia, nes	5.74
					156	China	25.4%	490	Other Asia, nes	20.64
								410	Rep. of Korea	19.11
								156	China	17.11
								392	Japan	13.32
					344	China, Hong Kong SAR	20.8%	156	China	32.69
								490	Other Asia, nes	28.96
								702	Singapore	15.10
								392	Japan	6.28
					702	Singapore	8.6%	458	Malaysia	34.58
								156	China	18.16
								842	USA	10.08
								392	Japan	7.86
					764	Thailand	2.3%	392	Japan	23.07
								702	Singapore	20.51
								156	China	17.01
								458	Malaysia	10.48
						Rest	6.1%			
7	HS-92-9025	Hydrometers, thermometers, barometers, etc	83,001.8	0.51%	392	Japan	43.7%	156	China	81.70
								56	Belgium	5.59
								490	Other Asia, nes	2.66
								842	USA	2.38
					156	China	9.1%	392	Japan	18.91
								842	USA	15.81
								276	Germany	12.08
								156	China	9.29
					344	China, Hong Kong SAR	7.3%	156	China	16.39
								842	USA	5.95
								490	Other Asia, nes	4.59
								392	Japan	2.99
					410	Rep. of Korea	7.0%	156	China	43.77
								276	Germany	13.31
								392	Japan	11.97
								842	USA	8.62
					360	Indonesia	6.8%	156	China	45.47
								702	Singapore	12.97
								392	Japan	12.40
								842	USA	6.04
						Rest	26.1%			
8	HS-02-853932	Electric discharge lamps (excl. Ultra-violet lamps), mercury/sodium vapour . . .	43,441.8	0.27%	156	China	46.0%	392	Japan	45.20
								56	Belgium	18.21
								156	China	14.45
								276	Germany	7.33
					392	Japan	11.2%	56	Belgium	69.12
								276	Germany	10.78
								156	China	6.46
								826	United Kingdom	4.27
					410	Rep. of Korea	9.4%	156	China	60.22
								842	USA	9.52
								392	Japan	9.13
								276	Germany	8.47
					36	Australia	8.7%	392	Japan	19.63
								276	Germany	19.54
								842	USA	17.93
								56	Belgium	17.80
					344	China, Hong Kong SAR	8.2%	156	China	36.01
								392	Japan	32.63
								56	Belgium	15.15
								276	Germany	7.91
						Rest	16.6%			

No	Code	Name of Product	Amount (Tonnes)	%	Main Importer			Main Supplier		
					Code	Country	%	Code	Country	%
9	HS-07-2852	Compounds, inorganic or organic, of mercury, excluding amalgams.	33,849.1	0.21%	702	Singapore	86.8%	458	Malaysia	52.81
								826	United Kingdom	35.63
								156	China	3.31
								392	Japan	3.10
					410	Rep. of Korea	6.0%	392	Japan	99.02
								842	USA	0.84
								276	Germany	0.09
								699	India	0.03
					554	New Zealand	3.6%	56	Belgium	48.98
								842	USA	21.90
								376	Israel	11.54
								608	Philippines	6.47
					764	Thailand	2.4%	458	Malaysia	79.42
								156	China	15.05
								724	Spain	2.51
								528	Netherlands	0.90
					36	Australia	1.1%	276	Germany	53.95
								842	USA	20.32
								348	Hungary	17.18
								156	China	5.55
						Rest	0.2%			
10	HS-02-854012	Cathode-ray television picture tubes, incl. Video monitor cathode-ray tubes . . .	14,774.1	0.09%						
11	HS-96-280540	Mercury	10,269.0	0.06%						
12	HS-02-850630	Primary cells & batteries, mercuric oxide	1,698.0	0.01%						
13	HS-02-262060	Ash & residues (excl. from the mfr. of iron/steel) cont. mainly arsenic/mercury/thallium/ their mixtures	1,070.1	0.01%						
	Total		**16,295,252.6**							

Table: 5-34 Main mercury and mercury containing products, by product code, and their principal importing countries, MT, 2000 – 2009 period

Code	Description	China, Hong Kong	Rep. of Korea	China	Japan	Singapore	Malaysia	India	Thailand	Indonesia	Philippines	Rest	Totals
SITC-3-772	Elec.Switch.Relay.Circuit	3,214,278	616,858	933,989	899,656	850,650	1,137,027	951,885	663,752	414,932	303,373	633,861	10,620,262
HS-02-847160	Input/output units (of auto. Data processing machines)	152,972	350,958	363,351	329,700	249,304	48,842	82,821	71,042	-	14,683	334,229	1,997,902
HS-96-8540	Thermionic and cold cathode valves and tubes	15,424	680,039	36,605	72,834	68,358	44,020	18,672	201,668	274,089	76,898	212,330	1,700,936
HS-92-8525	Radio and TV transmitters, television cameras	75,329	23,724	79,645	56,570	128,838	19,942	83,295	51,389	69,861	18,676	145,501	752,769
HS-92-853931	Fluorescent lamps, hot cathode	42,319	108,960	87,645	61,299	37,724	18,777	23,793	13,584	87,075	38,115	92,381	611,672
SITC-4-776	Thermionic, cold cathode or photo-cathode valves and tubes	87,978	155,800	107,554	9,042	36,586	3	4	9,810	-	-	16,830	423,607
HS-92-9025	Hydrometers, thermometers, barometers, etc	6,042	5,781	7,585	36,259	3,413	1,463	1,881	3,385	5,658	1,505	10,030	83,002
HS-02-853932	Electric discharge lamps (excl. Ultra-violet lamps), mercury/sodium vapour	3,554	4,097	19,966	4,866	1,721	301	327	407	-	746	7,457	43,442
HS-07-2852	Compounds, inorganic or organic, of mercury, excluding amalgams.	1	2,021	0	0	29,368	13	5	814	-	-	1,626	33,849
	Other Products	1,163	6,050	8,381	372	2,586	773	2,429	2,040	186	256	3,576	27,811
Totals		**3,599,060**	**1,954,289**	**1,644,719**	**1,470,598**	**1,408,548**	**1,271,160**	**1,165,110**	**1,017,893**	**851,801**	**454,251**	**1,457,823**	**16,295,253**





Graph: 5-71 Main mercury importing countries by total imports, in MT, and the percentage of imports by product code for the principal importers, 2000 – 2009 period

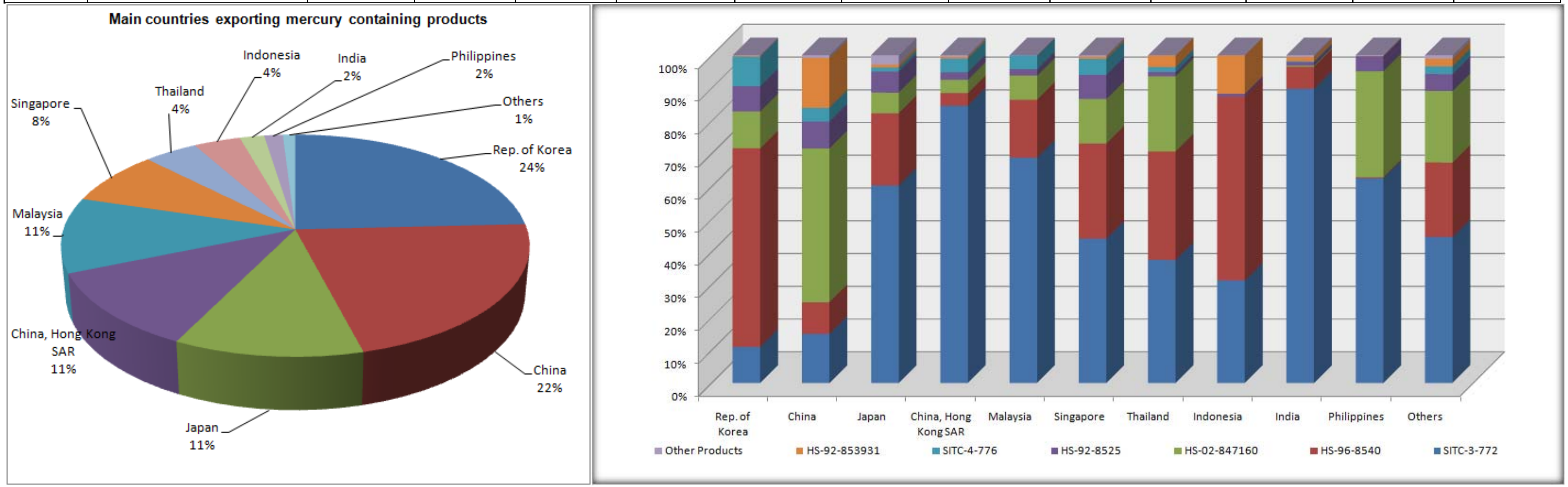
Table: 5-35 Principal exporting countries of Asia and the Pacific of products containing mercury and their principal trading partners, 2000 – 2009 period

No	Code	Name of Product	Amount Tonnes	%	Main Exporter Code	Main Exporter Country	Main Exporter %	Main Buyer Code	Main Buyer Country	Main Buyer %
1	SITC-3-772	Elec.Switch.Relay.Circuit	11,798,373.2	39.3%	344	China, Hong Kong SAR	24.5%	156	China	50.21
								842	USA	10.21
								392	Japan	5.47
								826	United Kingdom	3.57
					458	Malaysia	19.2%	392	Japan	28.72
								764	Thailand	14.06
								344	China, Hong Kong SAR	10.02
								842	USA	9.63
					392	Japan	17.5%	156	China	21.63
								842	USA	14.03
								344	China, Hong Kong SAR	9.03
								764	Thailand	6.00
					702	Singapore	8.8%	458	Malaysia	30.06
								360	Indonesia	10.87
								764	Thailand	9.53
								344	China, Hong Kong SAR	8.22
					156	China	8.3%	344	China, Hong Kong SAR	28.63
								842	USA	11.42
								392	Japan	8.20
								490	Other Asia, nes	6.52
						Rest	21.7%			
2	HS-96-8540	Thermionic and cold cathode valves and tubes	8,346,381.5	27.8%	410	Rep. of Korea	52.8%	156	China	30.03
								76	Brazil	10.53
								764	Thailand	9.80
								484	Mexico	9.58
					392	Japan	9.0%	156	China	34.63
								484	Mexico	15.30
								842	USA	10.13
								458	Malaysia	6.05
					702	Singapore	8.2%	458	Malaysia	38.21
								484	Mexico	20.71
								764	Thailand	13.60
								344	China, Hong Kong SAR	3.77
					156	China	7.5%	344	China, Hong Kong SAR	32.05
								458	Malaysia	7.72
								764	Thailand	7.62
								643	Russian Federation	6.65
					360	Indonesia	7.5%	458	Malaysia	30.31
								764	Thailand	11.77
								156	China	9.35
								410	Rep. of Korea	8.04
						Rest	14.9%			
3	HS-02-847160	Input/output units (of auto. Data processing machines), whether or not cont . . .	5,298,292.0	17.7%	156	China	57.7%	842	USA	32.54
								528	Netherlands	19.25
								344	China, Hong Kong SAR	10.57
								392	Japan	7.81
					410	Rep. of Korea	15.4%	156	China	23.01
								842	USA	14.23
								344	China, Hong Kong SAR	13.85
								704	Viet Nam	6.15
					702	Singapore	6.1%	842	USA	19.38
								699	India	7.74
								458	Malaysia	7.05
								276	Germany	6.91
					764	Thailand	5.6%	842	USA	29.28
								528	Netherlands	13.78
								392	Japan	13.06
								826	United Kingdom	6.19
					458	Malaysia	4.6%	842	USA	29.04
								528	Netherlands	20.38
								392	Japan	7.92
								826	United Kingdom	4.32
						Rest	10.7%			
4	HS-92-8525	Radio and TV transmitters, television cameras	1,699,028.1	5.7%	410	Rep. of Korea	32.9%	842	USA	33.26
								699	India	7.55
								826	United Kingdom	4.16
								344	China, Hong Kong SAR	3.61
					156	China	31.4%	842	USA	24.55
								344	China, Hong Kong SAR	20.84
								276	Germany	8.74
								702	Singapore	4.54
					392	Japan	12.9%	842	USA	29.79
								156	China	13.14
								528	Netherlands	6.53
								344	China, Hong Kong SAR	5.46
					702	Singapore	10.2%	360	Indonesia	17.72
								842	USA	15.03
								458	Malaysia	12.25
								276	Germany	11.94
					344	China, Hong Kong SAR	4.7%	842	USA	22.74
								276	Germany	7.51
								392	Japan	6.64
								702	Singapore	6.44
						Rest	7.8%			

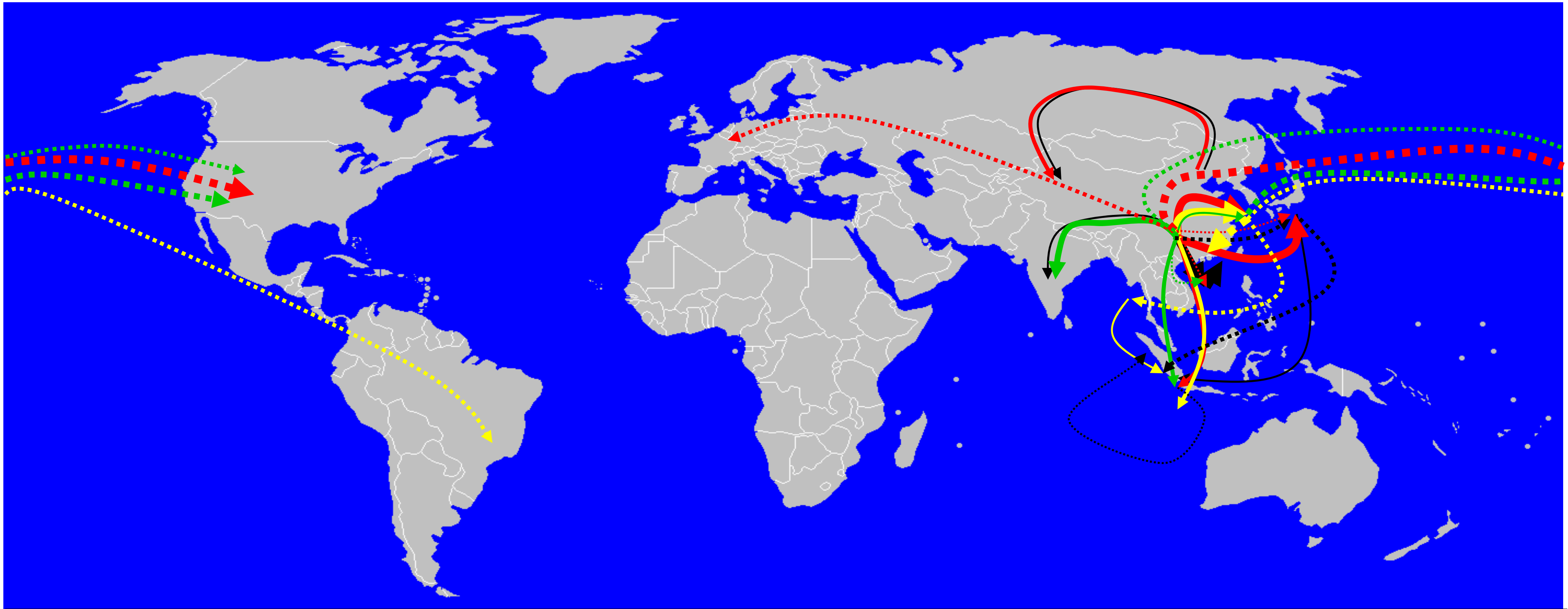
No	Code	Name of Product	Amount Tonnes	%	Main Exporter			Main Buyer		
					Code	Country	%	Code	Country	%
5	SITC-4-776	Thermionic, cold cathode or photo-cathode valves and tubes (e.g., vacuum or vapour or gas-filled valves and tubes, mercury arc rectifying valves and tubes, cathode-ray tubes, television camera tubes); diodes, transistors and similar semiconductor devices	1,399,779.0	4.7%	410	Rep. of Korea	47.1%	76	Brazil	22.04
								156	China	15.54
								764	Thailand	10.91
								360	Indonesia	7.44
					156	China	19.7%	344	China, Hong Kong SAR	42.77
								699	India	9.96
								76	Brazil	6.06
								410	Rep. of Korea	5.37
					344	China, Hong Kong SAR	10.2%	156	China	87.05
								490	Other Asia, nes	4.21
								458	Malaysia	1.34
								608	Philippines	1.04
					458	Malaysia	9.8%	156	China	26.98
								842	USA	14.97
								276	Germany	13.56
								490	Other Asia, nes	11.56
					702	Singapore	8.3%	764	Thailand	21.76
								458	Malaysia	19.88
								484	Mexico	15.39
								344	China, Hong Kong SAR	11.25
						Rest	5.1%			
6	HS-92-853931	Fluorescent lamps, hot cathode	1,267,765.7	4.2%	156	China	78.4%	842	USA	18.52
								76	Brazil	6.76
								360	Indonesia	5.18
								276	Germany	3.50
					360	Indonesia	10.3%	392	Japan	19.59
								458	Malaysia	11.33
								608	Philippines	10.41
								784	United Arab Emirates	8.44
					764	Thailand	3.6%	156	China	14.39
								344	China, Hong Kong SAR	10.93
								458	Malaysia	8.67
								410	Rep. of Korea	5.94
					392	Japan	2.3%	842	USA	21.43
								490	Other Asia, nes	11.49
								36	Australia	9.12
								276	Germany	8.99
					410	Rep. of Korea	1.6%	842	USA	27.27
								276	Germany	13.27
								76	Brazil	12.43
								392	Japan	10.28
						Rest	3.9%			
7	HS-02-262060	Ash & residues (excl. from the mfr. of iron/steel) cont. mainly arsenic/mercury/thallium/ their mixtures	64,941.5	0.22%						
8	HS-92-9025	Hydrometers, thermometers, barometers, etc	63,498.8	0.21%						
9	HS-02-853932	Electric discharge lamps (excl. Ultra-violet lamps), mercury/sodium vapour . . .	39,874.7	0.13%						
10	HS-02-854012	Cathode-ray television picture tubes, incl. Video monitor cathode-ray tubes . . .	10,107.1	0.034%						
11	HS-07-2852	Compounds, inorganic or organic, of mercury, excluding amalgams.	5,898.2	0.020%						
12	HS-96-280540	Mercury	4,987.9	0.017%						
13	HS-02-850630	Primary cells & batteries, mercuric oxide	1,109.2	0.004%						
	Total		**30,000,037**							

Table: 5-36 Main mercury and mercury containing products, by product code, and their principal exporting countries, MT, 2000 – 2009 period

Code	Description	Rep. of Korea	China	Japan	China, Hong Kong SAR	Malaysia	Singapore	Thailand	Indonesia	India	Philippines	Rest	Totals
SITC-3-772	Elec.Switch.Relay.Circuit	797,640	976,112	2,063,673	2,892,275	2,261,497	1,041,547	481,905	349,830	524,903	276,653	132,337	11,798,373
HS-96-8540	Thermionic and cold cathode valves and tubes	4,408,279	626,895	753,072	131,743	579,451	686,936	425,171	626,545	39,379	1,324	67,587	8,346,381
HS-02-847160	Input/output units (of auto. Data processing machines), whether or not cont . . .	815,378	3,058,595	216,146	138,266	243,412	322,239	294,321	-	2,029	143,041	64,866	5,298,292
HS-92-8525	Radio and TV transmitters, television cameras	559,581	533,691	219,837	79,879	64,000	173,439	16,589	9,715	6,459	20,463	15,377	1,699,028
SITC-4-776	Thermionic, cold cathode or photo-cathode valves and tubes	658,779	274,983	42,852	142,638	136,738	115,624	19,833	-	1,360	-	6,971	1,399,779
HS-92-853931	Fluorescent lamps, hot cathode	19,700	993,889	28,682	17,753	1,593	15,394	45,130	130,529	7,725	351	7,017	1,267,766
SITC-3-772	Elec.Switch.Relay.Circuit	797,640	976,112	2,063,673	2,892,275	2,261,497	1,041,547	481,905	349,830	524,903	276,653	132,337	11,798,373
	Other Products	7,726	49,193	98,741	15,581	936	10,411	790	414	2,883	769	2,973	190,417
Totals		**7,267,083**	**6,513,359**	**3,423,004**	**3,418,134**	**3,287,627**	**2,365,591**	**1,283,739**	**1,117,034**	**584,738**	**442,600**	**297,127**	**30,000,037**



Graph: 5-72 Main mercury exporting countries by total exports, in MT, and the percentage of exports by product code for the principal exporters, 2000 – 2009 period



CODE	DESCRIPTION	MT	IMPORTER	FLOW	MT	SUPPLIER		MT	EXPORTER	FLOW	MT	BUYER
SITC-3-772	Elec.Switch.Relay.Circuit	3,214,278	Hong Kong, China SAR		2,481,422	China		2,892,275	Hong Kong, China SAR		1,452,211	China
		1,137,027	Malaysia		435,709	Japan		2,261,497	Malaysia		649,502	Japan
		951,885	India		156,775	China		2,063,673	Japan		446,372	China
		933,989	China		256,847	China		1,041,547	Singapore		313,089	Malaysia
HS-02-847160	Input/output units (of auto. Data processing machines),	363,351	China		183,601	China		3,058,595	China		995,267	USA
		350,958	Republic of Korea		255,321	China					588,780	Netherlands
		329,700	Japan		232,471	China					323,293	Hong Kong
		249,304	Singapore		106,625	China					238,876	Japan
HS-96-8540	Thermionic and cold cathode valves and tubes	680,039	Republic of Korea		234,069	China		4,408,279	Republic of Korea		1,323,806	China
		274,089	Indonesia		83,843	China					464,192	Brazil
		201,668	Thailand		64,816	Malaysia					432,011	Thailand
HS-92-8525	Radio and TV transmitters, television cameras	128,838	Singapore		34,489	China		559,581	Republic of Korea		186,117	USA
		83,295			28,498	Republic of Korea		533,691	China		131,021	USA
		79,645	India		41,497	China		219,837			111,221	Hong Kong

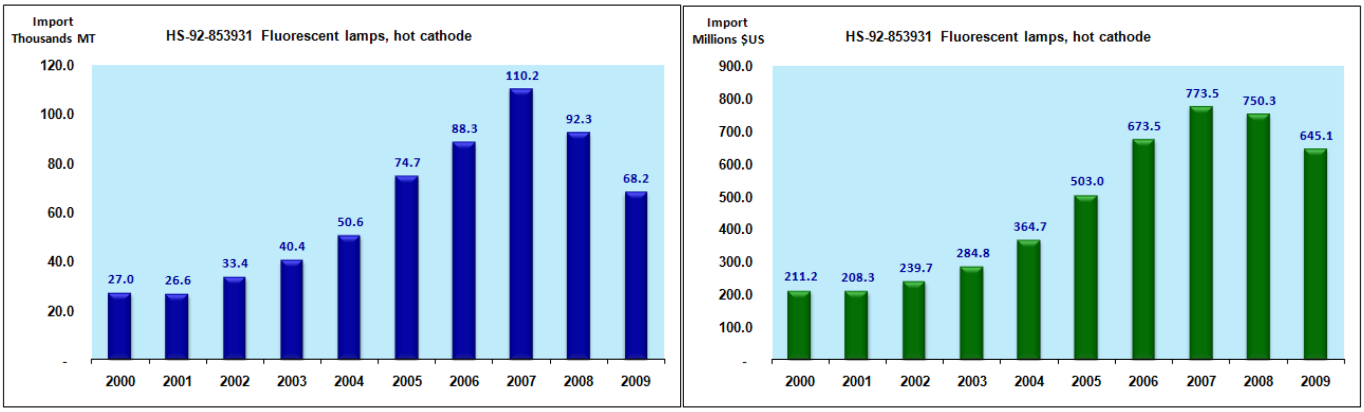
Figure 5-3 Trade flows of products containing mercury to and from the Asia and Pacific region, 2000 - 2009 period

5.3.4 Analysis of trade in Asia and the Pacific of products containing mercury, 2000 – 2009 period

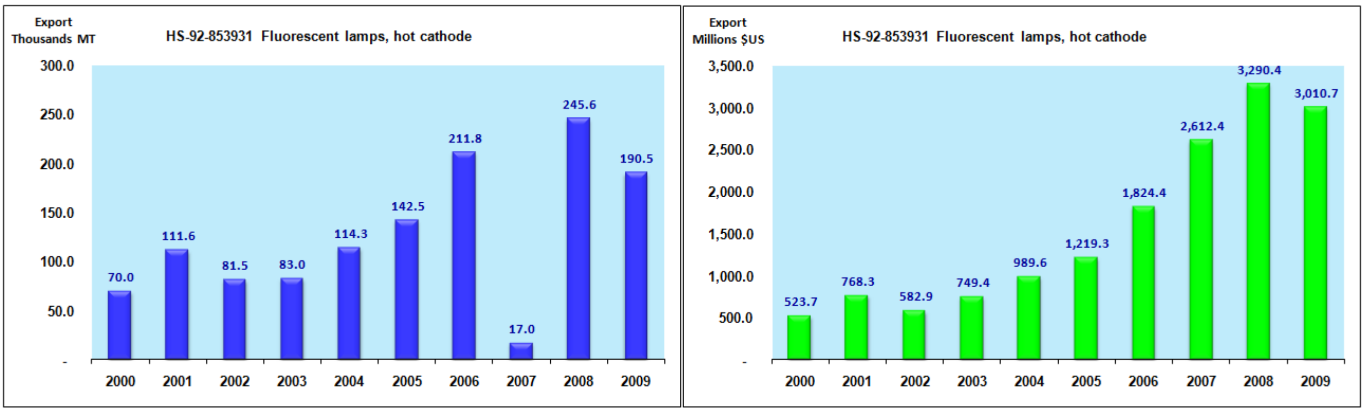
5.3.4.1 Fluorescent lamps, hot cathode (HS-92-853931)

The trade volumes of fluorescent lamps, hot cathode accounted for 3.76% of the imports and 4.23% of the exports over the study period. The import volumes increased by a factor of approximately 4 from 2000 to 2007 prior to decreasing by almost a third to 2009. The Import value over the same period followed a very similar trend although the decline from 2007 to 2009 was not as pronounced as for the import volumes. The export volumes showed a general increase in products exported. There is an apparent significant drop in export volumes in 2007 which, when the original data was inspected, showed much higher proportion of entries with a zero weight entry. All of the data was denoted as being "number of units", which was similar to other years for this data, and the "Supplementary Quantity" data for 2007 was in the same magnitude of 2006. This would indicate that the apparent decrease in exports over this period is likely to be related to a deficiency in the data rather than am actual drop in exports. The lack of a corresponding drop in the value of exports for the same year would support this hypothesis, as they indicate a relatively constant growth of export value over the study period to approximately 6 times the 2000 export value.

Major importers of fluorescent lamps, hot cathode were the Republic of Korea (17.8%), China (14.3%), and Indonesia (14.2%). These were mainly sourced from China, Thailand, and the Republic of Korea. The major exporters over the study period were China (78.4%) and Indonesia (10.3) and their main trading partners were the USA, Brazil and Japan.



Graph: 5-73 Import of fluorescent lamps, cold cathode in thousands of MT and millions of $US, 2000 – 2009

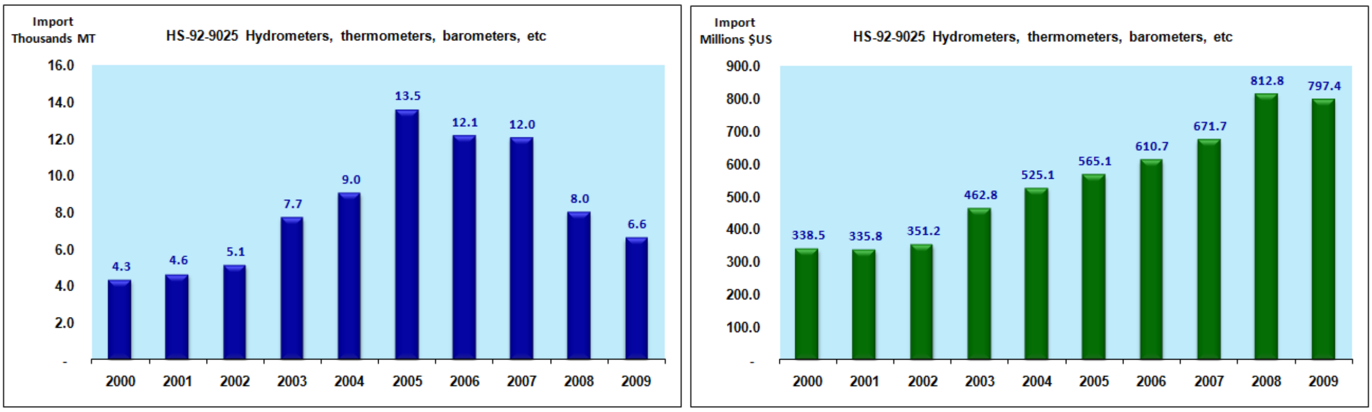


Graph: 5-74 Export of fluorescent lamps, cold cathode in thousands of MT and millions of $US, 2000 - 2009

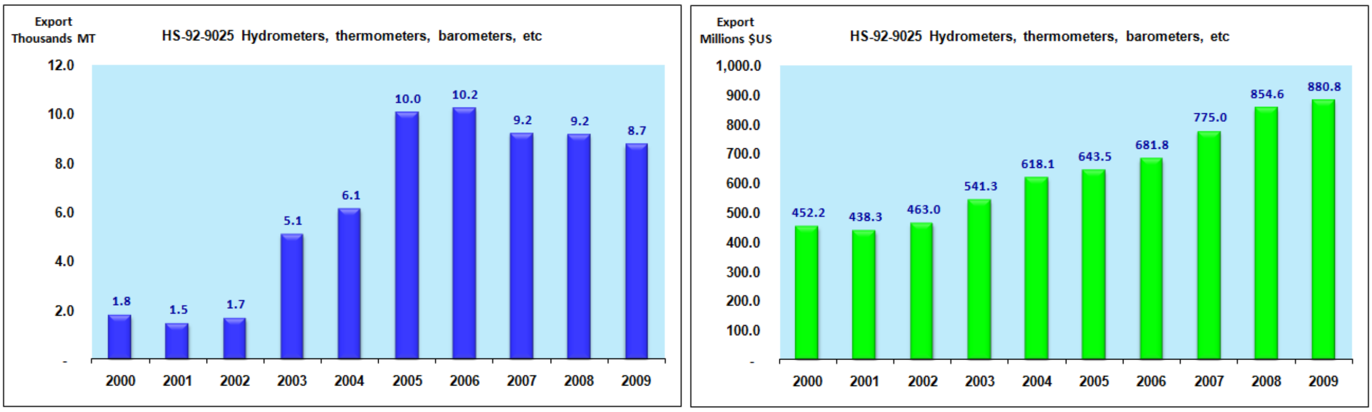
5.3.4.2 Hydrometers, thermometers, barometers, etc (HS-92-9025)

The import volumes of hydrometers, thermometers and barometers accounted for 0.51% of the imports and 0.21% of the exports of mercury containing products over the study period. The import volumes increased from 2000 to 2005 prior to declining in the latter years of the study with the result of a 50% increase on 2000 import volumes by 2009. The import value grew steadily over the study period to be slightly higher than double the 2000 value in 2009. Export volumes were stable for the first three years prior to increasing rapidly from 2002 to 2005 where it has slightly declined to the 2009 volume that is slightly more than four times the 2000 volumes. The export value has approximately doubled over the study period and has exhibited relatively constant growth over that period.

The main importing countries of hydrometers, thermometers and barometers were Japan (43.7%) and China (9.1%) and they predominantly sourced the products from China, and Japan. The exporting countries were not segregated for this product code.



Graph: 5-75 Import of Hydrometers, thermometers, barometers, etc in thousands of MT and millions of $US, 2000 - 2009

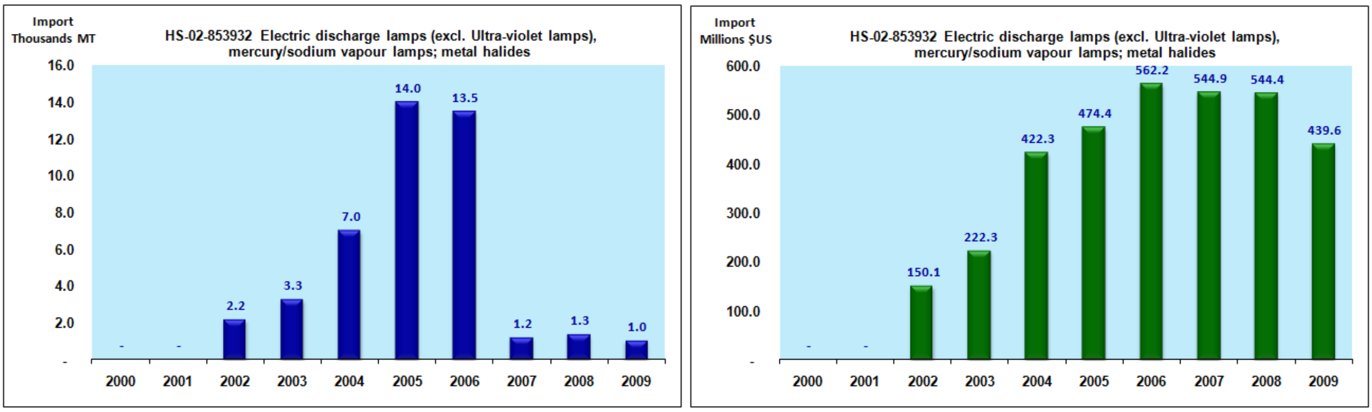


Graph: 5-76 Export of Hydrometers, thermometers, barometers, etc in thousands of MT and millions of $US, 2000 - 2009

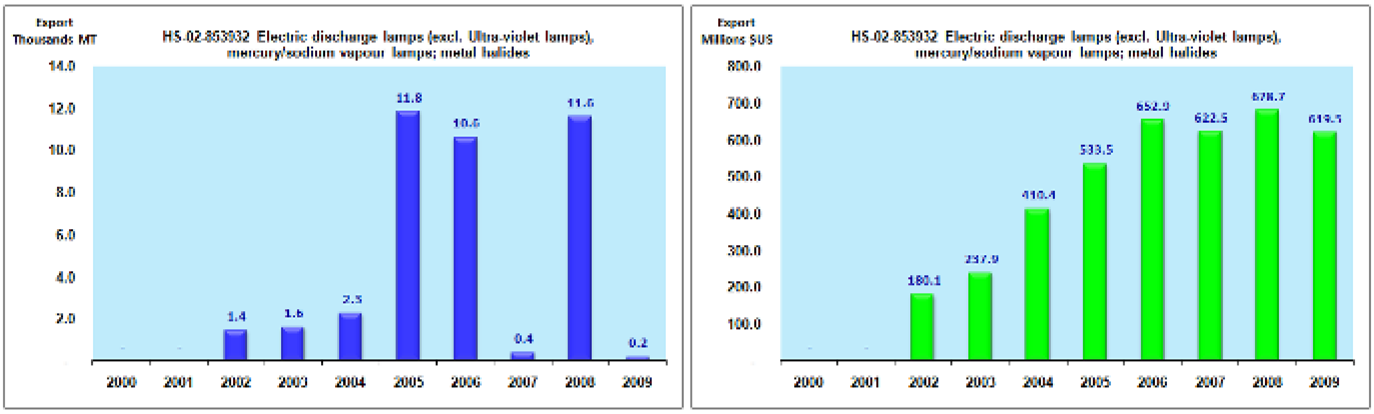
5.3.4.3 Electric discharge lamps (excl. Ultra-violet lamps), mercury/sodium vapour lamps; metal halides (HS-02-853932)

The import volume of electric discharge lamps over the study period accounted for 0.27% of the total import volume of mercury containing products, while the export volume accounted for 0.13% of the export volume. The import volumes increased initially from 2002 to 2006, where volumes increased by a factor of six, and then declined to approximately half of the 2002 values. The import values over this period exhibited a constant growth from 2000 to 2006 from where it declined approximately 30% to 2009. This absence of a corresponding drop in import volumes may indicate that the import volumes may be affected by the quality of the data. The export volumes also appear to be variable when compared with their export values which have demonstrated a stable increase from 2002 to 2006 and then being stable until 2009.

The main importing countries are China (46.0%), Japan (11.2), and the Republic of Korea (9.4%) who sourced their imports from Japan, Belgium, and China. Exports over the study period were not segregated.



