International POPs Elimination Network

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Pesticide Working Group

Lindane

Answers to common questions

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The IPEN Pesticide Working Group is one of several working groups of the International POPs Elimination Network (IPEN). This fact sheet was developed by Madhumita Dutta, an independent activist formerly with Toxics Link India, and Kristin S. Schafer of Pesticide Action Network North America.

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For a full list of working group members and for more information on IPEN and the IPEN Pesticide Working Group, see www.ipen.org or contact the Pesticide Working Group coordinating office: Pesticide Action Network (PAN) Africa, B.P. 15 938 Dakar-Fann, Senegal, email panafrica@pan-africa.sn.

Lindane

Answers to common questions

May 2003

Lindane is an organochlorine pesticide that has been used to control many types of insects since the early 1950s. It is known to be a relatively volatile and persistent pesticide that accumulates in the body fat of humans and other animals. It can migrate over long distances through air, water and sediment. Because of these properties and also its use world wide for more than 50 years, lindane is now found throughout the global environment and has even been detected in areas of non-use like the Arctic, indicating global atmospheric transport.[1] Studies of chemical body burden in various countries document that lindane exists worldwide in human tissues as well. Lindane has been banned in many countries, and where it is still in use it often faces pressure for additional restrictions or phaseout.

How is lindane used ?

Lindane is used both for agricultural pest control and for public health or «pharmaceutical» applications. It is also used to control insect infestation in materials like wood, leather, wool and cotton as well as livestock applications for control of parasites.

Lindane kills insects that ingest it or inhale its vapor. It stimulates the central nervous system to cause trembling, hyperexcitation, loss of coordination, paralysis, and eventually death. Its exact mode of action is not well understood. Although lindane acts on the nervous system it does not inhibit the cholinesterase enzyme, which is the primary mode of action of organophosphate insecticides.[2]

In agriculture, lindane is used for a variety of crops, fruits, soil treatment, seed treatment and on livestock. Specific examples include use in India to control pests in cotton, sugarcane, pumpkin, cabbage, onion, apple, walnut, maize, okhra, potato, tomato, cauliflower, radish, cucumber and beans. In Canada (which will be phasing out all uses by December 2004) lindane is also registered for use on fruit and vegetable crops, tobacco, and in greenhouses. Canada has already discontinued lindane seed treatment on canola, which used to account for 80% of the country's total use of lindane in agriculture.[3] [4]

Lindane is currently registered for seed treatment of 17 crops in Canada, 19 crops in the U.S., and six crops in Mexico. In Nigeria, lindane is used extensively to control weevils in kolanut production, and reports from Uganda indicate that the pesticide is used illegally to poison and harvest fish in some rivers and in Lake Victoria.[5] [6]

In the public health sector, various formulations of lindane are registered for use. Most are pharmaceutical products (as lotions and medicated shampoos) for control of head lice and scabies on people and fleas and ticks on domestic animals. It is also registered for use to control fly, flea, cockroach, mosquito, bed bug, and beetle populations in some countries like India.

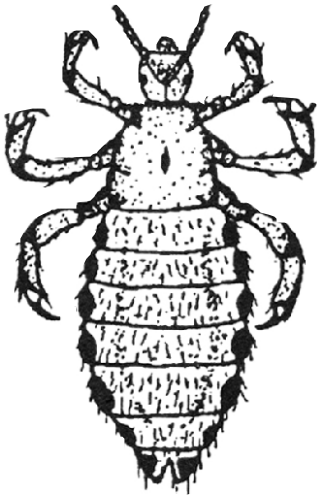

Figure 1: head lice

Recent data shows that head lice are becoming resistant to current pesticide therapies including lindane, permethrin and malathion. Lice resistance to lindane has been reported in Great Britain, the Czech Republic, France, Canada, Denmark and the U.S.[7] According to some researchers, lindane-based pharmaceutical products should no longer be on the market because this growing resistance renders the products ineffective.[8] Sale of lindane for head lice and scabies control has been prohibited in California since 2002.

