Screening of New Chemicals in Sweden: The Siloxane Case

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Screening of "new" chemicals in Sweden

Main objective:

to investigate the occurrence and concentration levels of selected chemicals in a variety of environmental media

Limitation

Measurements of a chemical in several media at several sites but only a few samples at each site

Several screening studies, have been initiated and financed by the Swedish Environmental Protection Agency. The selection of substances is made by EPA
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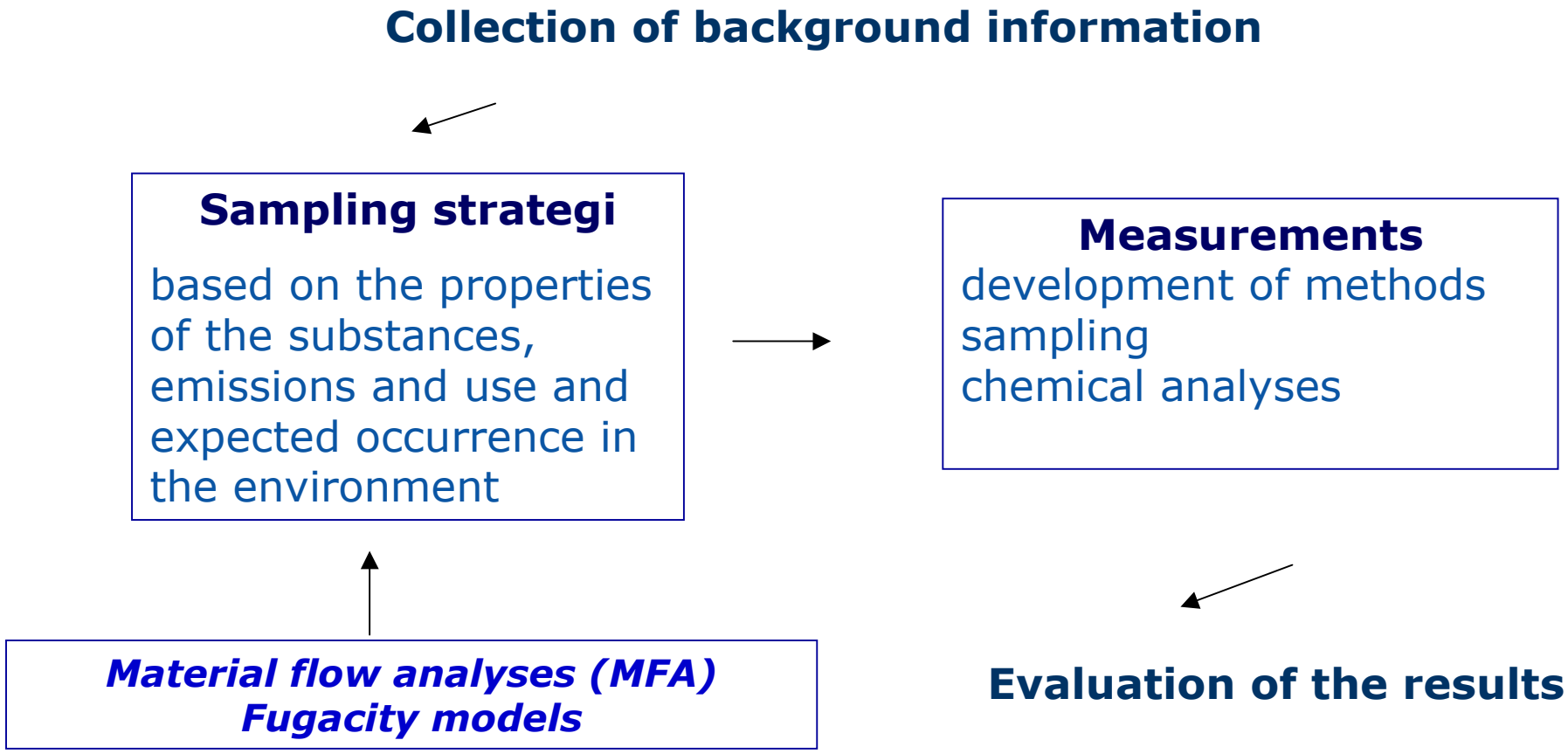
Screening of chemicals