Graph: 5-77 Import of Electric discharge lamps (excl. Ultra-violet lamps), mercury/sodium vapour lamps; metal halides in thousands of MT and millions of $US, 2000 – 2009

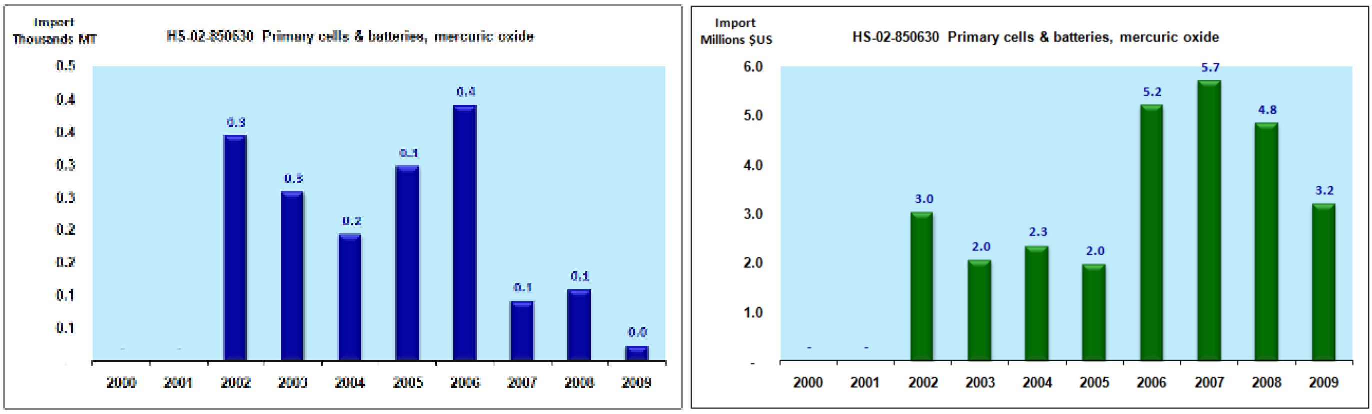


Graph: 5-78 Export of Electric discharge lamps (excl. Ultra-violet lamps), mercury/sodium vapour lamps; metal halides in thousands of MT and millions of $US, 2000 - 2009

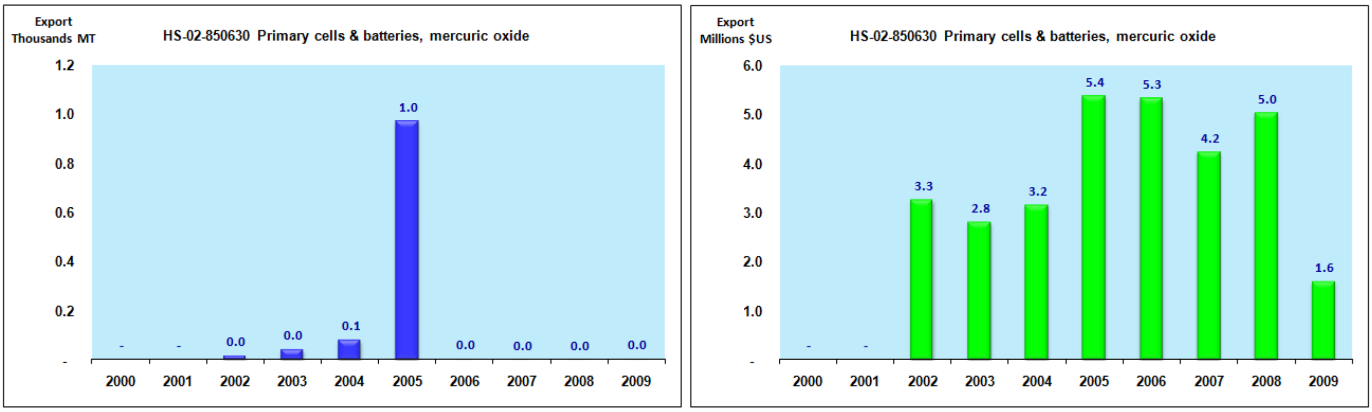
5.3.4.4 Primary cells & batteries, mercuric oxide (HS-02-850630)

The import and export volumes of primary cells & batteries made from mercuric oxide make up a very small proportion (0.01%) of the total trade volumes of mercury containing products. Their import and export volume data appears to be affected by the data quality issue that has been described earlier where trade volumes fluctuates and trade values do not follow the same trend.

No import or export partners were segregated in the data due to small product volumes.



Graph: 5-79 Import of Primary cells & batteries, mercuric oxide in thousands of MT and millions of $US, 2000 - 2009

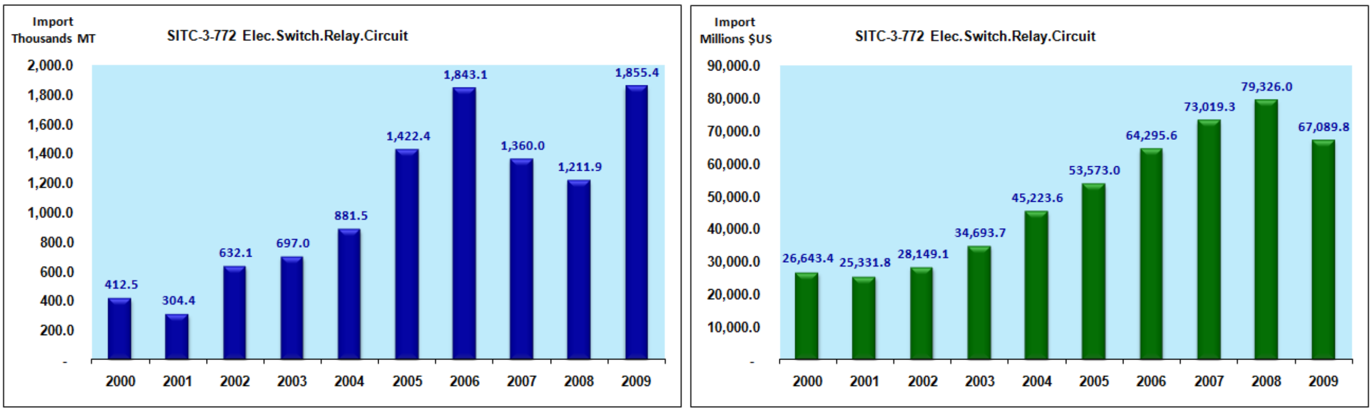


Graph: 5-80 Export of Primary cells & batteries, mercuric oxide in thousands of MT and millions of $US, 2000 - 2009

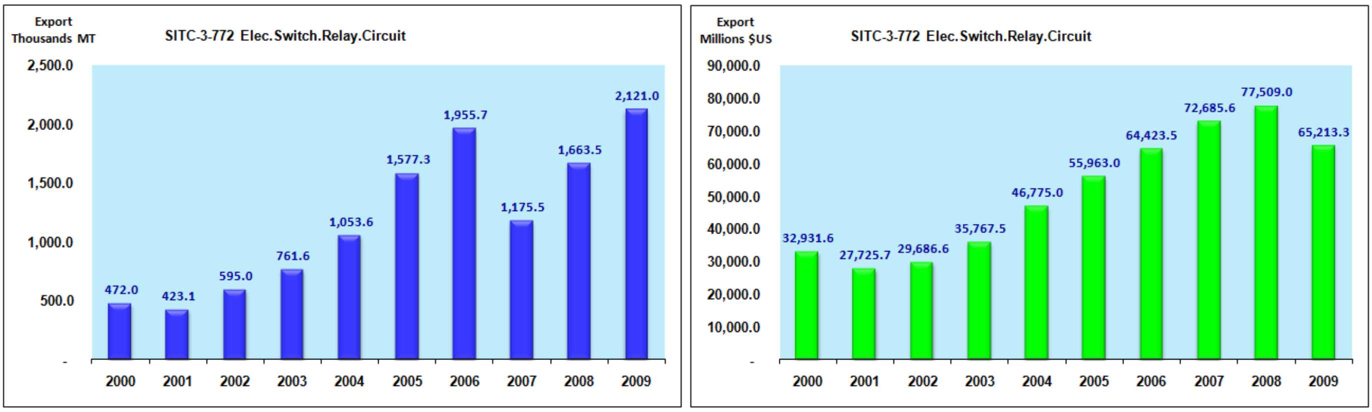
5.3.4.5 Elec.Switch.Relay.Circuit (SITC-3-772)

Elec.Switch.Relay.Circuit are the largest mercury containing product that is imported or exported. The import volumes account for 65.4% of the total imports and exports account for 39.3% of the total exports over the study period. Both the import and export volumes exhibited a steady increase from 2000 to 2006, followed by a decline and recovery to 2009 there is was approximately 4.5 times the 2000 trade volumes. Trade values for both imports and exports have also increased over the period 2000 – 2008 and a slight decline to 2009, with the value of imports and exports increasing by a factor of 2.5 and 2 times respectively.

The major importing countries are China – Hong Kong SAR (30.3%), Malaysia (10.7%), and India (9.0%). The major suppliers to these importers were China, Japan, and Other Asia nes. The major exporters of these products were China – Hong Kong SAR (24.5%), Malaysia (19.2%), and Japan (17.5%) who traded with the following main buyers of China, Japan, and USA.



Graph: 5-81 Import of Elec.Switch.Relay.Circuit in thousands of MT and millions of $US, 2000 – 2009

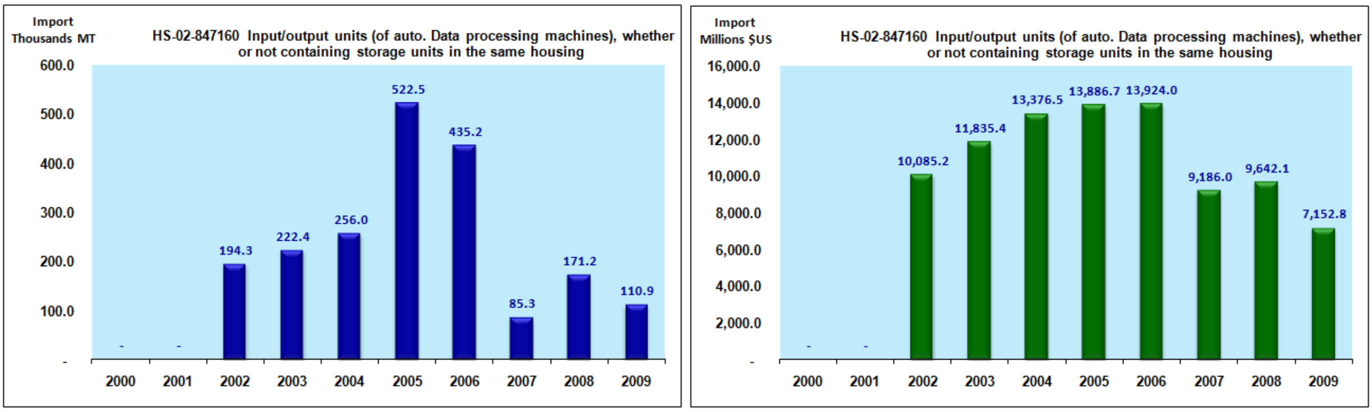


Graph: 5-82 Export of Elec.Switch.Relay.Circuit in thousands of MT and millions of $US, 2000 - 2009

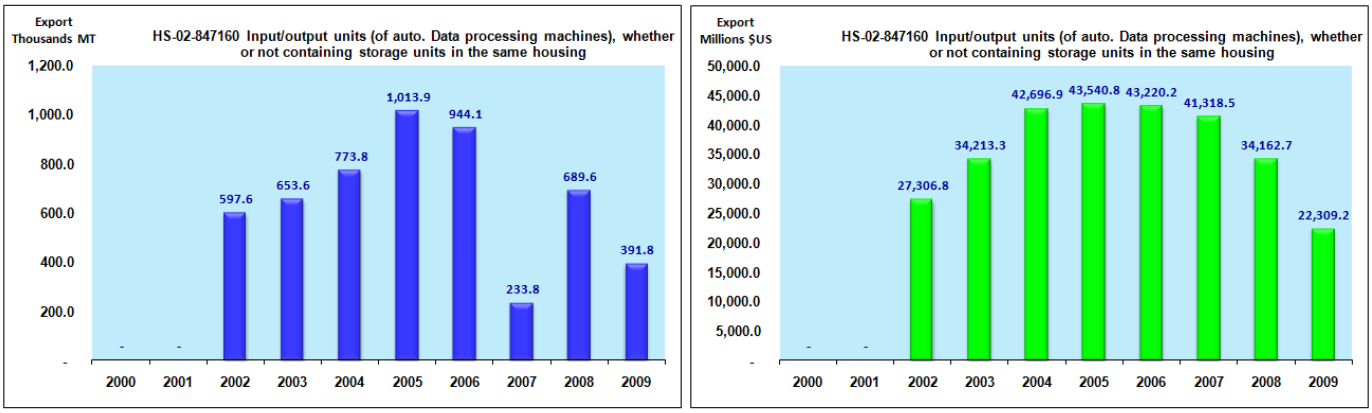
5.3.4.6 Input/output units (of auto. Data processing machines), whether or not containing storage units in the same housing (HS-02-847160)

The import volumes of input/output units (of auto. Data processing machines) represents 12.3% of the import volumes of mercury containing products and 17.7% of the export volumes. The import and export volumes exhibit an increase from 2002 to 2006 prior to declining to 2009 where the import volumes were approximately 40% lower and export volumes approximately 50% lower than the 2002 values. The import and export values demonstrated a similar trend where there were increased from 2002 to 2006 and a decline in value through to 2009 to levels approximately a quarter lower than the 2002 values.

Major importers of these products were China (18.2%), the Republic of Korea (17.6%), and Japan (12.5%). The source of these imports were predominantly China and Japan. The major exporters of these products within the region are China (57.7%), the Republic of Korea (15.4%), and Singapore (6.1%) and their major trading partners were the USA, China, and The Netherlands.



Graph: 5-83 Import of Input/output units (of auto. Data processing machines), whether or not containing storage units in the same housing in thousands of MT and millions of $US, 2000 - 2009

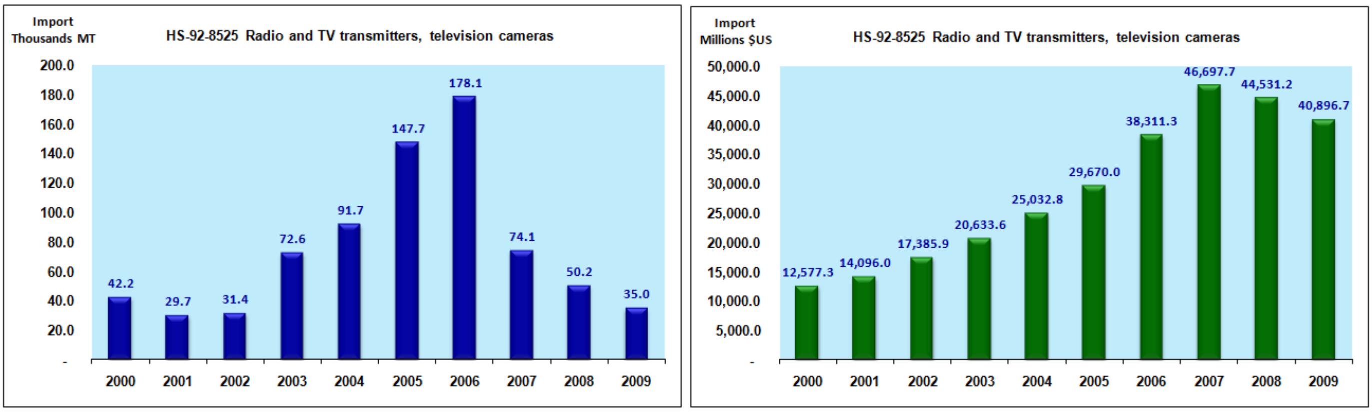


Graph: 5-84 Export of Input/output units (of auto. Data processing machines), whether or not containing storage units in the same housing in thousands of MT and millions of $US, 2000 - 2009

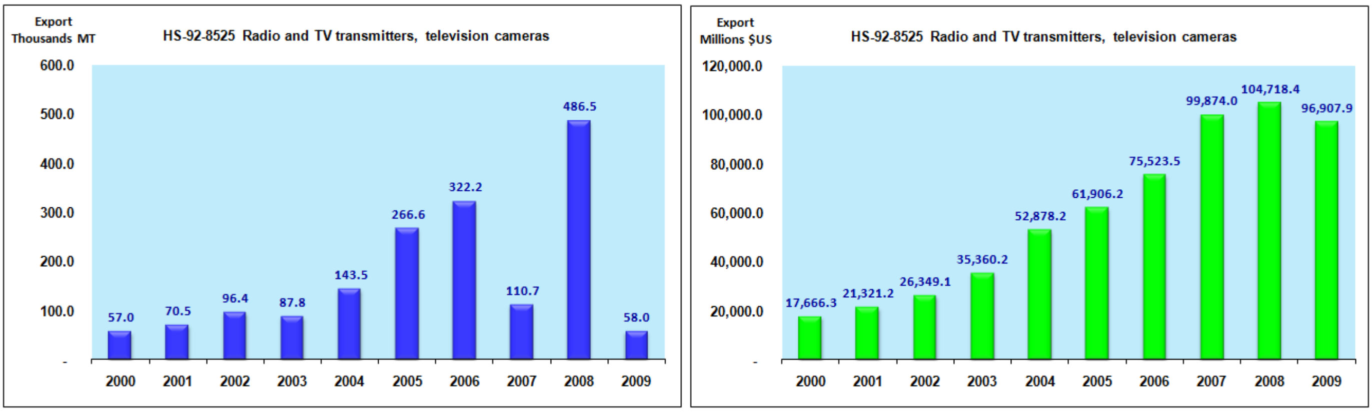
5.3.4.7 Radio and TV transmitters, television cameras (HS-92-8525)

The import volumes of radio and TV transmitters and television cameras accounts for 4.63% of the import volumes and 5.67% of the export volumes of the total mercury containing products over the study period. The imports appear to indicate an increase from 2000 to 2006, followed by a decline to near 2000 volumes by 2009. The import values, however, indicate a relatively consistent increase in values imported from 2000 to 2007, followed by a modest decline in values. Export volumes show an increase from 2000 to 2006, followed by some inconsistent years and an overall decline from 2006 to 2009. The export value, however, follows a similar trend to the import values, where there is a steady increase to 2008 and a slight decline to 2009. This may indicate that the volume data may not be as reliable as the values data.

The major importers of these products are Singapore (17.1%), India (11.1%), China (10.6%), and China – Hong Kong SAR (10.0%) and the major source countries were China, the Republic of Korea, and Malaysia.



Graph: 5-85 Import of Radio and TV transmitters, television cameras in thousands of MT and millions of $US, 2000 – 2009

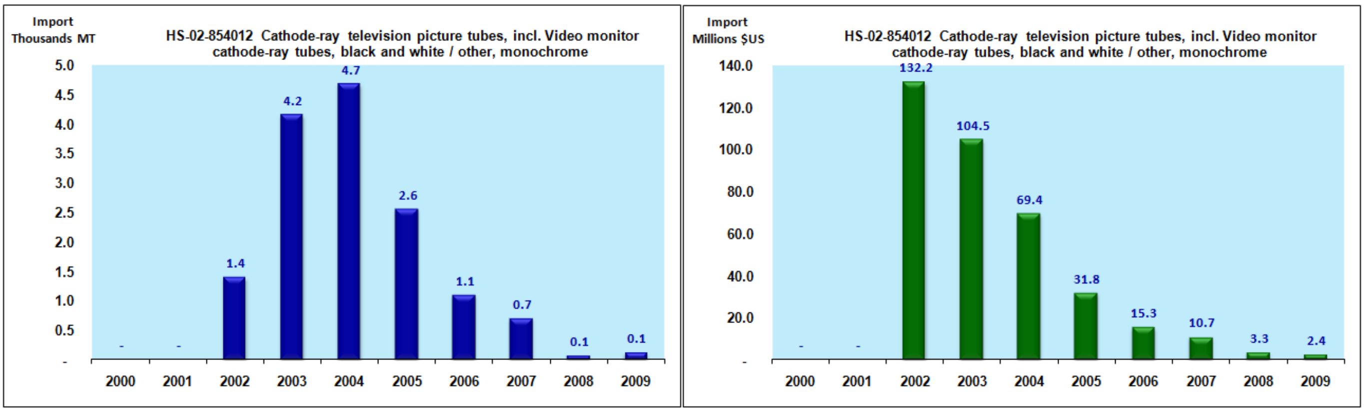


Graph: 5-86 Export of Radio and TV transmitters, television cameras in thousands of MT and millions of $US, 2000 - 2009

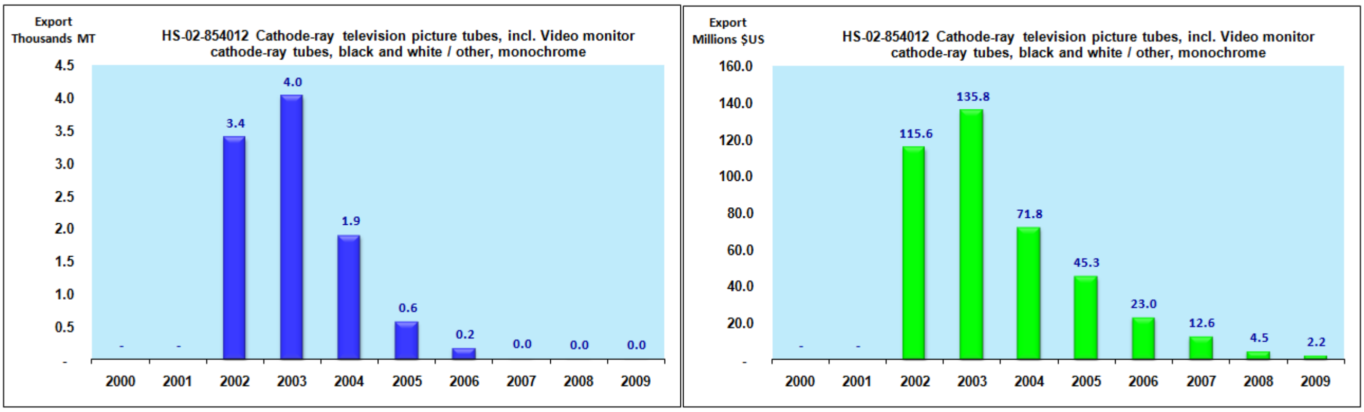
5.3.4.8 Cathode-ray television picture tubes, incl. Video monitor cathode-ray tubes, black and white / other, monochrome (HS-02-854012)

The imports of cathode-ray television picture tubes account for 0.09% of the imports and 0.03% of the exports of mercury containing products. There is a common trend throughout the import and export volumes and values that show a decline in volumes and values from 2002 through to 2009. This could be attributed to a change in technology away from cathode ray tube televisions to flat panel style displays.

No import or export partners were segregated in the data due to small product volumes.



Graph: 5-87 Import of Cathode-ray television picture tubes, incl. Video monitor cathode-ray tubes, black and white / other, monochrome in thousands of MT and millions of $US, 2000 - 2009

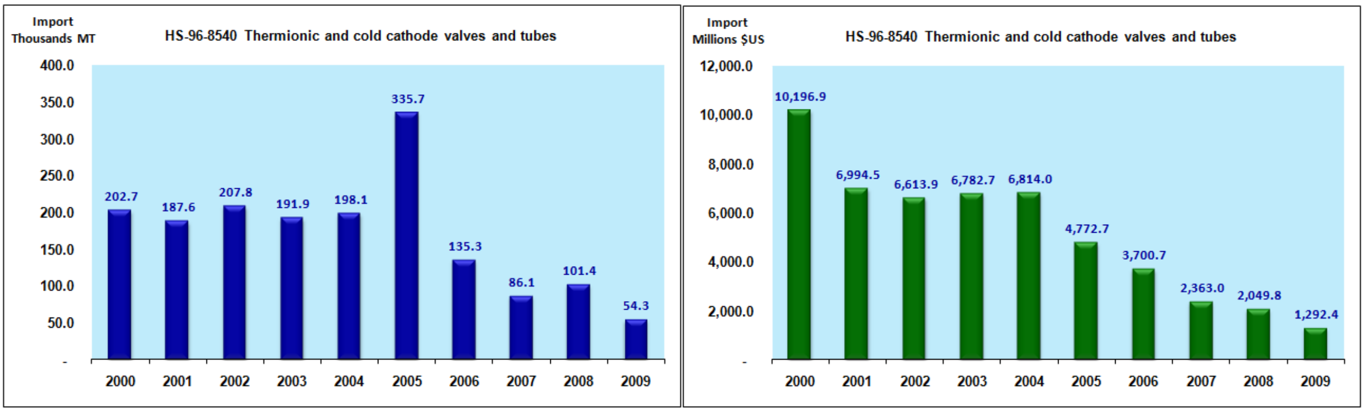


Graph: 5-88 Export of Cathode-ray television picture tubes, incl. Video monitor cathode-ray tubes, black and white / other, monochrome in thousands of MT and millions of $US, 2000 - 2009

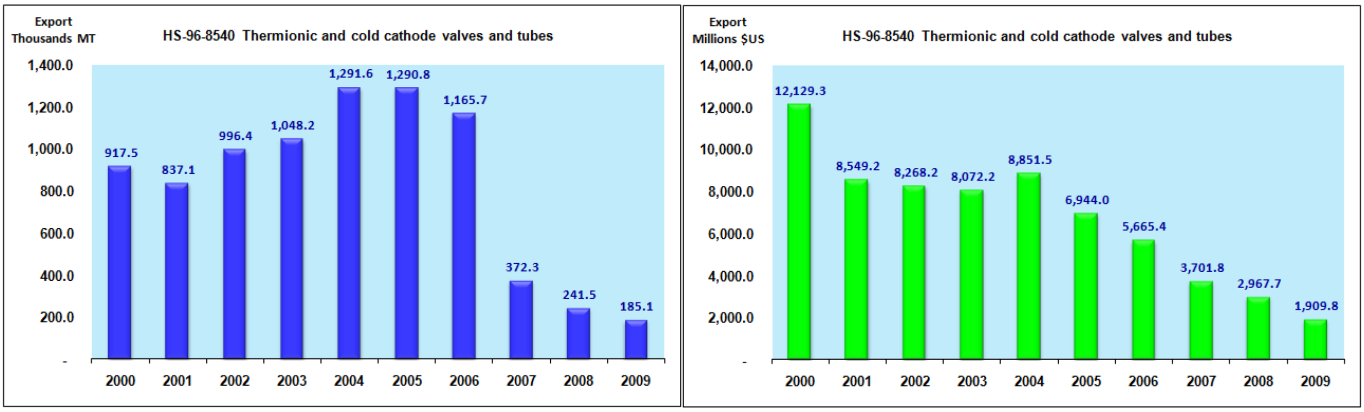
5.3.4.8 Thermionic and cold cathode valves and tubes (HS-96-8540)

Thermionic and cold cathode valves and tubes accounted for 10.5% of the imports and 27.8% of the exports of the products containing mercury over the study period. The imports have shown a decline over that period, apart from an apparent increase in imports in 2005, to a volume approximately a quarter of the initial volume. The import value declined over the period to a level that was almost a tenth of the initial value in 2000. Exports showed a slightly different trend where it initially increased in volume prior to declining to a level approximately a fifth of the 200 volumes. Export value demonstrated a steady decline over the study period to a level that was less than a sixth of the initial value.

The main importers over the study period were the Republic of Korea (40.04%), Indonesia (16.1%), and Thailand (11.9%) who sourced their imports from China, Malaysia, and Japan. The main exporters over the study period were the Republic of Korea (52.8%), Japan (9.0%), and Singapore (8.2%) who exported the majority of their product to China, Brazil, and Mexico.



Graph: 5-89 Import of Thermionic and cold cathode valves and tubes in thousands of MT and millions of $US, 2000 – 2009

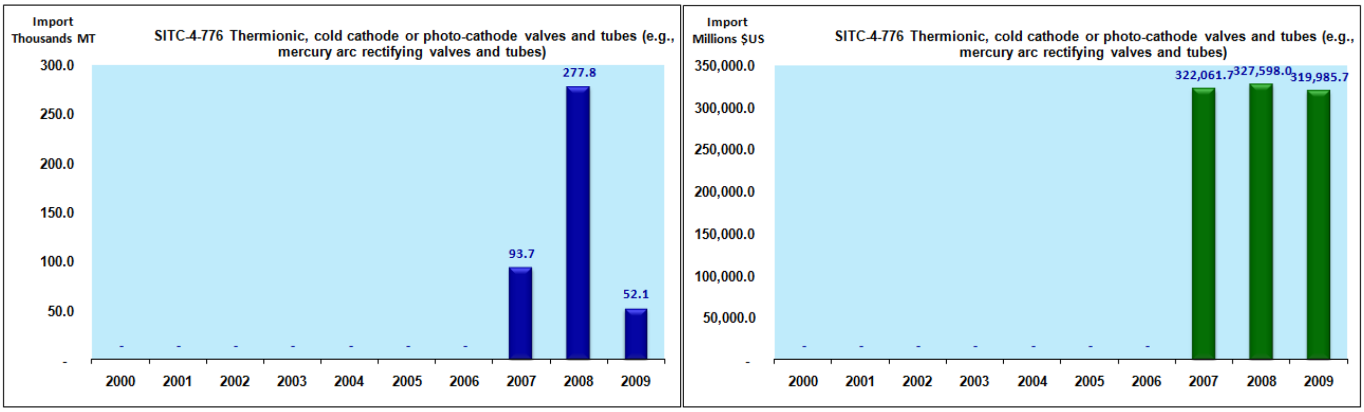


Graph: 5-90 Export of Thermionic and cold cathode valves and tubes in thousands of MT and millions of $US, 2000 - 2009

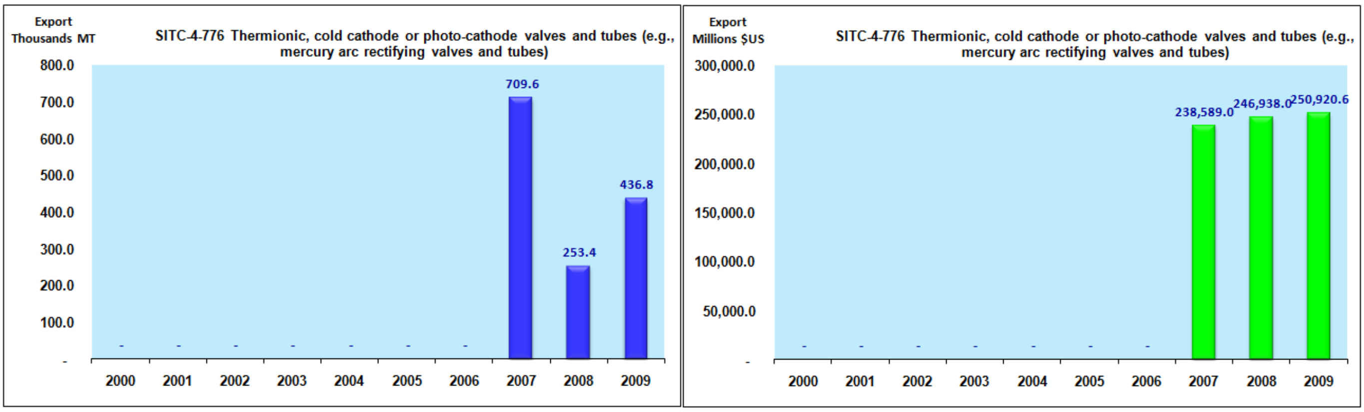
5.3.4.8 (SITC-4-776)

Thermionic and cold cathode or photo-cathode valves and tubes accounted for 2.61% of the imports and 4.67% of the exports of the products containing mercury over the study period. The imports do not demonstrate a specific trend although the import value has remained relatively constant over the three years of available data. The export data does not demonstrate a specific trend, although the export value shows a year on year increase for the three years of data that was available.

The main importers over the study period were the Republic of Korea (36.8%), China (25.4%), and China – Hong Kong SAR (20.8%) who sourced their imports from China, the Republic of Korea, and Japan. The main exporters over the study period were the Republic of Korea (47.1%), China (19.7%), and China – Hong Kong SAR (10.2%) who exported the majority of their product to Brazil, China, and China – Hong Kong SAR.



Graph: 5-91 Import of Thermionic, cold cathode or photo-cathode valves and tubes (e.g., mercury arc rectifying valves and tubes) in thousands of MT and millions of $US, 2000 – 2009

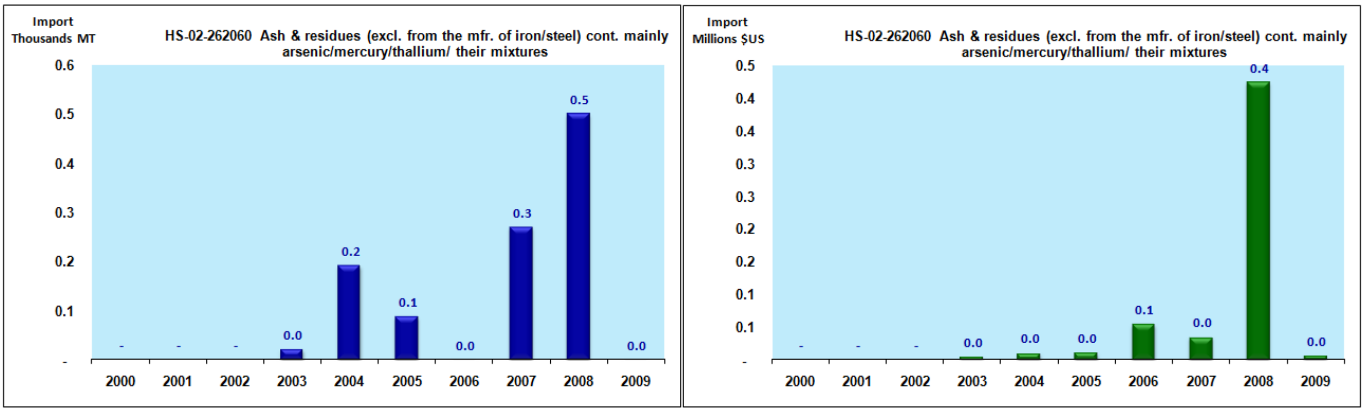


Graph: 5-92 Import of Thermionic, cold cathode or photo-cathode valves and tubes (e.g., mercury arc rectifying valves and tubes) in thousands of MT and millions of $US, 2000 - 2009

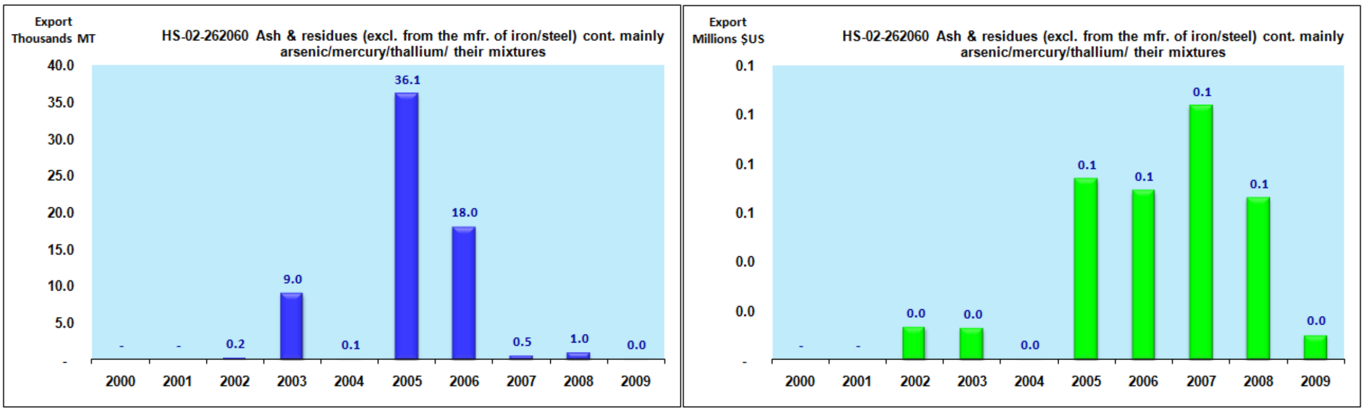
5.3.4.8 Ash & residues (excl. from the mfr. of iron/steel) cont. mainly arsenic/mercury/thallium/ their mixtures (HS-02-262060)

Ash and residues (excl. from the mfr. of iron/steel) cont. mainly arsenic/mercury/thallium/ their mixtures was the lowest imported product in the study period and accounted for 0.01% of the imports. The exports accounted for 0.22% of the total exports in the study period. From the relatively small volumes and values, there is no specific trend in the imports and exports of these products.

No import or export partners were segregated in the data due to small product volumes.



Graph: 5-93 Import of Ash & residues cont. mainly arsenic/mercury/thallium/ their mixtures in thousands of MT and millions of $US, 2000 – 2009

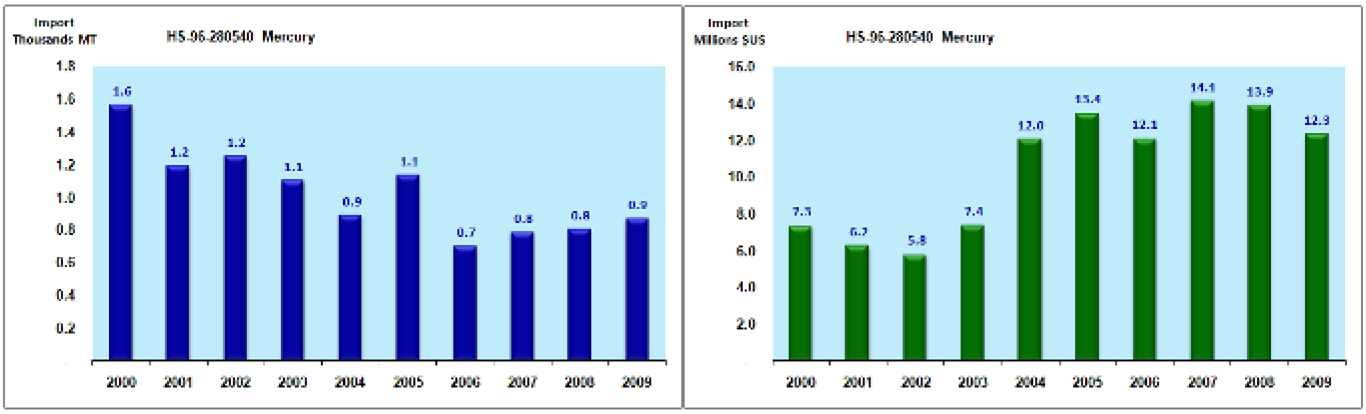


Graph: 5-94 Import of Ash & residues cont. mainly arsenic/mercury/thallium/ their mixtures in thousands of MT and millions of $US, 2000 - 2009

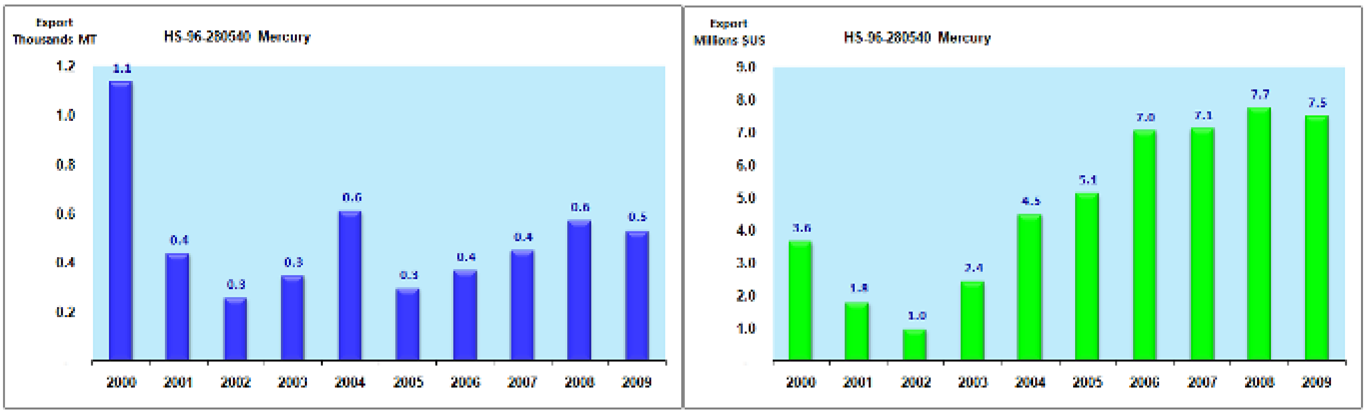
5.3.4.8 Mercury (HS-96-280540)

The imports of mercury account for 0.06% of the total imports of mercury and mercury containing products and 0.017% of the total exports. The import volumes demonstrate a general downward trend over the study period to approximately half of the import volumes in 2000. The import values have shown a general increase over that same period to be approximately 60% higher than 2000 values. Export volumes initially dropped by half in 2001 and have been relatively constant since that time. The export value, after falling for the first two years, has increased and stabilised at a level that is approximately double that of 2000.

