ISDE position paper on
the formulation of a sustainable policy for
Persistent Organic Environmental Chemicals

General considerations

Rationale for a call to minimise Chlorine and Related Halide Production[1]

Naturally occurring biochemicals can be degraded and assembled rapidly in living systems by the action of enzymes, which have evolved over millions of years. When organic chemicals persist in the environment and bioaccumulate in animal tissues, it is an indication that the enzymes required to denature them either don't exist or are extremely inefficient. Examples of this are provided by a number of organo-chlorine compounds.

Until the beginning of this century, the chlorine on our planet existed as inorganic salts, mainly common salt. Since then, a steadily increasing quantity of chlorine gas has been made by the electrolysis of brine. For over a decade, the global production has been around 40,000,000 tonnes per annum (Howard et al, 2000). The original primary motive for this is to use the sodium produced to make caustic soda, a feedstock for many chemical production processes, e.g. soap. However, the chlorine gas is too toxic to be released into the environment, so it has to be 'tied up' in a less toxic form. The chlor-alkali industry that has evolved has dealt with this by combining chlorine with carbon, which is available from oil and coal.

There are over 11,000 commercially available organochlorine compounds, including plastics, solvents, paints, floor coverings, pesticides and medicines (Howard et al, 2000). After release into the environment in combustion, biodegradation and other processes, an unknown number of additional carbon-chlorine compounds are formed. When organochlorines become involved in combustion processes, for example incineration of waste or house fires, a large number of products of incomplete combustion are formed. Amongst the most widely known and studied are the dioxins. There are no naturally occurring organochlorine compounds found in the mainstream of the biochemistry of life, for example in any vertebrate animal.

Many organochlorine compounds are persistent and bioaccumulative, because they are fat-soluble and not easily biodegraded. In addition, many are highly toxic, some by design e.g. pesticides such as Lindane and some by misfortune e.g. chemicals such as PCBs. This class of compounds undergoes long-range transport and the process of 'global distillation', preferentially condensing in the colder regions. They bio-magnify up the food chain - bio-magnification factors in excess of 20,000,000-fold have been measured between the water of the Great Lakes and top predators (Colborn T et al, 1996). Inuit Indians currently have much higher body burdens of certain organochlorines than most other populations (Kuhnlein et al, 1995). For example, their levels of the pesticide toxaphene are over 3 times higher than the levels in the inhabitants of the regions where it is used.

The body burden of many organo-chlorine compounds increases with age. When women become pregnant, they pass part of their body burden to the baby, initially across the placenta and then subsequently in the breast milk (at about 15% of the body burden per month).

The known adverse effects of dioxin and dioxin-like substances include carcinogenesis and the non-cancer effects include hormone disruption, immuno-suppression and neurobehavioural deficits. Recent research in The Netherlands has shown that at current background body burdens the most highly exposed mothers are producing adverse effects on the development of their children (Koppe et al, 2000). An average 4-point loss of IQ and a 6-fold increase in the incidence of middle ear infections have been described.

Once chlorine is not bound to sodium or some other cation any more it will remain so for centuries. This means that we are steadily increasing the amount of potentially reactive chlorine in the environment. Toxic products like pesticides can be regulated through a ban combined with sound measures of elimination of the stocks. Byproducts like dioxins will always be produced as long as we continue to increase the load of non-permanently fixed chlorine in the environment.

Policy implications

Thus far, legislation for the control of POPs has always been retrospective, after the recognition that a problem has emerged. In general, the introduction of a Tolerable Daily Intake (TDI) has been adopted as a standard for the protection of human health.