Lindane use has recently been proposed for malaria control in India. According to the Indian lindane industry, use of lindane costs significantly less than other pesticides used

for malaria control (*except* DDT) and its use would save the government significant funds.[9]

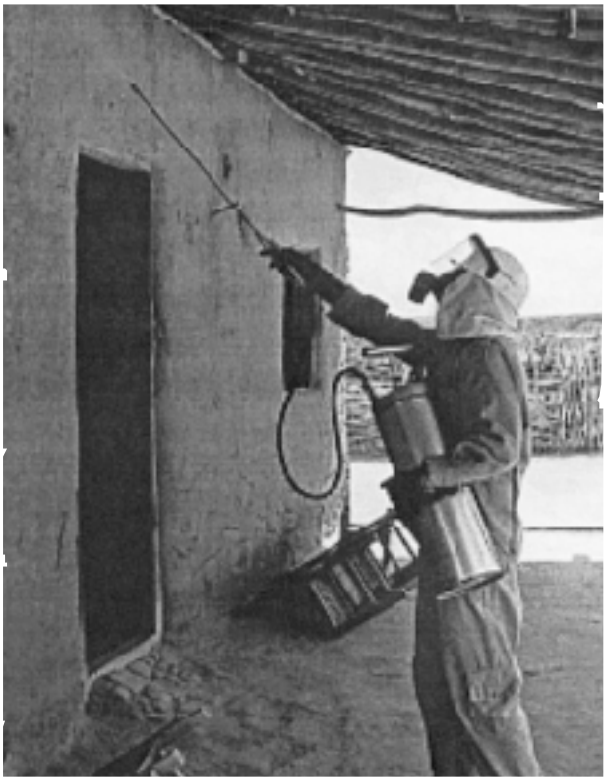

Figure 2 : Sprayman from Brazilian National Health Foundation applying insecticide in a house to kill the adult mosquitoes

How much lindane is produced, used and stockpiled - and where?

The most recent available global production figures for lindane are for the period 1990-1995. During that period 3,222 tons of lindane were produced per year worldwide.[10] Presently India, China and Romania produce lindane. Many countries that do not manufacture lindane import it and formulate it into pesticide products. Some of these countries then export lindane products to other parts of the world.

According to industry sources, the global demand for lindane in 1997 was approximately 3,000 metric tons per year. Most consumption (1400 - 1500 tons) was in Europe, which has since banned most uses of lindane. Consumption in the U.S. and Canada followed with 700 tons combined. Southeast Asia was the only region to show increasing demand, from a previous level of 400 up to 650 tons in 1997. Lindane was also used in Eastern Europe and Russia, Central and South America, Africa, Middle Eastern countries and Australia. [11]

According to the United Nations Food and Agriculture Organization over 320 metric tons (322,642 kilograms) of lindane are stockpiled in Africa. Obsolete stocks of lindane can pollute soils, water resources and atmosphere, and in several African countries lindane from obsolete stockpiles is reportedly used illegally by farmers.[12]

Figure 3: Obsolete stockpiles leaking in Cameroon

Does lindane harm people ?

Lindane is known to have a number of both acute and chronic health effects. Acute exposure mainly affects the central nervous system with symptoms including vomiting and diarrhea followed by convulsions. International Agency for Research in Cancer (IARC) reports that digestive tract inflammation, hemorrhaging, coma and death have been reported after lindane poisoning. Workers who were heavily exposed to lindane, DDT or both for periods ranging from 5-13 years showed higher rates of cirrhosis and chronic hepatitis of the liver.[13]

Exposure to small amounts by skin contamination or ingestion have been known to lead to headaches, nausea, dizziness, tremors and muscular weakness. Chronic effects of exposure to lindane include nervous disorders and increased liver weight[14]. Children are significantly more susceptible to the toxic effects of lindane.[15]

IARC has concluded that lindane is a possible human carcinogen (class 2B), and

the US EPA has also classified it as a possible human carcinogen. In addition, it is considered an endocrine disruptor capable of imitating certain hormones in humans and thereby disrupting the physiological functions which these hormones control. Studies suggest that where lindane is used extensively, and particularly where cattle are exposed to it, the incidence of breast cancer is higher.[16]

Lindane is classified by the World Health Organization (WHO) as 'moderately hazardous' and has an oral LD50 in the rat of 88 milligrams per kilogram (mg/kg).[17] This means that a dose of 88mg of lindane administered orally for each kg of body weight will kill 50% of a sample population of rats. Human volunteers ingesting a dose of 17 mg/kg have experienced severe toxic symptoms, and a lethal dose to an adult would be in the region of 0.7 - 1.4 g.[18] Many cases of human poisoning by lindane have been reported.[19]

How are people exposed to lindane ?