No import or export partners were segregated in the data due to small product volumes.



Graph: 5-95 Import of Mercury in thousands of MT and millions of $US, 2000 – 2009

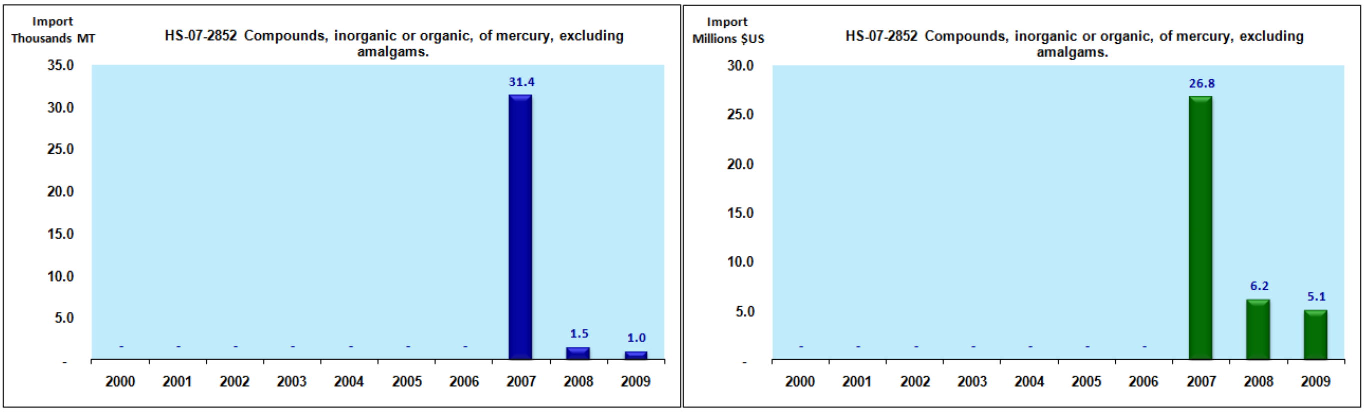


Graph: 5-96 Export of Mercury in thousands of MT and millions of $US, 2000 - 2009

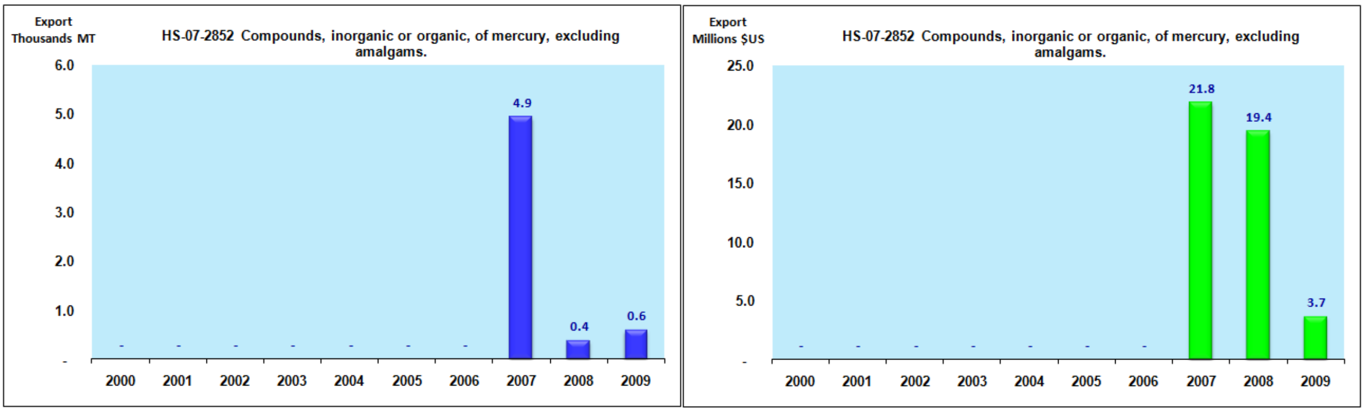
5.3.4.8 Compounds, inorganic or organic, of mercury, excluding amalgams. (HS-07-2852)

Compounds, inorganic or organic, of mercury imports account for 0.09% of the total volume of imports of mercury and mercury containing products. The export volumes accounted for 0.02% of the export volumes. The available data demonstrates that both the import volumes and values have declined significantly from 2007 to 2009, with the volumes dropping thirtyfold and import values dropping fivefold. Export volumes followed a similar trend where the volumes declined eightfold from 2007 – 2009 while the export value declined by a factor of approximately sixfold over the same period.

The main importer of these products was Singapore (86.8%), the Republic of Korea (6.0%), and New Zealand (3.6%). Main suppliers were Malaysia, the United Kingdom, and Japan. No export partners were segregated in the data due to small product volumes.



Graph: 5-97 Import of Compounds, inorganic or organic, of mercury, excluding amalgams in thousands of MT and millions of $US, 2000 – 2009



Graph: 5-98 Export of Compounds, inorganic or organic, of mercury, excluding amalgams in thousands of MT and millions of $US, 2000 - 2009

CHAPTER 6
ENVIRONMENTALLY SOUND INITIATIVES FOR COLLECTION, RECYCLING AND DISPOSAL OF USED PRODUCTS CONTAINING LEAD, CADMIUM AND MERCURY IN ASIA.

6.0 INTRODUCTION

This chapter outlines examples of existing and emerging environmentally sound management strategies and practices that have been adopted by individual governments in Asia and the Pacific region for the environmentally sound collection, recycling and disposal of used products containing cadmium, lead and mercury. The initiatives include legislation, regulations, policies or programmes to manage waste products containing cadmium, lead and mercury. There is also additional information on international, regional and sub-regional initiatives arising through multilateral efforts between stakeholders and governments to avoid and control generation of wastes from products containing cadmium, lead and mercury.

Many of the initiatives documented in this study address the objective of minimising human and environmental exposure to lead, cadmium and mercury through controls on point source emissions and development of threshold criteria for air, soil and water. Currently and historically, industrial manufacture and power generation have been key sources of emissions for these heavy metals and control measures have been based around soil, air and water contaminant threshold criterion. These matters are documented in the second part of this chapter.

However, it should also be recognised that the rapid rise in global use and distribution of electronic consumer products has led to a trade in used equipment and end of life equipment which is broadly defines as e-waste (electronic waste). Other products containing lead, cadmium and mercury such as batteries are also traded globally and subject to illegal trade due to their value. ULABs are a key source of lead pollution due to poor recycling practices in the informal sector of many countries and a range of initiatives are being undertaken to address the problem.

The following section of this chapter explores the challenges inherent in the both the legal and illegal trade in e-waste and other products and wastes that may contain lead, cadmium and mercury. Most of the value in e-waste is due to the small amounts of precious metals found within the discarded article which are removed and traded. Increasingly, initiatives are being developed at international, national and regional level to manage these wastes in an environmentally sound manner which protects human health and the environment and to prevent illegal trade. Cases of sound environmental management of these wastes are also highlighted in the first section on this chapter.

6.1 TRADE IN PRODUCT WASTES THAT CONTAIN LEAD, CADMIUM AND MERCURY: A FOCUS ON E-WASTE

Certain products containing lead, cadmium and mercury are considered valuable at the end of their useful lives due to their precious metal content or re-usable parts. When these products are discarded they can either be recycled, subject to metal or parts recovery while the remainder is disposed of. Due to the value of the discarded products they are often traded at various stages of the recycling and recovery process. This trade and the activities that surround it operate in both legal and illegal circumstances. In many cases the operations are conducted in the absence of legal or regulatory controls and may take place in the informal sector where the activity is difficult to monitor or control.

Two of the most common used product types that are subject to this trade are electronic waste (e-waste) also known as WEEE (waste electrical and electronic equipment) and used lead acid batteries (ULABs). The trade that operates around these materials is extensive in Asia but relatively small in the Pacific due to the remote nature, limited freight options and small populations of most Pacific Island Countries (PICs). Nonetheless, PICs still face major challenges in management of their domestic waste streams from imported products containing lead, cadmium and mercury at the end of their useful lives. In Chapter 7 case studies provide more detail on e-waste and ULAB management in selected PICs.

As global recognition of the scale of trade in these waste products increases so has the understanding of the human health and environmental impacts that can arise from the handling of these materials. This increased awareness has resulted in a range of strategies and initiatives to address the problems arising from this trade. However, despite all the positive activity directed at this issue, illegal trade and poor working conditions in the informal sector remain a major challenge for global and national governance.

6.1.1 E-waste trade in Asia and the Pacific

In 2002 public interest NGOs such as the Basel Action Network[125] (BAN) and Greenpeace exposed the extent of the e-waste trade from the US and Europe to Asia and later Africa. The investigative work of these organisations revealed that most of the ‘recycling’ of e-waste was conducted by the informal sector using dangerous techniques in poor conditions without protective equipment. The potential for environmental contamination and human health impacts in locations where these operations were performed was confirmed in numerous assessments in many locations. BAN conducted a range of tests across environmental media in the Chinese town of Guiyu where intensive e-waste recycling and smelting was conducted and found elevated levels of heavy metals such as lead, cadmium and mercury in a range of environmental media.[126] [127]

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[125] Basel Action Network (2002) *Exporting Harm – The High-Tech Trashing of Asia*. Available online at www.ban.org
[126] op cit BAN (2002) at Annex II and III.
[127] Leung, A., Cai, Z.W., & Wong, M.H. (2004) Environmental contamination from e-waste recycling at Guiyu, Southeast China. In: Proceedings of the 3rd Workshop on Material Cycles and Waste Management in Asia, Tokyo, 14–15 December, pp. 73–84.

6.1.2 The Illegal trade in e-waste and other products containing lead, cadmium and mercury.

The trade in e-waste takes place both legally and illegally and remains a challenge for governments in all countries around the world. Tracking and controlling the trade in e-waste has become a key environmental management priority for many countries. Current information suggests that in broad terms the majority of e-waste exports over the last decade have been sent to China, India, Pakistan and Africa with the US supplying the largest volumes to China and Europe exporting to India and Pakistan.

Figure 6-1 Trade flows of e-waste in the Asia and Pacific region

Source - UNEP

Figure 6.1 provides an overview of the main trade in e-waste to Asia based on data from the early 2000's. Since then many Asian countries have introduced controls or bans on imports of e-waste and suspected e-waste (shipments that claim to be working, used electronic products but are actually destined for waste processing) but illegal trade continues to grow[128] and domestic generation of e-waste continues to present major challenges.

The Criminal Intelligence Service Canada (CISC) 2008 annual report noted *that the illicit trafficking and disposal of 'e-waste' - computers, televisions, cell phones - is driving a burgeoning environmental and human health crisis in several developing nations in Asia and, increasingly, in Africa*[129]*.*

The International Network for Environmental Compliance and Enforcement (INECE) and the EU Network for the Implementation and Enforcement of Environmental Law (IMPEL) have estimated that around 1.5 million waste loaded containers are shipped illegally every year.[130] The value of this illegal waste trade (including e-waste) is estimated at $USD 10-12 billion per annum.

It is estimated that each year around seven million tonnes of high tech electronics become obsolete[131]. The global e-waste market is growing by 9% per annum with a value increasing from $7.2 billion in 2004 to around $11 billion in 2009. European estimates in 2007 were that total e-waste arisings will grow by around 2.5 percent annually to around 12.3 million tonnes.[132] However these estimates have recently been revised upwards and at the International Conference on Chemical Management 2 (ICCM 2) held in Geneva in 2009 to 20-50 million tonnes of e-waste annually. These volumes will be exacerbated by the transition to digital

[128] Van Houten, J., (2008) *Lets Join Forces to Stop Waste Dumping.* Netherlands Environmental inspectorate (VROM Inspectorate) International Network for Environmental Compliance and Enforcement. 8th International Conference. Cape Town South Africa.2008

[129] Criminal Intelligence Service Canada. 08 Report on Organized Crime, Criminal Intelligence Service Canada. May 21, 2008. www.cisc.gc.ca/annual_reports/annual_report_2008/document/report_oc_2008_e.pdf

[130] Ruessink, B.H. and Wolters, G.J.R., (2010) *Combating illegal waste shipments*. Shipping Hazardous Waste. INECE and IMPEL Naples Greenport Conference 2009

[131] USEPA website statistics cited in INECE (2009) *The International Hazardous Waste Trade through Seaports*. Seaport Environmental Security Network. Working Paper November 2009

[132] UNU (2007) *Electronic Equipment (WEEE), Final Report*. United Nations University. 2007. http://ec.europa.eu/environment/waste/weee/pdf/summary_unu.pdf.

television in a number of developed countries in 2011 including the US and Australia. Obsolete analogue televisions will be discarded at a much higher than normal rate in those locations.

The illegal trade in e-waste operates in a number of ways but most commonly by exporters, brokers and handlers from countries that prohibit export of obsolete electronics documenting shipments of inoperable e-waste as used electronic goods for re-use and refurbishment. The illegal shipments can thereby avoid scrutiny and enter the informal recycling sector in Asia and Africa.

An international cooperative initiative against illegal shipping of wastes in June and July 2010 provided some indication of the scale of the problem. The International Hazardous Waste Inspections Exercise at Seaports involved more than twelve countries and was coordinated by the International Network for Environmental Compliance and Enforcement's (INECE) Seaport Environmental Security Network (SESN). The inspection exercise was also supported by the Secretariat of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

During the month-long program of targeted inspections 72 shipments were investigated resulting in infringements in 54 percent of inspections. The most common illegal shipments were e-waste incorrectly declared as second hand goods, ULABs described as plastic or mixed metals scrap and cathode ray tubes incorrectly declared as metal scrap. The most common routes for the illegal waste were from North America to destinations in Asia and from Europe to destinations in West Africa and Asia.[133] North American exports were primarily directed toward Hong Kong, Japan, Korea, Taiwan and Vietnam with Hong Kong as a transit port for final shipping to China.

Some countries have attempted to restrict the import of 'used working electronics' that are really e-waste by requiring pre-shipment inspections from the country of origin with a 'time of manufacture' based test. In 2003 Thailand banned imports of used computers and household appliances more than three years from the date of manufacture and photocopiers more than five years from the date of manufacture.[134]

When the e-waste arrives in Asian and African countries it is usually purchased by private collectors who then employ workers from the informal sector (often children) to work in poorly constructed factories or in the open air to break the electronic goods with hammers, pliers or rocks, burn the plastic coatings off copper cables, and extract gold, copper, lead and other materials in open acid pits or containers. This leads to high levels of exposure to toxic fumes and hazardous materials[135].

Many businesses in developed countries such as the US are reluctant to meet the strict export regulations imposed by authorities such as the USEPA. The US requires exporters to seek consent of the USEPA and the receiving country before the shipment of cathode ray tubes (a common e-waste article) can take place. A recent report by the United States Government Accountability Office (GAO) found that many operators were willing to side step these requirements. GAO officers posed as foreign buyers of broken CRTs from India, Pakistan and other countries. Forty-three companies expressed a willingness to export these items without the proper governmental consent.[136]

Despite these challenges many countries in the Asia and Pacific region have undertaken positive initiatives to prevent illegal e-waste imports and to improve domestic e-waste recycling conditions to reduce human exposure and environmental impacts.

A notable US based initiative to prevent illegal exports of e-waste to developing countries and to ensure the highest environmental and worker health standards in the recycling industry is the e-Stewards Certification programme[137]. In North America there are now over fifty pledged and certified e-Steward recyclers. The programme is open to recyclers of e-waste globally and requires them to adhere to the *e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment®*. The program was designed and is promoted by the Basel Action Network (BAN) and industry leaders and has the support of the US government.

Specifically the program;

- Requires a certified ISO 14001 environmental management system that builds in occupational health and safety requirements specific to the electronics recycling industry, minimizing exposure of recycling workers to hazards
- Prohibits all toxic waste from being disposed of in solid waste landfills and incinerators
- Requires full compliance with existing international hazardous waste treaties for exports and imports of electronics, and specifically prohibits the export of hazardous waste from developed to developing countries
- Prohibits the use of prison labor in the recycling of toxic electronics, which often have sensitive data embedded
- Requires extensive baseline protections for and monitoring of recycling workers in every country, including developed nations where toxic exposures are routinely taking place
- Is written for international use

[133] INECE (2010) *International Hazardous Waste Inspection Project at Seaports: Results and Recommendations*. INECE Seaport Environmental Security Network. December 2010
[134] Kojima, M., (2005) *Current Trade Flows in Recyclable Resources within Asia & Related Issues*. Institute of Developing Economies – Japan External Trade Organisation (IDE-JETRO)
[135] op cit BAN (2002)
[136] United States Government Accountability Office (GAO). *Electronic Waste: EPA Needs to Better Control Harmful U.S. Exports through Stronger Enforcement and More Comprehensive Regulation.* GAO-08-1044, August 28, 2008. http://www.gao.gov/products/GAO-08-1044.
[137] http://e-stewards.org/about/

6.2 E-WASTE INITIATIVES AND MANAGEMENT MEASURES IN ASIA

6.2.1 China

In the early 2000's China was a key target of e-waste exporters both legal and illegal. In 2002 the US e-waste recycling industry claimed that 80 percent of the e-waste they received was sent to Asia and 90 percent of that flow was directed to China.[138] In response China banned the importation of e-waste in August 2002. However, e-waste imports remain a problem and are spreading from the main import region of Guangdong Province to other regions such as Zhejiang, Shanghai, Tianjin, Hunan, Fujian and Shandong. Only 14 shipments of illegal e-waste were intercepted between1994-2004.[139]

In response to this trade China has also passed or is preparing a number of regulations and laws to control the import and impacts of domestic e-waste recycling including;

- *The Management Measures for the Prevention of Pollution from Electronic Products* (based on the EU RoHS directive) prepared by the Ministry of Information Industry (MII).
- *The Ordinance on the Management of Waste Household Electrical and Electronic Products Recycling and Disposal* was passed in 2008. (largely based on the EU WEEE Directive).

While these laws may help reduce the impacts of e-waste recycling and disposal in China over time there are structural conflicts in the economy that remain unresolved. An example is the notice issued in 2003 by the China State Environmental Protection Administration (SEPA) entitled *Notice on Strengthening the Environmental Management of e-waste.* The notice prohibits environmentally adverse methods of e-waste recycling and was intended to bring the operations of the informal sector under control. However, no alternate high technology recycling operations were available to direct the e-waste to and existing arrangements were largely unaltered.

China recognised the need for advanced recycling facilities and in 2005 set out to construct and operate eight technically advanced plants throughout the east coast of China. Two of the facilities were operating in 2006 but suffered low profitability due to price competition from the informal sector and a lack of feedstock. The main feedstock for these recyclers was by-products and faulty products from manufacturers. The high cost of pollution control for the advanced facilities compared to the informal sector's near complete absence of pollution control resulted in a struggle to maintain competitiveness in the formal sector.[140] However, as China increases pressure on the informal sector through laws and regulations and implements EPR with larger producers it is expected that increased volumes of e-waste will flow to the more advanced recycling facilities.

6.2.2 Singapore

Singapore has a number of advanced e-waste recycling facilities and initiatives to control the impacts of e-waste and these include;

- A major e-waste take back scheme with collaboration between retailers and recyclers (Harvey Norman under Pertama Merchandising Pty Ltd, Citiraya Industries Ltd and NatSteel Asia Pty Ltd).
- E-waste recycling awareness programme including collection from schools (North-West Community Development Council, Town Council, Hewlett Packard Asia Pacific Pte Ltd, SembWaste Pty Ltd, Citiraya Industries Ltd)
- A programme to take back and recycle computer and printing hardware products from corporate clients (Hewlett-Packard Singapore Pty Ltd).
- A programme to take back and recycle PCs and related peripherals from corporate clients and household consumers. (Dell Asia Pacific Sdn)
- A programme to allow consumers to return and recycle hand phones and hand phone batteries. (Nokia Pty Ltd)[141]

Global e-waste recycling companies based in Singapore, such as Tess-Amm have established environmentally sound certification such as ISO 14001 and OHSAS 18001 and have established operations in China (Beijing, Suzhou, Shanghai, Guangzhou), Malaysia (Penang), India (Chennai), Thailand (Pathumthani) and Taiwan. Tess-Amm has also been in negotiations with NGOs and Pacific Island countries to scope a collection service for e-waste among PICs.[142]

6.2.3 Thailand

Thailand appears to have made progress in establishing initiatives to collect recycle and dispose of e-wastes. Community awareness raising campaigns about the impacts of incorrectly managed e-waste and other household hazardous wastes are well established. This is complemented by household hazardous waste collection days where e-waste, fluorescent bulbs, batteries paints and other materials are collected at centralised points and forwarded to recyclers. A national e-waste inventory has been established examining household behaviour and e-waste generation rates.

Mobile phone take-back programs have been established and a pilot programme for fluorescent tube recycling has been established by Toshiba. Private companies such as Wongpanit Group operate e-waste recycling and disposal services including on-site operations at commercial venues that generate significant quantities of e-waste.[143] Thailand customs services have also intercepted a number of illegal imports and exports of e-waste, ULABs and other hazardous wastes in recent years.

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[138] Liu. X., Tanaka. M., and Matsui. Y., (2006) *Electrical and electronic waste management in China: progress and the barriers to overcome***.** Waste Management and Research 2006 24: 92
[139] ibid
[140] ibid
[141] Singapore MOE WR (2006) http://www.env.go.jp/en/recycle/asian_net/reports/thirdyearwork/singapore.pdf
[142] http://www.tes-amm.com/locations.asp?id=6
[143] Tularak, P. (2007) Thai Ministry of Natural Resources and Environment Pollution Control Department *Management of transboundary movement and Recycling of wastes (e-wastes) in Thailand.* Regional Workshop on Prevention of Illegal Transboundary Movement for Hazardous Waste, 28-29 March 2007, Beijing

Commercial ULAB recycling also takes place in Thailand where a strong informal sector collects ULABs and sell them on to secondary lead smelters. ULAB imports and exports are banned in Thailand making recycling a high priority. The Ministry of Natural Resources and Environment's Department of Pollution Control regulate the collection, storage and transport of ULABs. The Ministry of Industry licenses ULAB recycling plants and has the powers to close plants that do not comply with pollution limits. The Klity Primary Lead Smelter was closed by the Ministry of Health in 2002 for emission violations.[144]

6.2.4 Indonesia

E-waste management in Indonesia has been hampered by a lack of regulations according to the Ministry of Environment who have difficulty estimating the scale of the problem due to a significant illegal trade in electronic goods. The Ministry expects new regulations for Extended Producer Responsibility are to be in place during 2011.

Indonesian's consumption of electronic goods is among the highest in Southeast Asia. In 2007 Indonesians purchased 4.3 million TV sets compared to 2.7 million in Thailand, 1 million in Vietnam, 530,000 in Malaysia and 300,000 in Singapore. It is also estimated that around 100 million mobile phones are in circulation in Indonesia.[145]

Rates of electronic goods imports have risen sharply with a 50 percent increase in imports for the period January to November 2010 compared to the same period in the previous year with a value of USD$3.66 billion. Of this China has the major market share currently at 35 percent. Mobile phones accounted for 58 percent of this market and notebooks (computers) around 26 percent.[146]

The lack of e-waste regulations and public awareness of the hazards has resulted in poor disposal practices with most e-waste dumped in open waste dumps and then collected randomly by scavengers from the informal sector and sold on to electronics repair shops for parts re-use. The parts that cannot be re-used are then dumped in the environment. According to The Indonesian Association of Scavengers over 500,000 scavengers in Jakarta alone seek e-waste, cardboard, plastics and scrap metal. However a fledgling formal recycling industry for Indonesia is developing with one hazardous waste treatment company PT Prasadha Pamunah Limbah Industri planning to establish an e-waste recycling centre in the near future.[147]

6.2.5 Malaysia

It has been estimated that by 2020 the cumulative total of WEEE that will be discarded in Malaysia will be about 1.165 billion units or 21.379 million metric tonnes. As of January 2008 Malaysia had 107 licensed e-waste collectors however licensed contractors only collect disassembled components or whole units of WEEE from manufacturers and not whole units of WEEE from households or the business/institution sector. There are several recycling and reuse activities being conducted by some of the manufacturers however, the scope of the materials collected is limited.[148]

In January 2008 the Department of Environment (DOE) announced a draft regulation to control and manage e-waste in Malaysia. *The Environmental Quality (Recycling and Disposal of End-of Life Electrical and Electronic Equipment) Regulations* compel manufacturers or importers to design equipment to minimize hazardous components and facilitate ease of recycling, and to require the manufacturers and importers to take back end-of-life equipment for the purpose of recycling or safe disposal.

Under the Environmental Quality (Prescribed Premises) (Scheduled Waste Treatment and Disposal Facilities) Regulations 1989 the DOE licences a specific group of contractors for collection, transport, processing and disposal of e-waste. As of 2010 there were 122 partial recovery contractors and 16 full recovery contractors licensed by the DOE located around Malaysia.[149]

A number of manufacturers have established Take Back Programs (TBP). The Ministry of Natural Resources and Environment has negotiated with manufacturers to extend the system to achieve higher recycling rates for the articles collected and the programs include;

- Motorola Malaysia operates a limited TBP with its employees and dealers to recycle mobile phones, two-way radios, batteries, broadband devices, and network equipment to accessories such as chargers, hands-free units and cables. The system had not yet been extended to the public in 2009.
- Nokia Malaysia operates 30 recycling bins at Nokia centres, retail outlets and at selected phone network operator offices such as Celcom and Maxis. Nokia collects mobile phones, chargers, rechargeable batteries and other phone accessories. The TBP has operated since 2001 and in 2007 Nokia collected 900kg of material.
- Dell Malaysia takes Dell and other brand computers at its recycling centre and provides an option for customers to have their old computer collected when a new Dell computer is delivered or purchased. Since 2007 Dell has collected 6500 kg of used monitors, desktop and notebook computers, printers and accessories. A joint government and Dell computer recycling program in Penang in 2007 collected 3,827 kg of computers and accessories.[150]

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[144] Basel Secretariat (2004) *Training Manual for the preparation of national used lead acid batteries environmentally sound management plans in the context of the implementation of the Basel Convention.* Basel Convention Series / SBC No 2004/5

[145] Hamdani H., (2009) Indonesian Ministry of Environment cited in Irin news report *Indonesia: Hazardous e-waste needs regulation.* December 11 2009

[146] Widianarko B., (2011) *Winding stream of e-waste.* Opinion piece featured in The Jakarta Post by Professor Budi Widianarko, Professor of Environmental Toxicology, Soegijapranata Catholic University, Semarang. http://www.thejakartapost.com/news/2011/01/14/winding-stream-ewaste.html

[147] Irin news (2009) report *Indonesia: Hazardous e-waste needs regulation.* December 11 2009

[148] Department of Environment Malaysia (2009) *The E-waste Inventory Project in Malaysia*. A joint project of EX-Corporation Japan, DoE Malaysia, Ministry of Environment Japan and PGE Sdn Bhd.

[149] Awang, A.R., (2010) E-waste management in Malaysia. Department of Environment Malaysia

[150] op cit Department of Environment Malaysia (2009)

6.2.6 India

India has become an international hub for the development of hardware and software manufacturing for the information technology industry. This has led to strong economic growth and change in socio-economic conditions and consumption patterns including a sharply increased uptake of electronic equipment. This has resulted in the India generating significant quantities of e-waste which, according to some reports, equals the amount of e-waste being imported for recycling.

The total amount of e-waste produced and imported to India is difficult to estimate as virtually all e-waste is recycled in the informal sector.[151] However, some recent estimates suggest that total e-waste generated domestically is around 150,000 tonnes per annum and around the same in imports.[152] Domestic e-waste generation in India is predicted to rise to 400,000 tonnes in 2011 and up to 700,000 tonnes in 2012.[153]

The informal recycling sector in India manually dismantles and sorts the fractions of the used equipment in cathode ray tubes (CRT), cables, plastics metals, condensers and batteries. Women and children routinely use hammers, pliers and bare hands to extract the components and unusable parts such as cable sheaths and some plastics are burnt in open dumps. These practices are repeated in nearly all countries where an informal sector operates to recycle e-waste and recover metals.

Human health impacts include inhalation of toxic fumes, acid burns from strong acid baths used to dissolve metals such as gold out of printed circuit boards (PCBs) and ongoing exposure to brominated flame retardants in the plastic components. Dioxin is also released from the PVC sheathing of copper cables and inhaled by workers who commonly have no protective equipment such as gloves and respirators. Environmental impacts are increasingly being documented in India and China as a result of these practices and some concerns are arising that a secondary contamination flow is occurring where primary produce (vegetables, meat etc) are being contaminated as a result of broad environmental contamination from waste recycling and then re-exported as foodstuffs to other countries.[154]

India recognises that there are significant social and economic benefits arising from the employment generated by e-waste recycling and are developing a strategy to move e-waste (and the informal sector recyclers) into formalised, environmentally sound recycling operations.[155] India has a wide range of environmental laws and regulations but has only recently considered introducing specific legislation to manage e-waste. In the absence of specific domestic laws regulators have relied on the Hazardous Waste Rules (1989) but this law only captured that e-waste with elevated levels of certain substances such as CRTs and printed circuit boards (PCBs).

In terms of imports of e-waste to India the Basel Convention lists waste electronic assemblies under A1180 and mirror entry in B1110 due to concerns about lead, cadmium and mercury. India includes electronic wastes under List-A and List-B of Schedule-3 of the Hazardous Wastes (Management and Handling) Rules, 1989 (amended in 2000 & 2003). As a result the import of e-waste requires the permission of the Ministry of Environment and Forests. This scrutiny is often avoided by the labelling of shipments as used electronics for recycling and repair.

The Indian government has targeted the informal sector e-waste recyclers for a range of initiatives involving awareness raising campaigns about the toxicity of materials and hazards of poor recycling processes to assist this sector to better protect themselves and the environment while a formal recycling industry emerges.

These initiatives include;

- Workshops on environmentally sound management of e-waste in collaboration between the Central Pollution Control Board (CPCB) and Toxics Link (a leading NGO on environmental pollution) and the Confederation of Indian Industry (CII)
- Rapid Assessments of e-waste inventories and practices in major cities have been initiated by the CPCB.
- A National Working Group has been formed to formulate a national strategy for e-waste.
- The Department of Information Technology (Ministry of Communication and Information Technology) have published and circulated a technical guide on the *Environmental Management for Information Technology Industry in India.*
- The Department of Information Technology have also established a demonstration project at an Indian Telephones Industries facility to promote the environmentally sound recovery of copper from printed circuit boards.

6.2.6.1 The Indo-European E-Waste Initiative

A highlight of these initiatives is the cooperative project between the CPCB, the GTZ and EMPA (Swiss Federal Laboratories for Materials Testing and Research) to help the informal sector through identification of measures that reduce environmental degradation and the health risks to workers while developing income-generating opportunities through environmentally sound management of e-waste. The program is designed to exchange the best practices, policies and technologies in Indian mega-cities such as Delhi, Bangalore and Mumbai.

The objective of the project is to use pilot projects in certain cities to take processes with the highest environmental and health impact and transfer them from the informal to the formal sector. A model scheme will be established in Bangalore to track old PC systems from the IT sector through to the informal recycler using a Nodal Agency as a Clearing House and will incorporate NGO

[151] Federal Ministry for Economic Cooperation and Development and GTZ Germany (2005). Indo-European E-waste Initiative. *E-waste Management in India - Fact sheet*
[152] Renckens, S., (2007) *A network and flows perspective on e-waste trade and its governance arrangements*. February 2007 IIEB Working Paper 23
[153] Jain, A., (2010) *E-waste Management in India: Current Status, Emerging Drivers & Challenges.* Regional Workshop on E-waste/ WEEE Management July 8th, 2010, Osaka, Japan.
[154] Robinson, B., (2009) *E-waste: An assessment of global production and environmental impacts.* Science of the Total Environment 408 (2009) 183–191
[155] Joseph. K.., (2007) *Electronic Waste Management in India – Issues and Strategies.* Centre for Environmental Studies, Anna University, Chennai, India. Paper presented at the Eleventh International Waste Management and Landfill Symposium Sardinia 2007.

participation. The project will be supported by the establishment of the first formal recycling plants in Bangalore which are to be certified by government officials.[156]

India has also introduced the Hazardous Waste (Management, Handling and Transboundary Movement) Rules Amendment 2008[157] and the registration of e-waste recyclers since 2008 and they anticipate that the 11 licences may manage up to 60 percent of the estimated inventory.

Draft EPR Regulations have been open for public consultation since May 2010 and provide for mandatory registration of retailers, refurbishers, dismantlers and recyclers. It also suggests a ban on imports of e-waste.[158]

The *E-waste (Management and Handling) Rules 2010* address end of life products whereas previous regulations only addressed industrial e-waste from manufacturing. Under the new laws consumers will also be required to hand in their old equipment for recycling and manufacturers will be required to take their own brands and any electronics they manufacture but are branded by sub-contractors. The ban on importation of e-waste extends to used electronic equipment donated to local charities – a common method of avoiding existing e-waste import controls at the country of export.

6.3 E-WASTE INITIATIVES AND MANAGEMENT MEASURES IN PACIFIC ISLAND COUNTRIES.

In recent years more attention has been focused on the management of e-waste in the Pacific. Pacific Island Countries do not have dedicated infrastructure for the recycling of e-waste at this time, either in the formal or informal sector although there is some very limited small-scale informal recycling and dismantling of e-waste in some PICs to serve the needs for repair and refurbishment in some areas.

Due to the long distances between islands and low population base PICs are rarely the destination for illegal e-waste shipments which tend to be directed toward Asian and African countries. The extent to which environmentally sound e-waste management is a problem in PICs tends to be directly related to domestic e-waste arising as a result of imports of electronic products. There are signs that some companies are beginning to negotiate schemes for collection and export of e-waste from PICs to countries with well developed formal e-waste recycling facilities.

The key regional organisation that tracks issues with e-waste and provides advice and capacity building in the region is the Secretariat of the Pacific Regional Environment Programme (SPREP). SPREP promotes cooperation and provides technical assistance on hazardous waste in the region through the Waste Management and Pollution Prevention Division of the 'Pacific Futures' Programme. SPREP identifies the key e-waste issues for the region as;

- problems with donations of used electronic equipment from developed nations
- environmental impacts through poor management of e-waste and unlined landfills
- lack of technical capacity in PICs
- low volumes of e-waste necessitating the need for a regional rather than country-based recycling facility
- the need for a levy on electronic goods to support environmentally sound recycling.
- A particular need for EPR schemes to deal with low volumes and large distances

Since 2007 initiatives have been underway by SPREP, PICs and NGO's to assess the extent of the e-waste problem in the Pacific and raise awareness about environmentally sound management of e-waste. The Basel Convention Secretariat and Regional Centres Asia-Pacific provided $US 2.65 million to assess the regional situation, provide tools for policy development on re-use, repair, refurbishment and recycling and also to support local initiatives to divert e-waste from landfills.[159]

A key part of this project has been to undertake studies in Kiribati, Samoa, Cook Islands and The Federated States of Micronesia examining storage, disposal, management and inventories of e-waste. Where available a summary of this information is presented below. NGO organisations have also undertaken an independent assessment of e-waste in Fiji and Samoa during a joint project between The National Toxics Network of Australia (NTN) and the Island Sustainability Alliance Cook Islands (ISACI) in 2008.[160]

6.3.1 Kiribati

Lifestyle changes in Kiribati have seen an increase in the uptake of electronic items and electrical goods – particularly in South Tarawa and Betio where electricity supplies have now been established. As there is no assembly or manufacture of electronic goods in Kiribati e-waste volumes are essentially a function of domestic electronic and electrical imports. The main exporters of electronic goods to Kiribati are Australia, New Zealand and Japan.[161]

E-waste in Kiribati does not currently have separate management or disposal practices to other solid wastes and is placed in the official landfills at Nanikai or the Red Beach in Betio. Government offices are the main source of used electronic goods such as computers but end of life products are subject to an asset disposal regulation that can take up to a year to process. This means that a large proportion of Kiribati's e-waste is still stored at offices and has not yet reached landfill.

[156] op cit Federal Ministry for Economic Cooperation and Development and GTZ Germany (2005).
[157] To include e-waste in Schedule 4
[158] op cit Jain (2010)
[159] Matatia. K., (2010) *E-waste in the Pacific*. Presentation on behalf of the Secretariat of the Pacific Regional Environment Programme. Regional e-waste meeting Tonga.
[160]op cit ISACI/NTN (2008).
[161] Ngalu, F., (2009) E-Waste in Kiribati. Secretariat of the Pacific Regional Environment Programme.

