International POPs Elimination Project

Fostering Active and Efficient Civil Society Participation in Preparation for Implementation of the Stockholm Convention

PCBs Monitoring in Environmental Media in Armenia and Identification of Hot Spots

English Summary

NGO - "Ecotox"
Contacts – (374 1) 27-34-66
E-mail: ecotox@yahoo.com

Republic of Armenia
December 2004

About the International POPs Elimination Project
On May 1, 2004, the International POPs Elimination Network (IPEN http://www.ipen.org) began a global NGO project called the International POPs Elimination Project (IPEP) in partnership with the United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Program (UNEP). The Global Environment Facility (GEF) provided core funding for the project.

IPEP has three principal objectives:

- Encourage and enable NGOs in 40 developing and transitional countries to engage in activities that provide concrete and immediate contributions to country efforts in preparing for the implementation of the Stockholm Convention;

- Enhance the skills and knowledge of NGOs to help build their capacity as effective stakeholders in the Convention implementation process;

- Help establish regional and national NGO coordination and capacity in all regions of the world in support of longer term efforts to achieve chemical safety.

IPEP will support preparation of reports on country situation, hotspots, policy briefs, and regional activities. Three principal types of activities will be supported by IPEP: participation in the National Implementation Plan, training and awareness workshops, and public information and awareness campaigns.

For more information, please see http://www.ipen.org

IPEN gratefully acknowledges the financial support of the Global Environment Facility, Swiss Agency for Development and Cooperation, Swiss Agency for the Environment Forests and Landscape, the Canada POPs Fund, the Dutch Ministry of Housing, Spatial Planning and the Environment (VROM), Mitchell Kapor Foundation, Sigrid Rausing Trust, New York Community Trust and others.

The views expressed in this report are those of the authors and not necessarily the views of the institutions providing management and/or financial support.

This report is available in the following languages: English Summary and Full report in Russian

PCBs Monitoring in Environmental Media in Armenia and Identification of Hot Spots
English Summary

Sources of POPs

As it is known, in the past, Armenia had well developed industry and agriculture. The industrial sector was dominated by chemical and petrochemical industries, power industry, engineering and metal processing industries, ferrous and non ferrous metallurgy. Major facilities at the territory of the republic produced calcium carbide, sodium hydroxide, chlorine, hydrochloric, sulphur and nitric acids, chloroprene rubber and latex, nitrogen fertilisers, glass, fibres and plastics.

However, after the decay of the former USSR and the post-Soviet economic crisis in Armenia, the national industry underwent radical transformations and a serious production decline. Economic difficulties were mainly associated with disruption of economic ties of the former centralised industrial complex. As a result, many large and small facilities became idle.

Now, at the background of development and reorganisation of the Armenian industry, the power industry has developed particularly intensively and represents a leading industrial sector in the republic. The power industry incorporates numerous thermal power plants and hydroelectric stations.

Similarly to the gradually developing industrial sector, the power industry is a main source of POPs environmental releases, including emissions of polychlorinated biphenyls (components of dielectric liquids of transformers, rectifiers, high-voltage switches, compressors, etc.).

Accounting for the above factors, the problem of environmental monitoring of potential PCBs releases of power installations seems to be fairly relevant.

In the past, to meet operational needs of power plants and associated facilities, Armenia annually imported tens of thousands of tons of technical dielectric liquids, containing polychlorinated biphenyls (PCBs).

These technical dielectric liquids were produced under such brand names as: Sovol, Sovtol, Klofen A60, Fetkhlor D15, Arakhlor 1200, Arakhlor 5460 and others. In Armenia, mainly Sovol and Sovtol brands were used.

Besides power supply installations, different brands of mineral oil are broadly used in other spheres (elevators, transformers, compressors, etc.). Installations with mineral oil also release PCBs.

In addition, it is well known that in 1980s Armenia was the largest supplier of capacitors to other republics of the former USSR. In fact, the republic produced 70% of the overall production of capacitors in the USSR.

Now, the following large generating facilities operate in Armenia:

- Spandaryanskaya Hydroelectric Station
- Shambskaya Hydroelectric Station
- Gyumushskaya Hydroelectric Station
- Tatevskaya Hydroelectric Station
- Razdanskaya Hydroelectric Station
- Argelskaya Hydroelectric Station
- Arzniyskaya Hydroelectric Station
- Kanakerskaya Hydroelectric Station
- Sevanskaya Hydroelectric Station
- Armavirskaya Hydroelectric Station
- Razdanskaya Thermal Power Plant
- Yerevanskaya Thermal Power Plant
- Vanadzorskaya Thermal Power Plant

Accounting for the fact that PCBs-containing liquids are mainly applied in power supply installations, we focused our research activities in marzs (provinces) where the above generating facilities are located.