Most human exposure to lindane is from eating food contaminated with the pesticide. The international authority on food residues, Codex Alimentarius, has set the Acceptable Daily Intake (ADI) for lindane at 0.001 mg/kg of body weight. According to this standard, the maximum daily dose for a 60 kg adult should not exceed 0.06 mg. The ADI was changed in 1997 from a previously less stringent figure of 0.008 mg/kg.

Figure 4 :Fish collected from rivers are the main source of protein for the riverine population but also are factor of human exposure to pesticides

Recent data published by Codex Alimentarius shows that a person consuming an average local diet in any region of the world will exceed the ADI for lindane by between 3.8 and 12 times. The highest consumption of lindane in food occurs in Europe where a theoretical maximum daily intake of lindane in a typical European diet would reach 0.742 mg, or 1237% of the ADI. The highest intake of lindane is likely to occur from consumption of cereals, red meat and tomatoes.[20 21]

Another major source of human intake is drinking water. Lindane has been detected in surface and drinking water and industrial effluent and sewage in Europe and the U.S. and in rainwater in Tokyo.[22] A recent investigation of packaged bottled water in India showed very high levels of lindane, among other pesticides like chlorpyrifos, DDT and malathion.[23]

Figure 5: Wastewater being discharged for a water reclamation plant in Whittier, California. The Los Angeles Sanitation District estimates that it costs US$4,000 to clean up the lindane from a single head lice treatment

Humans can be exposed to lindane through contaminated air and soil as well. The World Health Organization found lindane in outdoor air samples in various continents when testing was done in the 1980s. Much higher lindane concentrations were found in houses after treatment with products containing lindane. The pesticide has also been found in soil in many parts of the world. Studies from the Netherlands and the Ukraine found lindane in soil samples at various levels.[24 25]

Occupational exposure to lindane occurs either on-farm or at commercial seed treatment facilities and involve farmers or workers who mix, load and/or apply lindane as a seed treatment, and persons who handle or plant treated seed.[26] In developing countries, pesticide handling during manufacturing, packaging, transportation and application are of major concern due lack of proper guidelines and weak enforcement of pesticide regulations.

Figure 6 : Brazilian sprayman handling insecticides

Indigenous people in the Arctic region are at special risk from organochlorines such as lindane. The Arctic is considered a “sink” for persistent organic pollutants, because they become less volatile and are deposited in colder regions. Once in the Arctic, lindane bioconcentrates rapidly in microorganisms, invertebrates, fish, birds and mammals, especially in fatty tissue. This puts indigenous people of the Arctic region at greater risk, since they often rely heavily on game for their primary food source.[27]

Monitoring studies from around the world have found residues of lindane in human breastmilk.[28] In several countries lindane has also been identified in human blood serum, fat and adipose tissue.[29]

Does lindane harm wildlife?

Like other organochlorine pesticides, lindane is fat soluble so it tends to bioaccumulate through food chains. Residues have been detected in the kidneys, livers and fat of a wide variety of wild animals and birds.

Lindane is highly toxic to aquatic invertebrates and fish.[30] A recent ecological risk assessment by U.S. EPA suggests that use of lindane can result in adverse effects to birds, mammals, and aquatic organisms. The risk assessment also indicated that lindane is highly acutely toxic to honeybees. Lindane is also a potential endocrine disruptor in birds, mammals, and possibly fish[31] and negatively affects the ability of birds and freshwater invertebrates to reproduce.[32]

There is limited data on the effects of lindane on wildlife in the field. EPA reports that a spill of lindane at a tree farm close to a stream in North Carolina (U.S.) very likely resulted in the death of hundreds of trout.[33] In addition, bats exposed to wood shavings that contained lindane, resulting from application at the recommended rate, died within 17 days.[34] Trout injected with lindane showed immunosuppression at doses similar to those found in polluted water.[35]

What are alternatives to lindane?

Many of the pests controlled by lindane can be managed effectively with non chemical alternatives.

