# Industrial and environmental emergencies; lessons learned

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The occurrence of emergencies caused by polyhalogenated aromatics (PHAs) have not been systematically registered in the past. Indirect evidence on their incidences can, however, be obtained by making estimates of used, produced and stored quantities of substances and by estimating the occurrence of potential sources of emergencies on the basis of accident rates in individual countries. Table 1 gives a rough estimate of the amounts of polyhalogenated compounds produced so far. There is little information on the rate of incineration of PHAs but an estimate according to which some 50 to 90 % of the substances ever produced still exist either in use, stored or as hazardous wastes or as a contaminant either in materials or in the environment.

Table 1. Estimates for production volumes of chlorinated industrial products

| Product | Production volume (million tonnes) | PCDD + PCDF contamination ppm ranges | Tonnes |
|---|---|---|---|
| PCBs | 1.5 | 0.2- 40 (5) | 7.5 |
| Chlorophenols | 5.0 | 0.1-100 (1) | 50.0 |
| Phenoxy acids | 1.0 | 1 -100 (3) | 3.0 |
| Total | 7.5 | | 60.5 |

Principally all substances mentioned in Table 1 can imply a potential risk of emergency through several different mechanisms. The typical accidents registered so far are listed in Table 2.

Table 2 shows that the emergency situations can be of many different types, they may be acute or develop slowly within the years and they may be locally isolated or global in character. This makes the planning of control measures and emergency responses difficult. In the highly-industrialized countries where the use of PCBs and other chlorinated compounds, such as PBBs and PCPs has been limited or banned about 5-10 years ago the likelihood of the industrial type of emergency, such as Seveso may be an unlikely one whereas such possibility still exists in developing countries, newly-industrialized countries and possibly in the Eastern European countries. On the other hand, emergencies from the incinerators, fires or explosions of electrical appliances, leakages from land-fill sites or storages and release from contaminated soil may still be possible. This implies that termination of the active use of substances even years ago does not eliminate the potential for wide-scale hazard.

Table 2. Types of emergencies involving PHAs in 1970s to 1990s

**General environment and food**

Wildlife fish contaminated by PHAs from polluted lakes

Livestock feed contaminated by PCB-paint of silos

Livestock feed contaminated by PBB due to mislabelling of packages

Sewage sludge contaminated by PCBs and used as garden fertilizer

Food contaminated by PCBs from package material

Drinking water contaminated through ground water by PCPs which was used several years before in the nearby sawmill

Contamination of rice by PCB- and PCDF-contaminated oil

Residence house contaminated by explosion or fire of electrical capacitor or transformer

**Industrial and occupational accidents**

Explosion of a chemical industry process producing PCPs

Fire in which oil in capacitors or transformers was burned

Explosion of capacitor or transformer by electrical overloading

Emission by municipal incinerators or other waste disposal procedures to the environment

Explosion of capacitors in railway locomotive

Fire of toxic waste storehouse containing large amounts of PCBs

Explosion of steel oven and ignition of fire in capacitors by molten metal

Overheating of capacitors beside foundry oven

Contamination of office buildings from exploded capacitors or transformers due to external fire or overloading

In certain specific cases, such as accidents by electrical appliances the preventive actions undertaken, for example in Finland for control of the use of PCB and chlorobenzenes has substantially decreased the annual rates of accidents recorded by the Finnish Institute of Occupational Health (Table 3).

Table 3. The number of PCB-, PCDF- or PCDD-accidents and clean-up cases in Finland in 1982-89

| Year | No. of cases |
|---|---|
| 1982 | 8 |
| 1983 | 25 |
| 1984 | 26 |
| 1985 | 12 |
| 1986 | 8 |
| 1987 | 1 |
| 1988 | 10 |
| 1989 | 5 |
| 1990 | 3 |
| 1991 | 2 |
| Total | 100 |

The preventive strategies start from identification of potential sources of hazard by making preliminary hazard analysis, using check-lists for hazard identification, carrying out failure-effect and hazard and operability studies, accident sequence analysis and fault tree analysis where these are appropriate.

Primary prevention by substituting the hazardous substance or technology for a nonhazardous one is the most effective strategy (as in the cases of substituting PCB in electrical appliances for non-chlorine compounds).

When total elimination of hazard is not possible its limitation and minimisation by setting standards and exposure limits for work room air and surfaces, food items, different environmental media and compartments is the most important tools for control. Such standards guide the working practices and consumption habits and give guidance for decontamination of contaminated sites. In the standard setting prudent approach is recommended aiming at high level of protection for potentially exposed both population and the ecosystem.

Though primary prevention may be successful in stopping the production and use of polyhalogenated compounds the persistent nature of these compounds, difficulty in effective incineration and disposal, large quantities of landfilling and sea dumping in the past and a potential for occurrence of new sources of PHAs justify organization of effective preparedness for emergency response.

For management of the emergencies of various kinds a full set of actions should be planned including among others the following:

- identification of potential sources;
- hazard evaluation;
- assessment and modelling of emergencies;
- primary prevention by substituting the PHAs for nontoxic alternatives;
- actions for limitation of the use of compounds;
- emergency response and first aid;
- rehabilitation and decontamination.

In planning such measures it should always be kept in mind that the control of the emission and the minimizing of the hazard as near the source as possible will also minimize the technical difficulties in control, it will limit the area of contamination, extent of exposures, number of exposed people and costs of decontamination. This makes particularly the work environment an important and most effective site for prevention of health and environmental hazards caused by PHAs.