POPs contamination levels

We studied PCBs contamination levels in different media in the Republic of Armenia (surface water bodies, soil, and food).

Our studies demonstrated that numerous industrial facilities of interest operated and still operate in the territory of the republic now and in the Soviet period. These facilities incorporate hydropower stations and thermal power plants, transformer substations of the power supply lines, transformer installations of industrial facilities, as well as numerous producers of transformers and capacitors that were supplied earlier to different districts of Armenia and other republics of the former USSR. PCBs-containing items were also imported to Armenia (mineral oil, hydraulic liquids, pesticides, some domestic items, carbon paper, etc.

The above data suggest that PCBs contamination might be also found in other places, besides areas of direct impacts of facilities that use PCBs-containing equipment items, as PCBs-containing pesticides contaminated rural areas as well.

These substances are prone to global pollution, because they tend to vaporise at high temperatures and may migrate in air to areas free of local PCBs sources.

Therefore, we selected different territories for our research studies in several marzs (oblasts or provinces) of the republic, including industrial centres (Razdan, Vanadzor, Kapan) and comparatively clean cities of Dilizhan (Tavushskiy marz) and Ararat (Araratskiy marz).

We monitored residual levels of PCBs in different environmental media (soil, surface water) and food. In all regions under study, accounting for expected contamination levels, we took comparatively large samples.

In the course of selection of samples, we accounted for their nature and importance for human exposure. For example, animal food is known to contain almost 2 times higher levels of PCBs (due to their high liposolubility) and we analysed only food products of animal origin. Comparatively high numbers of soil samples were taken. To meet objectives of the study, we took 50 samples in different marzs (provinces) of Armenia (Syunik, Lori, Kotaik, Ararat), including 14 samples of soil, 11 samples of water and 25 samples of food (9 samples of meet, 6 samples of eggs, 5 samples of cheese and 5 samples of milk).

Results of our research studies are shown in 5 tables for individual marzs (provinces). In Table 1, PCBs contamination levels are shown for Loriyskiy marz of Armenia. According to the data obtained, average PCBs levels in soil samples, taken nearby industrial facilities of Vanadzor, reached 52.48 µg/kg. In water samples from the Pambak River, PCBs levels reached 0.71 µg/l, while average PCBs levels in food samples (meat, eggs, cheese and milk) reached 19.46 µg/kg; 1.47 µg/kg; 42.93 µg/kg and 6.56 µg/l, respectively.

Table 1. PCBs levels in environmental media of Loriyskiy marz of Armenia (soil, water, food), in 2004, in mg/kg, mg/l

No	Sampling sites	Samples	PCBs levels (mg/kg, mg/l)	Notes
1.	Vanadzor	soil	0. 055	samples were taken at the territory adjacent to the power plant and other industrial facilities
2.	Vanadzor	soil	0.061	samples were taken at the territory adjacent to the power plant and other industrial facilities
3.	Vanadzor	soil	0.042 average 0.053	samples were taken at the territory adjacent to the power plant and other industrial

No	Sampling sites	Samples	PCBs levels (mg/kg, mg/l)	Notes
				facilities
4.	the Pambak river	water	0.00084	samples were taken in the river that runs through Vanadzor
5.	the Pambak river	water	0.00054	samples were taken in the river that runs through Vanadzor
6.	the Pambak river	water	0.00074 average 0.00071	samples were taken in the river that runs through Vanadzor
7.	Vanadzor	meat (pork)	0.022	samples were taken at a local marketplace
8.	Vanadzor	meat (beef)	0.017 average 0.019	samples were taken at a local marketplace
9.	Vanadzor	eggs	0.002	samples were taken at a local marketplace
10.	Vanadzor	eggs	0.001 average 0.001	samples were taken at a local marketplace
11.	Vanadzor	cheese	0.058	samples were taken at a local marketplace
12.	Vanadzor	cheese	0.028 average 0.043	samples were taken at a local marketplace
13.	Vanadzor	milk	0.007	samples were taken at a local marketplace

Similar results were obtained in the case of samples, taken in Razdanskiy district (Razdan) of Kotaikskiy marz) - see Table 2.

