Centr. eur. J. publ. Hlth 2, 1994, Supplement, p. 83-84.

GROUP II – PERSISTENT ORGANIC COMPOUNDS HAZARDOUS WASTES – SOURCE OF HARMFUL PERSISTENT ORGANICS

I. Holoubek, B. Pokorný
Regional Research Centre for Atmospheric Pollutants and Effects of Atmospheric Pollutants, Masaryk University, Brno
TOCOEN Ltd., Centre for Environmental Studies, Brno, Czech Republic

Persistent Organic Pollutants (POPs) are chemicals having a ring, chain or branched chain framework of carbon atom that is resistant to photolytic, biological or chemical degradation. They can remain in the environment for long periods (weeks or years) and can cause adverse environmental effects.

Many POPs are characterised by low water solubility and high lipid solubility, leading to their bioaccumulation in fatty tissues. Due to their relatively high octanol – water partitioning coefficient POPs can cross and/or interact with the phosholipid structure of biological membranes.

POPs with these characteristics are typically semi-volatile. This term is often used to describe the properties that permit POPs to occur either in the vapour phase, on atmospheric particles and adsorbed or dissolved on the Earth's surface. The semi-volatility of POPs favours their long-range transport and enables them to move great distances through the atmosphere, which is a primary transport medium. The temperature dependence of physico-chemical properties such as vapour pressure results in a cycle of contaminant evaporation, transport and condensation/deposition, leading to a systematic transfer to and accumulation in colder and cooler latitudes (so called "cold condensation" effect). Some of the more volatile POPs, such as HCH and toxophene, have been found at higher levels in the Arctic than at more southern latitudes.

Examples of POPs that are well known to be bioaccumulative and semivolatile include:

- persistent pesticides (dieldrin, DDT, toxaphene, chlordanes, HCH, HCB . . .),
- several industrial compounds (polychlorinated biphenyls, polybrominated biphenyls, chloroparaffins),
- some degradation, industrial and combustion byproducts (polycyclic aromatic hydrocarbons, polychlorinated dibenzo-p-dioxins and dibenzofurans).

The properties of these POPs (i.e. their persistence and ability to bioaccumulate) lead to increased concern for the toxic effects that they can exert on a range of biota, in particular top-of-the-food-chain species (including humans), even at extremely low levels in the ambient environment.

Many POPs are anthropogenic in origin, heavily used and deliberately, unintentionally and/or accidentally released to the environment in large quantities. Once dispersed to the environment, clean-up is not possible. Emissions can be from diffusive sources and point sources, and can be associated with manufacturing processes, product use and application, waste disposal and spills, combustion of fuels and/or wastes and with the application of pesticides. Because of their environmental persistence, volatilization from the growing inventory of residues in the environment is an important difficulty in the identification of emission sources.

Projections have been made which suggest that global production, usage and release of POPs will increase significantly in the future, however there are many factors which influence the scale of the release.

Atmospheric deposition is the predominant pathway of many POPs to earth surface. POPs are ubiquitous in the global environment, with the highest environmental concentrations usually occurring close to sources. However, long-range atmospheric transport, favoured deposition in cool regions, and biomagnification have led to the occurrence of significant environmental accumulation in regions remote from any source. POPs have historically increased in the environment since their introduction into commerce. Where regional actions have been taken, coincidental decreases can be observed in the abiotiv environment. However, the biological environment is slower to respond.

Lipophilicity and persistence of POPs permit them to bioaccumulate and biomagnify to relatively high levels in living organisms, even at low exposure rates. Therefore, POP emission levels to the abiotic environment which would otherwise be considered low, may continue to generate concern for adverse chronic effects in biota. Organisms at the top of the food-chain, including humans, experience the greatest exposure, accumulated the highest levels and are, therefore, most vulnerable to potential health risks.

Laboratory evidence of the harmful effects of many POPs is corroborated to wildlife data, human data, while sparser, in consistent with both laboratory and wildlife studies. In the case of organochlorines, several have been shown to have an oestrogenic mode of action, and cause a wide range of effects including immune and metabolic dysfunction, neurological deficits, reproductive anomalies, behavioural abnormalities and carcinogenesis. Humans are known to be susceptible to effects from oestrogenic compounds. The developing embryo is very vulnerable to chemical exposure. Transfer of maternal contaminant burdens through the yolk of an eggs or via the placenta can elicit effects on offspring at levels which have no effects on the adult. The effects are not always clinically apparent at birth. Therefore, there may be delays between increases in environmental contaminant levels and obvious impairment of ecosystem health.

Because of the wide range of types of POPs sources such as industrial plants, residential combustion, mobile sources and product application and use, there are many abatement options that may by used.

The term abatement is used here to include the full spectrum of risk reduction options, ranging for example, from voluntary reductions in product usage to complete phasing out of specific substances.

Usually these abatement options include:

1. the restriction, phase-out or banning of products,