Alternatives to prevent flea beetle damage in canola crops, for example, include crop rotation, early planting, using larger seeds, reducing tillage, and increasing the seeding rate. Lindane used on rice can in many cases be replaced with cultural controls, including crop rotation, winter plowing, clean cultivation, close reaping/burning (to reduce stubble), late transplanting, manual collection of egg masses, and UV light traps. Alternative control of the paddy armyworm includes digging and oiling trenches across the “larval line of advance,” as well as use of some biological controls. The paddy fly can be controlled using spoiled meat traps, clean cultivation (clearing fields of all weeds), mechanical control (netting swarms of the fly), and pyrethrum dust.

Good forest management, including thinning stands and removing damaged trees, can substantially

reduce pest damage and negate the need for lindane treatments in forest environments.

Animal parasites, including mange, lice, and ticks, can also be controlled with a variety of alternative methods. The best control is prevention. Healthy animals tend to suffer less from parasites, so improving health conditions can significantly reduce parasite problems. Other treatments include topical application of diatomaceous earth or a variety of herbal remedies, and the addition of garlic or other foods to the diet.

There are numerous effective alternatives for treatment of head lice**.** The best alternative involves preventive measures against lice infestation, such as avoiding sharing clothing, hairbrushes, or bedding. Once lice have been identified, the best way to eliminate the infestation is to manually remove lice and nits, using a metal comb specifically designed for the purpose, wash all bedding and clothing, and vacuum or otherwise thoroughly clean furniture and carpets.[36]

How many countries have banned lindane ?

While lindane use continues in many countries, at least 17 countries have banned all uses, and more than 20 have restricted (or severely restricted) its use.[37]

According to data submitted under the Rotterdam Convention, the following countries have banned all uses of lindane (in some countries, it has been banned for many years): Colombia, Costa Rica, Denmark, Finland, Gambia, Honduras, Hungary, Indonesia, Kuwait, New Zealand, Netherlands, Saint Lucia, Slovenia, South Africa, South Korea, Sweden and Turkey.

European officials recently banned lindane's use in agriculture and garden products. The European Commission took the decision as part of a risk assessment process for health and the environment based on a report submitted by lindane producers. Experts claim that so far there is insufficient data to show lindane-based products are safe for use, either for workers handling them or for the environment.[38]

Under the North America Free Trade Agreement's environmental side agreement, the U.S., Canada, and Mexico are developing a North American Regional Action Plan for lindane. To date, Regional Action Plans have been developed for DDT, chlordane, mercury and PCBs. Lindane is the first chemical under consideration that is registered for use in all three countries of the region.

What do international treaties say about lindane ?

The Rotterdam Convention on Prior Informed Consent (PIC) includes lindane on its PIC list. This reflects that fact that lindane has been banned or severely restricted by one or more countries in two or more regions of the world.

The PIC treaty requires that importing countries be notified by the exporting country that a chemical they are planning to import is banned or severely restricted in other countries (and is thus on the PIC list), allowing these countries to make an informed choice as to whether to bring the chemical into their country. Forty countries have ratified the Convention to date (as of March 2003) with 50 ratifications being needed for the Convention to officially come into force (for a current list of ratifiers and chemicals included on the PIC list, see http://www.pic.int).

Lindane is also restricted under the international protocol on Long-Range Transboundary Air Pollution (LRTAP). LRTAP, a regional convention covering Europe, Central Asia and North America, has been in effect since 1983. The protocol regulates sixteen POPs compounds including lindane. Production and use is banned for eight of these chemicals and restricted (like lindane) for the other eight.[39]

In May 2001, the Stockholm Convention on Persistent Organic Pollutants (POPs) was adopted by the global community. It will go into effect when ratified by 50 countries (for a current list of ratifiers, see http://www.pops.int). This legally binding treaty calls for the eventual global elimination of POPs chemicals, with an initial target list of 12: PCBs, DDT, hexachlorobenzene, dioxin and furans, dieldrin, aldrin, endrin, chlordane, heptachlor,

toxaphene and mirex. The international community has agreed that these chemicals should be banned worldwide because they are toxic to humans and wildlife, persist in the environment, are transported by wind and air currents and accumulate in the bodies of humans, marine mammals and other wildlife.

The current Stockholm Convention list does not include lindane. However, the convention lays out specific guidelines for targeting new POPs chemicals for elimination, and according to many analysts, lindane meets the criteria for inclusion in the POPs list.