Table 2. PCBs levels in environmental media of Kotayksiy marz of Armenia (soil, water, food), in 2004, in mg/kg, mg/l

No	Sampling sites	Samples	PCBs levels (mg/kg, mg/l)	Notes
1.	Razdan	soil	0.038	samples were taken nearby industrial facilities of the city
2.	Razdan	soil	0.031	samples were taken nearby industrial facilities of the city
3.	Razdan Thermal Power Plant	soil	0.058 average 0.042	samples were taken at the power plant site
4.	Maliy Sevan lake	water	0.00035	samples were taken at the riverhead of the Razdan river
5.	the Razdan river	water	0.00064	samples were taken at the territory, adjacent to the power plant
6.	the Razdan river	water	0.00073 average 0.00057	nearby the city of Razdan
7.	Razdan	meat (pork)	0.027	samples were taken at a local marketplace
8.	Razdan	meat (beef)	0.012 average 0.020	samples were taken at a local marketplace
9.	Razdan	milk	0.004	samples were taken in private farms
10.	Razdan	milk	0.004 average 0.004	samples were taken in private farms
11.	Razdan	eggs	0.005	samples were taken in private farms

Data of Table 2 provide the following average PCBs levels in soil (42.31 µg/kg), water of the Razdan river (0.57 µg/l), meat (19.93 µg/kg), milk (3.97 µg/l), and eggs (5.46 µg/kg).

Results of monitoring studies in Syunikskiy marz of Armenia are shown in Table 3.

Table 3. PCBs levels in environmental media of Syunikskiy marz of Armenia (soil, water, food), in 2004, in mg/kg, mg/l

No	Sampling sites	Samples	PCBs levels (mg/kg, mg/l)	Notes
1.	Kapanskiy district	soil	0.072	samples were taken nearby Kadzharanskiy plant
2.	Kapanskiy district	soil	0.060	samples were taken nearby Kapan
3.	Kapanskiy district	soil	0.022 average 0.052	samples were taken nearby Kapan
4.	Kapanskiy district	water	0.00053	samples were taken in different sections of the Vokhchi river
5.	Kapanskiy district	water	0.00068	samples were taken in different sections of the Vokhchi river
6.	Kapanskiy district	water	0.00074 average 0.00065	samples were taken in different sections of the Vokhchi river
7.	Kapanskiy district	meat (pork)	0.020	samples were taken at a local marketplace
8.	Kapanskiy district	meat (pork)	0.024 average 0.022	samples were taken at a local marketplace
9.	Kapanskiy district	cheese	0.015	samples were taken at a local marketplace
10.	Kapanskiy district	cheese	0.018 average 0.017	samples were taken at a local marketplace
11.	Kapanskiy district	eggs	0.002	samples were taken in private farms

Results of monitoring studies in Syunikskiy marz (see Table 3) also suggest that PCBs levels are similar to those in other marzs of Armenia - Lori (Vanadzor) and Kotaik (Razdan).

A radically different situation was observed in the course of study of environmental media (soil, water) and food in Ararat (Araratskiy marz) - see Table 4. PCBs levels are of the same level of magnitude, but they are substantially lower than PCBs levels in water and soil samples of Loriyskiy, Kotakskiy and Syunikskiy marzs. In the case of food products, residual levels of PCBs do not demonstrate substantial differences.

Table 4. PCBs levels in environmental media of Araratskiy marz of Armenia (soil, water, food), in 2004, in mg/kg, mg/l

No	Sampling sites	Samples	PCBs levels mg/kg, mg/l)	Notes
1.	Ararat	soil	0.008	samples were taken nearby industrial facilities
2.	Ararat	soil	0.005	samples were taken nearby industrial facilities
3.	Ararat	soil	0.010 average 0.008	samples were taken nearby industrial facilities
4.	Ararat	water	0.00038	samples were taken in a drainage ditch
5.	Ararat	milk	0.004	samples were taken in private farms
6.	Ararat	milk	0.004 average 0.004	samples were taken in private farms
7.	Ararat	meat (beef)	0.014	samples were bought in local shops
8.	Ararat	meat (beef)	0.012 average 0.013	samples were bought in local shops
9.	Ararat	eggs	0.001	samples were taken in private farms
10.	Ararat	eggs	0.002 average 0.002	samples were taken in private farms

Similar results were obtained in Dilizhan (Tavushskiy marz) - see Table 5. The following average PCBs levels were found: soil (10.57 µg/kg), water (0.38 µg/l), meat (12.60 µg/kg), and cheese (6.53 µg/kg).