The actual level adopted has often appeared to be what is politically achievable without much regulatory activity, rather than on genuine health grounds. Thus, when the WHO adopted a TDI for dioxins of 10 pgTEQ/kg body wt/day (10 picogramme Toxic Equivalent per kilogramme body weight per day), it was regarded by many as a perverse decision but it was clearly one which did not require any immediate action by governments. Since then, there has been a degree of backtracking. Based on the recent Dutch breast milk studies, the Dutch Health Council (Sixma, 1996) recommended to the Dutch Government that a TDI of 1 pgTEQ/kg body wt/day be adopted. This would have had immediate political implications, because the average adult daily intake of dioxins in The Netherlands is currently between 2 and 3 pgTEQ/kg body wt/day, over twice the proposed TDI. The WHO then reconsidered its position (Van Leeuven & Younes, 1998) and recommended a TDI of between 1 to 4 pgTEQ/kg body wt/day, with a strong recommendation that it should be 1 pgTEQ/kg body wt/day. This juggling act thus acknowledged the standard proposed by the Dutch Health Council but by allowing the range to extend up to 4 pgTEQ/kg body wt/day, no political action to reduce sources was required.

Is the TDI actually a useful metric to use for the protection of human health with respect to POPs? The answer must be "No". Index levels such as TDIs were developed for non-persistent pollutants, where a reduction in the environmental level is mirrored by an immediate fall in body levels. That is not true of a persistent bioaccumulative pollutant. Additionally, they are based on average age, weight, health and consumption over a lifetime etc and therefore don’t take account of special subsets of the population, such as children.

With POPs which bioaccumulate, the total body burden is the metric of choice, as proposed for dioxins by Dr Linda Birnbaum (1998) of the USEPA. When total body burdens are examined, we find that the average US citizen has about 10 ngTEQ/kg body wt, while about 1% of the population has between 30 to 40 ngTEQ/kg body wt. It is at this latter level that deleterious effects have been observed in experimental situations. The Dutch breast milk study (Koppe et al, 2000), by concentrating on the most vulnerable members of society, infants, supports the notion that there is a proportion of the population which are exposed to dioxins in excess of the no-effect levels and are therefore not protected by the current TDI regulatory system. This carries a completely different political message. Sensible action to protect human health now requires positive action to restrict the release of dioxin and dioxin-like substances and their precursors into the environment. That means the manufacture of less organochlorine compounds. As the chlorine industry constitutes an appreciable proportion of the chemical industry, this poses a big political problem.

The next policy problem is mixtures of chemicals. The polychlorinated dioxins and furans themselves are made up of over 100 different congeners (=slightly different molecules). This is true of many other families of organochlorine compounds such as the PCBs, PCNs, toxaphenes, etc, each of which consist of several hundred congeners. Added to this now is the widespread introduction of polybrominated (Howard and Staats de Yanes, 2001) and polyfluorinated compounds.

It is conservatively estimated that we have in our bodies measurable residues of several hundreds of environmental pollutants. One hundred years ago, few if any of these anthropogenic compounds could have existed and in the past 50 years their levels have been rising inexorably. We simply do not have the toxicological tools to analyse the effects of such a mixture (Howard, 1997). However, the current regulations nearly all require the toxicology to be addressed one chemical at a time. Current regulations demand conclusive proof of harm before a particular chemical has to be removed from the market. Effects have to be massive and/or cause very unusual conditions for them to be identified. More usually, alterations to the pattern of existing diseases, such as cancer, occur. These are very difficult or impossible to elucidate. While it may be possible in time to develop assays for testing the toxicology of complex mixtures, in toto, that will still not indicate which compounds in the mixture are the real problem.

Specifically this means:

1. Organic chemicals will need to be controlled by class or family. Hitherto, when a compound has been demonstrated to be toxic, a common response has been to produce a very similar or identical compound, except for the pattern of halogenation. For example, in the case of PCBs, there was a shift from higher- to lower-chlorinated mixtures and deca-CBs and later on to polybrominated diphenylethers (PBDEs) and other halogenated hydrocarbons (Howard and Staats de Yanes, 2001). The toxic mechanism, persistence and bioaccumulativity of many of these replacements are in similar ranges to the compounds they have replaced. An immediate ban on halogenated biphenyls would have been a better approach. Replacements should proven to be less toxic and problematic before their introduction. Furthermore, if the use of toxic chemicals is unavoidable in a particular application, e.g. PBDEs as flame-retardants, then they should be applied at the lowest possible effective concentration and should not be put into generalized usage. As it is now, we are repeating old mistakes - the human breast milk levels of brominated organic compounds have doubled in the every 5 years over the past 25 years.