What can I do?

Momentum is building for more bans of lindane around the world. You can make a difference by taking the following steps:

- avoid purchasing lindane for home and pharmaceutical uses;
- pressure your government to ratify the Stockholm and Rotterdam Conventions if it has not already done so (see http:/www.pops.int and http://www.pic.int for current lists of ratifiers), and press for addition of lindane to the Stockholm Convention list;
- find out whether lindane is registered for use in your country and if so press for a ban (see www.pesticideinfo.org for current registration information for many countries);
- join one of the ongoing international campaigns to ban lindane.

Figure 7: Protesters outside the 5th HCH and Pesticide Forum in Bilbao, Spain campaigning against lindane

Organizations working to ban lindane

- *Friends of the Earth*, 26-28 Underwood Street, London, N1 7JQ, United Kingdom
  Tel: 44-20-7490-1555, Fax: 44-20-7490-0881
  Web site: http://www.foe.co.uk/
- *International POPs Elimination Network*, Pesticide Working Group, c/o PAN Africa, B.P. 15 938 Dakar-Fann, Senegal
  Tel: 221-825-4914, Fax: 221-825-1443, Email: henrydiouf@pan-africa.sn
  Web site: http://www.ipen.org
- *National Pediculosis Association*, 50 Kearney Road, Needham, MA 02494, USA
  Tel: 781-449-6487, Fax: 781-449-8129, Email: npa@headlice.org
  Web site: http://www.headlice.org/index.html
- *Pesticide Action Network Latin America* (Red de Accion sobre Plaguicidas y Alternativas en América Latina (RAP-AL)
  Email: aplagui@rdc.cl
  Web site: http://www.rap-al.org
- *Pesticide Action Network North America*, 49 Powell Street, Suite 500, San Francisco, CA 94012, USA
  Tel: 415-981-1771, Fax: 415-981-1991, Email: panna@panna.org
  Web site: http://www.panna.org
- Pesticide Action Network UK, Eurolink Centre, 49 Effra Road, London SW2 1BZ, United Kingdom (with several partner groups in the UK).
  Tel: 44-20-7274-8895, Fax: 44-20-7274-9084, Email: admin@pan-uk.org
  Web site: http://www.pan-uk.org/
- Soil Association, Bristol House, 40-56 Victoria Street, Bristol, BS1 6BY, United Kingdom

  Tel: 0117 929 0661, Fax: 0117 925 2504, Email: info@soilassociation.org
  Web site: http://www.soilassociation.org/

Additional sources of information on lindane

- International Program on Chemical Safety: http://www.inchem.org/documents/icsc/icsc/eics0053.htm

- Lindane Education And Research Network: http://www.lindane.org/
- PANNA's pesticide database: http://www.pesticideinfo.org
- U.S. Environmental Protection Agency: http://www.epa.gov/reregistration/lindane

Local/trade names for lindane

Lindane is sold in the market by various trade names listed below:[40]

Aalindan; Africide; Agrocide; Agrocide III; Agrocide WP; Ameisenmittel Merck; Ameisentod; Aparasin; Aphtiria; Aplidal; Arbitex; BBH; Ben-Hex; Bentox; Bexol; Celanex; Chloresene; Codechine; DBH; Detmol-Extrakt; Devoran; Dol; Drill Tox-Spezial Aglukon; ENT 7796; Entomoxan; Exagamma; Forlin; Gallogama; Gamaphex; Gammalin; Gammalin 20; Gammex; Gammexane; Gammaterr; Gexane; Grammapox; Hecltox; Hexa; Hexachloran; y-Hexachloran; Hexachlorane; Hexaverm; Hexicide; Hexyclan; HGI; Hortex; Inexit; Isotox; Jacutin; Kokotine; Kwell; Lacca Hi Lin, Lacca Lin-O-Mulsion; Lendine; Lentox; Linafor; Lindafor; Lindagam; Lindagrain; Lindagam; Lindagram; Lindatox; Lindasep; Lin-O-Sol; Lindagranox; Lindalo; Lindamul; Lindapoudre; Lindaterra; Lindex; Lindust; Lintox; Lorexane; Milbol 49; Msycol; Neo-Scabicidol; Nexen FB; Nexit; Nexit-Stark; Nexol-E; Nicochloran; Novigam; Omnitox; Ovadziak; Owadizak; Pedraczak; Pflanzol; Quellada; Sang-gamma; Silvanol; Spritz-Rapidin; Spruehpflanzol; Streunex; TAP 85; Tri-6; Vitron; Agrox Premiere®; Germate Plus®; Isotox F®; and Kernel Guard®; DB Green®; Vitavax®; Enhance®; Seed Shield®.