Table: 6-1 Increase in electronic goods imported in Kiribati 1999-2007

	1999	2000	2001	2002	2003	2004	2005	2006	2007
	Units								
Air con	520	553	291	527	201	266	697	536	590
Computer	355	471	83	42	936	173	1,661	674	261
Laptop	67	29	26	247	54	7	82	18	49
Television	459	430	218	249	415	345	1,751	1,143	1,126
Video	56	20	53	5	40	84	264	178	298

(Source: Ngalu, 2009)

Kiribati customs records indicate a significant rise in electronic goods imported in Kiribati between 1999 and 2007. As none of these articles are re-exported as scrap or product it is assumed it will all become e-waste to be managed in Kiribati under current arrangements. Under these assumptions e-waste will accumulate to around 84,000 kg by 2013.[162]

There are no laws or regulations in Kiribati that specifically address e-waste. However, there are a number of laws with broad environmental scope that could assist in the management of e-waste. These include;

- The Environment Act 1999 Part IV (s) 30 and 31 which are relevant to solid waste
- The Public Health Act (pollution)
- Special Fund (Waste Material Recovery) Act 2004 (container deposit legislation)

There are very few specific e-waste recycling initiatives in Kiribati with only a very small amount of copper recovery in the informal sector which is assumed to be destined for export.

6.3.2 Samoa

The studies[163] of e-waste management in Samoa identified a range of problems related to e-waste management;

- lack of legislation and regulatory framework to effectively coordinate the national implementation of the Basel Convention in Samoa with regard to e-waste.
- support measures and mechanisms to promote waste minimization at source and support recycling operations do not exist.
- The Customs Import and Export Recording System require amendment to be able to effectively track import and export of e-waste
- Lack of appropriate facilities and infrastructure to safely store, collect, refurbish, recycle and dispose of e-wastes in an environmentally sound manner.
- Expertise in e-waste management and particularly materials recovery and recycling are lacking.

Current laws and regulations have some scope to deal with waste generally but not e-waste specifically these include;

- The Lands, Surveys and Environment Act 1989
- National Waste Management Policy 2001(but lacks legislative framework for implementation)

Proposed laws and strategies that will provide adequate legal provisions to support and promote national implementation of the Basel Convention and the Stockholm Convention include;

- The Waste Management Bill
- National Solid Waste Management Strategy

Import of e-waste to Samoa appears to be non-existent although customs records are not accurate enough to determine this with any finality. Two organisations have exported relatively small amount of e-waste from Samoa though these were not tracked by customs records. The Yazaki EDS Co. Ltd exported around four containers a year of hazardous waste to New Zealand up until 2006 (including e-waste) but no longer exports this waste. Mobile phone company, Digicel Samoa Ltd, are also believed to export some of their e-waste overseas but the details are not available.[164]

Government collection services for bulky wastes, including e-wastes, operate three times a year and are disposed of at the local landfill sites. Around 140 items of e-waste are collected per year from households through the government collection service but it is acknowledged that many more items are stored in people's houses and sheds. E-waste volumes from the public are relatively low but increasingly rapidly. Although most collected e-waste has been destined for landfill, two small e-waste material recovery operators have been established by RCN/Samoa Observer Joint Venture, Vaitele and Pacific Recycler Co. Ltd Tafaigata. The

[162] ibid
[163] Sagapolutele, F., (2009) *The National Inventory of E-Wastes in Samoa.* For the Ministry of Natural Resources and Environment. Government of Samoa.
[164] ibid

former company exports the materials to New Zealand while the latter is packing around 500 tonnes of materials for export to unknown destinations.

The informal sector also plays a role with twenty organised scavengers on the Tafaigata landfill collecting an unknown amount of materials on an ongoing basis. There are significant concerns for this group who burn e-waste to recover valuable metals.[165]

Government organisations generate the most significant quantities of e-waste in Samoa with around 1280 units per year accounted for in asset write-offs. The government has a very good system for tracking and collecting this waste but the Government storage site in Vaimea has limited space and much of the e-waste is stored outside in the corrosive Pacific climate with heavy rainfall.

Although environmentally sound storage and disposal options for e-waste in Samoa don't exist, the government has developed plans for a sound storage facility and recycling operations at Tafaigata landfill pending the allocation of funding.

6.3.3 Federated States of Micronesia (FSM)

The Federated States of Micronesia is a developing island nation of 607 islands across 1 million square miles of the Western Pacific Ocean. Despite this geographic spread the total land area is only 271 square miles. The 2000 population census indicated 107,008 people inhabited 65 of these islands. Around 22 percent of the population live in urban centres.

It is reported[166] that e-waste volumes have increased dramatically since the 1980's. In much the same manner as other PICs the recycling operation in FSM are so small that they do not attract e-waste from other countries for processing and e-waste is largely a function of domestic disposal of electronic equipment. Currently there is no specific system in FSM for environmentally sound collection and disposal of e-waste. There are a number of legal and illegal waste dumps in FSM and e-waste is likely to be disposed of at all sites.

Lifestyle and communications have become more sophisticated in FSM and this has resulted in a corresponding increase in the import of electronic goods that are destined to be e-waste. While no specific legislation or regulations address e-waste the four member states of FSM have agencies with an EPA mandate and have powers that may address issues related to e-waste. Title 25 of the FSM Code (TT EPA Board Regulations 1975) controls chemical waste with regard to water pollution. Title 18 of the Yap State Code Section 1509(a) of the Yap State Environmental Quality Protection Act (YSL 3-73) from 1995 controls air and water pollution.

While no official inventory exists volumes of e-waste have been calculated indirectly through FSM's Customs and Tax Administration under the National Department of Finance. Electronic goods are imported from China, Guam, Hong Kong, Japan, Republic of Korea, New Zealand, the Philippines, Singapore, Taiwan, Thailand and the US.

Customs records identify articles that are likely to become e-waste at the end of their useful life for the four states of FSM namely Chuuk State, Kosrae state, Pohnpei State and Yap State. In 2007 around 14,300 imported articles are recorded that have potential to become e-waste. Telephones, TV's and computer equipment are likely to constitute the highest fraction of the e-waste stream. Exports of salvage e-waste have rarely occurred and only by the private sector due to high collection and transport costs.

In summary, FSM have no current capacity to manage e-waste, no specific regulations, laws or policies regarding e-waste yet face an increasing range of imports of electronic goods that will contribute to the low but growing amount of e-waste material that will be disposed of to unlined and sometimes unregulated landfills in FSM. However, there is some optimism that the Pacific Island Regional Recycling Initiative (PIRRI) may have the capacity to develop a cost-effective regional based collection and export project.

6.4 NATIONAL INITIATIVES

The UNEP Final Reviews of Scientific Information on Lead[167] and Cadmium[168] provide a summary of the different forms of management measures that have been implemented by various countries globally to avoid, reduce or control the effects of cadmium, lead and mercury. The management measures may address any stage of the life cycle of these products including production, use and disposal. In addition various initiatives to avoid, reduce or control the effects of mercury have been extracted from the Global Mercury Assessment Report[169]. A summary of these initiatives is presented in Table 6-2. The UN Working Group on Lead and Cadmium has also provided information relating to national initiatives for the management of cadmium and lead.

The national initiatives have the objective of limiting or preventing the release of lead, cadmium and mercury to the environment so as to minimise or avoid harm to public health or the environment. The national initiatives are characterised by four general themes:

1) **Environmental quality criteria**. These generally take the form of either guidelines or standards that prescribe maximum acceptable concentrations of lead, cadmium or mercury for different matrices (such as soil, air, groundwater, surface water and food). The criteria may vary for each matrix depending on its proposed use (e.g. there are different standards for human drinking water, livestock drinking water and irrigation water).
2) **Environmental point source actions and regulations** which aim to control lead, cadmium or mercury from point source emissions such as smokestacks. These include best available technologies (BAT) and best environmental practices (BEP) for industrial processes, waste management and concentration limits on emissions to air, soil and water. This often applies to waste treatment and disposal activities.
3) **Product control actions and regulations** for restricting, monitoring or banning the use of lead, cadmium or mercury in products.

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[165] op cit ISACI/NTN (2008)
[166] SPREP (2010)*The E-waste Situation in FSM*. Country Report. 2010
[167]op cit UNEP (2008e)
[168] op cit UNEP (2008d)
[169] op cit UNEP (2002)

4) **Other standards actions and programmes** including workplace exposure limits and monitoring, consumer protection standards and lead, cadmium and mercury release inventories and reporting.

Table: 6-2 Overview of implemented national measures related to cadmium, lead and mercury

Production and Use Phase of Life-Cycle		
Type and Aim of Measure		**State of Implementation**
Point Sources	Apply emission control technologies to limit emissions of lead, cadmium or mercury from combustion of fossil fuels and processing of minerals	Implemented in many countries
	Prevent or limit the release of cadmium, lead or mercury from industrial processes to the wastewater treatment system and the environment	Implemented in many countries
	Prevent of limit the intentional use of mercury in processes	General bans implemented in few countries
	Require the use of best available technology to reduce or prevent lead, cadmium or mercury releases	Implemented in some countries, mainly OECD countries.
Products	Prevent or limit products containing lead, cadmium or mercury from being marketed nationally	Very few general bans. Bans or mercury content limits on specific products more common, particularly for batteries, lighting and medical thermometers. Increasing country limits or bans on lead in petrol and paint. More widespread restrictions on cadmium pigments and plating formulations restricted.
	Prevent products containing mercury from being exported	Only a few countries
	Limiting allowable cadmium content in bulk materials such as phosphate fertilisers	Implemented in many countries – particularly the OECD countries.
	Limiting allowable mercury content in bulk materials	Only implemented in a few countries.
	Limits on lead, cadmium and mercury content in commercial foodstuffs and animal feed.	Implemented in some countries – particularly the OECD countries. WHO guidelines used in some countries
Disposal Phase of Life Cycle		
Type and Aim of Measure		State of Implementation
Prevent lead, cadmium and mercury in products (especially batteries) and process waste from being released directly to the environment by efficient waste collection		Implemented in many countries – particularly OECD countries.
Prevent or limit cadmium, lead or mercury releases to the environment from incineration of household waste, hazardous waste and medical waste by emission control technologies		Implemented or implementation is ongoing in many countries
Prevent lead, cadmium or mercury in products and process wastes from being mixed with less hazardous waste in the general waste stream, by separate collection and treatment		Implemented in many countries especially OECD countries
Set limit values for allowable lead, cadmium and mercury content in sewage sludge or other organic waste products used for land application.		Implemented in many countries
Prevent the re-marketing of used, recycled mercury		Only implemented in a few countries.
Set limit values for lead, cadmium and mercury in incinerator ash used in road-building, construction and other applications		Only implemented in a few OECD countries.

Source: UNEP (2008e and d), UNEP (2002)

A review of key source information indicates that no country has developed comprehensive legislation or regulations which address the entire life-cycle of cadmium, lead and mercury. Most countries have a range of legislation, regulations or other measures to control lead, cadmium and mercury but only in specific scenarios such as airborne or water-based emission limits. These regulations and measures also tend to group other metals and chemicals into a suite of analytes for the purpose emission controls and are not generally specific to lead, cadmium and mercury.

For those countries who are signatories to international agreements such as the Stockholm and Basel Conventions it is more common to see regulations prohibiting the import and export of certain chemicals in products where those chemicals have been listed in the Convention annexes (eg PCB's in electrical transformers and heavy metals in wastes). OECD countries are increasingly developing policies to address hazardous metals in products (particularly imports) and there are indications that this is encouraging manufacturers in non-OECD countries to restrict the use of lead, cadmium and mercury in products destined for export.

The following section outlines some of the existing initiatives by Asian and Pacific region countries which have been detailed in the Appendices of the UNEP Draft Final Reviews of Scientific Information on Lead and Cadmium, the Global Mercury Assessment Report and information from the UNEP Working Group on Lead and Cadmium and other literature sources.

6.4.1 Environmental Quality Criterion

Some Asian countries have developed a range of environmental standards and guidelines that include criterion for acceptable limits of lead, cadmium and mercury in range of environmental media such as air, soil and water. In many cases there are multiple criterion for each media depending on the beneficial use to which the medium is applied (e.g. drinking water guidelines may be different to crop irrigation guidelines). A selection of this criterion is detailed in Table 6. as well as summarised data.

Table: 6-3 Maximum acceptable concentration of Pb, Cd and Hg in different media in Asia and the Pacific

Country	Water	Air	Soil	Food/beverage
China	Drinking water Maximum allowable concentration): Cd ≤0.005 mg/L. **Surface water (limiting value):** Cd Category I: 0.001 mg/L Category II: 0.005 mg/L Category III: 0.005 mg/L Category IV: 0.005 mg/L Category V: 0.01 mg/L **Farmland irrigation water:** Cd - limiting value: ≤0.005 mg/L.	Lead ≤0.0015mg/Nm3 Quarterly Average ≤0.0010mg/Nm3[170]	Cd Level 1: - pH Value of soil: Natural background level; Limiting value: ≤0.20 mg/kg. Level 2: -pH Value of soil: <6.5; Limiting value: ≤ 0.30 mg/kg. - pH Value of soil: 6.5-7.5; Limiting value: ≤0.30 mg/kg. - pH Value of soil: >7.5; Limiting value: ≤0.60 mg/kg. Level 3: - pH Value of soil: >6.5; Limiting value: ≤1.0 mg/kg.	Pb Cd (Max levels): Rice and Soy 0.2 mg/kg Peanut 0.5 mg/kg Flour 0.1 mg/kg Mixed Grains Other Than Rice 0.1mg/kg Meat of Birds and Livestock 0.1 mg/kg Liver of Birds and Livestock 0.5 mg/kg Kidney of Birds and Livestock 1.0 mg/kg Fruit 0.05 mg/kg Rootstock vegetable (celery excluded) 0.1 mg/kg Foliate vegetable, celery, edible fungus 0.2 mg/kg Other vegetable 0.05 mg/kg Fish 0.1 mg/kg Fresh egg 0.05 mg/kg Hg: Freshwater fish. < 0.3 mg/kg
Japan	*Quality standard for groundwater under Water Pollution Control Law* – remediation required if groundwater exceeds 0.01mg Cd/L.		Soil Contamination Countermeasures Law[171] Pb: less than 150 mg/kg Cd: less than 1mg/kg in rice growing land Hg: less than 15 mg/kg	Hg: 0.4 ppm total/kg 0.3 ppm methyl Hg (as a reference) Food Sanitation Law – Provisional regulatory standard for fish and shellfish
Rep of Korea				Hg: Fish 0.5 mg/kg Food Act 2000
Philippines				Codex Alimentarius Predatory fish (shark, tuna, swordfish) 1 mg methyl Hg/kg Fish (except for predatory) 0.5 mg methyl Hg /kg
Thailand		Ambient air; Not to exceed monthly average of Pb[172] 1.5 μg/m^3	Soil quality for agriculture and daily living standard = 37 mg/kg Cd Soil quality for other purposes beside agriculture and daily living standard not to exceed;[173] 810 mg/kg Cd, 750 mg/kg Pb, 610 mg/kg Hg	Food Containing Contaminant Standard Seafood - 0.5 μg Hg/g Other food - 0.02 μg Hg/g
Uzbekistan	Drinking water Cd 0.001 mg	0.0003 mg Cd2+/m3	0.5 mg Cd2+/kg.	
India		Ambient Air[174] standard for lead Annual 0.5 ug/m^3 24 hours 1 ug/m^3		
Samoa	Currently using WHO guidelines. National guidelines being developed			
New Zealand	Sediment guideline high low	Hg 1mg/kg Hg 0.15 mg/kg		
	Ambient air guidelines (2002)	Hg inorganic 0.33 μg/m^3 Hg organic 0.13 μg/m^3		
	Landfill and biosolids for land app.		< Hg 4 mg/kg	

170 Ministry of Environmental Protection (1996). *Ambient air quality standard>GB3095-1996*. China.
171 Ministry of The Environment (1994) Environmental Quality Standards for Soil Pollution Government of Japan http://www.env.go.jp/en/water/soil/sp.html
172 Thailand Ministry of Natural Resources and the Environment, Pollution Control Department. Air Quality Standards 2004. http://www.pcd.go.th/info_serv/en_reg_std_airsnd01.html
173 Thailand Ministry of Natural Resources and the Environment, Pollution Control Department. Soil Quality Standards 2004. http://www.pcd.go.th/info_serv/en_reg_std_soil01.html
174 Government of India, (November 2009) Gazette of India No. 660. National Ambient Air Quality Standards. Schedule VII Rule 3 (3B).

6.4.2 Environmental source control actions and regulations

In Asia and the Pacific region only China and Thailand have reported regulations prescribing maximum limits on emission concentrations of heavy metals from point sources. However, other countries have adopted source control actions that are not detailed in the Draft Final Reviews of Scientific Information on Lead and Cadmium or the UNEP Global Mercury Assessment. Some of these have been included below. It is important to recognise that although laws and regulations for source control may appear on the statute books of most countries, there are some formidable barriers and challenges to their implementation in practice. These obstacles include a lack of resources, a lack of community awareness, difficulties in interpretation and enforcement, and problems with identifying and regulating the informal sector which in some countries may comprise the majority of certain industry sectors. These problems are not limited to developing countries and countries with economies in transition as developed countries such as Australia often have difficulties enforcing regulations for point source emissions.

6.4.2.1 China

Since the 1980's China has used an Environmental Impact Assessment scheme for industrial construction projects. In 2003 China passed the Environmental Impact assessment Act of People's Republic of China. This process assesses the emissions of a proposal and assigns maximum limits. The EPA Act of the PRC also provides for a "Mandatory Synchronization" mechanism to ensure that pollution control equipment is designed, assessed and implemented at the same time as the rest of the industrial proposal that is being assessed.

Point source limits for cadmium include:

- Category 1 - Special protection area for nature Cd - Prohibited
- Category 2 – Mixed commercial and residential area ≤0.85 mg/Nm3
- Category 3 – Industrial zones ≤0.85 mg/Nm3

Waste-water cadmium and lead discharge concentrations are limited to ≤ 0.1 mg/L and ≤1.0 mg/L respectively.

Airborne lead emissions have historically been a problem with China's older less efficient lead smelters and sinter plants. New policies have been implemented which close down older plants that have low efficiency or high lead emissions and which promote new, cleaner smelters with higher production efficiency. The PRC policy should have ensured the closure of the old smelters by the end of 2008. The current airborne lead emission limits are;

Metal smelting

- Category 1: Special protection area for nature- Prohibited.
- Category 2: Mixed commercial and residential area ≤ 10 mg/Nm3
- Category 3: Industrial zones ≤ 35 mg/Nm3

Other sources:

- Category 1: Special protection area for nature- Prohibited.
- Category 2: Mixed commercial and residential area ≤ 0.7 mg/Nm3
- Category 3: Industrial zones ≤ 0.7 mg/Nm3

In response to a study[175]indicating widespread acidification and metal mobilisation in Chinese soils the government is considering a Soil Pollution Prevention Law and draft Guidelines for Risk Assessment of Contaminated Sites.

China has also banned the import of e-waste although illegal shipments are still occurring and regulation of these imports has been difficult due to mislabelling as used electronic products for refurbishment.

6.4.2.2 Thailand

Thailand established the National Environmental Act of 1992 which has subsidiary regulations defining various emission standards. Some of these regulations define discharge limits by land use such as industry, farming, real estate and buildings. Standard and regulations are revised periodically and updated to reflect advances in knowledge about pollutants.

The Pollution Control Department of the Ministry of Science, Technology & Environment in Thailand sets guidelines for the sampling of wastewater discharges and analysis of samples are to American Public Health Association guidelines. Guidelines from the American Water Works Association and the Water Pollution Control Federation are also used.

The Pollution Control Department also sets a range of emission limits to air for a wide range of industries including incinerators, cement works, power stations, steel and gold smelters some of which include lead, cadmium and mercury limits. The following example is for medical waste incinerators

[175] Guo, J.H., et al (2010) Significant Acidification in Major Chinese Croplands. *Science* Vol. 327 no. 5968 pp. 1008-1010 19 February 2010

Medical waste incinerator air emission limits;

- Pb 0.5 mg/m^3
- Hg 0.05 mg/m^3
- Cd 0.05 mg/m^3

Other Thai environmental protection laws include;

- The Constitution of the Kingdom of Thailand B.E.2550 (2007)
- The Factories Act B.E. 2535 (1992)
- The Public Health Act B.E. 2535 (1992)
- The Hazardous Substances Act B.E. 2535 (1992)
- The Public Cleansing Act B.E. 2535 (1992)

6.4.2.3 India

India has a range of environmental laws and regulations to address broader pollution issues although they do not specifically address lead, cadmium and mercury;

- ***The Air (Prevention and Control of Pollution) Act*** was enacted in 1981 and amended in 1987 to provide for the prevention, control and abatement of air pollution in India.
- ***The Water (Prevention and Control of Pollution) Act*** was enacted in 1974 to provide for the prevention and control of water pollution, and for the maintaining or restoring of wholesomeness of water in the country. The Act was amended in 1988.
- ***The Water (Prevention and Control of Pollution) Cess Act*** was enacted in 1977, to provide for the levy and collection of a cess on water consumed by persons operating and carrying on certain types of industrial activities. This cess is collected with a view to augment the resources of the Central Board and the State Boards for the prevention and control of water pollution constituted under the Water (Prevention and Control of Pollution) Act, 1974. The Act was last amended in 2003.
- ***The Environment (Protection) Act*** was enacted in 1986 with the objective of providing for the protection and improvement of the environment. It empowers the Central Government to establish authorities [under section 3(3)] charged with the mandate of preventing environmental pollution in all its forms and to tackle specific environmental problems that are peculiar to different parts of the country. The Act was last amended in 1991.

6.4.2.4 New Zealand

Discharges of mercury to land, water and air are controlled under the Resource Management Act (RMA) (1991). The use, storage, handling, transport and disposal of hazardous substances are controlled under both the RMA and the Hazardous Substances and New Organisms (HSNO) Act 1996.

All mercury-containing products are made offshore and imported into New Zealand. Currently there are no controls on the quantity of mercury allowed in certain manufactured products that are imported into New Zealand. Imports of products containing hazardous substances such as mercury are determined by the Environmental Risk Management Authority (ERMA), Ministry of Health (MoH), Ministry if Economic Development (MED), Ministry for the Environment (MfE), and the New Zealand Police to provide the regulations.

The RMA 1991 (the Act) is New Zealand's main environmental legislation, which sets out the framework for managing the effects of activities on the environment and is implemented by the Ministry for Environment

There are four main guideline documents which are commonly used in New Zealand to assess the impact of mercury on the environment. These are:

1. ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality;
2. MfE (2002b) Ambient Air Quality Guidelines;
3. MfE (2004) Hazardous Waste Guidelines, Module 2: Landfill Waste Acceptance Criteria and Landfill Classification; and.
4. NZWWA (2003) Guidelines for the safe application of Biosolids to land in New Zealand

Table: 6-4 Environmental Source Control Concentration Limits

Environmental Source Control Concentration Limits. **(selected examples)**			
Country	**Source**	**Air**	**Water or soil**
China	Industrial furnaces, smelters and plating activities.	Industry specific limits apply to a range of industries	Industrial effluent discharge Lead ≤1.0mg/L Cadmium ≤0.1mg/L[176]
Japan	Combustion based Industry	smelting or manufacture of cadmium pigment. 1.0 mg/Nm^3 lead recycling smelting 10 mg/Nm^3 Primary lead refinery 30 mg/Nm^3	National Effluent Standards for all industry 2007[177] Cd 0.1 mg/l Pb 0.1 mg/l Hg 0.005 mg/l
Thailand	Medical waste Incinerator	Pb 0.5 mg/m^3 Hg 0.05 mg/m^3 Cd 0.05 mg/m^3	Water discharge from *any* industries Cd standard = 0.03 mg/l • discharge into ground water standard = 0.1 mg/l • discharge into public water system standard = 0.03 mg/l
India	Pharmaceutical industry incinerator[178]	Pb, Cd and Hg 1.5 Mg/Nm^3	
	Pharmaceutical industry effluent[179]		Hg 0.01mg/l Pb 0.1 mg/l
	Organic chemical manufacturing industry[180]	(for incinerator) Pb 1.5 mg/Nm^3 Hg 1.5 mg/Nm^3 Cd 1.5 mg/Nm^3	Hg 0.01 Pb 0.1 mg/l
Australia	Various	Australia has a wide range of source control concentration limits for mercury in laws and regulations for details see footnote[181]	Various

6.5 ACTIONS AND REGULATIONS ON PRODUCTS CONTAINING LEAD, CADMIUM OR MERCURY

Some countries in the Asia and Pacific region have reported measures to control the use of products containing lead, cadmium and mercury. In general terms OECD countries within this region have more extensive controls than developing countries. Table 6-5 includes a selection of those actions and regulations that have been reported in the UN Draft Final Reviews of Scientific Information on Lead (2008) and Cadmium and the Global Mercury Assessment Report (2002). This section of the study should be interpreted with some caution as prescribed regulations and other controls do not necessarily translate to effective enforcement due to resource constraints and gaps in auditing procedures for manufactured products. Where restrictions do apply on the content of these metals in products they may only be subject to random inspections of a small sub-set of the targeted products allowing. There is evidence to suggest that many products make it to the market place contaminated with lead, cadmium and mercury in spite of regulations to prevent incorporation of these metals into products.

[176] China. Ministry of Environmental Protection (MEP). Integrated wastewater discharges standard>GB8978-1996
[177] Ministry of Environment, Japan (2007) National Effluent Standards. http://www.env.go.jp/en/water/wq/nes.html
[178] Government of India. (2009) Gazette 130. G.S.R. 149(E), *Incinerator for Pharmaceutical Industry*
[179] Government of India. (2009) Gazette 395. G.S.R. 512(E). *Effluent Standards for Pharmaceutical Industry.*
[180] Government of India. (2010) Gazette 400 S.O. 608(E) *Standards for Organic Chemicals Manufacturing Industry.*
[181] Nelson, P., Nguyen, H., and Malfroy, H., (2007) *Study of Current regulatory and voluntary measures related to mercury in Australia*. Final Report to the Australian Department of Environment and Water Resources. RFQ 101/0607DEW

Table: 6-5 Actions and regulations on products containing cadmium lead or mercury

Actions and regulations on products containing lead, cadmium or mercury.		
Japan	Lead	**Import/export control:** Waste with harmful characteristics, e.g. including lead concentration of 0.01 mg Pb/ℓ and higher: *Export* - a) Approval by the Minister of economy, trade and industry is required. b) “A movement document of export” should be carried and the statement therein should be followed at transport. *Import* - a) Approval by the Minister of economy, trade and industry is required. The Minister of economy, trade and industry gives the approval to the import and checks whether the movement document submitted by the applicant meets the notification concerning regulations in Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, then provides “a movement document of import”. b) “Movement document of import” should be carried and the statement therein should be followed at transport. c) The statement of the movement document of import should be followed at disposal. Tetra alkyl lead and its preparation: *Export* - Approval by the Minister of economy, trade and industry is required. **Restriction on using lead pellet:** In order to prevent lead poisoning of water bird caused by lead pellet intake, a legal system is established on April 16, 2003: use of lead pellet is restricted in specific waterfront zones. Also, lead pellet left in shot animals’ body and eaten by birds of prey causes lead poisoning in those birds, resulting in detriment of ecological system.
	Cadmium	**Import/export control:** Waste with harmful characteristics, e.g. including cadmium concentration of 0.01 mg Cd/L and higher: *Export* - a) Approval by the Minister of economy, trade and industry is required. b) “A movement document of export” should be carried and the statement therein should be followed at transport. *Import* - a) Approval by the Minister of economy, trade and industry is required. The Minister of economy, trade and industry gives the approval to the import and checks whether the movement document submitted by the applicant meets the notification concerning regulations in Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, then provides “a movement document of import”. b) “Movement document of import” should be carried and the statement therein should be followed at transport. c) The statement of the movement document of import should be followed at disposal.
	Mercury	Chlor-alkali production (chlorine and caustic soda)*, mercury oxide batteries*, Biocides and seed dressing*, mercury in paints*, pharmaceuticals*
China	Lead	Leaded petrol phased out
	Mercury	Mercury in gold extraction*, batteries* mercury in seed dressing*, cosmetics*
	all	e-waste imports*
Turkey	Lead	Import of lead is regulated by a notification entitled "Chemicals under control for protection of the environment". In addition, a document entitled "Chemical Substances Import" has to be obtained from the Ministry of Environment and Forestry to import lead.
	Cadmium	Import of cadmium is regulated by a notification entitled "Chemicals under control for protection of the environment". In addition, a document entitled "Chemical Substances Import" has to be obtained from the Ministry of Environment and Forestry to import cadmium
	Mercury	Batteries*,
Thailand	Lead	Leaded gasoline total phase out in 1996 Lead in paint is 0.06% by weight , it will be revised to 0.01% by weight
	Mercury	Thailand reports that less than 25 percent of the factories in Thailand still use mercury as an additive in the process and in quantities of not more than 0.5 percent by total weight. Some paint industries in Thailand have no mercury involved in their processes since 1991, and are certified “green label”.

Actions and regulations on products containing lead, cadmium or mercury (continued . . .)		
Philippines	Lead	**Gasoline** - Administrative Order No. 47 (Series of 1998) about the phasing-out of leaded gasoline. The Order states that beginning January 1, 2000, no person shall sell, offer for sale, supply or offer for supply, gasoline, from bulk plant or final distribution facility in Metro Manila unless the gasoline complies with the latest issue of the Philippine National Standards (PNS):1131"Specifications for unleaded motor gasoline". Nor shall any person import leaded gasoline and lead containing fuel after December 31, 1999, except those that shall be used in areas outside of Metro Manila". Beginning January 1, 2001, no person shall manufacture, sell, offer for sale, dispense, transport or introduce into commerce gasoline unless the gasoline complies with the latest issue of the PNS:1131. However, beginning October 1, 2000, no person shall import leaded gasoline and lead-containing fuel additives.
	Mercury	Gold extraction*
Pakistan	Lead	**Gasoline** - Pakistan Oil Marketing Companies are marketing lead free gasoline
Iran	Lead	Elimination of the use of leaded gasoline to control air pollution. Recycling of Lead batteries.
	Cadmium	Actions to replace nickel-cadmium batteries with other appropriate batteries
Indonesia	Lead	Leaded fuel phased out since 2006
Samoa	Mercury	Seed dressing*

Source: UNEP 2008 Draft Final Reviews of Scientific Information on Lead and Cadmium

*Import, sale and/or use banned or restricted nationally (further details in the annex to the UN Global Mercury Assessment Report)

6.5.1 Lead in fuels

In the Asia Pacific region most countries have already phased out leaded petrol and progress is being made to negotiate the elimination of lead in petrol in those countries that still permit its use. The UNEP Partnership for Clean Fuels and Vehicles (PCFV)[182] has made significant progress on this issue. The PCFV aims to assist developing countries to reduce air pollution from the vehicle transport sector by promoting and assisting with the development of lead-free and low-sulphur fuels. The PCFV also promotes cleaner vehicle standards and encourages transfer of cleaner technologies.

All Pacific Island countries now report that they use unleaded petrol. Initial discussions have been held in Burma between the National Commission for Environmental Affairs (NCEA) and the PCFV with positive signs that a 'road map' may be negotiated to phase out leaded fuel in Myanmar. The use of both leaded and unleaded fuel continues In Bhutan while only leaded fuel is used in North Korea.

6.6 OTHER STANDARDS AND WASTE MANAGEMENT INITIATIVES.

There are a wide range of waste management initiatives emerging in Asia and the Pacific region that address the issues of lead, cadmium and mercury in products – particularly in the waste phase. They are driven by a range of actors including national governments, international governance organisations, industry associations, public interest Non-Governmental Organisations (NGO's) and partnerships involving combinations of these actors. Examples of these initiatives are provided below.

6.6.1 The Bangalore Initiative

In Bangalore, India, an initiative with active support of the German and Swiss Government was started in 2002. Funded by the German Federal Ministry of Economic Cooperation and Development the Bangalore Initiative is focused on environmentally sound electronic waste management, recycling, capacity building and awareness raising. The project has resulted in seminars, studies and cooperative initiatives with NGO's on sound management of batteries and fluorescent lights. The major risks associated with the e-waste trade are exposure to heavy metals such as lead, cadmium and mercury during dismantling, breaking and smelting of components for recycling or materials recovery.

The initiative has also resulted in the establishment of the E-Waste Agency Bangalore[183] (EWA) created in Bangalore in 2005 as a model institution for the management of e-waste for all of India. The agency specialises in research and advice on technical and policy measures to promote the environmentally sound management of e-waste. EWA is supported by the Ministry of Environment and Forestry and the Central Pollution Control Board.

6.6.2 Better Environmental Sustainability Targets (BEST) For Lead Battery Manufacturers India.[184]

International NGO - Occupational Knowledge International (OK International) has worked with industry, government and NGO stakeholders in India to develop minimum emission standards for companies manufacturing and recycling lead batteries in India. The programme is intended to reduce the risk of lead poisoning to workers and residents living near the battery manufacturers through implementation of a series of standard operating procedures, minimum emission standards, occupational health protection measures and environmentally sound waste management. The program also sets out minimum criterion for chemical storage and handling, resource consumption and emergency response.

The BEST Standard 1001 for lead battery manufacture/recycling was developed in conjunction with Development Alternatives[185] and the National Referral Centre for Lead Poisoning[186] in India. The program is expanding and copies of the standard are now available in Vietnamese.

The BEST standard is targeted toward the medium to large formal sector recyclers of ULABs in an effort to minimise human health and environmental impacts of lead exposure. Many countries in Asia are considering the BEST standard or similar instruments for similar reasons as a consequence of the ULAB export restrictions imposed under Annex VII (OECD, EC, Liechtenstein) to non-Annex VII countries pursuant to decision III/1 of the Basel Convention.

These restrictions have reduced feedstock to secondary smelters in many parts of Asia and have promoted greater competition between the informal and formal recycling sector for the limited domestically generated feedstock.[187] The low overhead associated with the informal sector (wages, infrastructure, OH&S and pollution control) make it difficult for the formal sector to compete on a price basis for lead scrap batteries.

A government registration scheme for ULAB recyclers in India requires all registered operators to meet Environmentally Sound Management criteria. The registration scheme accompanies legislation intended to reduce pollution from battery recycling (the Batteries (Management & Handling) Rules, 2001) In excess of 35 operators are now registered for the scheme and their distribution through India ensures that lead scrap does not have to be transported great distances.

Indian authorities are implementing other strategies aimed at channelling lead scrap into formal smelters and away from the informal sector. One method has been to only allow registered recyclers to attend auctions for battery scrap – a key

[182] The Partnership for Clean Fuels and Vehicles http://www.unep.org/transport/pcfv/
[183] http://www.ewa.co.in/
[184] http://www.okinternational.org/lead.html
[185] http://www.devalt.org
[186] http://www.tgfworld.org/news-nrc.htm
[187] UNCTAD/ILMC (1999) *A Review of the Options for Restructuring the Secondary Lead Acid Battery Industry, in Particular the Smaller Battery Recyclers and Secondary Lead Smelters and the Informal Sector, with a View to Enhancing Their Environmental Performance and Improving Health Standards.* A joint project on UNCTAD and the International Lead Management Centre Inc.

supply source for the informal sector. This has resulted in significant increases of supply to the organised smelting sector.[188]

6.6.3 Solving the E-waste Problem (StEP)

StEP[189] is an initiative of a number of different UN organisations in conjunction with prominent industry bodies, scientists, governments and NGO's to solve the global problem of e-waste. StEP conducts research and analysis on the entire life cycle of e-waste and develops solutions that can be implemented to ensure that e-waste can be handled, recycled and recovered without human health impacts or environmental impacts.

StEP has an increasingly global focus with the establishment of Thai Electrical and Electronic Institute as the StEP Regional Focal Point for South East Asia. In conjunction with the Basel Secretariat, StEP has negotiated for the Basel Convention Coordinating Centre (China) to act as the StEP Regional Focal Point for East Asia. Australia's Griffith University has been appointed as the StEP Regional Focal Point for the South Pacific.

6.7 INTERNATIONAL AGREEMENTS AND INSTRUMENTS

6.7.1 The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal

The Basel Convention[190] aims to protect human health and the environment against adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous and other wastes. This comprehensive global environmental agreement has 175 Parties (member countries) and came into force in 1992.

The Basel Convention emerged in response to the increasing number of cases of hazardous waste imports into developing countries in Africa and Asia in the 1980's which led to unacceptable human health and environmental impacts. One of the key restrictions imposed by the Basel Convention is the prohibition of shipments of hazardous waste from OECD to non-OECD countries where there is unlikely to be environmentally sound waste treatment and disposal capacity. This feature of the Convention is known as the Ban Amendment.

The Basel Convention has been one of the main international legal instruments for the control of lead, cadmium and mercury in products that have come to the end of their useful life. In recent years e-waste has come under scrutiny from the Basel Convention as many countries have difficulties in classifying used electronic equipment as a 'product' or 'waste' particularly where second hand goods such as computers may be imported in working order but break down quickly or are rendered technically obsolete and rapidly become e-waste.

The Basel Ban amendment was passed in 1994 whereby Parties agreed to an immediate ban on the export from OECD to non-OECD countries of hazardous wastes intended for final disposal. The Conference of Parties (COP) also agreed to ban the export of wastes (from OECD to non-OECD countries) intended for recovery and recycling by no later than 31 December 1997.[191] At this point in time the Basel Ban Amendment has not been implemented due to an insufficient number of national signatories and legal debate over ratification issues.

6.7.2 The Rotterdam Convention

The Rotterdam Convention on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (1998)[192] has the objective of promoting shared responsibility and cooperative efforts among parties in the international trade in hazardous chemicals. The long-term goal is to reduce the risk to human health and the environment from hazardous chemicals.