2. There should be a move away from testing by the use of standard batteries of assays towards a more chemical class/structure based approach, taking into account the planned use and any known problems associated with the chemical group. Testing requirements should not be tied strictly to production volume. E.g. chemicals which are similar to known endocrine disruptors have to be tested for these effects which can already occure at very low doses.

3. Special attention has to be given to vulnerable groups such as children or persons with a genetic predisposition for a different metabolism of certain substances. Therefore limit values cannot be simple based on healthy adult men.

4. A weight of evidence approach will have to be adopted, rather than an absolute proof approach. The simple adoption of a policy to control all organic chemicals, which persist, and bioaccumulate, irrespective of the level of any toxicity, will go a long way to recovering the situation. There should be a policy of ‘reverse onus’ or shifting the burden of proof from government to producers whereby chemicals are assumed to be damaging until proven otherwise. All aspects of the precautionary principle have to be applied for chemicals. (see earlier ISDE policy document)

5. Products should be assessed on the whole of their life cycle and final fate. With the organochlorine plastic PVC, for example, a number of stages in its manufacture, use and disposal could be examined for environmental effects. In chlorine manufacture, the electrolysis of brine is an enormously energy-demanding process. The oxychlorination process for making vinyl chloride monomer itself produces dioxin pollution. The polymer requires softening for most uses, which involves environmental pollutants such as cadmium and phthalate esters, some of which are environmental oestrogens or carcinogens. When the product PVC is finally released onto the market it represents ‘pent up’ pollution, for whenever it becomes involved in combustion processes again, dioxin is generated and the other toxic substances in its matrix are liberated to the environment. The energy that can be recovered by incineration of such products is minor compared to the energy required to obtain the raw materials and make them. Such analyses, which should be quantitative, should be considered for all major persistent pollutants, so that a true picture of their environmental impact in terms of energy use and toxicity can be obtained for comparative purposes. This should drive policy in target setting.

6. For the health effects of some chemicals there is no protection other than a global ban, for other chemicals individual and local protection plays a more important role. This protection is only possible if the existing information is available to everybody. There is a fundamental right to know (with the access to information as a specification), which can be made real in the context of chemicals through Pollution Release and Transfer Registers PRTR.

7. Our economy depends currently heavily on the use of specific chemicals and on mass production chemicals such as PVC. Therefore an immediate ban of all potentially harmful products is neither feasible nor desirable. In the reduction of the use of such products the health relevance of their use should be strongly considered. This has already be done with the essential use exception of the POP Convention where some developing countries have a longer phase out period for DDT used in malaria control or the exemption in the Montreal Protocol on Substances Depleting the Ozone Layer for CFCs in asthma sprays. As it has been recently done for asthma sprays, these exemptions on their part have to be phased out as soon as safer alternatives are available. Similar essential use exceptions should be foreseen for the phase out of chlorinated mass productions like PVC.

8. Fiscal instruments, such as eco-taxes, should be considered so that market place prices truly represent the environmental cost of bulk products, in the light of environmental accounting, particularly for health effects. This is the best way of relying on the inventiveness of companies through the market mechanism to replace harmful substances by harmless ones providing even better services for humans and the economy.

9. ISDE clearly acknowledge the importance of the chemical industry for modern life. Most of our members use drugs in their daily practice and welcome a further development of this industry in a more sustainable way.