Notes & References

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40 Rotterdam Convention, *op cit.*

The International POPs Elimination Network (IPEN) is a global network of public interest non-governmental organisations united in support of a common POPs elimination goal. The mission of IPEN, achieved through its participating organisations, is to work for the global elimination of persistent organic pollutants, on an expedited yet socially equitable basis.

Founded in early 1998 by a small number of NGOs, IPEN was formally launched with a public forum at the first session of the UNEP Intergovernmental Negotiating Committee (INC1) in Montreal in June 1998, convened by UNSP to start negotiations to develop a global, legal instrument to control and/or eliminate persistent organic pollutants (POPs). Throughout the course of the five negotiating sessions, the network grew to include more than 350 public health, environmental, consumer, and other non-governmental organisations in 65 countries. The network worked to mobilise grassroots support for a global treaty to eliminate POPs. It also leveraged the resources and created a forum for NGOs and activists from around the world to participate in the negotiations. IPEN coordinated NGO conferences and workshops at each of the five negotiating sessions in Montreal (June 1998), Nairobi (January 1999), Geneva (September 1999), Bonn (March 2000), Johannesburg (December 2000) and at the diplomatic conference in Stockholm in May 2001. Since formal negotiations of the Convention text was completed IPEN particpating organizations and IPEN Working Groups continue to participate in the ongoing UNEP discussions related to this Convention and is now focussing on ratifying and implementing the POPs Convention (now called the Stockholm Convention on POPs) in countries around the world.
Since its inception early in 1998, IPEN has:

- **Developed a POPs Elimination Platform**, which summarizes some of the key findings about POPs' effects on the environment and human health and outlines the core principles that should be embodied in a global POPs agreement. At the conclusion of Convention netitations IPEN particpating organizations reaffirmed their joint committment to continue to work collectively to implement the POPSs Convention by signing the Stockholm Declaration
- **Gained the participation of non-governmental organizations on six continents** through their endorsement of the IPEN platform. IPEN continues to grow, and expects to gain the endorsement and participation of hundreds of NGOs around the world in the coming months.
- **Convened NGOs, activists, and scientists for conferences that coincided with all POPs treaty negotiating sessions.** IPEN was formally launched with a public forum at the first session of the Intergovernmental Negotiating Committee (INC1) in Montreal in June 1998. In January 1999, the network brought together representatives from around Africa for INC2 in Nairobi, Kenya.In September 1999, INC3 was held in Geneva, Switzerland. INC4was held in Bonn, Germany in March 2000 and the final negotiating session was held in December 2000 in Johannesburg, South Africa.
- **Established an organizational and governance structure** consisting of a provisional Steering Committee, Secretariat, and two Co-Chairs. IPEN's Northern Co-Chair, Jack Weinberg, Director of the Global Chemical Safety Programme for the USA based Environmental Health Fund. Dr. Romeo Quijano, is a medical doctor and a representative of the Pesticide Action Network in Manila is IPEN's Southern Co-Chair,.
- **Begun seeking Regional Focal Points** in Africa, Latin America, Asia-Pacific, Eastern and Western Europe. Regional Focal Points coordinate and communicate with IPEN participating organizations in their geographic regions, and report to the Network on the regions' needs, activities, and perspectives.
- **Launched 3 Working Groups**. In May 2001 IPEN established 3 Working Groups. Working Groups focus on specific activities related to POPs treaty implementaion. These Working Groups are Pesticides Working Group with a secretariat located in the PAN Africa office in Senegal; the Dioxin Wastes and Stockpiles Working Group is located at Arnika an NGO based in the Czech Republic and the Community monitoring Working Group is located in the Alaska Community Action on Toxics, Alaska USA.
- **An email listserve, mailing lists, and website** for communication about POPs issues and the activities of IPEN and its participating organizations.