The Rotterdam Convention has been created to address the dramatic growth in chemical production and trade in toxic chemicals on a global scale. It also helps participating countries learn more about the characteristics of potentially hazardous chemicals and pesticide formulations. It also provides countries with the information and the means to stop unwanted imports of toxic chemicals. The Convention puts the requirement on the exporter to advise of an export of potentially hazardous substances and an onus on the exporting country to comply with the decisions of importing countries and those transit countries through whose territory the chemical shipments will pass.

The Rotterdam Convention has a role to play in ensuring that some products containing lead, cadmium or mercury are scrutinized prior to import. The scope of the Rotterdam Convention is primarily focused on hazardous pesticide formulations some of which are known to contain mercury and other heavy metals.

The Rotterdam Convention entered into force on February 24, 2004. At Conference of the Parties One (COP 1) in September 2004, 14 chemicals were added to Appendix III. At COP 4 in October 2008 Appendix III was amended to include all compounds of tributyltin and this amendment entered into force on February 1, 2009.

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[188] Rajagopalan, V., (2006) *Recent Indian Policy Initiatives in Lead Battery Scrap Management and their Impact on the domestic Demand-Supply Gap of Lead*. Ministry of Environment and Forests. Government of India. 2006.
[189] http://www.step-initiative.org/index.php
[190] http://www.basel.int/
[191] http://www.basel.int/pub/baselban.html
[192] http://www.pic.int/home.php?type=t&id=5&sid=16

6.7.3 The Aarhus Protocol on Heavy Metals

The United Nations Economic Commission for Europe (ECE) in conjunction with the Convention on Long-Range Transboundary Air Pollution (LRTAP)[193] developed the Aarhus Protocol on Heavy Metals[194] as one of eight protocols intended to address air quality issues within the ECE. While LRTAP has been operational since 1979, the adoption of the Aarhus Protocol (which addresses lead, cadmium and mercury emissions) took place in 1998, with entry into force taking place in December 2003.

The Aarhus Protocol shares the same objective as the other seven protocols which are to control emissions of harmful substances from anthropogenic activities particularly when those emissions are known to travel long distances and are known, or are likely to have significant negative impacts on human health and the environment. The other seven protocols address a range of pollutants and measures including persistent organic pollutants (POPs), sulphur, volatile organic compounds (VOC's) and nitrogen oxides.[195]

The protocol requires member countries to implement control measures to ensure a reduction in total annual airborne emissions of lead, cadmium and mercury. The control measures may include Best Available Technology (BAT) implementation for stationary industrial emission sources which are recognised by the Aarhus Protocol as the primary source of heavy metal emissions to atmosphere in the ECE.

The UNEP (2008) Draft Final Reviews of Scientific Information on Lead and Cadmium provide detailed graphic analysis of the sources and fate of airborne heavy metals emissions in Europe and the relative contribution of the pollutants by country. This baseline information is critical to allow control measures to be developed within individual countries that contribute relative high pollution loads to atmosphere of cadmium, lead and mercury. Although this instrument is focused on European activity, research into the long range transport of heavy metals in the atmosphere (particularly mercury) is applicable and relevant to impacts in other regions of the world including Asia and the Pacific region.

While the Aarhus Protocol does not apply directly to the countries in the Asia Pacific region it provides a model for regional conventions on airborne lead, cadmium and mercury and sets a framework for control of industrial emissions that can be tailored to regional circumstances. It also provides a guide to those industries that have been identified as the primary source of emissions of lead, cadmium and mercury which include;

- Iron and steel industries
- Non-ferrous metals industry
- Combustion based power generation
- Waste incineration

6.7.4 SAICM

The Strategic Approach to International Chemical Management (SAICM) is an international policy framework to encourage the sound management of chemicals to avoid impacts to human health and the environment. SAICM was adopted by The International Conference on Chemicals Management (ICCM) on 6 February 2006 in Dubai, United Arab Emirates.

The 2002 Johannesburg World Summit on Sustainable Development set a number of goals for international action. One goal was to be able to produce and use chemicals with minimal impact on human health and the environment by 2020. SAICM has been developed by a multi-stakeholder Preparatory Committee to assist in reaching this goal.

SAICM comprises the Dubai Declaration on International Chemicals Management, expressing high-level political commitment to SAICM, and an Overarching Policy Strategy which sets out its scope, needs, objectives, financial considerations underlying principles and approaches and implementation and review arrangements. Objectives are grouped under five themes: risk reduction; knowledge and information; governance; capacity-building and technical cooperation; and illegal international traffic.[196]

As part of the SAICM Overarching Policy Strategy the Quick Start Program (QSP) was developed. The QSP provides a time-limited trust fund which is administered by UNEP for the purpose of providing support for enabling capacity building and implementation activities in developing countries, least developed countries, Small Island developing States and countries with economies in transition.

The QSP was established by Resolution 1/4 of the ICCM and is intended to fund projects in target countries which lead to;

(a) Development or updating of national chemical profiles and the identification of capacity needs for sound chemicals management;

(b) Development and strengthening of national chemicals management institutions, plans, programmes and activities to implement the Strategic Approach, building upon work conducted to implement international chemicals-related agreements and initiatives;

c) Undertaking analysis, interagency coordination, and public participation activities directed at enabling the implementation of the Strategic Approach by integrating – i.e., mainstreaming – the sound management of chemicals in national strategies, and thereby informing development assistance cooperation priorities

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[193] http://www.unece.org/env/lrtap/
[194] http://www.unece.org/env/pp/
[195] http://www.unece.org/env/lrtap/status/lrtap_s.htm
[196] http://www.saicm.org

Examples of activities already undertaken under the SAICM QSP include;

- Technical assistance to the Bahamas, Barbados and Haiti to improve the ability of those countries to analyse persistent organic pollutants through training and the provision of hardware.
- Technical cooperation between dioxin analysis laboratories in the US and Sweden with China and Mexico to assess the release of dioxins and furans from burning of biomass. The project was intended to build the capacity of China and Mexico to design and implement these types of studies which in turn will lead to the identification and reduction of hazardous chemical emissions. The ultimate goal of these exercises being to reduce or eliminate emissions of hazardous chemicals that may impact on human health and the environment.

The CiP Project

SAICM activities gained greater relevance to the issue of international trade in lead, cadmium and mercury with the first meeting to discuss products that contain chemicals taking place in February 2009 with a second meeting in December 2009.[197] The meeting was supported by the Japanese and Swedish governments and identified chemicals in products as a priority emerging issue for the international sound management of chemicals. The Second International Conference on Chemicals Management (ICCM 2) took this issue a step further with a resolution to initiate a project on Chemicals in Products to promote the implementation of Objective 15 (b) of the SAICM Overarching Policy Statement. The objective states that information on chemicals, (and where appropriate) chemicals in products should be available, accessible, user friendly, adequate and appropriate to the needs of all stakeholders.[198] UNEP was invited to lead and facilitate the CiP project and to report on the project implementation and its outcomes to the SAICM Open-ended working group in mid 2011 and to ICCM3 in mid 2012.

SAICM stakeholders identified toys, building materials, textiles and electronics as key priority areas for assessment and case studies for each sector have been commissioned. The electronics sector was considered a priority due to the impacts of e-waste on human health and the environment in developing countries. Information on chemicals in products has been difficult to obtain due to claims of commercial in confidence and lack of data consolidation. The case studies will assist in filling a number of key data gaps. The project aims to;

(a) Collect and review existing information on information systems pertaining to chemicals in products including but not limited to regulations, standards and industry practices;

(b) Assess that information in relation to the needs of all relevant stakeholders and identify gaps;

(c) Develop specific recommendations for actions to promote implementation of the Strategic Approach with regard to such information, incorporating identified priorities and access and delivery mechanisms.

Chemical incidents

An essential element of sound international chemical management is preparedness for the prevention of and response to serious chemical incidents. The rapid industrialisation of many developing countries has not been matched by an equally rapid development of environmentally sound chemical management frameworks. As a result the number of countries with industrial sites that have a high potential to cause major chemical accidents has risen sharply.

In 2007 a UNEP expert working group, involving selected experts and institutions in the fields of chemical safety and prevention of industrial accidents was established to develop and implement a Guidance document for a flexible framework on chemical accidents. The 4th Meeting of the Expert Working Group in May 2008 resulted in the draft Guidance document - *The Flexible Framework for Chemical Accident Prevention*[199]*.* The Norwegian government has provided funding to facilitate the implementation of the framework in Cambodia and the Philippines with additional countries under consideration through the SAICM QSP.

In terms of mercury exposure reduction SAICM, through the Quick Start Programme, has initiated funded projects for the purpose of protecting human health and the environment from mercury in artisanal and small scale gold mining (ASGM) in Asia. Projects for ASGM were funded in the Philippines and Cambodia in the 4th funding round of QSP.

Mercury contamination from ASGM is an issue that is taken very seriously in the Philippines and recent news indicates that strong action is being undertaken to prevent contamination in some regions. On January 10, 2011 Provincial Governor Eduardo Firmalo of Romblon issued Executive Order No. 001, s.2011 incurring a moratorium on all mercury based ASGM after mercury vapor tests around the island of Sibuyan, by NGO group Ban Toxics, found disturbing levels of mercury contamination caused by ASGM..

The SAICM QSP has also funded a number of Asian countries and PICs to update their national chemicals management profile, develop national SAICM capacity assessment and to hold a national SAICM priority setting workshop. Funding for these projects has been issued to Cambodia, Kiribati, Kyrgyzstan, Mongolia, and Nepal.

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[197] UN (2009) 25th session of the Governing Council/global Ministerial Environment Forum, Nairobi, February 16 to 20, 2009 item 4) of the provisional program Policy issues: chemicals management including mercury.
[198] The International Chemical Secretariat (2011*) Information on Chemicals in Electronic Products. A study of needs, gaps, obstacles and solutions to provide and access information on chemicals in electronic products.* February 2011.
[199] http://www.unep.fr/scp/sp/saferprod/pdf/FlexibleFramework_Brochure_April09.pdf

Other QSP projects relevant to the Asia and Pacific region include;

- Strengthening Capacities for National SAICM Implementation in the Democratic People's Republic of Korea
- Development of an effective national chemical safety program towards chemical poisoning prevention and control in the Philippines
- Establishing an Institutional Framework and strengthening National Capacity within an integrated national programme for the sound management of chemicals and implementation of the Strategic Approach in Samoa
- Strengthening National Capacities for Sound Management of Priority Industrial Carcinogens and Updating National Chemicals Profile in Sri Lanka
- Capacity Building and Awareness Raising Programmes on the Implementation of the Rotterdam Convention in Thailand
- Technical Support to Strengthening National Capacities for Sound Management of Priority Industrial Carcinogens in Indonesia and Thailand.

6.7.5 UNEP Global Mercury Partnership

The goal of the Global Mercury Partnership was initiated at UN Governing Council 23 to protect human health and the environment from the release of mercury and its compounds by minimizing and, where feasible, ultimately eliminating global, anthropogenic mercury releases to air, water and land.[200]

UN Governing Council 25/5 held in Nairobi, Kenya, on the 16-20 February 2009, declared The Global Mercury Partnership to be the main mechanism for delivering immediate action on mercury while international governments work toward a global instrument for mercury control.

The Global Mercury Partnership has identified seven Priorities for Action including:

- Reducing mercury use in artisanal gold mining
- Controlling mercury from coal combustion
- Reducing mercury from Chlor-Alkali production
- Reducing mercury in products
- Mercury waste management
- Mercury supply and storage
- Airborne mercury fate and transport

The control and reduction of mercury in wastes is closely related to reduction of mercury in products. Some of the key products identified as having a significant mercury component include thermometers, switches, thermostats, fluorescent lamps, sphygmomanometers, batteries and dental amalgam.

The program has already made significant progress in identification of alternative materials and processes to replace mercury in thermometers, switches and relays, batteries other than button cells, thermostats, HID auto discharge lamps, and sphygmomanometers. Batteries and lamps containing mercury remain problematic and cost effective alternatives are still being sought.

Current projects of the Global Mercury Partnership in the Asia and Pacific region include that relate to mercury in products include:

- the gradual phase out of all mercury containing equipment in all Philippines medical facilities[201].
- a market research report on Chinese mercury-free thermometers and sphygmomanometers[202]

The Global Mercury Partnership also has listed the storage and management of mercury waste as a Priority for Action. The Japanese Ministry of Environment leads the partnership activities in this area with annual meetings on the subject and the initiation of projects. These include the *5 Country Waste Management Project* and the *Technical and Economic Assessment of Mercury Containing Tailings.*

6.7.6 The 5 Country Waste Management Project

This project has currently run from 2008-2010 and is funded by the Government of Norway and is implemented by the UNEP Chemicals Branch The objectives of the project are to increase the technical capacity of selected countries and other stakeholders in assessing, managing and reducing the risks to human health and the environment posed by mercury and mercury-containing waste. The second objective is to assess the applicability of the Draft Technical Guidelines on Environmentally Sound Management of Mercury Waste.[203]

This project builds upon the work already completed by many countries in developing national inventories of mercury wastes and emissions. The inventories were developed using the UNEP Toolkit for Identification and Quantification of

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[200] http://www.unep.org/hazardoussubstances/Mercury/GlobalMercuryPartnership/tabid/1253/Default.aspx

[201] Republic of Philippines (2008) Department of Health. Administrative Order No. 2008-002. *Gradual Phase-Out of Mercury in all Philippine Health Care Facilities and Institutions.*

[202] http://www.chem.unep.ch/mercury/Sector-Specific-Information/Docs/China%20-%20GVB%20Non-Mercury%20Medical%20devices%20Report.pdf

[203] Basel Convention Secretariat (2010) Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of, Containing or Contaminated with Mercury – 5th Draft. January 2010.

Mercury Releases[204] which has recently been updated. This project has a high degree of relevance to this study due to the close relationship between mercury waste and mercury in products. The five countries participating include Burkina Faso, Cambodia, Chile, Pakistan, and the Philippines. All participants have completed workshops over the last two years.

6.7.7 Technical and economic assessment of mercury-containing tailings (2009)

Mercury plays a significant role in the mining sector both as an extract from cinnabar for sale as a product and as an intermediary processing component in the refining of gold, silver, copper and other metals. The project explored the feasibility of environmentally sound reprocessing of mercury tailings in areas that have suffered environmental degradation from historical mining activity resulting in mercury contaminated waste and tailings. Outcomes from the project to date include a detailed *Report on the Technical and Economic Criteria for processing Mercury Containing Tailings* and a *Chile Feasibility Study*[205].

6.7.8 The Global Alliance to Eliminate Lead in Paints (GAELP)

The overall goal of the partnership (which is the co-responsibility of UNEP and WHO), called the Global Alliance to Eliminate Lead in Paints[206], is to prevent children's exposure to lead via paints containing lead and to minimize occupational exposures to lead in paint. The broad objective is to phase out the manufacture and sale of paints containing lead and eventually to eliminate the risks from such paint.

In 2008 the International POPs Elimination Network (IPEN) partnered with the Indian organization "Toxics Link", to conduct global sampling of lead in paint with organisations in developing countries and countries with economies in transition. Ten countries in Asia, Africa, Eastern Europe and Latin America were involved (see http://www.ipen.org/ipenweb/work/lead/lead_paint.html#sample). The results confirmed that lead in paint is still being produced and sold, exposing children and communities to this toxic substance. The study showed that, with a few exceptions, all plastic paint samples had low lead concentrations, and the majority of enamel paint samples had lead concentrations higher than regulatory levels of 90ppm (US, China) or 600ppm (Singapore). Lead concentrations in paints ranged from 0.6 ppm to 505,716 ppm.

In parallel, the international community has taken action to build on this NGO initiative. IPEN proposed a Global Partnership to eliminate lead from paint to Forum VI of the Intergovernmental Forum on Chemical Safety (IFCS) in September 2008. IFCS, through a resolution passed at Forum VI, endorsed this NGO initiative. This NGO initiative also gained attention and support as an Emerging Issue within the Strategic Approach to International Chemicals Management (SAICM) that requires immediate attention and consideration for the International Conference on Chemicals Management. During this process, governments, the private sector, health groups, and other international agencies joined IPEN and Toxics Link to endorse and confirm the need for a Global Partnership. Then in May 2009, the International Conference on Chemicals Management endorsed the Global Partnership to promote the global phase-out of lead in paints, which tasked both UNEP and WHO establish the Global Partnership mechanism.

The key activity areas of GAELP are:

a) Raising awareness of toxicity to human health and the environment and alternatives;
(b) Guidance and assistance to identify potential lead exposure;
(c) Assistance to industry (manufacturers, wholesalers and retailers);
(d) Prevention programmes to reduce exposure;
(e) Promotion of national regulatory frameworks.

Initial organisational meetings were held in Geneva in May 2010 to establish a framework for action and to develop work plans for the five focal areas of the Global Alliance, i.e. Health Aspects, Environmental Aspects, Legislation and Regulation, Assistance to Industry, and Workers Health.

6.8 INTERNATIONAL ORGANISATIONS AND PROGRAMMES

There are a wide range of international organisations operating programmes in Asia and the Pacific region who are addressing the issues of pollution arising from lead, cadmium and mercury. These include but are not limited to:

- The Asia Development Bank (ADB)
- The Global Environment Facility (Pacific Alliance for Sustainability)
- The International POPs Elimination Network (IPEN)
- The United Nations Environment Program (UNEP)
- The Blacksmith Institute and the Green Cross
- The International Programme of Chemical Safety (IPCS)
- The United Nations Industrial Development Organization (UNIDO)
- The International Labour Organization (ILO)
- Intergovernmental Forum on Chemical Safety (IFCS)
- International Agency for Research on Cancer (IARC)
- The World Bank (WB)

[204] Document available at: http://www.unep.org/hazardoussubstances/Mercury/tabid/434/Default.aspx
[205] Both of these reports can be accessed at:
http://www.unep.org/hazardoussubstances/Mercury/InterimActivities/Partnerships/Addendum/tabid/3536/language/en-US/Default.aspx
[206] http://www.chem.unep.ch/Lead_in_paint/default.htm

6.9 SUB-REGIONAL AND REGIONAL AGREEMENTS

6.9.1 The Waigani Convention

The full title of the convention is *The Waigani Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Transboundary Movement and Management of Hazardous Wastes within the South Pacific Region (1995)*[207]*.*

The Convention is very similar to the Basel Convention in that it seeks to limit the movement of hazardous wastes and other material for the protection of human health and the environment. The major difference lies in the fact that Waigani is administered within the Pacific Forum region. This means that Pacific Island countries have a significant say in how the Convention will evolve. The Waigani Convention is also different to the Basel Convention in that it covers radioactive wastes and extends to the Economic Exclusion Zone (200 nautical miles) rather than the territorial sea (12 nautical miles) under the Basel Convention.

The Convention was opened for signature in Waigani, Papua New Guinea in 1995 and entered into force in 2001. As of June 2008 there were 13 parties to the Convention including Australia, Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Nauru, New Zealand, Niue, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu. The Conference of Parties meets biannually.

The Waigani Convention has four major objectives:

- to reduce or eliminate transboundary movements of hazardous and radioactive wastes into and within the Pacific Forum region;
- to minimise the production of hazardous and toxic wastes in the Pacific Forum region;
- to ensure that disposal of wastes is done in an environmentally sound manner and as close to the source as possible; and
- to assist Pacific Forum developing countries in the environmentally sound management of hazardous and other wastes they generate.

The Convention covers toxic, poisonous, explosive, corrosive, flammable, ecotoxic, infectious and radioactive wastes. As such it plays a role in the identification, regulation and prohibition of shipments of wastes attempting to enter the Pacific Islands Forum region. This includes waste shipments containing lead, cadmium and mercury.

Obligations on member countries include a ban on the import of hazardous and radioactive wastes. They should minimize the production of hazardous wastes and cooperate to ensure that wastes are treated and disposed of in an environmentally sound manner. The member countries also need to introduce national legislation that meets the reporting mechanisms and other obligations of the Convention. All potential traffic in hazardous wastes through the region defined by the convention has to been documented and transmitted through the convention Secretariat (in this case SPREP) for notification to member countries.

6.9.2 Secretariat of the Pacific Regional Environment Programme

With its headquarters based in Apia, Western Samoa, the Secretariat of the Pacific Regional Environment Programme (SPREP)[208] is a regional organisation established by the governments and administrations of the Pacific region to manage and monitor the regional environment. It has grown from a small programme attached to the South Pacific Commission (SPC) in the 1980s into the Pacific region's major intergovernmental organisation charged with protecting and managing the environment and natural resources.

The establishment of SPREP also sends a clear signal to the global community of the deep commitment of the Pacific Island governments and administrations towards sustainable development, especially in light of the outcomes of the World Summit on Sustainable Development in the form of the Plan of Implementation, the Millennium Development Goals and Declaration[209], the Barbados Plan of Action[210]and Agenda 21[211]. SPREP has 21 Pacific Island member countries and four countries with direct interests in the region.

SPREP acts as a focus point for policy and environmental expertise in the region and runs dozens of environmental projects and partnerships including projects focused on:

- Marine pollution
- Pollution prevention
- Persistent Organic Pollutants
- Landfills
- Hazardous and solid waste

[207] For a detailed description of the Convention and its obligations see: http://www.sprep.org/publication/MEA/waigani/waigani/descr_c1.html
[208] http://www.sprep.org/
[209] http://www.un.org/millenniumgoals/
[210] http://www.unep.ch/regionalseas/partners/sids.htm
[211] http://www.un.org/esa/dsd/agenda21

6.9.2.1 SPREP/AFD Regional Solid Waste Management Initiative

SPREP has also signed a regional initiative with the French Development Agency (AFD) to undertake a Regional Solid Waste Management Initiative which will result in 1 million euro of funding for solid waste initiatives over the next four years in the region. The project has three components 1) vocational training in waste management through regional institutions, 2) development of waste oil collection and recovery programs and 3) reparation of country activity proposals to secure additional funding.

This project will assist with co-funding for UNEP regional funding under the Global Environment Facility (GEF)[212] to address POPs Release Reduction Through Improved Management of Solid and Hazardous Wastes. This project aims to ensure that chemicals are used in an environmentally sound manner and to reduce releases of POPs and other persistent toxic substances such as lead, cadmium and mercury. It includes a component to address contaminated sites issues.

6.9.3 Barbados Programme of Action for the Sustainable Development of Small Island Developing States

In 1994 an international conference was held in Barbados to examine how small island states could deal with the increasingly complex social, economic and environmental problems they face. The 1994 *Global Conference on the Sustainable Development of Small Island Developing States* agreed that a program of sustainable development was the best solution and adopted the Barbados Programme of Action for the Sustainable Development of Small Island Developing States[213].

The UN Inter-Agency Committee on Sustainable Development considers on a regular basis the United Nations system-wide coordination in the implementation of the Conference outcome. Forty one small island developing States and territories are monitored by the UN for the purposes of implementation of the Barbados Programme of Action. These Island States and territories work cooperatively through the Alliance of Small Island States (AOSIS) and includes numerous South Pacific countries.

In 2002, the United Nations General Assembly called for a comprehensive review of the Barbados Programme of Action (BPoA) which was adopted in 1994. The BPoA sets forth specific actions and measures at the national, regional, and international levels in support of the sustainable development of the Small Island Developing States (SIDS). Key issues to be tackled under the BPoA include environmental degradation, climate change, over-exploitation of fisheries resources, land-based pollution, and natural disasters.

6.9.4 Regional Initiative on Environment and Health in Southeast and East Asian countries

The Regional Initiative on Environment and Health in Southeast and East Asian countries is a global framework for action provided by Agenda 21 of the 1992 United Nations Conference on Environment and Development; the Johannesburg Plan of Implementation of the 2002 World Summit on Sustainable Development; and the Millennium Development Goals of the United Nations; the recommendations of the 5th Ministerial Conference on Environment and Development in Asia and the Pacific held in Seoul, Republic of Korea, March 2005 on Enhancing the Environmental Sustainability of Economic Growth.

Participating countries include Brunei Darussalam, Cambodia, China, Indonesia, Japan, Lao People’s Democratic Republic, Malaysia, Mongolia, Myanmar, The Philippines, Republic of Korea, Singapore, Thailand, and Vietnam.[214]

[212] http://www.thegef.org/gef/
[213] http://www.unep.ch/regionalseas/partners/sids.htm
[214] http://www.environment-health.asia/intro/EH_MF1_MD_Brochure.pdf

CHAPTER 7
CASE STUDIES ON THE EFFECTS ON HUMAN HEALTH AND THE ENVIRONMENT LEAD, CADMIUM AND MERCURY AND PRODUCTS CONTAINING LEAD, CADMIUM AND MERCURY.

7.0 Introduction

This chapter includes a range of case studies developed by NGO's in the Asia Pacific region which document health or environmental impacts of lead, cadmium and/or mercury arising from the use and disposal of products containing lead, cadmium or mercury. The case studies include references to data and relevant laboratory results as well as background information on the problem and lessons to be learned from addressing the problem and any progressive practices that may avoid these problems in future.

7.1 CASE STUDY 1 – HEAVY METALS IN USED LEAD ACID BATTERIES AT RAROTONGA, COOK ISLANDS

Author: Imogen Pua Ingram - Island Sustainability Alliance CIS Inc. ("ISACI") Relevant Heavy Metals Management Practice Under Annex 1 of the Basel Convention (to which the Cook Islands acceded in June 2004) there is a list of hazardous wastes to be controlled. This list is categorized by Items Y1 to Y18 as waste streams and by Items Y18 to Y45 as Wastes as having heavy metal constituents. Heavy metals fall under the second group of Y18 to Y45 Wastes as having constituents. Lead and lead compounds are identified as Item Y31 in this Annex 1 list. There are no provisions in the Cook Islands for proper storage and disposal of wastes containing heavy metals. Discarded batteries, particularly ULABs, are a source of hazardous waste containing high quantities of lead.

Background

From 2003 until 2005, ULABs were delivered, together with other recyclable waste, to a site managed by Recycle Cook Islands Limited in the sub-district of Turangi, at Ngatangiia village in Rarotonga. Recycle Cook Islands Limited is a private Cook Islands company that had been working in partnership with NZAID, the New Zealand agency for Overseas Development Assistance (which assisted with funding), together with the NZ Ministry for the Environment (which provided capacity-building and study tours on best practice) and the NZ Ministry for Economic Development.

In 2005, the handling of vehicular batteries and other hazardous wastes was privatized and in 2008 the Turangi site closed down and operations were moved to Raro Ariki Road in the Teotue sub-district of Avarua on the north side of Rarotonga. As can be seen in the recent photograph below, vehicular batteries are poorly stored in the open air.

The Cook Islands is an archipelago of 15 islands in eastern Polynesia, consisting of volcanic islands with fringing coral reefs in the south, and in the north circular coral atolls around a large lagoon. The population at the last Census was 15,000 persons (SOPAC 2007), mostly of indigenous Polynesian descent. The total area is 635 square kilometres, with a population density of 64 persons per square kilometre. Approximately 9,000 people live on the capital island of Rarotonga. Since 1965, the Cook Islands have been self-governing in free association with New Zealand.

Figure 7-1 Raro Ariki Road: Storage in this manner is considered environmentally unsound because it allows for soil contamination by heavy metals through leachate generated by rainfall. (source ISACI)

Understanding the Heavy Metal Product Management and its Environmental and Health Impacts

Those ULABs that are not delivered to the Recycle Cook Islands site are either landfilled, or dumped on vacant land. Scientific literature indicates that open-air storage of ULABs is likely to result in contamination of soils, surface-water, groundwater and eventually lagoons through leaching of heavy metals. The main concern for Small Islands Developing States (SIDS) is leachate will find its way into the food chain and contaminate drinking water. There is also concern about lead exposure to children and adults in contact with contaminated soil and fumes when waste is burnt.

The former site for Recycle Cook Islands Ltd was in the sub-district of Turangi, on the east side of Rarotonga, the capital island. The current site is in the north of Rarotonga, in the sub-district of Teotue, at Avarua. There are residential houses across from the site, and Nukuture School is diagonally opposite. The residents are in the middle-income bracket and work at service jobs in the Avarua central business district.

In December 2008, Recycle Cook Islands cleared the Turangi site and put up signs indicating the site was closed. However, the recent photograph below shows the people continue to dump ULABs at the old site where they are burnt with mixed waste, and at the adjacent property which is under the control of Cook Islands Exports. There is another site near the Big Orange Store in Matavera village that Cook Islands Exports use for interim storage.

Figure 7-2 Waste burning at the Turangi site

Laws, policies or regulations that address the issue

As yet, the Cook Islands Government has no policies or laws relating to the safe management of heavy metals or other hazardous wastes. In 2004, the Cook Islands government ratified the Basel, Rotterdam, Stockholm and Waigani Conventions. However, no laws have been passed yet to incorporate the provisions of these Conventions into national legislation.

Despite the capacity-building efforts of the NZ Ministry for the Environment, and the NZ Ministry for Economic Development, there has been no compliance with the Basel Convention guidelines and no oversight with regard to management of this waste stream since it was given to the private sector. Apart from a DVD documenting the first shipments of batteries from the Turangi site, there has been no public reporting about activities.

Proposed Actions by Government or Industry to Improve Management of the Heavy Metal Products and Clean Up the Problem

When contacted in December 2010, the operators of Recycle Cook Islands Ltd agreed that open-air storage of ULABs was inadequate and that capacity-building in safe interim storage practices was needed. The operators had arrangements with firms who would receive the batteries and were familiar with the shipping documentation that was required.

The operators of Cook Islands Exports, a second recycling firm have a background in resource recovery and recycling through their association with a company which became Waste Management NZ. Cook Islands Exports indicated that in the 12 months to November 2010 they had despatched 28 tonnes of ULABs for recycling. This would indicate that they are also familiar with the requirements for shipping vehicular batteries.

Monitoring and evaluation of the collection and re-export of ULABs falls under the jurisdiction of the Compliance Division of the National Environment Service. The resources of this Division are under-resourced, and with the absence of legislation, all compliance is voluntary. There is little incentive for effective enforcement of hazardous waste management guidelines.

Assessment

No local data has been gathered on the impact of heavy metals on human health and the environment. However, scientific research results from neighbouring Pacific states will most probably be applicable to the Cook Islands. These include studies in Fiji that have identified elevated heavy metals at the Lami landfill and migration of heavy metals to the near shore environment (Gangaiya et al 2001; Chandra 2002). Further research on metal pollution at the Lami dump site was called for.

In Rarotonga, Cook Islands the Turangi former recycling site has been identified as potentially contaminated site. During the POPs Project 2010, sampling was carried out at some sites for heavy metals including cadmium and lead (Laing 2010). The summary was that levels were acceptable for the sites tested, but with the qualification that only one spot on the 2-acre site had been tested, and that grid-testing might reveal different results.

Lessons Learned and Opportunities for Improvement

Vehicular batteries need to be kept under cover and preferably on raised platforms to avoid spreading of leachate by rain which is frequent on the islands which have climatic conditions that are very corrosive. Private sector management of waste streams requires stronger regulatory oversight. Monitoring and evaluation procedures backed by legislation, including remedies for enforcement, would enable government regulatory agencies to be more effective in achieving compliance.

Recommended Actions

Awareness-raising activities should be carried out about the impacts of heavy metals on human health and the importance of proper management and careful disposal of discarded products containing heavy metals. This could be conducted in conjunction with a pilot project be developed for the Cook Islands to regulate annual collection, safe interim storage and re-export of the vehicular batteries for environmentally sound recycling and/or disposal.

Soil samples should be collected and analysed for heavy metals using a grid pattern assessment over the area where the vehicular batteries and e-waste stood at the Turangi former recycling centre site. Aquatic biota from the lagoon at the site where the underground water flow is estimated to exit from the Recycle Cook Islands at the Teotue coastal drain, on the north side of Rarotonga should be assessed for any heavy metal contamination. A remediation plan for the current Arorangi landfill should be developed and implemented which includes removal of items containing heavy metals.

Institutional measures should be developed to better manage the life-cycle of products containing heavy metals, including the implementation of harmonized Customs tariffs to enable more accurate data and better tracking of waste flows for the Cook Islands. The Cook Islands Government, as one of the biggest users of products containing heavy metals, should establish a procurement policy that only permits imports of the least problematic products with extended producer responsibility, including take-back.

An institutional mechanism should be established to collect an advance disposal fee (“ADF”) payable at the time of import for ULABs. The fee could then be used to pay the cost of collection, interim storage and re-export for environmentally sound recycling or disposal. The ADF should be paid into a trust fund, established with the objective of covering the cost of collection, interim storage and re-export for environmentally sound recycling and/or disposal at the end of product life, and managed by a statutory board with both government and civil society representatives. Financial incentives should be established, payable out of the trust fund established for the ADF, which will encourage the collection of products containing heavy metals and avoid landfilling and other improper disposal.

Sub-regional guidelines should be developed with emphasis on protecting human health and the environment for Small Island Developing States which currently have no BAT-BEP for hazardous wastes that contain heavy metals.

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7.2 CASE STUDY 2 - METHYLMERCURY FROM MERCURY IN E-WASTE IN APIA, SAMOA

Author: O Le Siosiomaga Society Inc.

Heavy Metals Management Practice

There are no provisions for proper storage and disposal of electrical and electronic waste ("WEEE") in Samoa, one of the fastest growing sources of hazardous waste in the Pacific Islands. Exposure of WEEE to the elements also contaminates the soil through leachate containing heavy metals such as lead, cadmium and mercury.

Background

The Tafaigata landfill, which is in a rural setting near the capital city of Apia in Samoa, has been transformed using the Fukuoka method introduced by the Japan International Cooperation Agency ("JICA"). It now operates with an aerobic design, which has reduced the odours and hastened the breakdown process and incorporates a number of innovative leachate scrubbing techniques. E-waste was present at this site and at the adjacent private sector recycling operation which collects some e-waste and vehicle parts (such as ULABs). Both waste types were exposed to the elements. Storage in this manner is considered unsafe because it allows and soil contamination of heavy metals through leachate after rain.

Samoa is a small least developed country in the eastern South Pacific, with total area of 2,820 square metres (SOPAC 2007) on the two main islands of Upolu and Savai'i and seven smaller islands. Arable land is about 43%, and all are volcanic islands with fringing coral reefs. The current population is 160,000, the majority of indigenous Polynesian descent, with 21% resident in the capital city Apia on the island of Upolu and another 55% resident in other, more rural parts in Upolu. Two-thirds of the labour force are engaged in agriculture, but tourism is growing and now represents 25% of GDP. Samoa became independent in 1960.

Understanding the Heavy Metal Product Management and its Environmental and Health Impacts

Open-air storage of electrical and electronics waste (WEEE) is likely to result in contamination of soils, surface-water, groundwater and lagoons through leaching of cadmium, lead and mercury. Atmospheric contamination may also take place if these materials are burned. WEEE has been a growing problem dating from the 1990s when the first imports of electronic equipment and the widespread use of mobile phones, electronic games and computers began. The biggest user of computers in Samoa is government itself, closely followed by the commercial banks. As part of their disaster-prevention program, 20-30 computers will be replaced every 3-4 years. Disposal is either by delivery to the Pacific Recyclers site, storage in a back room, shed or container, or dumping.

The concern for Small Islands Developing States is that landfilling e-waste usually results in leachate that finds its way to the lagoon enclosed by a coral reef, and from there into seafood. One researcher has noted that the organic form of mercury, methylmercury, takes longer to degrade in seawater.

*"(However), in seawater, (the) methylmercury remains tightly bonded to the chloride, where sunlight does not degrade it as easily. In this form, methylmercury can then be ingested by marine animals...... Because fish and shellfish have a natural tendency to store methylmercury in their organs, they are the leading source of mercury ingestion for humans."(*Zhang et al, 2010)

The main exposure pathway of heavy metals to humans would through fish and other seafood, which people regularly harvest in Samoa. Heavy metals would leach from where there are piled into the soils and surface water, eventually finding their way to the lagoons. Mercury then becomes methylmercury and is taken up by marine life through ingestion together with seawater.

Figure 7-3 Exposed E-Waste at Pacific Recyclers, Taifagata Landfill

Poor storage practices are thought to prevail because people are unaware of the severe impacts that contamination by heavy metals on human health. If management practices are improved, then these impacts can be avoided. The first people to be affected are the workers who collect and handle the e-waste; the risks to their health are increased if they do not wear protective clothing.

Figure 7-4 E-waste Storage at Samoan “Observer” newspaper

After reports in the Samoa newspaper about e-waste recycling, the “Observer” newspaper collection site was photographed (above) in February 2009. There appeared to be little activity at the site and minimal e-waste collected.

Figure 7-5 Pacific Recyclers site at Taifagata

Laws, policies or regulations that address the issue

Currently, the Samoan Government has drafted policies relating to the safe management of heavy metals or other contaminants, but there is no legislation in place. Samoa has acceded to the Basel, Rotterdam, Stockholm and Waigani Conventions. Despite the capacity-building efforts of JICA, there appeared to be no oversight or regulation of activities by Pacific Recyclers at this recycling site.

Proposed Actions by Government or Industry to Improve Management of the Heavy Metal Products and Clean Up the Problem

In February 2009, Cook Islands NGOs ran a seminar on e-waste attended by officers from the Ministry of Natural Resources & Environment (MNRE), a local recycling private sector firm called Pacific Recyclers and Samoa NGOs at the Insel Fehmarn Hotel in Apia. Representatives of TES-AMM, a Singapore-based firm which deals with environmentally sound disposal of e-waste made presentations at the seminar about methods of environmentally sound recycling, recovery and disposal. TES-AMM had previously assisted with the New Zealand E-waste collection day by receiving a shipment of e-waste for processing.

There was general agreement by the participants, including officers of MNRE, that because of relatively low volumes, it made sense to develop a Pacific sub-regional program to collect, amalgamate and export e-waste to a reputable disposal firm. Another recommendation was to establish infrastructure arrangements for an annual e-waste collection across a broad range of products so as to prevent the build-up of future stockpiles in poor conditions on Samoa. It was acknowledged that advance disposal fee arrangements were desirable in order to pay for the annual collection, and to encourage users to bring in their e-waste rather than dump it.