Table 5. PCBs levels in environmental media of Tavushskiy marz of Armenia (soil, water, food), in 2004, in mg/kg, mg/l

No	Sampling sites	Samples	PCBs levels (mg/kg, mg/l)	Notes
1.	Dilizhan	soil	0.012	samples were taken at the territory of the city
2.	Dilizhan	soil	0.009 average 0.011	samples were taken at the territory of the city
3.	Dilizhan	water	0.00038	samples were taken in the Agstev river
4.	Dilizhan	meat (beef)	0.013	samples were bought in local shops
5.	Dilizhan	cheese	0.007	samples were bought in local shops

Summing up results of our studies of PCBs levels in environmental media and food in 5 marzs of Armenia (Lori, Tavush, Kotaik, Syunik and Ararat), we should note that these substances were found in environmental media and animal food samples in all these marzs (provinces). These results suggest the countrywide contamination of these media by residual levels of PCBs. The contamination was caused by application of PCB-containing items in technological processes. However, we should also note that contamination levels in different media and in different marzs do differ, and sometimes substantially. For example, PCBs levels are several times higher in soil samples taken in areas with large industrial facilities and power plants - these findings suggest that the facilities continue to use PCBs-containing liquids.

Almost twice higher levels of PCBs were found in water reservoirs at territories of industrialised marzs of Armenia. Besides that, our research results also demonstrate differences in PCBs levels in food products (meat, cheese, etc.).

The study results suggest that the range of key PCBs pollution hot spots incorporates industrial centres of the country and areas nearby power plants, where PCBs-containing materials are intensively used for technological purposes.

Adverse impacts of POPs

Research studies of adverse health impacts of POPs, epidemiological studies and available clinical reports on occupational morbidity in Armenia suggest adverse health impacts of POPs on workers of chloroprene, mining and metallurgy facilities.

There are numerous production facilities in Armenia, that apply high-temperature technologies for production of different chemicals, including chlorine, chloroprene, organochlorine and other substances, raw and secondary copper, aluminium, casting of iron, gold, bronze, cast iron and steel, lime and cement production, production of calcium carbide, glass, flint, ceramic items, drying and burning of molybdenum concentrate, production of pure molybdenum, ferromolybdenum and other molybdenum compounds, as well as production of enamelware, asphalt, steel reinforcement bars, aluminium constructions and foil, processing of used oil, production of paints, etc. The above technologies, as well as uncontrolled incineration of industrial and municipal waste might facilitate generation of dioxins and their environmental releases.

Annual dioxin emissions in Armenia are estimated to reach 28.33 g TEQ. The chloroprene rubber production plant deserves particular attention, as its annual dioxin emissions might reach 4.5 – 5 g TEQ. At the plant site, several separate installations operated including production of chlorine by electrolysis of sodium chloride solutions and production of calcium carbide and acetylene (later, they switched to production of acetylene from natural gas). At the facility's site, mono-vinylacetylene and butadiene were chlorinated to produce 3,4-dichlorobutane-1, with further dehydrochlorination to produce chloroprene. After rectification of the chlorination products, residual high boiling fractions were used to produce acetate of dichlorophenoxylacetic acid (an herbicide also known as 2,4 - D).

Long term clinical observations allowed identification of occupational disorders among chloroprene production workers, that are absolutely similar to pathologies generated by 2,3,7,8-tetrachlorodibenzo-*p*-dioxin.

For example, symptoms of acute health impacts included irritation of eyes and respiratory organs, rhinitis, nasopharyngitis, chloracne, skin rash; while chronic impacts resulted in the following symptoms:

a. chloracne, hyperpigmentation, changes of hair, hyperdermia and skin edema;
b. asthenovegetative syndrome, psychasthenia, toxic encephalopathy, vegetodystonia, polyneuropathy;
c. suppression of hormone secretion (hypophysis, android glands, adrenal, thyroid gland);
d. hypertension, hypotension, coronarism, toxic myocarditis;
e. spontaneous abortions, premature birth, birth defects, physical and intellectual retardation, brain pathologies;
f. suppression of spermatogenesis, reduction of blood levels of testosterone, FSH, LH, prolactin;
g. malignant tumours of liver, stomach, lungs and skin;
h. functional disorders or organic damage of kidneys;
i. gastritis, duodenitis, toxic hepatitis with associated biochemical and enzyme disorders;
j. reduction of phagocitic activity of leucocytes, low antibody titres after immunisations;
k. higher incidence of chromosome aberrations in lymphocytes of workers' peripheral blood.

All these factors suggest that development of such symptoms might be caused by dioxins, that act in parallel with chloroprene.