Based on these considerations ISDE takes the following position on persistent organic chemicals. ISDE future work one chemicals will be based on this position:

Guiding principles

The fundamental principles, which should underpin a sustainable chemicals policy, are:

1. To not knowingly do harm
2. If in doubt about the likelihood of harm to apply the precautionary principle in minimising the use of chemicals
3. To acknowledge that each generation only exercises stewardship of the planet and has a duty to future generations to avoid leaving long term toxic legacies as a result of chemical use for short term gain
4. That the best approach for the control of persistent organic pollutants is a global transnational one.
5. That there is currently no suitable technology to analyse the toxicity of the complex mixture of man made chemicals to which we are subjected, through the environment.
6. That while we need to be vigilant about many chemicals currently in use, for some groups there is already a weight of evidence that human harm has been caused.
7. That there is a fundamental right to information and public participation in chemical related matters.
8. That the approach of global agreement on limiting activity used in the UN Framework Convention on Global Climate Change should be applied in the case of certain groups of persistent organic pollutants to eliminate or minimize production levels according to agreed time schedules. For the necessary ban on the most toxic POPs the Stockholm Convention signed in May 2001 has opened they right approach. This convention must be implemented rapidly and enlarged beyond the covered “dirty dozen ” to other highly toxic For the reduction of mass production organochlorines such an instrument does not yet exist.
9. That many applications and uses of chemicals are essential for human health and well-being.
10. That in the formulation of any policy economic aspects have to be considered but that they cannot prevail over human health.
11. That a sound policy should combine a mix of bans and restriction of use of substances known or likely to be highly toxic and economic incentives for products where mainly the volume create problems of toxicity through the environment.

Specific demands

1. *Existing international legal instruments* have to be signed, ratified and implemented rapidly by all countries. These include the Basel Convention on the control of transboundary movements of hazardous wastes and their disposal, the Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade and most importantly the Stockholm Convention on Persistent Organic Pollutants POP and the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter.
2. The use of *transparency* on the known toxicity and the use and disposal of persistent chemicals have to become universally applied. Therefore the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters should be ratified and implemented by all UNECE countries and other regions should follow the same approach either through a global or other regional conventions. The negotiations and a protocol on Pollutant Release and Transfer Registers PRTR under the Aarhus Convention should lead rapidly to a strong instrument to be followed by a global agreement on PRTR.

3. Additives and specific applications such as *PVC* with phthalate softeners *in medical devices* have to be phased out rapidly because of their carcinogenic potential, the direct leaking into the human body and the availability of alternatives.

4. In order to reduce the environmental burden of chlorine and other halides which is not safely bound in salt form there needs to be a global reduction right at the source of their production. ISDE calls for negotiations on a *UN Framework Convention on Chlorine and other halides*. This should lead to an overall reduction of the release of organochlorines mainly through economic incentives with the definition of which uses are essential and therefore permitted.

Why a Framework Convention on Chlorine and other halides?

The international regulatory framework has already started a move from an end of pipe approach in controlling the waste management to an approach banning the production of the most toxic chemicals. This shift should be continued towards a reduction in the production of the precursors of POPs such as Dioxin.

The long term aim has to be a move out of the bulk unsustainable chemical production, as the long term aim in climate policy has to be a move out of the bulk use of fossil fuels. In the short and medium term priorities have to be set considering a balance of factors, with health outcome as the guiding measurement. Health outcome has to be seen in a broad and integrative manner including short and long term environmental health burdens, health benefits of the chemicals application (e.g. water pipes are essential for safe water and sanitation), availability of alternatives, health aspects and risks of these alternatives and to some extent economic consideration. That is a long term approach which can only work with a global agreement avoiding a simple shift of production from one country to another. Therefore a global cap on chemical production should be set and reduced stepwise. This would allow the creation of a production rights trading system which would lead to an internationalisation at least part of the external costs. A global Framework convention would also be the right place to bring current non-binding work on principles on sound management of chemicals as it is done by the Intergovernmental Forum on Chemical Safety, OECD and others into a binding form.

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[1] This paper deals with Organochlorides and other halides. Other classes of chemicals such as heavy metals (mercury, lead, arsenic, manganese) are also very health relevant but will be dealt with in the separate forthcoming paper.