Assessment

No local data has been gathered on the impact of heavy metals on human health and the environment. However, scientific research results from neighbouring Pacific states should be applicable for Samoa. For instance, the studies of elevated heavy metals at the Lami dump near Suva, Fiji and migration of heavy metals to the near shore environment (Gangaiya et al 2001; Chandra 2002). Disposal of e-waste was considered to be a contributor to the heavy metal pollution at the Lami dump site but the need for further research on the issue was identified.

Lessons Learned and Opportunities for Improvement

Samoa has taken its first steps on the regulation of e-waste through the SAICM project carried out during 2009 documenting the scale and management of e-waste in Samoa. However, capacity-building and technical assistance is needed to ensure that there is proper interim storage and safe operation of any preliminary disassembly activities before export programs can be developed.

Recommendations

Awareness-raising activities should be carried out to inform islanders of the impacts of heavy metals on human health and the importance of careful management and proper disposal of discarded electronic waste.

A plan should be developed to assess and remediate the current recycling site at Taifagata Landfill, including the mining and removal of items containing heavy metals, to establish safe interim storage and eventual re-export of such waste for environmentally sound safe recycling and/or disposal. Grid-pattern soil samples should be collected and analysed for heavy metals where the e-waste piles stood at the Taifagata Landfill to establish hot-spots and the need for remedial action. Samples of marine life from the coast at the site where the surface and underground water flow from the Taifagata area exits should be taken to assess heavy metal impacts.

Burning of e-wastes at the landfill may also have contributed to health impacts among scavengers who seek valuable metals from the discarded articles and they should be offered health assessments and medical advice. Scavenging is economically important to these people and they should be assisted to join a formal recycling programme and provided with protective equipment.

The Samoan Government, as one of the biggest users of electronic products, should establish a procurement policy that only permits imports of "green" electrical and electronic products with extended producer responsibility, including take-back. The government should also take institutional measures to ensure better management of the life-cycle of electronic products, including the implementation of harmonized Customs tariffs to enable more accurate data and better tracking of waste flows for Samoa.

A pilot project should be developed for Samoa to regulate annual collection, safe interim storage and re-export of the e-waste stockpiles for environmentally sound recycling and/or disposal. In conjunction with the pilot project an institutional mechanism should be established to collect an advance disposal fee ("ADF") payable at the time of import, such fee to be used to pay the cost of collection, interim storage and re-export for environmentally sound recycling or disposal.

Any ADF should be paid into a trust fund established with the objective of covering the cost of collection, interim storage and re-export for environmentally sound recycling and/or disposal at the end of product life and managed by a statutory board with both government and civil society representatives. Financial incentives should be established, payable out of the trust fund established for the ADF, which will encourage the collection of e-waste products and avoid landfilling, dumping and/or other improper disposal.

Role of the Proposed Mercury Convention

A broad legally binding instrument on mercury, with emphasis on protecting human health and the environment would provide guidelines for Small Island Developing States which currently have no technical guidelines for disposal of hazardous wastes that contain heavy metals. Any country that ratified such an instrument would be required to implement national mechanisms to reduce the impact on its citizens. A global instrument to identify sources of mercury emissions and ways to reduce mercury emissions would assist with the reduction in methylmercury in seafood which is the preferred food of Pacific Islanders.

Under a global treaty, a global monitoring program, similar to that operated by the WHO for persistent organic pollutants, would not only fill the knowledge gaps about mercury levels in Pacific Islands people but also help to raise awareness in the impacted communities.

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7.3 CASE STUDY 3 - MERCURY IN HEALTH CARE SYSTEMS IN NEPAL

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Relevant Heavy Metal Management Practice

Mercury bearing medical equipment is in very common use in health care establishments in Nepal. Thermometers and sphygmomanometers are common equipment used in the health sector and contain mercury in significant quantities. Mercury is also present in gastrointestinal tubes, laboratory chemicals and pharmaceutical products. Apart from these instruments, mercury amalgam has been widely used as a restorative material in dentistry. However CEPHED has restricted this case study to the assessment and management practices of mercury in sphygmomanometers, thermometers and in dentistry.

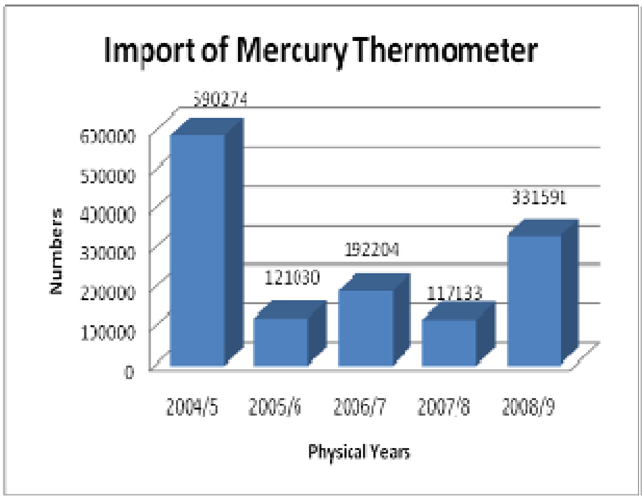
Mercury as the metallic form is being imported in Nepal mostly for traditional uses and in dental amalgam filling. There are no mercury-based industries in Nepal as such; however mercury containing products are abundantly used in Nepal especially in health care equipment and lighting devices (CFLs).

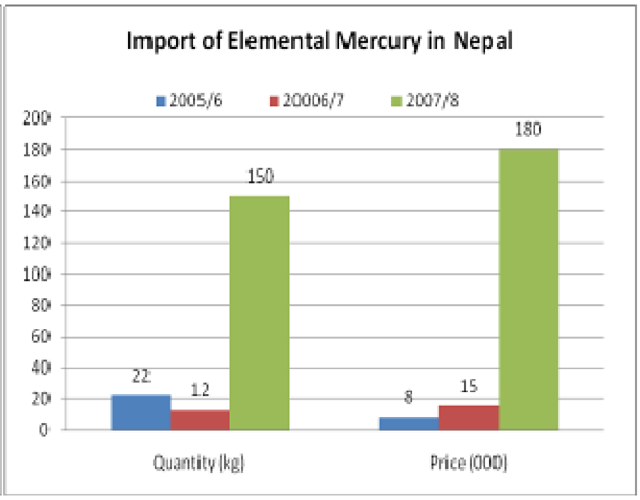
Management and handling of mercury-based equipment is not being managed in an environmentally sound manner in Nepal. For instance, in health care, thermometer breakage is quite common but the collection and disposal of spilled mercury from this equipment is being done in an environmentally unsound manner. Most spilled mercury is either being left unattended or swept or washed away. Similarly the practice of mercury bearing waste being burned openly or in incineration is quite common.

Further, dental filling through mercury amalgam is very common in Nepal. However, the problem becomes much serious when untrained human resources are engaged in tendering such services. Although alternatives to the mercury based equipment is available internationally, poor information exchange on health impacts, non-availability of these alternatives, high price and indifferent government attitudes are posing serious barriers to the replacement of these mercury based products.

Background

In Nepal the highest use of mercury is in the health care sector. According the records of Customs Department, about 331591 units of mercury thermometers, 8000 blood pressure meters and 8 382 020 units of fluorescent lamps have been imported in Nepal in the year 2008. The annual import of elemental mercury to Nepal ranges from 12 kg in 2007 up to 150 kg in 2008. These instruments are often at risk of breakage because in both cases mercury columns are made of glass. In the study conducted by Centre for Public Health and Environmental Development (CEPHED 2008 and 2009) in Nepal, hospitals with 100 to 150 beds had a very high maximum monthly breakage rate of about 50 mercury thermometers. As there is no proper mechanism to capture this mercury, it ends up with the general waste stream.





Box 1: Health Impact of Mercury

- Mercury is highly toxic in all its elemental, inorganic and organic forms.
- It readily absorbed through skin and reaches to the brain crossing over skin and blood brain barrier.
- It may fatal if inhaled and harmful if absorbed through skin.
- It causes harmful effects to the nervous, digestive, respiratory, immune systems, kidneys and lung damage.
- Exposure to it may result tremors, impaired vision and hearing, paralysis, insomnia, emotional instability.
- It also causes developmental deficits during pregnancy and childhood (WHO 2005).
- A drop of mercury enough to cause contamination of a ponds (>8 ha) beyond expectable level of fish consumption.

Similarly in dental sector, on average, about a gram of mercury has been used for dental restoration in every four patients. The maximum monthly dental restoration in a particular dental hospital in Kathmandu is about 900 patients, which is consuming 225 gm of mercury in a month. As there are quite large numbers of dental hospitals and clinics in Nepal, the above picture shows the magnitude of mercury use in the dental amalgam process.

The Ministry of Health and Population and the Ministry of Environment are the key agencies for regulating the mercury in Nepal. Ministry of Environment is also the focal point for UNEP on mercury. The Department of Customs has recognized mercury and its compounds, as hazardous chemicals and grants licensing, permission to import, sale, distribution etc. But unfortunately the level of information and understanding by these agencies are very poor in addressing these issues. The gaps are clearly reflected in practice, as hardly any systems are being placed in the country in the health care settings to manage the mercury in an environmental sound manner after the end of the life cycle of the mercury bearing products.

In Nepal there are a couple of NGOs actively working on the mercury issues and their role is critical in bringing about the changes. Their efforts range from awareness raising, conducting studies and research to promoting adoption of best practice in the country. The NGOs efforts also lead to creation of mercury free hospitals in Nepal. As an example, CEPHED has been engaged on these issues since 2008: carried our research; inventories, preparing and disseminating IEC materials such as posters, fact sheets, briefing papers, radio jingles and a video documentary (CEPHED 2010 A). In addition, we are also engaged in awareness raising and capacity building of the stakeholders including medical communities through organizing several districts, regional and national level workshops on mercury. The mercury spill management toolkits were developed and distributed to the various health care facilities. CEPHED has also been actively engaged in policy dialogue with the concerned ministries, writing policy papers and engaging directly with the stakeholders.

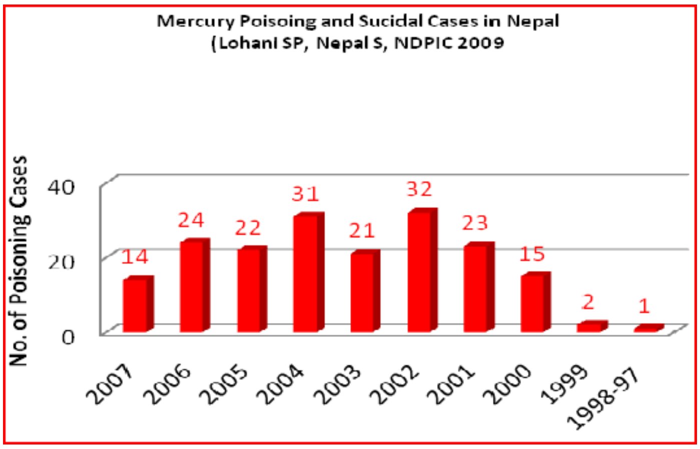
As the mercury is being handled very poorly in health care settings, the medical communities especially nurses, doctors, hospital staffs are exposed to a greater risk of mercury contamination. Even the patients are subject to mercury exposure. Further, there is every possibility of students and teachers being constantly exposed to mercury by virtue of lab equipment contamination. As there is no system in place to capture the elemental mercury from the breakages, it ends up in the municipal waste stream and the public may be exposed to the risk of mercury exposure.

Understanding the Heavy Metal Product Management and its Environmental & Health Impacts

Mercury based instruments are in common use in the health care settings in Nepal. Following accidental breakage or end of life cycle of these instruments, the mercury released is very poorly handled. In most of the cases, the mercury is being washed away, swept away, poured down the drain and mixed with other bio-medical waste, kept in sharps buckets and incinerated resulting in human exposure directly to its handler first and then more broadly as it escapes into the environment. Similarly In dental settings, large amounts of elemental mercury are being used. People engaged in the mercury amalgam preparation are not being properly trained and hardly take any safety measures to prevent themselves from the risk of exposure.

In Nepal, management of mercury release from the health care setting is very poor. There are specific instances of mercury poising in the country, though these may be attributed to the mismanagement in health care sector.

- A patient exposed to mercury from breakage of a thermometer in his mouth was admitted to the nearby hospital in Biratnagar. He started vomiting blood, and later died.
- A lady having a mercury amalgam filling in her tooth developed chronic headache. Investigation for the headache followed and it is reported that she was relieved of headache on removal of the dental amalgam.
- A nurse at Makwanur districts Nepal consumed large amount of mercury to terminate her last unwanted pregnancy and died.
- In Nepal back-yard abortionists use mercury to terminate unwanted pregnancies by administrating mercury directly into the uterus.
- Data available in National Drugs and Poisoning Information Center (NDPIC) about 185 mercury-poisoning cases in Nepal.



At present in Nepal, there are no specific laws and regulations to address the issues of mercury in health care settings. Ministry of Health and Population through its relevant department and branches are willing to develop policy and regulations to address these issues however the progress is very slow. The Customs Department have only recognized the mercury and mercury containing chemicals as hazardous substances but there are no restrictions such as mandatory licensing requirement for import, sale, distribute and use. Ministry of Environment is a key nodal agency but has not promulgated any regulatory mechanism or policy on mercury. This is despite the fact that they have just undertaken an inventory of mercury usage in the country.

It seems that with the growing concern due to mishandling of mercury in health care settings and NGOs continuous efforts in highlighting the issues, the Department of Health is sensitive to mercury issues among the relevant stakeholders and is developing a strategy and piloting some mercury-free health care facilities. Even some health care institutions with the help of NGOs and their institutional interest have demonstrated some initiatives to move toward mercury-free health care services.

Assessment

CEPHED conducted a study in 6 General hospitals and 20 dental hospitals in Nepal based on questionnaires.

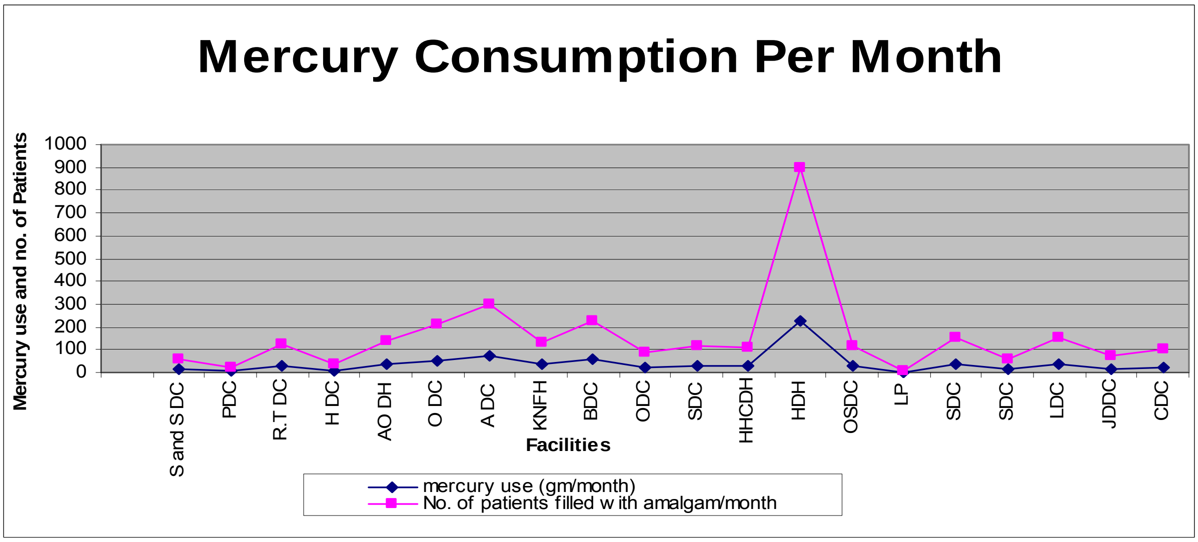
In the study it has been found that only mercury-based thermometers have been used in all the hospitals, however these hospitals were using both Hg based and non-Hg blood pressure devices. The average monthly breakage of thermometers in a 150-bed hospital (B&B hospital) was found to be 43. This was the highest breakage rate among the hospitals surveyed.

The table shows the handling practices of the mercury spillage in hospitals.

Hg Spill collection/handling from breakage and its management in the General Hospital.

S.No.	Districts of Kathmandu Valley	Name of Hospital	Spill Collection / Handling	Breakage management	Frequency of Cleaning	Knowledge about Hg`s Health hazards
1	Kathmandu	Norvic	Keep in dustbin	Incineration		skin burn
2		Paropakar Maternity	do not know	Kept in dustbin	2 times a day	not known
3	Lalitpur	Sarvanga	do not know	Kept in separate container	2 times a day	Health problem
4		B & B	keep in sharp bucket	Incineration	3 times a day	cancer
5	Bhaktapur	Korea-Nepal Friendship	Collect with help of paper	Incineration	In every 6 hours	tissue damage
6		Bhaktapur	Collect with help of paper	Kept in dustbin	2 times a day	Cancer
Source: CEPHED 2008,						

The table also depicts the mercury spill management scenario of the hospitals in Nepal. During the survey it has been found that some of the hospitals have not been aware of the spill management of mercury. According to them, if the quantity of spill is small and it will get vaporize within few minutes. Ironically incinerating the broken thermometers including mercury was quite common practice being followed by the hospitals.



Lessons learned and Opportunities for Improvement

The study clearly shows that there are critical gaps in managing the mercury in health care settings in Nepal. Cross cutting factors range from low information penetration, lack of initiative by the key regulatory agencies to availability of alternatives. These are posing barriers to the sound management of mercury in the medical sector.

However in the last few years there have been some forward movements in Nepal on mercury issue. There are discussions, meetings and workshops on the mercury issues being held in the country. During these years, CEPHED is also able to engage the relevant groups in the country persistently to bridge the information gaps on these issues. There are also significant changes in the perception of the government agencies in the country with an increased response from them to become a signatory and /or party to any conventions on mercury. In response to our study, some hospitals have also started to switch over to the mercury-free alternatives in Nepal.

Finally there are some suggestions and recommendations based on our learning and experiences, which will be crucial to bring necessary changes in the management of mercury in heath care settings in Nepal.

- A national-level mercury-free health care strategy and policy needs to be in place.
- There is a need for a prescribed standard formulation for the mercury use in the products.
- More pilots for mercury free health care facilities should be begun.
- There needs to be promotion of alternative mercury-free medical equipment with a system in place to check the quality and the price of these alternatives.
- More research needs to be carried out on the health impacts of mercury from local practices.

There must be adequate assistance for a broad-scale awareness program, pilot projects as well as for development of infrastructure to deal with the mercury waste issues.

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7.4 CASE STUDY 4 - LEAD IN DECORATIVE PAINTS IN SRI LANKA

Author: Centre for Environmental Justice – CEJ Sri Lanka

Relevant Heavy Metals Management Practice

Lead in paint was not a concern for the regulatory authorities or the paint manufacturers in Sri Lanka until Toxics Link/IPEN global research identified that the lead levels in Sri Lankan paints represented a threat to human health. There were no voluntary or mandatory standards for emulsion, toy and automotive paints in Sri Lanka until 2010. Recently the voluntary standard for emulsion paints has been specified however, the paint manufacturers do not necessarily adhere to the standard. Of the dozens of paint manufacturers in Sri Lanka only one had obtained the Sri Lanka Standards Institution (SLSI) mark, which was later cancelled by SLSI for violating the standards.

Background

The paint industry in Sri Lanka comprises about 30 large and small players, some of which are well known having a strong market presence of brands. Lead is still incorporated into paints in Sri Lanka. In this study 33 paint samples were tested out of which 19 samples were of enamel paints, 10 emulsions or plastic paints, one of weather coat paint and three varnishes including a polyurethane varnish.

Lead is a highly toxic material, which is used for various purposes. Lead based raw material has been commonly used by the paint industry as pigments, dryers or in solvents. Earlier lead based gasoline was the major source of lead pollution in Sri Lanka. However as most countries, including Sri Lanka have now introduced unleaded gasoline, the only major source for widespread lead exposure is leaded paint.

Lead can disrupt numerous crucial bodily functions due to its systemic toxicity, and can cause a wide variety of symptoms. It is known to be a potent blocker of receptors of glutamate, a neurotransmitter crucial for learning. Lead has the ability to displace a series of other metals from normal activity in the body - most significantly, calcium, iron and zinc. In particular lead displaces zinc from the enzyme delta-aminolae vulinate dehydrates, which is crucial for the biosynthesis of heme, the iron-binding part of the haemoglobin molecule carrying oxygen around the blood. This results in cells around the body being deprived of oxygen, causing a cascade of associated problems (www.rsc.org/chemistryworld/News/2007).

According to WHO and UNEP figures at least 143,000 people die every year due to lead poisoning and 600,000 people suffer due to lead exposure (GAELP 2010).

Sri Lanka was predominantly an agriculture-based country. The pattern of industrialization has changed gradually with the economic and political reform initiated in 1977. As lead is one of the of the important elements, which has varied industrial usage, it is thought the economic shift was the prime factor responsible for releasing lead into the environment in Sri Lanka. More specifically use of tetraethyl lead as an important ingredient in gasoline was the biggest contributor of this heavy metal into the environment.

In Sri Lanka, though bit limited, some research has been conducted on heavy metals (lead) contamination and impacts on the environment. The research paper on *Heavy Metal abundances in the Kandy Lake – An environmental case study from Sri Lanka (*Dissanayake et al 1987) was widely discussed in Sri Lanka. There are also some scientific papers available on lead exposure and its impact on biodiversity (Jordan et al 1957). There is also an important study available on the impact of lead contamination in small children below 12 years. More than 15 large paint manufacturers have dominated the paint market In Sri Lanka. Several of them are international paint manufacturers. There are also small-unregulated manufacturers who hold about 10% of the paint market in the country.

Recently Sri Lanka Standards Institute (SLSI) has introduced voluntary standards for lead content in paint. The Central Environmental Authority, a key environmental agency in Sri Lanka, has initiated discussions on lead and other heavy metal issues, which are largely as a result of the campaign of Centre for Environmental Justice. However the other regulatory agency in the country - the Consumer Affairs Authority - is silent on the issue. Further, Sri Lanka Customs Department is unaware of the issues surrounding heavy metals. Incidentally there is some level of understanding of these issues among university academics and healthcare professionals. Most importantly the Department of Occupational Health of Sri Lanka is interested in taking up the issues pertaining to lead exposure.

Unfortunately, in Sri Lanka, civil societies' participation in raising the issue of lead in paints is very limited and is mostly confined to CEJ. That may be the reason why the issue has not been raised before at community level. The population of Sri Lanka is approximately 20 million. Decorative paints are an unavoidable product in urban life. Except for some rural communities and the indigenous population, almost all Sri Lankan households use paint for decorative purposes. Therefore, over 90% of Sri Lankans are subject to lead exposure.

Understanding the Heavy Metal Product Management and its Environmental & Health Impacts

According to the Census and Statistical Department of the Government of Sri Lanka, 100 paint companies operated in 2003, which declined to 60 in 2004. In Sri Lanka paint is being manufactured as well as being imported from countries like India, China, Japan, USA, Pakistan etc. Sri Lanka exports paints mainly to countries like India, Maldives and Seychelles.

According to these statistics, the average annual import (for the last three years) of decorative paints to Sri Lanka stands at 26970 kg and the export of paints is about 1945 Kg. As per the Gazette Notification dated by 21st Nov. 2000 No. 1159/22 Relating to National Environmental Act No. 47 of 1980, an environmental protection licence is required for paint manufacturing or formulating industry. After release of the global study report, SLSI has developed the voluntary standard of 600ppm of lead content for enamel paints. Further, there are guidelines for lead levels in both enamel and emulsion paints. However at this juncture it can be rightly said that the activities of paint industries are not adequately regulated.

Though there are reports of lead contamination in Sri Lanka, use of lead in gasoline may be one of the contributing factors for this. However as lead in gasoline has been phased out and lead is still used in paints, future research may be able to establish possible linkages of lead contamination from paint.

Assessment

International POPs Elimination Network (IPEN) and Toxics Link, India as a part of the global call against lead in paint, carried out a research on lead in paint in 2009 (IPEN/Toxics Link 2009). Centre for Environmental Justice (CEJ) a member of the IPEN, is the Sri Lankan partner in this global study. It was found that out of 33 Sri Lankan paint samples tested from 4 different brands 19 have very high lead levels such as 137325, 133463, 55237 ppm etc.

Table 7-1 Statistical measure of lead concentrations in samples from Sri Lanka

	All Samples	Enamel Samples	Emulsion Samples	Varnish samples
Average	15, 927	25, 210	4, 177	220
Standard Deviation	34, 317	42, 089.3	13, 786	20.4
Maximum	137, 325	1373, 247	45, 753.1	605
Minimum	4	4	6	333.4

Table 7-2 Distribution of Samples Having Lead concentrations more than 90 ppm and 600ppm

	No of Samples	No. of samples bearing more than 90 ppm of lead	No. of samples bearing more than 600 ppm of lead
Enamel	19	13 (68.4%)	13(68.4%)
Emulsions	11	1 (10%)	1 10%)
Varnish	3	1(33.3%)	1(33.3%)
Total	33	15 (45.4%)	15 (45.4%)

(Source: Lead in New decorative Paints: A Global Study)

Six samples were tested from the same brands in the ITI, Sri Lanka and high lead levels in enamel paints were found. Some examples of the elevated levels include 37405, 37400 and 13500 ppm of lead. This study was crucial to substantiate the global study findings on lead in paint. Further in response to a claim by the Paint Manufacturers' Association that global tests were incomplete, another 14 samples were tested and it was found that 10 samples contained lead levels as high as 42495, 29281 and 13205 ppm (SGS 2010).

Lessons learned and Opportunities for Improvement

Lead in paint was unknown to many Sri Lankans until the Centre for Environmental Justice publicised its use in 2009. Based on the findings of the study, CEJ has launched a national campaign against lead use in paints involving relevant stakeholders of the country. The campaign is one of the most impressive and successful environmental campaigns in Sri Lanka in recent times as at least half of the population of the country has come to know about the issue. The campaign has also triggered some level of discussions among the community on the issue. CEJ is regularly receiving calls from medical practitioners, government officials and the general public raising queries about the best paints for household applications in terms of lead content.

The issue has been well received by the mainstream media of Sri Lanka and their awareness is a result of the success of the campaign led by CEJ. The report "Lead in New Decorative Paints: Global Study" was released in Sri Lanka on 10th February 2010. Immediately after the report was released, the first article entitled "Killer of tender brains" by Ifham Nizam was published in The Island Newspaper on 11th March 2010. A day later, an editorial entitled "Colorful killer" was also published in the same newspaper. Some of the leading newspapers of Sri Lanka, like Sunday Times and the Sunday Observer, also carried articles on the issue (see references for websites). These have all been important aspects of awareness-raising in the community regarding lead content of paints and the potential for human exposure and health impacts.

The CEJ lead-free paint campaign has resulted in some serious discussions at the policy level. Some of the major outcomes of the lead campaign are:

- The Ministry of Environment and Natural Resources has requested the Central Environmental Authority to test all paints brands and produce regulations.
- The draft specifications for enamel paints by the Sri Lanka Standards Institution were published for public comment.
- A stakeholders meeting was convened by the SLSI to create consensus on fixing the lead standard.

Most notably - CEJ has recently convened a meeting, where all the paint manufacturers have agreed that SLSI standards on lead should be reduced to 90 ppm.

Finally as the proposed standard is voluntary, there is an urgent requirement to have a *mandatory* standard on the use of lead in paints to achieve the desired goal. In Sri Lanka this responsibility lies with the Consumer Affairs Authority or with the Central Environmental Authority. Under the Consumer Affairs Authority Act, the Authority may take necessary action for protection of the consumer from manufacturers and traders in respect of labelling, price marking, packaging, sale or manufacture of any goods [Section 09]. However CEJ will continue its effort, to achieve the goal of mandatory standards for the use of lead in paints sold or formulated in Sri Lanka to protect the health and environment of Sri Lankans and our export partners.

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7.5 CASE STUDY 5 - TOXIC TRINKETS: AN INVESTIGATION OF LEAD IN CHILDREN'S JEWELLERY IN INDIA, 2010

Author: Toxics Link, New Delhi, India.

Heavy Metals Management Practice

India consumes about 350,000 tonnes of lead annually. Imported primary lead accounts for 40-50 percent of demand, domestic lead firms contribute 15-20 percent and the rest comes from recycled sources. Lead is used in ammunitions, batteries, automobile, electronics and electrical goods, paints and pigments, cosmetics and so on. Unfortunately lead also makes way into the jewellery for ease of shaping, an attractive appearance and durability.

In India, the artificial jewellery business is flourishing. Artificial children's jewellery is in great demand across all sections of society and is easily available from wholesalers, street vendors in a small town to the malls in the metros. The present study shows that most of them contain high levels of lead, which can cause irreversible damage to the health of our future generations.

There are several critical gaps in regulating these products:

- there is not much of awareness regarding toxic effect of lead across society
- poor regulation (lead standards in products, trade regulations, product labelling etc,)
- limited indigenous studies and scant domestic scientific literature
- there is a lack of a life-cycle management approach
- end of life management of products is mostly governed by the informal sector that lacks in understanding, technical expertise and infrastructure to handle the waste

Background

Jewellery, an item of adornment, is popular among different cross-sections of Indian society. Its popularity in the Indian society since time immemorial drives the current high demand for the products, which in present times are not only sold but also manufactured in many parts of the country. A number of Indian states are manufacturing traditional, ethnic, contemporary, and tribal jewelleries. These jewellery pieces are often hand-crafted and also mass-produced. Some of the important states being Assam, Delhi, Kerala, Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, and West Bengal. The high popularity of the product also drives the export and import of these items.

Today, as the WHO is reviewing the current science on lead, it is widely being accepted that there is 'no safe level', and that impacts on health can occur even at very low levels of lead in the blood. This investigation of lead in children's jewellery is to determine its use in this product and potential exposure to vulnerable sub-groups of the population.

Toxics Link's earlier investigations into toys and paints revealed a concerning situation of lead use in India that also applies to artificial children's jewellery which are in great demand. However, wherever one purchases these items, certain things are common; a. they imitate original jewellery made of gold, silver etc. but are low-priced; b. they are mostly unmarked and untagged; c. they do not reflect details on manufacturing; d. they are mostly sold loose; e. there is no significant product differential; and f. most of them contain high levels of lead (Pb). The only difference, a rather immaterial one, is the price which depends upon the market location.

There is a growing market for these products and due to their low prices and attractive appearance they are wide-spread within the community. This is of even greater concern a there is virtually no information on lead exposure and the potential for poisoning among the general population. The lack of awareness extends to manufacturers, wholesalers and retailers, who sell and promote these articles. Further, lax regulation and poor enforcement of voluntary lead standards permits the lead contaminated children's jewellery industry to flourish in India unabated.

Sadar Bazaar is the biggest wholesale market in Delhi, which sells a variety of household products including imitation jewellery. Most of the shops where samples were collected source their products from this market as well as from other parts of the country. Some of the larger sellers import jewellery from countries like China.

Regulation responsibilities lie with the Ministry of Environment and Forest and the Ministry of Consumer Affairs (MoCA) while Bureau of Indian Standards under MoCA formulate the standards for lead in products. The Director General of Foreign Trade (under the Ministry of Commerce and Trade) also has a decisive role in regulating the import of the heavy metals products to India. The involvement of civil society in this issue is limited apart from Toxics Link, and a few other NGOs who have conducted studies on lead in these products.

The leaded artificial jewellery directly impacts the health of children, especially those who are below the age of 6 years. Although there is limited data to analyze the sale of artificial jewellery across various socio-economic sectors children in the poorer communities have few opportunities to reduce their exposure and seek medical assessment or treatment.

The health hazard begins at the manufacturing stage itself and low income workers are exposed more than others due to their occupational settings in the manufacture of the articles without adequate protective equipment or awareness of the toxicity of lead. Secondary exposure can also be a factor for their families when workers arrive home with contaminated clothing.

Other than consumers those who may be subject to greater exposure include wholesale market workers who are bulk-handlers from economically poorer communities. Once the product has lost its shine and become part of the municipal waste and is mostly discarded in open dumps where poor waste pickers are then exposed (they form a large workforce in the waste management sector in India). These discarded articles eventually end up in the smelters of informal recycling sector whose workers are at an even greater risk from lead fumes inhalation.

Understanding the Heavy Metal Product Management and its Environmental & Health Impacts

The size of the global fashion jewellery industry was approximately 146 billion US dollars by the end of the year 2006 and it grew at a CAGR of 5.2 in preceding 6 years. China and India captured around 50 percent of the market share each and are also the major exporters. Indian consumers form 9 percent of the world market share and are set to grow to about 13 percent in a the next few years. There have been numerous instances of lead contamination in children's jewellery in developed nations such as the United States and Canada. Lilian Sundin of the Epoch Times reported on November 14, 2008 that a vast majority of the U.S Consumer Product Safety Commission recalls for lead in children's jewellery since 2003 were for China-made items. The others were made in India.

A study by the George Foundation (1999), on lead poisoning in major Indian cities, reported 51.4 percent of the total sampled population having more than 10 µg/dl of Pb-B, while 12.6 percent having more than 20 µg/dl of Pb-B. It also suggested that distance of the residence or school from a main road appeared to be associated with higher blood lead concentrations, but these differences were not statistically significant. Similar reports depict high concentrations of blood lead in children in various other cities in India and relate it with local practices and exposure pathways.

As far as jewellery or toys are concerned, there is no regulation in India on safer limits for lead. For lead in paints, the safe limit is 1000ppm and that is only a voluntary requirement. However, the government has recognised the need to formulate appropriate standards for lead in paints in accordance with international best practice. Recently the government has also constituted a committee of experts to look into the issue of lead in toys. NGOs like Toxics Link are following up with the concerned authorities and regulators. The table below shows a comparison between available standards in India and select developed nations.

Table 7-3 Lead standards across the globe and India

Country	Standard limit	Regulatory Body
USA	300ppm for children's products 90ppm for paints	US Consumers Product Safety Commission, Washington DC, January 2009
China	600ppm	China National Paints and Pigments Standardization Technical Committee, December 2009
European Union	1000ppm, moving gradually to lead-phase out	European Union Restriction of Hazardous Substances Directive, February 2003
Canada	600 mg/kg total lead and 90 mg/kg available lead	Consumer Product Safety Bureau, Health Canada, June 2005
Australia and New Zealand	90ppm 25ppm for finger paints	Consumer Product Safety Standard, Standards Australia, January 2009
India	Voluntary 1000ppm in paints	Bureau of Indian Standards

India is also a signatory to Dubai declaration of the Strategic Approach to International Chemical Management to foster the sound management of chemicals. This shows the commitment of India towards the management of heavy metals in environmentally sound manner. However at the present there appear to be no serious efforts undertaken by the respective government agencies to abide with the SAICM declaration

Assessment

Our objectives were to study the levels of lead in children's jewellery and understand the situation in the country and internationally. The scope of the jewellery market is very large in Delhi. Costume jewellery is readily available in nearly all parts of the city. Children's jewellery can be found from roadside vendors to big shops and shopping malls. For the present study, the samples were collected from three different markets from three geographical locations: Central, South and old Delhi, namely; Janpath, Lajpat Nagar, Old Delhi market, and Sadar Bazaar.

A total of 54 samples were collected to examine lead concentration in different jewellery pieces (necklace, ring, bangle, bracelet, earrings and hoops). A few samples from roadside vendors were also collected for the study. Samples were collected and analyzed as per Standard Operating Procedures for Lead in Jewellery by Hotplate or Microwave-based Acid Digestions and Inductively Coupled Plasma Emission Spectroscopy, EPA, PB92- 114172, Sept. 1991; SW846-740. [38]. Delhi Test House made an analysis of the samples collected with the help of a laboratory study.

The methodology of lab tests is provided in Box 1.

Box – 1: Sampling and Methodology for determining Lead in Children's Metal Jewellery

A1: Principle- Samples were examined in closed digestive assembly, in presence of Oxy acid (Suprapur Grade Nitric Acid) and Hydrogen Peroxide, after mixing a fixed volume. Lead content is determined by Graphite furnace Atomic Absorption Spectrometer.

A2: Chemical and glassware used-

a) 1000 mg/l Lead Standard Solution traceable to SRM (MERCK)
b) Nitric Acid (Lead free –Suprapur, MERCK)
c) Hydrogen Peroxide (Lead free, MERCK)
d) Digestion Assembly (Closed Reflux)
e) Volumetric Flask
f) Auto Pipette (100µl-1000µl)
g) Auto Pipette (20µl-200µl)

A3: Equipments used

a) Closed Digestion Assembly
b) Oven capable of maintaining medium 120°C-150°C
c) Atomic Absorption Spectrometer with graphite Furnace. (Make – GBC, Model-932 Plus)

A4: Lead Stock Solution: Stock standard solution of 1000 ppm of Lead Standard Solution, traceable to SRM from NIST

A5: Preparation of Working Standard Solution (by serial Dilution) of Lead in 0.1 $MHNO_3$

a) 100ppm by diluting 10ml 1000ppm stock solution to 100ml
b) 10ppm by diluting 10ml 100ppm working solution to 100ml
c) 1ppm by diluting 10ml 10ppm working solution to 100ml
d) 100ppb by diluting 10ml 1ppm working Solution to 100ml
e) Working standard of 5ppb, 10ppb, 20ppb, 30ppb are subsequently prepared by diluting 5ml, 10ml, 20ml, and 30ml of 100ppb stock standard to 100ml for preparation of calibration curve.

A6: Flow chart of sample preparation and analysis:

Jewellery samples – Crush to powder using dust free crusher – Take 0.3gm of powdered sample and dry at 105 degree centigrade – take 0.1gm of dried sample – add ml HNO_3 + 1ml H_2O_2 – Heat solution till dissolve and transparent – make up volume 25ml with lead free distilled water – run standards and prepare calibration curve (AAS) – Run blank sample (AAS) – Run sample against standard (prepared)

A7: Calculation: **Lead as Pb (ppb) = (Concentration of Pb in ppb** x **dilution factor** x **25 ml) / (Sample weight in grams)**

A8: Recovery Study: *- Recovery was between (80-120) percent for different lots of digestion.* **Reference: W. Houlka. Anal. Chim Act 74.216 (1975), cited from "Analytical Methods for Atomic Absorption Spectrometry" by Perkin Elmer**

Findings of the study

All 54 children's jewellery samples contain lead in a varied range.

