

RESEARCH AND REGULATION OF DIOXINS AND RELATED COMPOUNDS IN SWEDEN

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ABSTRACT

This presentation concentrates on the research activities within an established research area sponsored by the Swedish National Environmental Protection Board. The organisation and main research projects will be presented as well as some of the conclusions from the work done so far.

INTRODUCTION

The research department in the Swedish National Environmental Protection Board decided 1987 to concentrate the research activities concerning persistent toxic organic compounds in a large project with the acronym PETOS. Working in concert with this project, three other projects with more specialized questions have been running. This three projects are:

* *Seal and seal protection* which deals with the relation between exposure to organochlorine and health effects in the Baltic seal population.

* *Environment/cellulose II* which deals with effects on the aquatic environment in relation to exposure to effluents from pulp and paper mills.

* *National dioxin survey* which maps levels of dioxins and related compounds in the environment in relation to possible sources.

The total annual budget for the four projects amounts to about 3 million US dollars. Added to that comes funding from sources other than the National Environment Protection Board, making a total annual budget of probably more than 5 million US dollars.

PERSISTENT TOXIC ORGANIC COMPOUNDS (PETOS)

PETOS is divided into three subproject areas, i.e. chemistry, ecotoxicology and toxicology. Within each subproject several individual projects are sponsored. Several reports from these individual projects will be presented during the present meeting. Following below, only a few of the results so far will be mentioned.

Chemistry

The main research areas within the chemical project concern

- * Synthesis of test compounds as well as metabolites, both cold and labelled material
- * Development and improvement of analytical methods
- * Studies on the photochemical degradation of dioxins and related compounds
- * Studies on the enzymatic formation of dioxins in the environment

An intensive work within the area of synthesis of compounds has made possible many studies both within the chemical subproject as well as in the other two subprojects. Compounds synthesized cover PCBs, PCB-methylsulfones, various chlorinated naphthalenes and many others (Haglund and Bergman, 1989). Among the findings could be mentioned the development of sensitive analytical methods for the analysis of dioxins and PCBs in human mother's milk (Lindström 1988, Norén, 1988). The studies have been able to demonstrate a decline of dioxin levels in Swedish mother's milk during the last 15 years as well as changes in levels of planar PCBs over time (Norén, 1988, Norén *et al.*, 1990)

Another interesting finding is the demonstration that PCDDs and PCDFs may be formed in the environment through a peroxidase-catalyzed reaction with chlorinated phenols (Öberg *et al.*, 1990).

Ecotoxicology

The main research areas within the ecotoxicological project concern

- * Mapping of environmental load and transportation
- * Environmental transformation
- * Bioavailability
- * Biomagnification
- * Ecotoxicological dose-effect studies

The approach in this area is somewhat different from the other two. It represents a larger single project that still is ongoing. Among the results obtained so far it can be mentioned that it has been demonstrated that the toxic 2,3,7,8-substituted PCDDs/PCDFs increase with increasing trophic level. 2,3,7,8-substituted PCDDs/PCDFs are also biomagnified, both relative to other congeners and in total (Broman *et al.*, 1990). Bioassays are also applied in order to study the influence of other compounds than PCDDs/PCDFs, e.g. polyaromatic hydrocarbons.

Toxicology

The main research areas within the toxicological project concern

- * Toxicokinetics
- * Immunotoxicology
- * Interaction with vitamin A
- * Tumour promotion

- * Bioassays for dioxinlike activity
- * Levels of organochlorines in exposed groups in relation to health status

Of the multitude of results achieved within this subproject only a few can be mentioned.

In the immunotoxicological field, a system has been developed that tests effects on the immune system using the *Bursa Fabricius* from chicken embryos as model. The system has successfully been applied to environmental samples (Andersson et al., 1990).

Systematical studies within the field of tumour promotion have so far demonstrated that the relative potency of some congeners, using the induction of altered hepatic foci as the endpoint, might differ somewhat from estimates of potency based on other endpoints (Flodström and Ahlborg, 1990). This finding may have implications for the calculation of TCDD-equivalency (see below). Another interesting finding is the fact that the tumour promotive effect of TCDD is influenced both by the vitamin A status of the test animal as well as by the diets used (Flodström et al., 1990).

The only extraordinarily exposed adult population in Sweden identified so far consists of professional fishermen active in the southern part of the Baltic sea and having a high fish consumption. Blood levels of PCDDs/PCDFs in this population is several times higher than in comparative controls. Non-fish eating populations have lower blood levels than average (Svensson et al., 1990). Taken together, these data support earlier assumptions that fish is the main source for human exposure to PCDDs/PCDFs in Sweden. Studies on the health status of these populations are ongoing.

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REGULATIONS

Despite all research activities and all efforts from various governmental agencies in Sweden to reduce dioxin emission and exposure, very limited regulations and recommendations have been applied. Emission limits for municipal solid waste (MSW) incinerators are, however, enforced. For existing MSW plants the emission should be below 2 ng/m³, for new plants, however, the limit is less than 0.1 ng/m³, in both cases expressed as TCDD-equivalents according to Eadon.

No recommendations or limitations are given as regards PCDDs/PCDFs in food. Breastfeeding is recommended but forced weight reduction following delivery should be avoided.

Sweden is today using the Nordic TCDD-equivalents (see table 1) and applying a tolerable daily intake of 5 picogram/kg bodyweight as recommended by a Nordic expert group (Ahlborg et al., 1988).

Table 1. Nordic TCDD-equivalents (Ahlborg *et al.*, 1988)

PCDD/PCDF	Nordic equivalents	International equivalents
2378-TCDD	1	1
12378-PeCDD	0.5 (1*)	0.5
2378-subst. HxCDD	0.1	0.1
1234678-HpCDD	0.01	0.01
OCDD	0.001	0.001
2378-TCDF	0.1	0.1
12378-PeCDF	0.01	0.05
23478-PeCDF	0.5 (0.1*)	0.5
2378-subst. HxCDF	0.1	0.1
2378.subst. HpCDF	0.01	0.01
OCDF	0.001	0.001

* Indicates possible new values for the congeners 1,2,3,7,8-PeCDD and 2,3,4,7,8-PeCDF based on recent studies using relative tumour promotive potency as endpoint (Flodström and Ahlborg, 1990). Note that the value for 1,2,3,7,8-PeCDF differs between the Nordic and the international model.

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