The lead level varied from a minimum of 12.68 ppm to a maximum of 856346.9 ppm, while the average lead level has been recorded at 91156.76 ppm.

65 percent (35 out of 54) jewellery samples have lead levels more than 90 ppm, 43 percent (23 out of 54) jewellery samples have lead levels more than 300 ppm, and 31.5 percent (17 out of 54) jewellery samples have lead levels more than 1000 ppm.

Among the total number of samples tested, ring samples contain the highest amount of lead, i.e. 856346.9 ppm.

Ring samples, despite being small in size contain high levels of lead, which indicates that lead is used as a malleable material and for giving better shape to the jewellery items.

Across all 54 samples, lead concentrations are higher in samples that have decorative colours, especially multi-colours.

Pink is the most common colour found in all sample groups and such samples suggest high lead levels.

Not only coloured jewellery samples show high lead level but also non-coated colourless jewellery samples show a high lead content, which clearly indicates that the jewellery item itself contains lead.

Lessons learned and Opportunities for Improvement

Metal jewellery comes in various shapes and sizes with each item being treated individually at the time of manufacture. At the time of manufacture jewellery items are separated into different types of components. One of the components acts as a representative for a number of component types, which is tested individually for analysis. Manufacturers purposely use lead in the metal of many different products like bracelets, necklaces and rings as it enables easy casting, shaping, and joining of lead products. The prevalence of its use is because lead possesses general physical properties of other metals and acts as a conductor of electricity and heat. It also has low melting temperature (327° C) and is extreme malleability.

On the basis of the findings, collated with background information on lead and its adversarial impact on children's health, Toxics Link presents a few recommendations:

- National mandatory standards/guidelines are required for limiting lead levels in paints, pigments, varnish etc, and upstream products like jewellery. (No lead should be allowed to be added at any stage of the manufacturing process)
- Regulate trade of imported jewellery. Ensure exported consignments are within safe lead limits
- Warning labels should be put on packets containing such products.
- Awareness among stakeholders needs to be greatly increased.
- There should be promotion of alternative eco-friendly non-toxic material in products.
- Technology assistance should be provided to manufacturers, especially in the small-scale and informal sector, to prevent worker exposure to lead and introduce alternative materials in their products which are safer.

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APPENDIX 1: TERMS OF REFERENCE FOR THIS STUDY

Terms of reference for the study on the possible effects on human health and the environment in Asia and the Pacific of the trade of products containing cadmium, lead and mercury

1. BACKGROUND

UNEP Governing Council through its Decision 25/5 II [215] taken in February 2009, noted that the export of new and used products containing lead and cadmium, remains a challenge for developing countries and countries with economies in transition which lack the capacity to manage and dispose of the substances in products in an environmentally sound manner. It also encouraged efforts by Governments and others to reduce risks to human health and the environment of lead and cadmium throughout the whole life cycle of those substances and to take action to promote the use of lead and cadmium-free alternatives, where appropriate, for instance in toys and paint as some products containing lead may cause a risk through normal use.

Upon requests from UNEP Governing Council since its 23rd and 24th session in February 2005 and 2005 respectively, UNEP produced a review of scientific information on lead and cadmium [216] which data and information gaps identified are in the process of being filled with the latest available information. The final reviews of scientific information will be presented to UNEP Governing Council at its twenty-sixth session in February 2011 with a view to informing discussions on the need for global action in relation to lead and cadmium.

The second session of the International Conference on Chemicals Management (ICCM2) in May 2009 addressed a number of emerging policy issues with a view to establishing co-operative actions. Resolution II/4 contains the agreed actions on lead in paint, among others, that are currently undertaken through the Global Alliance to Eliminate Lead in Paints [217].

AIM OF THE STUDY

This study will fill those data and information gaps identified in **the scientific reviews** on lead and cadmium and for mercury information gaps identified elsewhere related to the trade of products containing those heavy metals. It is focused mainly on the analysis of trade, use and disposal of products containing cadmium, lead and mercury in Asia and the Pacific in order to assess how this can lead to adverse human and environmental effects due to release of these toxic heavy metals. The study aims also to identify i) databases dealing with such trade statistics and ii) initiatives in Asia and the Pacific to address the negative impacts from products containing these heavy metals. Case studies of good and bad management of wastes from these metals and effects of the trade to humans and environment are also expected to be included in the study.

2. OBJECTIVES AND SCOPE OF WORK

The main objective of this project is to analyze the trade, use and disposal of products containing cadmium, lead and mercury in Asia and the Pacific in order to assess how this can lead to adverse human and environmental effects due to the release of these toxic elements. The study will be the basis for identifying measures that need to be taken on a national, regional and/or global level.

A short background information on products containing cadmium, lead and mercury is included in Annex 1. A non-exhaustive list of products, included in Annex 2 should be assessed in order to be able to identify and focus on types of products that constitute the main hazards to health and environment.

[215] http://www.chem.unep.ch/Pb_and_Cd/GC25/GC25Report_English_25_5.pdf
[216] http://www.chem.unep.ch/Pb_and_Cd/SR/Finalization_reviews_prior_GC26.htm
[217] http://www.chem.unep.ch/Lead_in_paint/default.htm

This study replicates a similar study already conducted in Africa and now released at http://www.chem.unep.ch/Pb_and_Cd/African_study_trade_products.htm

The study will consist of a comprehensive collection, compilation and analysis of data on the global trade (import from and exports to) and transfer (re-exports) of products to/within Asia and the Pacific based on available databases and sources. The study should quantify the extent of the problem to be able to identify what measures need to be taken on a national, regional and/or global level to reduce the risks to human health and the environment.

The study should include case studies to describe concrete examples of how some products containing cadmium, lead and mercury can have adverse effects on the human health and the environment in Asia and the Pacific, but also examples of sound management of products containing these toxic metals. UNEP will monitor the work through teleconferences and/or written communication in order to follow progress and discuss how the results are presented in the study.

Issues to be covered

The following elements should be covered in the study:

(a) Brief background and overviews of [218]:
   - Context of the work (UNEP Governing Council mandates, specific objectives, scope and coverage of the study);
   - Presence and use of cadmium, lead and mercury and products containing these elements; reference
   - Possible effects on human health and the environment from cadmium, lead and mercury in products;

(b) Key organizations and databases dealing with lead, cadmium and trade statistics (data collection, reporting, scope and limitations of trade data);

(c) Brief description of production, use and trade patterns of cadmium, lead and mercury containing products (description of type of products, quantities, etc and in accordance with Annex 2 of this document.) in a global perspective and with emphasis on Asia and the Pacific and the country where the study takes place (including international trade to Asia and the Pacific and trade routes within this region);

(d) Brief overview of initiatives for collection, recycling and disposal of used products containing cadmium, lead and mercury from the Asia and the Pacific region;

(e) Case studies related to the life-cycle of products containing cadmium, lead and/or mercury within the Asia and the Pacific context, and a description of effects on human health and the environment from such products ; and

(f) Glossary of terms, reference list and other annexes where necessary or required.

Sources of information

The sources of information to be used to develop the report are:

- Information from Governments, IGOs, NGOs and the private sector (producers, importers) regarding trade information of cadmium, lead and mercury containing products. This information is/will be made available on a running basis on UNEP Lead and Cadmium webpages. Publications, articles and reports of relevance to cadmium, lead and mercury contained in products identified through a search of the scientific literature;
- Members of the UNEP Working Group on Lead and Cadmium;
- Additional available information, publications and reports publicly available on websites of various Governments, intergovernmental and non-governmental organizations;

[218] Information is already available both in the reviews of scientific information on lead and cadmium and in the study on the possible effects on human health and the environment in Africa of the trade of products containing cadmium, lead and mercury. It is therefore expected that this section will be short aiming to avoid duplication. Relevant references should then be used to avoid duplication.

- Identified information on financial and other drivers of formal and informal sectors of the economy in the country where the study takes place in relation to the production, use and/or trade of products containing cadmium, lead and mercury; and
- Data bases, the UN Comtrade database (exports and imports of reported cadmium, lead and mercury containing products) will be the main source of information, with additional information/data bases including, but not limited to: the International Lead and Zinc Study Group (ILZSG), The International Cadmium Association (ICdA), the Secretariat of the Basel Convention for (national reporting on transboundary movements of hazardous wastes and other wastes for the year 2004 with special focus on under cover wastes that can become second hand products), the World Customs Organization database and national customs reports, if different from the other sources.

Expected output

The study is to be written in English including a short executive summary. The whole report should be less than 80 pages total.

It is expected that the study will include a review of relevant materials and databases (including qualitative data from 4-6 case studies from Asia and the Pacific), compilation and assessment of collected information, drafting, language editing and final formatting of the study (word version with other relevant supportive documentation e.g. excel sheets, figures, tables, etc).

A draft version of the study should be available at the UNEP Governing Council 26th session in February 2011 and to the open-ended working group that will prepare the ICCM3 in spring 2011, as well as to other relevant meetings.

The development of this study is to be performed over a period of approximately 6 months, in accordance with the workplan and timetable given in the next section.

DESCRIPTION OF THE WORK TO BE UNDERTAKEN

The work can be organized in the main tasks as described below, together with suggested deadlines, to be adjusted as necessary during the course of the work.

TASKS	Suggested timeframe	EXPECTED OUTPUT
A. Data collection [219] and commence case study coordination	September-October	Coordination of IPEN Regional Hubs (three Hubs among Asia & Pacific sub-regions) and development of case study ToR for each region. Case studies underway.
B. Data analysis ongoing and first draft of case studies finalised	October-November	Summarized background information and data. Write up and incorporate graphics in case studies
C. Data conversion (graphs etc) and finalisation of case studies.	November-December	Assemble components of the report and finalise first draft of case studies.
D. Develop the first draft of the study and include first draft case studies	December	First draft of the study
E. Incorporation of final comments and results (including final draft case studies).	Late-January 2011	Draft final study with incorporated comments and case studies
F. **Contractor submitting final study incorporated comments /suggestions**	February 2011	Final study to be submitted to UNEP
G. Contractor submitting final certified financial statement	March 2011	Final certified financial statement

UNEP Chemicals will contribute to the work as follows:

- Providing comments to the first draft study so the contractor will incorporate those comments accordingly (Timeframe: 2 weeks after contractor's submission of the first draft);
- Establish and ensure all communication and/or coordination with the UNEP Working Group on Cadmium and Lead, as well as GOV, IGOs, NGOs and SAICM Secretariat with regard to the requested information and necessary input;
- Post information and submissions received from Governments, IGOs and NGOs up on a dedicated UNEP webpage to allow easy electronic access for the contractor.
- Draft an introductory chapter providing necessary background and context;
- Provide guidance with regard to the direction of the work, through teleconferences hosted monthly and/or by a country visit;
- Provide comments and input to the draft documents according to the agreed workplan;
- Publish, print and distribute the finalized study.

3. **COSTING.** Suggested and expected cost up to be to a maximum of US $50,000, covering the South Asia, South-East Asia and Pacific regions.

[219] Briefly review materials by performing literature search, collect and review identified materials and download 2000-2007/8 data bases from the suggested different sources of information as described in the previous section i.e. sources of information

Background on products containing cadmium, lead and mercury

Cadmium, lead and mercury are used and traded globally as metals in various products. Cadmium is produced mainly as a by-product of mining, smelting and refining of zinc and, to a lesser degree, as a by-product of lead and copper production. Cadmium is used and traded globally as a metal and as a component in various products. This is the case in particular for its dominant use -NiCd batteries- but it is also used for many applications in alloys, plastics, pigments, stabilizers, plating and in electronic and electrical equipment. Fertilizers produced from phosphate ores constitute a major source of cadmium pollution in soil. This issue of concern is recognised but will not be addressed exhaustively within this project.

The major use of lead in recent years is in lead batteries, accounting for 78 percentage of reported global consumption in 2003. Other major application areas are lead sheets for roofing and flashing, ammunition, alloys and cable sheathing. Other uses include plastics, paints, petrol additives, electrical and electronic equipment and certain toys, crayons and some jewellery.

Main source categories of products containing mercury includes batteries, dental amalgams, measuring and control devices (largely medical sector), electric and electronic switches, fluorescent lamps, skin lighting creams and cosmetics. The rate of decline in mercury demand in the future will depend primarily upon reductions in the battery, electrical product, and measuring device manufacturing sectors, and in dental use.

As awareness of the adverse impacts of cadmium, lead and mercury has increased, many uses have been reduced significantly in industrialized countries. In addition, as public awareness has grown, waste management systems have increasingly been put in place in industrialized countries to reduce environmental releases of these three heavy metals. However, some of the uses of cadmium, lead and mercury which have been phased out in industrialized countries have continued in developing countries, and even increased in some less developed regions and countries.

A specific problem faced by developing countries is the import of new and/or used products containing cadmium, lead and mercury, including electrical and electronic equipment and batteries, since many developing countries lack the capacity to manage and dispose of such products in an environmentally sound manner. Regulations and restrictions are less comprehensive or less well enforced in some developing regions. This has resulted in the health and environmental risks, local and regional, that accompany the use, management (including collection, storage, recycling and treatment) and disposal of products containing cadmium, lead and mercury.

List of products (non-exhaustive)

Products containing cadmium:

Cadmium sulphide (Electroplating)

Pigments and preparations based on cadmium compounds

Nickel-cadmium electric accumulators

Cadmium, unwrought; cadmium waste and scrap; powders

Anti-oxidizing preps. & other compound stabilizers for rubber/plastics

Mineral or chemical fertilizers, phosphatic

Phosphatic fertilizers and materials

Ash & residues (excl. from the manufacture of iron/steel) containing antimony/beryllium/cadmium/chromium/their mixtures

Electronic equipment

Products containing lead:

Lead-acid electric accumulators (vehicle)

Lead-acid electric accumulators except for vehicles

Lead ore& concentrate

Ash or residues containing mainly lead

Lead oxides, red lead, orange lead

Lead monoxide (litharge, massicot)

Anti-knock preparations based on lead comps.

Lead and lead alloys unwrought

Lead waste and scraps

Lead bars, rods, profiles and wire.

Lead plates, sheets, strip and foil; lead powders and flakes.

Lead tubes, pipes and tube or pipe fittings (for example, couplings, elbows, sleeves).

Articles of lead

Lead and lead alloys, worked

Lead carbonates

Electronic computers

Certain toys, crayons and jewellery.

Paints containing lead

Products containing mercury:

Fluorescent lamps, hot cathode

Hydrometers, thermometers, barometers, etc

Electric discharge lamps (excl. ultraviolet lamps), mercury/sodium vapour ...

Primary cells & primary batteries, mercuric oxide

Electric switch relay/circuit

Input/output units (of auto. data processing machines), whether or not cont. storage units in the same housing

Radio and TV transmitters, television cameras

Cathode-ray television picture tubes, incl. video monitor cathode-ray tubes, black & white/other. monochrome

Thermionic and cold cathode valves and tubes

Organo-mercury compounds

Electronic equipment

APPENDIX 2: QUESTIONNAIRE

UNEP

Chemicals Branch

Division of Technology, Industry and Economics (DTIE)

DRAFT SURVEY

Study on the Possible Effects on Human Health and the Environment from Trade in Products Containing Cadmium, Lead and Mercury in the Asia Pacific Region.

GENERAL INFORMATION

Contact Name :	
Email :	
Institution :	
Position :	
Phone Number :	

This survey is seeking specific information regarding the trade in products containing lead, cadmium and mercury in the Asia Pacific Region for a study that is currently underway.

The information sought relates specifically to:

A. Production / use / export / import / re-export / trading / reuse and disposal to and within your country for the years 2000 - 2009 in kilograms (kg).

B. Databases your country may maintain for trade in these products (e.g. customs databases).

C. Current research, management practices and policy initiatives for these products in your country including waste disposal.

If the technical information requested is not available through your institution we would welcome advice on any sources you are aware of in your country or other organisations that may hold such data (these may include web page addresses, institutions, technical reports, etc.).

Your cooperation is greatly appreciated.

Please send responses to:

Lee Bell : leentn@bigpond.com

Senior Research Officer

National Toxics Network Inc.

Australia.

January 2011

PRODUCTS CONTAINING LEAD

a. Does your country have a registration system for the intended use of products containing **lead** prior to import, export and/or re-export?

YES_____ NO_____

If yes, can you describe the registration system?

b. Does your country have any requirement to identify the destination or end use of products containing **lead** prior to their shipment?

YES_____ NO_____

If yes, please describe the process:

c. Can you identify key trade partners of your country for products that contain **lead**?

Importing partners:

Exporting Partners:

Re-exporting Partners:

d. Below is a list of products with **lead** content. Please provide any sources of information on the production, trade and disposal these products in your country.

Sources of information on the trade of products containing lead (production / use / export /import / re-export / trading / reuse and disposal)	
Institution	**Web Page**

The following table contains a list of products that contain **Lead**. Please provide information about any initiatives your country is planning or has implemented to protect human health or the environment from lead in any of these products at any stage of the product life cycle (i.e. manufacture, use and disposal) in the box below.

Lead-acid electric accumulators (vehicle)	Lead and lead alloys, worked
Lead-acid electric accumulators except for vehicles	Lead carbonates
Lead ore & concentrate	Electronic computers
Ash or residues containing mainly lead	Certain toys and crayons
Lead oxides, red lead, orange lead	Paints containing lead
Lead monoxide (litharge, massicot)	Tools and learning materials for school children
Anti-knock preparations based on lead compounds.	Jewellery
Lead and lead alloys unwrought	Cosmetics for women
Lead waste and scraps	House ware: pottery or glazed ceramic
Lead bars, rods, profiles and wire.	Painting containing lead
Lead plates, sheets, strip and foil; lead powders and flakes.	Leaded gasoline sludge and leaded anti-knock compound sludge
Lead tubes, pipes and tube or pipe fittings (for example, couplings, elbows, sleeves).	Second-hand electrical and electronic appliances like computers that might contain lead
Articles of lead	Second-hand cell phones that might contain lead

Initiatives for products containing Lead:

PRODUCTS CONTAINING CADMIUM

a. Does your country have a registration system for the intended use of products containing **cadmium** prior to import, export and/or re-export?

YES_____ NO_____

If yes, can you describe the registration system?

b. Does your country have any requirement to identify the destination or end use of products containing **cadmium** prior to their shipment?

YES_____ NO_____

If yes, please describe the process:

c. Can you identify key trade partners of your country for products that contain **cadmium**?

Importing partners:

Exporting Partners:

Re-exporting Partners:

d. Below is a list of products with **cadmium** content. Please provide any sources of information on the production, trade and disposal these products in your country.

Sources of information on the trade of products containing cadmium (production / use / export /import / re-export / trading / reuse and disposal)	
Institution	**Web Page**

The following table contains a list of products that contain **cadmium**. Please provide information about any initiatives your country is planning or has implemented to protect human health or the environment from **cadmium** in any of these products at any stage of the product life cycle (i.e. manufacture, use and disposal) in the box below.

Cadmium sulphide (Electroplating)
Pigments and preparations based on cadmium compounds
Nickel-cadmium electric accumulators
Cadmium, unwrought; cadmium waste and scrap; powders
Anti-oxidizing preps. & other compound stabilizers for rubber/plastics
Mineral or chemical fertilizers, phosphatic
Phosphatic fertilizers and materials
Ash & residues (excl. from the manufacture of iron/steel) containing antimony/beryllium/cadmium/chromium/their mixtures
Paint containing cadmium
Computers
Toys for kids
Tools and learning materials for school children
Second-hand electrical and electronic appliances like computers that might contain cadmium
Second-hand cell phones that might contain cadmium
Initiatives for products containing cadmium:

PRODUCTS CONTAINING MERCURY

a. Does your country have a registration system for the intended use of products containing **mercury** prior to import, export and/or re-export?

YES_____ NO_____

If yes, can you describe the registration system?

b. Does your country have any requirement to identify the destination or end use of products containing **mercury** prior to their shipment?

YES_____ NO_____

If yes, please describe the process:

c. Can you identify key trade partners of your country for products that contain **mercury**?

Importing partners:

Exporting Partners:

Re-exporting Partners:

d. Below is a list of products with **mercury** content. Please provide any sources of information on the production, trade and disposal these products in your country.

Sources of information on the trade of products containing mercury (production / use / export /import / re-export / trading / reuse and disposal)	
Institution	**Web Page**

The following table contains a list of products that contain **mercury**. Please provide information about any initiatives your country is planning or has implemented to protect human health or the environment from lead in any these products at any stage of the product life cycle (i.e. manufacture, use and disposal) in the box below.

Fluorescent lamps, hot cathode	Mercury compounds
Hydrometers, thermometers, barometers, etc	Ash and residues containing mainly arsenic, mercury, thallium and mixtures
Electric discharge lamps (excl. ultraviolet lamps), mercury/sodium vapor	Cold cathode lamps or photocathode valves and tubes (e.g., vacuum, steam or gas valves and tubes, valves and tubes, mercury arc rectifiers, cathode ray tubes, television camera tubes), diodes, transistors and similar semiconductor devices
Primary cells & primary batteries, mercuric oxide	Skin creams
Electric switch relay/circuit	Toys for kids
Input/output units (of auto. data processing machines), whether or not cont. storage units in the same housing.	Tools and learning materials for school children
Radio and TV transmitters, television cameras	Paint containing mercury
Cathode-ray television picture tubes, incl. video monitor cathode-ray tubes, black & white/other. monochrome	Second use electrical and electronic appliances like computers that might have mercury
Thermionic and cold cathode valves and tubes	Second use cell phones that might have mercury

Initiatives for products containing mercury:

GENERAL INFORMATION

a. Are there cases of possible human health or environmental impacts from products containing lead, cadmium and mercury in your country?

YES_____ NO_____

If yes, please tell us briefly about the case (s) and indicate the reference material (website), if possible.

b. Does your country have any specific awareness raising activity on the effects of lead, cadmium and mercury?

YES____ NO____

If yes, provide names and contact details of the organization (s) engaged in these activities:

Institution	Web Address
a)	
b)	
c)	
d)	
e)	

c. Does your country have policies and regulations to prevent and control the production, use and disposal of products containing lead, cadmium and mercury?

YES_____ NO_____

If so, please list them below and / or give us the websites for more information:

d. Does your country have a strategy for collection, recycling, transport and disposal of products and / or waste containing lead, cadmium and mercury?

YES_____ NO_____

If so, please list below and / or give us the websites for more information:

National Strategies:

Regional/Local Strategies:

ANNEX 1

Case Study:

Compact Fluorescent Lamps in the Philippines and the need for Environmentally Sound Management of Mercury-Containing Lamp Waste.

A child watches his father recycle a spent CFL in Pier 18, Tondo, Manila. Photo by Thony Dizon.

Authors: EcoWaste Coalition / Global Alliance for Incinerator Alternatives

Funded by

UNEP

and

International POPs Elimination Network

Project Background:

This case study was completed as part of a major UNEP study into the possible effects on human health and the environment in Asia and the Pacific of the trade of products containing lead, cadmium and mercury. One of the key areas of concern for the international community and UNEP in particular is the use of mercury in consumer products which can result in human exposure from breakages or poor recycling and disposal practices. This case study examines the recovery of scrap metals from CFL waste in the Philippines by informal recyclers and the hazardous exposures that result from poor working conditions.

Heavy Metals Management Practice:

Spent CFLs from households and small institutional users are thrown into regular municipal waste, which is then hauled to Pier 18 Garbage Transfer Station in Tondo, Manila before being sent to the Navotas Sanitary Landfill in Navotas City. Before the mixed trash is transported from the transfer station to the landfill, informal recyclers forage through the waste to reclaim materials, including discarded CFLs, that can be recycled and sold. The salvaged CFLs, in particular, are later recycled in the adjacent dumpsite community. The recycling is done with bare hands and in uncontrolled conditions. Informal recyclers break the lamps with a hammer to retrieve the recyclable materials that make the lamp's structure and, in the process, releasing mercury vapors from the glass tubing. The mercury vapors escape into the immediate surroundings, directly exposing the recyclers, their children and community to mercury.

The government of the Philippines announced at the national energy summit in 2008, the country's shift from energy-wasteful incandescent bulbs to energy-efficient CFLs by January 2010, the first country in Asia to do so on a national scale.

Through a loan and grant agreement with the Asian Development Bank, the government launched the "Philippine Energy Efficient Project (PEEP)," which among other components, included: 1) retro-fitting about 40 government-owned office buildings with efficient lighting; 2) procuring 13 million CFLs for distribution to residential and other customers to reduce peak power demand, and

3) introducing energy efficient lamps for public lighting. The Philippines government project has an estimated total cost of US$46.5 million.

A special report by the Department of Energy, PEEP's implementing agency, published in Philippine Star (July 24, 2009) claimed annual savings of about US$90 million from avoided fuel cost with the introduction of energy-efficient CFLs and the implementation of other project components. In addition, the country can reportedly defer US$1.3 billion in investments in power generation, according to the report.

While CFLs are known to typically contain 1 to 25 milligrams of mercury, the project document stated that "the environmental implications were reviewed and no significant adverse impacts were identified."

However, the project has allocated US$1.5 million to set up a new mercury waste management facility "for recovery of mercury from used fluorescent lamps" and "for preventing the residual mercury from entering the food chain through landfill dumps leaching into groundwater."

At the inception workshop on extended producer responsibility (EPR) for CFLs Energy Undersecretary, Loreta Ayson said, "*True, we have switched from inefficient incandescent bulbs to efficient lighting systems such as CFLs. But it comes with a price – mercury. And mercury, if not properly disposed of, poses health hazards to humankind and the environment."*

The switch to CFLs has seen incandescent bulbs disappearing from store shelves. Replacing the once ubiquitous bulbs are CFLs, all manufactured overseas, particularly from China. Among the CFL brands available in the Philippine market are Akari, CATA, DK, Firefly, GE, Ichiban, Panasonic, Philips and Xin Mey.

(Samples of some CFLs being sold in the local market. Photo by Manny Calonzo)

Environmental and health groups were quick to raise a red flag of concern about the rapid switch to mercury-containing CFLs without a corresponding program for their environmentally-sound management after the lamps have ceased to be useful.

Groups such as the EcoWaste Coalition and the Global Alliance for Incinerator Alternatives specifically expressed concern over the lack of health and safety warning in the product label, the lack of public information on the risk of mercury exposure from lamp breakage during use, disposal or recycling, and the lack of environmentally-sound system for managing spent lamps.

“We are deeply concerned with the massive switch to mercury lamps for energy efficiency that is not matched with adequate consumer education on toxic risks and a functional system for managing lamp waste, especially among residential and commercial users, to prevent adverse health and environmental impacts,” lamented the groups.

“The widespread practice of tossing broken or spent mercury lamps in regular domestic waste stream, as if they were ordinary discards, and their recycling in uncontrolled conditions can expose informal recyclers and their communities to mercury,” they said.

(Environmental and health advocates stage a creative action to encourage the public not to dump or burn mercury-containing lamp waste. Photo by Gigie Cruz.)

Mercury in CFLs, while “small” in quantity compared to mercury in fluorescent lighting tubes, is released due to breakage during use or when spent bulbs are improperly disposed of such as by dumping, burning or recycling in unregulated conditions, causing the toxic metal to disperse into the environment.

According to the government-published *Mercury-Containing Lamp Waste Management* guidebook, “mercury and its compounds are highly toxic especially to the developing nervous system, which is very sensitive to all forms of mercury. Exposure to high levels of mercury can cause permanent brain damage, central nervous system disorders, memory loss, heart disease, kidney failure, liver damage, vision loss, sensation loss, and tremors.”

“Mercury is also a suspected endocrine disruptor, which means it damages the reproductive and hormonal development and growth of fetuses and infants. Even low-level exposure to mercury has caused serious health effects that include neurological damage, reproductive system damage, behavioral problems, and learning disabilities,” the guidebook stated.

Key Actors:

The Department of Energy, the Department of Environment and Natural Resources and the Department of Trade and Industry , as the main government partners in PEEP, are the key national agencies that could prevent an emerging hazardous waste crisis involving the improper disposal of mercury-containing lamp waste. The Energy Department, as the lead implementing agency for PEEP should pursue the adoption of a robust extended producer responsibility (EPR) that will define the responsibility of the CFL manufacturers/importers for the post-consumer stage of their products.

The Environment Department as the agency in charge of hazardous waste management should institute a collection system for spent CFLs so that these are not combined with regular municipal waste. The Trade Department should enforce the labeling requirements for products containing hazardous substances, including product information on mercury content and the necessary safety precautions. As the major funding source of PEEP, the Asian Development Bank plays an important role in ensuring that the health and environmental impacts of the switch from incandescent bulbs to CFLs are sufficiently addressed in a holistic, participatory and transparent manner. That includes issues related to recycling and disposal of waste phase CFL’s, especially by informal workers.
Other key players include the lighting industry associations, lamp vendors, hazardous waste handlers and treaters, formal and informal recyclers, and the environmental and health groups,

(Dump trucks on their way to the Pier 18 Garbage Transfer Station. Photo by Manny Calonzo)

(Waste pickers from Pier 18 Garbage Transfer Station join a discussion about the informal recycling of mercury-containing lamp waste. Photo by Manny Calonzo)

(A sample of the CFL given as part of the ADB-funded “Palit Ilaw” (Lamp Exchange) program. Photo by Manny Calonzo)

Understanding the Heavy Metal Product Management and its Environmental & Health Impacts

In 2008, the government of the Philippines announced an ambitious program that would phase out incandescent bulbs by January 2010 and their replacement with energy-efficient, but mercury-containing CFLs.

While recognizing the energy and climate benefits of CFLs, public interest groups are concerned that the massive switch to CFLs is not matched by a proactive program to reduce the risk of mercury contamination of humans and the environment.

Most product labels explicitly show energy efficiency information, but generally do not provide information about the product’s mercury content, its quantity and the steps to be followed in case of breakage and the proper manner of disposal.

Currently, ordinary Filipino consumers of CFLS are barely aware of the toxic risks when mercury-containing lamps are accidentally broken or improperly discarded into regular waste bins and sent to dumpsites, a number of which are located in environmentally critical areas such near water bodies or inside watershed areas.

The complete lack of a deliberate system for collecting and managing CFLs after their useful lives means that spent mercury-containing lamps are simply thrown into regular trash, which is not only irresponsible, but also unlawful.

(Discarded mercury-containing lamps are stored for recycling at a dumpsite area in Tondo, Manila. Photo by Thony Dizon.)

In a letter sent to the government, accompanied by photos taken from investigative trips to dumpsites, environmental and health groups urged policy makers to address what they described as an emerging toxic crisis due to the apparent lack of an environmentally-sound management for managing mercury-containing lamp waste. The photos, in particular, show the problematic disposal and recycling of discarded lamps that exposes informal recyclers in dumpsites and junk shops and their immediate communities to mercury.

As defined by the United Nations Environment Programme, "environmentally-sound management" means "taking all practicable steps to ensure that hazardous waste or other wastes are managed in a manner which will protect human health and the environment against adverse effects which may result from such wastes."

In his reply, then Secretary of Energy Angelo Reyes said "your photos depict the harsh reality of the manner our people dispose busted and/or broken lamps containing mercury, which is categorized as hazardous or special waste, not mere municipal waste."

Under the country's laws, namely Republic Act 6969 and Republic Act 9003, lamp waste is considered hazardous and should not be mixed with recyclable and compostable discards. Under R.A. 9003, hazardous household trash —old cell phones and computers, appliances like stoves, refrigerators, air conditioners, and TVs as well as light bulbs and batteries— are classified as "special waste" that should be handled separately from other residential and commercial wastes. The said laws further require the proper management and disposal of "special waste" through appropriate hazardous waste treatment facilities.

Data from the Philippine Efficient Lighting Market Transformation Project (PELMATP) show that 88% of households, 77 % of commercial establishments, 33% of hospitals, 9% of offices and 83% of schools surveyed disposed of their mercury-containing lamp waste as domestic waste.

The same data indicate that 67% of mercury-containing lamp waste from hospitals is sold to junk shops, while 15% from schools, 9% from offices, 3% from commercial establishments, and 1% from households do the same.

(An informal recycler breaks a CFL to retrieve lamp components that can be sold to intermediaries. Photo by Thony Dizon.)

Worse still, improper lamp waste disposal is adding mercury in the waste stream and thus exposing waste workers to mercury from lamps broken during the process of collection, transportation, dumping and recycling in unregulated conditions. Waste workers are directly exposed to mercury through touching the contaminated waste materials usually with bare hands and no protective clothing an through breathing the air that has mercury vapor in it.

The informal recycling that is happening in dumpsites and junkshops is done in the most archaic way where spent lamps are first collected and stored in heaps or kept in old rice sacks and then individually smashed with a hammer to retrieve the recyclable parts and thus releasing the mercury inside the glass housing.

In a press statement, public interest groups explained that:

"Mercury vapor is released into the environment from the breakage of fluorescent lamps during their use or when they are disposed. When spent lamps are thrown into the trash can, they usually end up in dumpsites or landfills where they are crushed, burned, or recycled without safety precautions and thereby causing the air, water and soil to be contaminated with mercury."

While some of the informal recyclers may be aware of the risk and hazard of mercury exposure, the recycling of spent CFLs will be likely to continue because of the financial gain involved. For instance, the aluminum component of the lamp waste can be sold at P50 per kilo.

Spent CFLs not reclaimed by enterprising recyclers such as dumpsite and itinerant waste pickers as well as "paleros" (garbage crew of trucks collecting trash) would normally end up being dumped in open or controlled dumpsites or "sanitary" landfills, which could lead to the discharge of methyl mercury compounds that can easily contaminate the water supply and the food chain.

A study by the Mercury Policy Project in 2009 and co-released in Manila by Ban Toxics, Global Alliance for Incinerator Alternatives and the EcoWaste Coalition showed that the burning of mercury-added products in waste such as mercury lamps emits upwards of 200 tons of mercury in the atmosphere annually.

Information from the PEEP project document indicates that the government is planning to 1) establish a mercury waste management plant for the recovery of mercury from used fluorescent lamps, and 2) institute a form of extended producer responsibility that will make the manufacturers or importers responsible for the lamp waste (e.g., to internalize waste management costs in their product prices).

Last September 2010, the Department of Energy, in partnership with the Department of Environment and Natural Resources, hosted an inception meeting on the feasibility and policy study of developing and establishing EPR for mercury-containing lamp waste.

The EcoWaste Coalition and the Global Alliance for Incinerator Alternatives expressed confidence that a robust EPR policy initiative will be crafted and enforced to curb the deleterious health and environmental impacts arising from the disposal of spent compact fluorescent lamps in waste bins and dumps.

“We envisioned a robust EPR that will impose lower levels of mercury in CFLs imported into the country, uphold consumer right to full product and safety information, internalize the environmental costs, and operate an environmentally-sound system for managing spent lamps, including a collection scheme that is easy for the public to access,” the groups said.

“This effort, we also hope, will lead to greater industry commitment to invest in product research and development to mainstream energy efficient and climate-friendly lights that are mercury-free,” they added.

To reduce the risk of mercury exposure for consumers as well as for waste handlers and recyclers and their communities, public interest groups are urging the government to draw up and enforce a system towards the environmentally-sound management of discarded mercury-containing lamps, including arrangements for the safe containment and storage of collected mercury wastes.

(A informal recycler directly exposes himself to mercury as he breaks discarded CFLs. Photo by Manny Calonzo)

As indicated in Proposed Senate Resolution 1396 that was introduced by Sen. Manny Villar, “the nationwide switch to CFLs must be matched by a proactive program to reduce the risk of mercury exposure and contamination of humans and the environment.”

Assessment:

In an effort to understand the problem with the improper disposal of mercury-containing lamp waste, the EcoWaste Coalition and the Global Alliance for Incinerator Alternatives have gone to dumpsites such as the Pier 18 Garbage Trasnfer Station to conduct photo documentation and to interact with the waste pickers.

The photos taken during the investigative work were then sent to the heads of concerned government agencies (e.g., Department of Environment and Natural Resources, Department of Energy, National Solid Waste Management

Commission) to emphasize the environmental, health and social problems resulting from the lack of public information about mercury hazard in CFLs and the lack of functional system for managing mercury-containing lamp waste that should accompany the switch program from incandescent bulbs to CFLs. The photos taken and the letters sent to authorities were also used to generate stories in the media to steer public debate and action.

As reported in the article “Group sounds alarm over electronic waste” published in the Philippine Daily Inquirer, “the EcoWaste Coalition said government regulators must move swiftly to avert what it said would be a “full-blown chemical and humanitarian crisis” at the dumpsite due to the improper disposal of electronic waste like computers and electronic items.”

(Waste pickers provide insights into the recycling of broken CFLs at Pier 18 Garbage Transfer Station. Photo by Manny Calonzo)

A focus group discussion (FGD) initiated by the EcoWaste Coalition last December, which involved 11 informal recyclers from Pier 18 Garbage Transfer Station, yielded the following information:

- 80% of the FGD participants are not aware of the various routes of mercury exposure
- 70% work as waste pickers 7 times a week, working for an average of 10.5 per day
- 80% recycle CFLs, wearing no protective clothing.
- 90% break CFL tubes without nose covering
- 60% break lamp waste with bare hands, wearing no gloves
- 100% recycle CFLs, other lamp waste recycled include linear fluorescent, circular fluorescent and other lamp types

The results of the said FGD corroborates the findings of various consultation workshops organized by the National Solid Waste Management Commission (NSWMC) in 2008 and 2009 that have identified the exposure of the informal waste sector to toxic and hazardous waste as one of the “major trends” observed. The workshops were held as part of the process to develop a “National Framework Plan for the Informal Waste Sector in Solid Waste Management”

“Electronic and electrical wastes are an increasing fraction handled by the informal waste sector. Both the formal and informal (waste) sectors engage in the recovery of e-wastes, but the latter is at a distinct disadvantage because of their lack of knowledge about the dangers of handling e-waste resulting to environmental and health hazards,” the report said.

“In terms of occupational health risks, there is a high level of exposure due to the manual handling of the waste and the lack of protective gear/equipment. Risks from manual handling come from direct contact with waste such as… materials with toxic substances… and smoke and toxic fumes from open burning of waste,” the report said.

A research conducted by the Global Alliance for Incinerator Alternatives, Mother Earth Foundation and the Smokey Mountain Resource Recovery System had likewise identified “exposure to a cocktail of toxic fumes and other chemicals in the dump and from open burning as a major threat to the health of the community."

Lessons learned and Opportunities for Improvement:

The key lessons learned from the conduct of the case study are as follows:

1. The provisions of Republic Act 9003, particularly on waste segregation, are poorly enforced as can be seen from the disposal of mixed trash in dumpsites and landfills, which expose waste workers to pathogens and toxic chemicals in waste.

2. The requirements of both Republic Act 9003 and Republic Act 6969 regarding the separate handling and treatment for "special waste", including mercury-containing lamp waste, have not been complied with.

3. The waste workers, particularly the informal recyclers in dumpsites and junkshops, bear the brunt of mercury pollution from the recovery of aluminum and other recyclable components of CFLs and other lamps, which are retrieved without any form of personal protective equipment for the workers protection.

4. The informal waste sector lacks basic information and knowledge about toxic substances released from spent CFLs and other waste products that they need to know in order to minimize their exposure to health-damaging chemicals.

5. The disposal of spent CFLs needs to be regulated by an effective extended producer responsibility (EPR) scheme to ensure that every CFL is being recycled in an environmentally-sound manner. Such a scheme will also provide disposal services that are efficient and accessible to consumers, especially to households and small institutional users.

6. The recycling of e-waste presents a major health and environmental threat and must be adequately and urgently addressed.

As a general proposal to address the mounting problem with e-waste, the enforcement of compulsory waste segregation at source, public information on the hazards of electronic waste disposal and recycling, the phase-out of harmful substances in electrical and electronic products, the implementation of extended producer responsibility and the imposition of stricter rules to prevent the dumping of old electrical and electronic products in the country are strongly recommended.

Specifically on CFLs, the following policy options are recommended:

1. Adopt and enforce a deliberate policy to allow only the importation, distribution, sale and use of low-mercury CFLs and with proper labeling.

2. Reiterate the legal classification of spent CFLs as "special waste" that should be appropriately treated as hazardous waste in an environmentally-sound manner.

3. Strictly prohibit the disposal of spent CFLs in regular municipal waste and their subsequent disposal in open or controlled dumpsites or even in "sanitary" landfills. Enforce "no dumpsite/landfill" policy for CFLs and other "special waste."

4. Implement a system for the environmentally-sound management of discarded mercury-containing lamps, including collection procedures from household and other small institutional users and arrangements for the safe containment and storage of collected mercury-containing waste.

5. Define and disseminate the specific responsibilities of household and institutional users, local and national government agencies, and business and industry towards the environmentally sound management of mercury containing lamp waste.

6. Introduce a mandatory take-back scheme that will require manufacturers, importers or distributors responsible for the management of CFLs after their useful lives.

The government should also look at the feasibility of mainstreaming other types of energy-efficient lamps that contain no mercury as it is likely that mercury free alternatives will replace mercury containing lamps over time.

Furthermore, “a mercury-control treaty can include measures that will limit the mercury content of fluorescent lamps; require cleaner lamp-production processes; increase the availability of safe, non-polluting lamp recycling facilities; and expedite the development of high quality, mercury free lighting alternatives that are energy efficient, affordable, and non-toxic,” as proposed by the International POPs Elimination Network and supported by public interest groups worldwide.

In the absence of a clear-cut policy and procedure, the EcoWaste Coalition, with inputs from Ban Toxics, Global Alliance for Incinerator Alternatives and Health Care Without Harm, has been disseminating the following practical steps for safely managing spent compact, linear and circular fluorescent lamps:

1. Do not break. Handle spent mercury-containing lamps with extreme care as they can easily break.

2. Do not burn lamps containing mercury or throw them into regular waste bins.

3. Do not play with discarded lamps or leave them lying around.

4. Return spent lamp to its original box container or place in a clear plastic bag, seal and mark the container: “Toxic: Lamp Waste with Mercury.”

5. Put the properly wrapped and labeled lamp waste into a secured place for temporary storage.

6. For increased protection against breakage, store spent lamps in an upright position and place in a covered tin or plastic container for smaller lamps or in a cupboard for linear lamps.

7. Mark the container where the lamp waste is stored with a readable warning: “Toxic: Lamp Waste with Mercury.”

8. Keep the storage area safe, out of children’s reach and away from the elements and human traffic.

9. Contact fluorescent lamp manufacturers and/or distributors to check if they have a take-back program for their spent products or suggest a take back program if they have none.

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ANNEX 2

Case Study:
The Results of Lead Analysis in Decorative Paints in Thailand

By

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Ecological Alert and Recovery – Thailand (EARTH)

Funded by

UNEP

and

IPEN

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Project Background

This case study was completed as part of a major UNEP study into the possible effects on human health and the environment in Asia and the Pacific of the trade of products containing lead, cadmium and mercury. One of the key areas of concern for the international community and UNEP in particular is the use of lead in paints which can result in human exposure from domestic and commercial applications. This case study examines the use of lead in paints in Thailand, the potential human exposures and suggested actions to meet the challenge of lead in paints in Thailand.

Methodology

Selection Criteria for determining lead in decorative paints

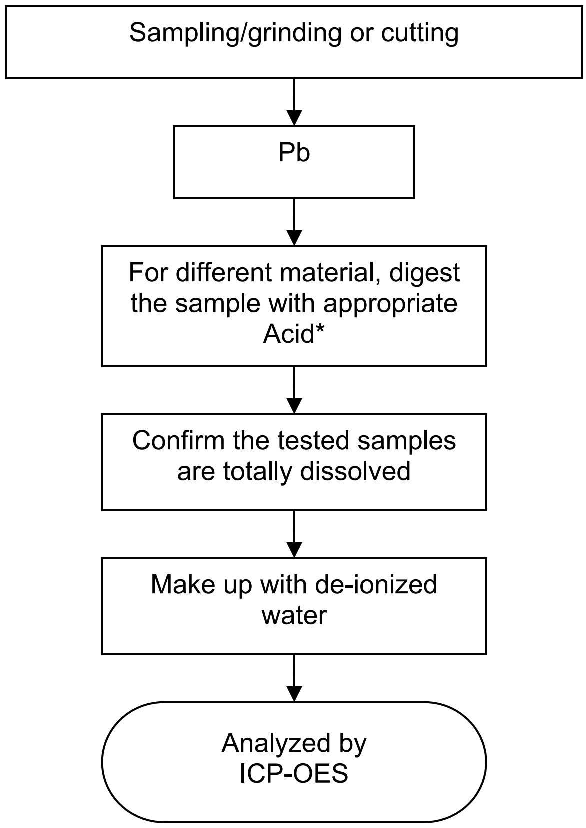
The selection of samples is associated with the results of the previous study, the Global Study to Determine Lead in New Decorative Paints in 10 Countries[220]. The previous study indicated that the oil-based decorative paint samples contained high concentrations of lead, in particular the yellow and red colors. The criteria of collected samples were then designated as following:

1) The samples collected were oil-based decorative paints.
2) The yellow color samples were the first priority for collection. If the yellow colors were not available, other colors were selected instead.
3) The samples should cover as many brands as possible. Therefore, in order to obtain a variety of brands, samples were chosen from paint shops and construction material stores in suburban areas.
4) The smallest packaged size, usually one litre, was collected.

Analyzing lead concentration

All of the samples were sent for laboratory analysis at the Interteck Testing Service (Thailand) Company Limited. The analysis method used is USEPA 3052 which has the procedure as shown in Figure 1.

[220] Toxic Links, 2009. Global Study to Determine Lead in New Decorative Paints in 10 Countries, New Delhi, Chennai, India.



*List of appropriate Acid:

Material	Acid added for digestion
Polymers	HNO_3, HCl, H_2O_2

Figure 1: The procedure and chemical analysis method to determine lead by Interteck Testing Service (Thailand) Company Limited

The following images demonstrate the procedure for collecting the samples, recording the information, and preparing samples before sending to Interteck Testing Service (Thailand) Company Limited

Figure 2: One of the paint shops where the decorative paints had been purchased

Figure 3: Recording the information of samples

Figure 4: Preparing samples before sending to analyze

Figure 5: All of the samples

Figure 6: The staff of Interteck Testing Service (Thailand) Company Limited picked up the samples

Figure 7: Interteck Testing Service (Thailand) Company Limited, the chemical laboratory company

Results

The total of 31 paint samples were collected between the 8th and 16th November 2010 from paint shops in three provinces, i.e. Bangkok, Nonthaburi and Samutprakarn. The collection locations in Bangkok covered six districts included Minburi, Laad-kra-bang, Ram-kham-haeng, Sa-paan-sung, Kan-na-yao, and Bung-khum. Furthermore, in Nonthaburi and Samutprakarn, the samples were collected from two districts (Muang and Pak-kred in Nonthaburi) and one district (Klongdaan in Klongdaan) respectively. The 31 samples were from 29 brands covering 19 companies. However, two samples did not have the information about the manufacturers.

The description of 31 paint samples presents in Table 1. According to the sample descriptions, these samples can be classified into two major groups. The first group is called "order-to-mix paint". Its character is that pigments had been added and mixed by the mixing machine controlled by computer when it was bought. The "order-to-mix paint" group comprised of six samples (THA 2010-01 to THA 2010-06) from five brands. The other group is called "ready-mixed paint". Its character is that pigments are ready mixed from the factories. This group consisted of 25 samples (THA 2010-07 to THA 2010-31) from 25 brands.

Table 1: The sample description of the decorative paints

Sample #	Brand Name	Color of Paint	Paint Can Size	Purchase Price (baht)	Batch #/Manufactured date Information [from can]	Date of Purchase	Other Comments, web site, mention of Pb on can etc	Manufacturer	Paint Character
THA 2010-01	Beger Super Gloss Enamel	B-175 Butter Cup	0.946 L	210	Base D: lot no.107166 / mfg.date 02.09.2010	9/11/2010	less odor; dirt repellent; sagging control; www.beger.co.th	BM Brathers	pigments added and mixed by mixing machine at purchase
THA 2010-02	ICI SuperCote Gloss Enamel	19YY51/758	1 L	261	base :	9/11/2010	No added Hg, Pb	Akzo Nobel Paint (Thailand) Co.,Ltd.	pigments added and mixed by mixing machine at purchase
THA 2010-03	Jotun Gardex Enamel	1080-Y Yellow	0.946 L	330	Base yellow: mfg.20.02.2006	12/11/2010	fungus resistant	Jotun Thai Co.,Ltd	pigments added and mixed by mixing machine at purchase
THA 2010-04	Jotun Gardex Enamel	1080-Y Yellow	0.946 L	200	Base yellow: mfg.10.06.2002	10/11/2010	fungus resistant	Jotun Thai Co.,Ltd	pigments added and mixed by mixing machine at purchase
THA 2010-05	TOA Glipton Super High Gloss Enamel	7941 Bright Lily	0.946 L	332	Base D: lot no.1010344693	9/11/2010	Anti fungus; No added Hg, Pb	TOA Paint (Thailand) Co.,Ltd.	pigments added and mixed by mixing machine at purchase
THA 2010-06	4 Season High Gloss Enamel	7941 Bright Lily	0.946 L	317	Base D: lot no.1009343289	9/11/2010	Anti fungus; No added Hg, Pb; TISI.	TOA Paint (Thailand) Co.,Ltd.	pigments added and mixed by mixing machine at purchase
THA 2010-07	TOA Glipton Super High Gloss Enamel	G175 Butter Cup	0946 L	150	lot no.385606	8/10/2010	Anti fungus; No added Hg, Pb; www.toagroup.com	TOA Paint (Thailand) Co.,Ltd.	pigments ready mixed from factory

Table 1 (continued)

Sample #	Brand Name	Color of Paint	Paint Can Size	Purchase Price (baht)	Batch #/Manufactured date Information [from can]	Date of Purchase	Other Comments, web site, mention of Pb on can etc	Manufacturer	Paint Character
THA 2010-09	NOC Synthetic Enamel	S234	0.875 L	100	lot no.234020 / mfg.05.03.2010	11/11/2010		HATO Paint (J.K.R.) co.,Ltd.	Pigments ready mixed from factory
THA 2010-10	Temco Enamel	T317	0.8 L	95	ไม่มีข้อมูล	11/11/2010	www.tkschemical.co.th	TKS Chemical (Thailand) Co.,ltd.	Pigments ready mixed from factory
THA 2010-11	Delta Gloss Enamel	303 Sunflower	0.946 L	149	lot no.102248 / mfg.-.05.2010	9/11/2010	TISI.327-2538; fungus resisting	Delta Paint Co.,Ltd.	Pigments ready mixed from factory
THA 2010-12	FTALIT Synthetic Resin Enamel	540 Medium Yellow	0.946 L	150	lot no.5070612 / mfg.14.07.2005	8/11/2010		Thai Kan Sai Paint Co.,Ltd.	pigments ready mixed from factory
THA 2010-13	Marco High Gloss Enamel	M-620 Reddish Yellow	0.825 L	100	lot no.093166 / mfg.01.07.2009	8/11/2010		Ha Chem Paint Co., Ltd.	pigments ready mixed from factory
THA 2010-14	DYNO Pro Gloss Enamel	G111 Soft Yellow	0946 L	169	lot no.S10070903 / mfg.09.07.2010	8/11/2010		Dyno Paints limited	pigments ready mixed from factory
THA 2010-15	National Gloss Synthetic Resin Enamel	303 Sunflower	0875 L	150	lot no.108220 / mfg.-.05.2007	8/11/2010		Delta Paint Co.,Ltd.	Pigments ready mixed from factory
THA 2010-16	SEFCO Synthetic Enamel	S155 Reddish Yellow	0.85 L	90	lot no.02355 / mfg.-.05.2010	8/11/2010		No data	pigments ready mixed from factory
THA 2010-17	AAA Synthetic Enamel	1003 Gloden Yellow	0.875 L	120	lot no.35/185 mfg.25.03.2010	8/11/2010	www.jbp.co.th	J.B.P. International Paint Co.,Ltd.	Pigments ready mixed from factory

Table 1 (continued)

Sample #	Brand Name	Color of Paint	Paint Can Size	Purchase Price (baht)	Batch #/Manufactured date Information [from can]	Date of Purchase	Other Comments, web site, mention of Pb on can etc	Manufacturer	Paint Character
THA 2010-19	Homecote Gloss Enamel	H581 Lemon Yellow	0.875 L	90	lot no.0912320480	8/11/2010	anti fungus	TOA Paint (hailand) Co.,Ltd.	Pigments ready mixed from factory
THA 2010-20	Lotto Super Gloss Enamel	L-1155 Reddish Yellow	0.825 L	100	lot no.083873 mfg.12.09.2008	9/11/2010		Lotto Paint Co.,Ltd. (on lid) Ha Chem Paint Co.,Ltd (on can)	pigments ready mixed from factory
THA 2010-21	Denzo Synthetic Gloss Enamel	D-612 Yellow	0.85 L	130	lot no.900601 mfg.06.04.2010	9/11/2010	No added Hg, Pb; Anti fugus; good cohesive; www.tirapaint.com	Thai TOA Industries Co.,Ltd.	Pigments ready mixed from factory
THA 2010-22	BANDAI Gloss Finish	D155 Reddish Yellow	750 gram	95	lot no.9070781	9/11/2010		Lena (Thailand) Co.,Ltd.	Pigments ready mixed from factory
THA 2010-23	IBC High Gloss Enamel	434 Lemon Yellow	0.946 L	100	lot no.100963 mfg.-.05.2004	9/11/2010		Delta Paint Co.,Ltd.	Pigments ready mixed from factory
THA 2010-24	Bold Eagle Synthetic Enamel	E-444 Yellow Orange	0.875 L	110	mfg.16.06.2010	9/11/2010		LEO Paint Co.,Ltd.	Pigments ready mixed from factory
THA 2010-25	Nippon Shield Pro Alkyd Enamel	9804 Canary	0.946 L	140	mfg.18.08.2010	9/11/2010		Nippon Paint (Thailand) Co.,Ltd	pigments ready mixed from factory

Table 1 (continued)

Sample #	Brand Name	Color of Paint	Paint Can Size	Purchase Price (baht)	Batch #/Manufactured date Information [from can]	Date of Purchase	Other Comments, web site, mention of Pb on can etc	Manufacturer	Paint Character
THA 2010-27	HATO Synthetic Enamel	Yellow	0.3 L	35		9/11/2010	Durable	HATO Paint (J.K.R.) co.,Ltd.	pigments ready mixed from factory
THA 2010-28	Y2K SEFCO Synthetic High Gloss Enamel	Y2559 Neptune	3.785 L	380	lot no.37129 mfg.-.01.2005	11/11/2010		Sefco chemical (2001) Co.,Ltd.	pigments ready mixed from factory
THA 2010-29	APPLE	Yellow Orange	1 pound	50	No data	8/11/2010		No data	pigments ready mixed from factory
THA 2010-30	Nakoya Industrial lacquer	904 Yellow	0.80 L	135	Can not read	9/11/2010	Nitrocellulose lacquer paint	Nagoya Paint Co.,Ltd.	pigments ready mixed from factory
THA 2010-31	KOBE Gloss Synthetic Enamel	K204 Lemon Yellow	0.875 L	90	lot no.1005334498	16/11/2010		TOA Paint (Thailand) Co.,Ltd.	pigments ready mixed from factory

Table 2: Lead concentrations in 31 paint samples

Sample #	Brand Name	Lead content (mg/kg = ppm)
THA 2010-01	Bager Super Gloss Enamel	96
THA 2010-02	ICI SuperCote Gloss Enamel	24
THA 2010-03	Jotun Gardex Enamel	30
THA 2010-04	Jotun Gardex Enamel	2,418
THA 2010-05	TOA Glipton Super High Gloss Enamel	ND
THA 2010-06	4 Season High Gloss Enamel	3
THA 2010-07	TOA Glipton Super High Gloss Enamel	3,823
THA 2010-08	Captain LongLife High Gloss	1,113
THA 2010-09	NOC Synthetic Enamel	14,795
THA 2010-10	Temco Enamel	19,208
THA 2010-11	Delta Gloss Enamel	13,207
THA 2010-12	FTALIT Synthetic Resin Enamel	6,094
THA 2010-13	Marco High Gloss Enamel	11,144
THA 2010-14	DYNO Pro Gloss Enamel	3,940
THA 2010-15	National Gloss Synthetic Resin Enamel	6,022
THA 2010-16	SEFCO Synthetic Enamel	16,070
THA 2010-17	AAA Synthetic Enamel	5,314
THA 2010-18	JBP Super Gloss Synthetic Enamel	26,516
THA 2010-19	Homecote Gloss Enamel	19,403
THA 2010-20	Lotto Super Gloss Enamel	15,187
THA 2010-21	Denzo Synthetic Gloss Enamel	18,580
THA 2010-22	BANDAI Gloss Finish	16,472
THA 2010-23	IBC High Gloss Enamel	2,904
THA 2010-24	Bold Eagle Synthetic Enamel	28,403
THA 2010-25	Nippon Shield Pro Alkyd Enamel	25,801
THA 2010-26	Rust-Oleum Protective Enamel	23,821
THA 2010-27	HATO Synthetic Enamel	23,815

THA 2010-28	Y2K SEFCO Synthetic High Gloss Enamel	5,513
THA 2010-29	APPLE	34,442
THA 2010-30	Nakoya Industrial lacquer	28,084
THA 2010-31	KOBE Gloss Synthetic Enamel	32,227

The following observations can be made from the results in Table 2.

The group of “order-to-mix paint” contained lead concentrations varying from 0 to 2,418 ppm. (Figure 2)

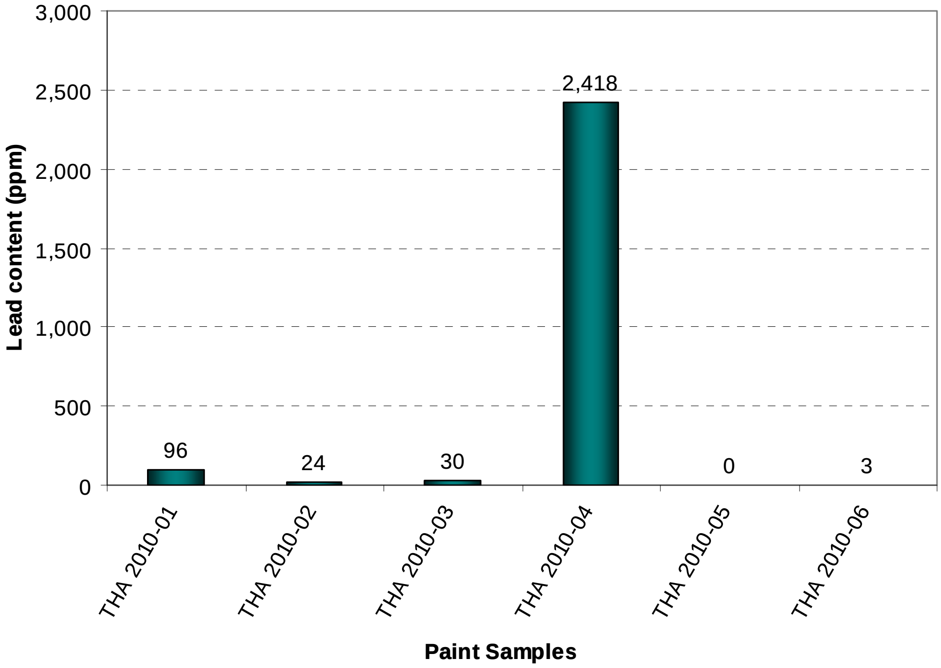


Figure 2: Lead concentrations in the paint samples of “ready-to-mix paint”

As results depicted in Table 2 demonstrate, there was one sample (THA2010-04) that was found to have lead exceeding 600 ppm., above the standard for lead in Thailand for semi gloss enamel paints (TIS 1005-2533) and flat enamel (TIS 1406-2540). The ‘standard’ is a voluntary regulation issued by the Thailand Industrial Standard Institute (TISI), Ministry of Industry. The standard says that that lead concentration in these two types of paints must not exceed 0.06% by weight of non -volatile (or 600 ppm). However, comparing with the standard in paints of the USA., there were 27 samples which had lead concentrations exceeding the standard for lead concentrations. The American’s Standard Consumer Safety Specification for Toy Safety, ASTM F963-07, is in effective since 14th August, 2009. The standard states that the lead level used in decorative paint is not more than 0.009% or 90 ppm.

One observation is that there was one sample (THA2010-05) where no lead was detected. Another observation is that the two samples (THA2010-04 and THA2010-03), which had the same brand and color but had different manufacturing dates, had the different lead concentrations. The THA 2010-04 sample had a very high lead concentration at 2,418 ppm, 80 times higher than the THA2010-03 sample. Thus, it is likely that the paint base, produced eight years ago, contained lead higher than those produced in the following year.

All samples of the “ready-mixed paint” group were found to have lead. The lead concentrations varied from 1,113 to 34,442 ppm (see Figure 3). The average of lead concentration of this group was 16,076 ppm.

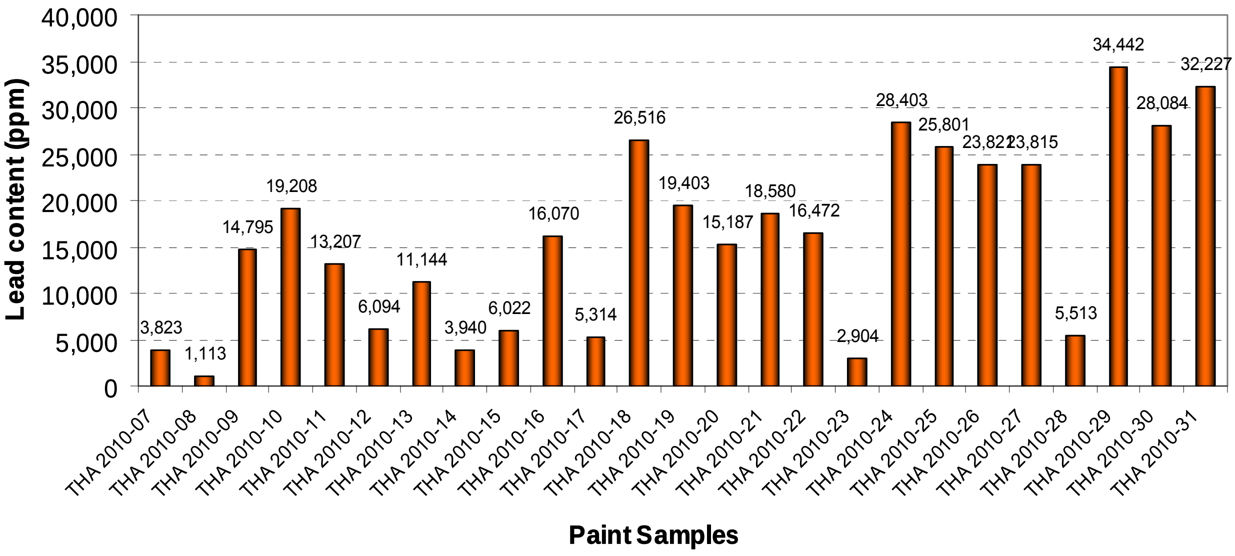


Figure 3: Lead concentrations in the samples of the "ready-mixed paint" group

All of the samples grouped "ready-mixed paint" contained lead exceeding the allowable limit of lead concentration of the voluntarily standard of the TISI. The results of this group, comparing with the TISI standard of lead levels for enamel paints are given in Table 3. The findings indicated that the highest concentration of lead was found in the THA2010-29 sample (34,442 ppm), 57 times higher than the limit of lead concentration. The second-highest concentration of lead was found in the THA2010-31 sample (32,227 ppm), 54 times higher than the limit of lead concentration.

Table 3 Lead concentration of the samples grouped "ready-mixed paint" comparing with the standard of lead (600 ppm.)

Sample #	Brand Name	Baht per litre	Lead content (mg/kg = ppm)	Lead exceeding the standard 600 ppm. (Times)
THA 2010-29	APPLE		34,442	57
THA 2010-31	KOBE Gloss Synthetic Enamel	103	32,227	54
THA 2010-24	Bold Eagle Synthetic Enamel	126	28,403	47
THA 2010-30	Nakoya Industrial lacquer	169	28,084	47
THA 2010-18	JBP Super Gloss Synthetic Enamel	127	26,516	44
THA 2010-25	Nippon Shield Pro Alkyd Enamel	148	25,801	43
THA 2010-26	Rust-Oleum Protective Enamel	377	23,821	40
THA 2010-27	HATO Synthetic Enamel	117	23,815	40
THA 2010-19	Homecote Gloss Enamel	103	19,403	32
THA 2010-10	Temco Enamel	119	19,208	32
THA 2010-21	Denzo Synthetic Gloss Enamel	153	18,580	31
THA 2010-22	BANDAI Gloss Finish	112	16,472	27
THA 2010-16	SEFCO Synthetic Enamel	106	16,070	27
THA 2010-20	Lotto Super Gloss Enamel	121	15,187	25
THA 2010-09	NOC Synthetic Enamel	114	14,795	25

THA 2010-11	Delta Gloss Enamel	158	13,207	22
THA 2010-13	Marco High Gloss Enamel	121	11,144	19
THA 2010-12	FTALIT Synthetic Resin Enamel	159	6,094	10
THA 2010-15	National Gloss Synthetic Resin Enamel	171	6,022	10
THA 2010-28	Y2K SEFCO Synthetic High Gloss Enamel	100	5,513	9
THA 2010-17	AAA Synthetic Enamel	137	5,314	9
THA 2010-14	DYNO Pro Gloss Enamel	179	3,940	7
THA 2010-07	TOA Glipton Super High Gloss Enamel	159	3,823	6
THA 2010-23	IBC High Gloss Enamel	106	2,904	5
THA 2010-08	Captain LongLife High Gloss	137	1,113	2
	Average	143	16,076	

1) The average price of paint samples found to have very high lead concentration exceeding 600 ppm, cost 143 Baht per litre (except for the THA2010-04 sample). Meanwhile, the average price of paint samples containing lower lead concentrations, cost 303 Baht per liter. Therefore, it was likely that oil-based decorative paints distributed at the low-level and medium-level markets, contained much higher lead.

2) The paint samples produced by TOA Paint (Thailand), one of the biggest paint industries in Thailand, distribute both the “order-to-mix paint” group and the “ready-mixed paint” group. The details are shown in Table 4. Therefore, it can be indicated that the TOA Paint (Thailand) is capable to produce decorative paints which have less or no lead content. Nevertheless, the paints with no lead content cost three times more than those paints containing lead.

3) Furthermore, some paint companies manufactured various brands of paints. For example, Delta Paint Company produced the paint brand “Delta National” and “IBC”. HATO Paint (J.K.R.) produced paints brand “NOC”, “NATO” respectively. However, these types of paints produced for distributing only at the medium-level and low-level market.

Table 4: The paint samples produced by TOA Paint (Thailand) Company

Sample No.	Brand Name	Color	Baht per litre	Comments	Paint Character	Lead content, ppm
THA 2010-05	TOA Glipton Super High Gloss Enamel	7941 Bright Lily	351	Anti fungus; No added Hg, Pb	1*	ND
THA 2010-06	4 Season High Gloss Enamel	7941 Bright Lily	335	Anti fungus; No added Hg, Pb; TISI.	1*	3
THA 2010-07	TOA Glipton Super High Gloss Enamel	G175 Butter Cup	158	Anti fungus; No added Hg, Pb;	2*	3,823
THA 2010-19	Homecote Gloss Enamel	H581 Lemon Yellow	103	anti fungus	2*	19,403
THA 2010-31	KOBE Gloss Synthetic Enamel	K204 Lemon Yellow	103		2*	32,227

1* pigments added and mixed by mixing machine when it was brought (“order-to-mix paint”)

2* pigments ready mixed from factory (“ready-mixed paint”)

1) Considering the lead analysis of the manufacturing companies and distributing companies, it was found that four companies were owned by multinational corporations or join ventures; 15 companies were owned by Thai limited companies or Thai limited partnerships. The lead concentrations in decorative paints from the multinational corporations or joint ventures are shown in Table 5. In addition, the lead concentrations in decorative paints from Thai limited companies and Thai limited partnerships are given in Table 6.

Table 5: The lead concentrations in decorative paints from the multinational corporations or join ventures

No.	Company Name	Brandname	Sample No.	Lead content, ppm
1	Akzo Nobel Paint (Thailand) Co.,Ltd [Nederland]	1. ICI SuperCote Gloss Enamel	THA 2010-02	24
2	Jotun Thai Co.,Ltd. [Norway]	1. Jotun Gardex Enamel	THA 2010-03	30
		2. Jotun Gardex Enamel	THA 2010-04	2,418
3	Nippon Paint (Thailand) Co.,Ltd [Japan]	1. Nippon Shield Pro Alkyd Enamel	THA 2010-25	25,801
4	Thai Kansai Paint Co.,Ltd. [Thailand+Japan]	1. FTALIT Synthetic Resin Enamel	THA 2010-12	6,094

Table 6: Lead concentrations in decorative paints from Thai limited companies and Thai limited partnerships

No	Company Name	Brandname	Sample No.	Lead content, ppm
1	B.M. Brother	1. Bager Super Gloss Enamel	THA 2010-01	96
2	Captain Paint (Thailand) Co.,Ltd.	1. Captain LongLife High Gloss	THA 2010-08	1,113
3	Delta Paint Co.,Ltd.	1. Delta Gloss Enamel	THA 2010-11	13,207
		2. National Gloss Synthetic Resin Enamel	THA 2010-15	6,022
		3. IBC High Gloss Enamel	THA 2010-23	2,904
4	Dyno Paints Limited	1. DYNO Pro Gloss Enamel	THA 2010-14	3,940
		2. Rust-Oleum Protective Enamel (Reseller)	THA 2010-26	23,821
5	Hachem Paint Co.,Ltd.	1. Marco High Gloss Enamel	THA 2010-13	11,144
6	HATO Paint (J.K.R.) co.,Ltd.	1. NOC Synthetic Enamel	THA 2010-09	14,795
		2. HATO Synthetic Enamel	THA 2010-27	23,815
7	J.B.P. International Paint Co.,Ltd	1. AAA Synthetic Enamel	THA 2010-17	5,314
		2. JBP Super Gloss Synthetic Enamel	THA 2010-18	26,516
8	Lena (Thailand) Co.,Ltd.	1. BANDAI Gloss Finish	THA 2010-22	16,472
9	LEO Paint Co.,Ltd.	1. Bold Eagle Synthetic Enamel	THA 2010-24	28,403
10	Lotto Paint Co.,Ltd.	1. Lotto Super Gloss Enamel	THA 2010-20	15,187
11	Nagoya Paint Co.,Ltd.	1. Nakoya Industrial lacquer	THA 2010-30	28,084
12	SEFCO Chemical (2001) Co.Ltd	1. Y2K SEFCO Synthetic High Gloss Enamel	THA 2010-28	5,513
13	Thai TOA Industries Co.,Ltd.	1. Denzo Synthetic Gloss Enamel	THA 2010-21	18,580
14	TKS Chemical (Thailand) Co.,ltd.	1. Temco Enamel	THA 2010-10	19,208
15	TOA Paint (Thailand) Co.,Ltd.	1. TOA Glipton Super High Gloss Enamel	THA 2010-05	ND
		2. 4 Season High Gloss Enamel	THA 2010-06	3
		3. TOA Glipton Super High Gloss Enamel	THA 2010-07	3,823
		4. Homecote Gloss Enamel	THA 2010-19	19,403
		5. KOBE Gloss Synthetic Enamel	THA 2010-31	32,227

Remark: Two samples did not specify the name sof manufacturers or distributors

The findings from Table 5 and Table 6 indicate that there is lead contained in the paint samples manufactured both by the multinational corporations and domestic companies. Two samples of multinational corporations had lead concentration less than 30 ppm. The two samples included: (a) the SuperCote Gloss Enamel brand produced by Akzo Nobel Paint (Thailand) Company Limited, and (b) the Jotun Gardex Enamel brand produced by Jotun Thai Company Limited, excluding the THA 2010-04 sample which had paint base rather old at eight years of age.

Moreover, the other two brands of multinational corporations, including: (a) Nippon Shield Pro Alkyd Enamel produced by the Nippon Paint (Thailand) Company Limited, and (b) FTALIT Synthetic Resin Enamel produced by the Thai Kansai Paint Company Limited, had lead concentrations at 25,801 and 6,094 ppm respectively. Similarly, the paint samples manufactured by the Thai companies containing lead varied from a low concentration to a very high concentration.

Conclusion

The results of lead analysis in the paint samples are summarized in Table 7.

Table 7 Summary of lead analysis in the paint samples

	All samples	The group of "order-to-mix paint" samples	The group of "ready-mixed paint" samples
Number of samples	31	6	25
Average cost per lit		303	143
Number of samples were found to have lead	30	5	25
Maximum – minimum value of lead concentration (ppm)	No detected – 34,442	No detected – 2,418	1,113 – 34,442
Average value of lead concentration (ppm)		30.6 (excluding the sample of old paint base which had the value of 2,418 ppm.)	16,076
Number of samples contained lead exceeding 600 ppm (per cent)	26 (83.9 per cent)	5 (83.3 per cent)	25 (100.0 per cent)
Number of samples contained lead exceeding 90 ppm (per cent)	27 (87.1 per cent)	4 (66.6 per cent)	25 (100.0 per cent)

Conclusions from the results summarized in Table 7can be made as follows:

- 30 samples out of all 31 samples (96.8%) were found to have lead. Among 31 samples, there were 26 samples (83.9%) contained lead exceeding 600 ppm and 27 samples (87.1%) contained lead exceeding 90 ppm.
- The "order-to-mix" group had six samples. Five of them (83.3%) had an amount of lead less than 600 ppm., and four of them (66.6) had an amount of lead less than 90 ppm. In addition, there was only one sample did not have lead content.

- The “ready-mixed” group had 25 samples. All of them contained lead exceeding 600 ppm. The average value of lead concentration was at 16,076 ppm. The maximum value of lead was 34, 442 ppm - 57 times higher than the limit of lead concentration (600 ppm.)
- The “ready-mixed” group, which has the average price at 143 Baht per liter, showed a high concentration of lead. The paints of this group are produced for selling at the medium-level and low-level markets, focusing on competitive pricing more than the quality of products.
- Lead was found in paints manufactured both by the multinational corporations and Thai companies. Therefore, it can be said that the major factor driving lead in manufacturing paint is cost reduction not the technology aspect. This could be seen in the five samples of TOA Paint (Thailand) Company Limited. The cost of samples having a very low concentration of lead (or even non detected) is relatively high ranging from 335 to 351 Baht per liter. On the contrary, the cost of samples having a very high concentration of lead is quite low ranging from 103 to 158 per liter. As a result of this, it is clear that technological advances can be made to produce paints without using lead, but the cost would be higher.

Recommendations

- TISI must issue the compulsory standard on lead in paints instead of the existing voluntary standard.
- Decorative paints must be controlled by the product label regulation, which requires manufacturers to show the amount of lead contained in their paint products.
- The associated authorities and organizations should find measures in order to assist small and medium entrepreneurs to produce low lead-containing paints. At the same time, these entrepreneurs must be capable of competing with other paint manufacturers in the markets.
- The responsible authorities should regularly inspect the amount of lead in decorative paints sold in the markets. This could help authorities to determine the progress of lead-controlling implementations.
- The associated organizations including governmental, private, and non-governmental organizations should broadly implement public engagement and campaigning programs so as to raise public understanding about the environmental and health impacts from lead in paints. This would lead to a change in consumer behavior. The first priority group should be the major paint users - in particular the real estate agents.