A way of dimensioning the problem

Additional objectives

- **Identification of possible emission pathways**
- **To highlight important transport pathways of the substance in the environment, e.g. atmospheric transport**
- **Investigate accumulation of the chemical in different parts of the ecosystem**
- **Investigate human exposure**

Screening of chemicals



Screening 2004:The siloxane case

Siloxanes, a large group of chemicals, used in a number of applications and it may be spread to the environment via diffusive emission from consumer products as well as via point sources

Substances with molecular weights up to hundred thousands

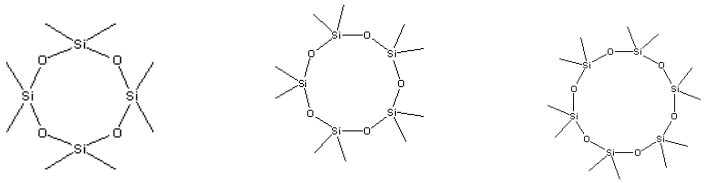
Fuel additives,
Cleaning/washing agents,
Impregnation materials,
Surface treatment, Construction materials, Paints, Laquers,
Reprographic agents, Process regulators, Cosmetics etc

The Swedish screening study was performed in parallel with a co-ordinated screening in the Nordic countries which was financed by the Nordic Minister of Council.

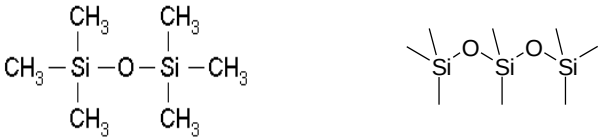
Siloxanes included in the screening

The screening was limited to substances with low molecular weights

- Octamethylcyclotetrasiloxane, D4
- Decamethylcyclopentasiloxane,D5
- Dodecamethylcyclohexasiloxane, D6



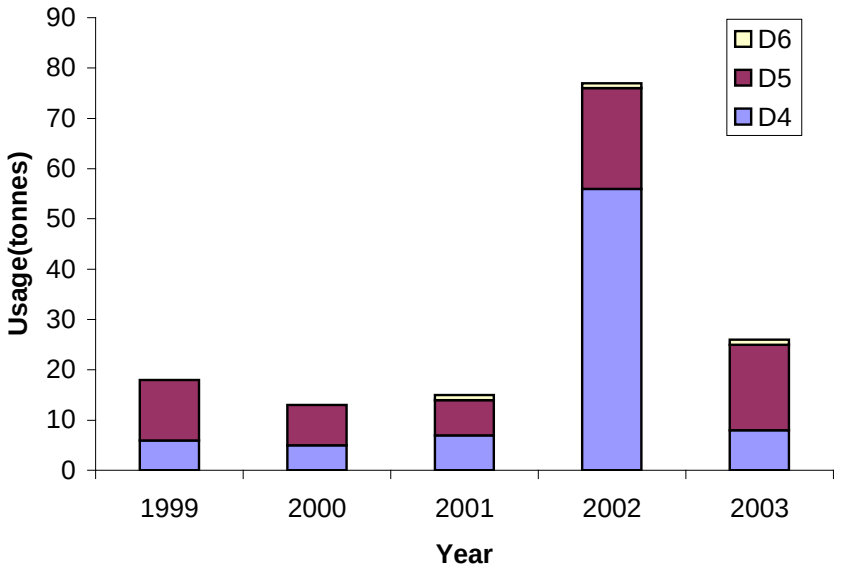
- Hexamethyldisiloxane, MM or HMDS
- Octamethyltrisiloxane, MDM



- Decamethyltetrasiloxane, MD2M
- Dodecamethylpentasiloxane, MD3M

Siloxanes widely used chemicals

- **D4, D5 and MM are chemicals of high production volume within EU**
- **MM is included in the OSPAR list as a candidate for dangerous substances**
- **In Sweden, there is limited use of MD2M, MDM and MM, and more extensive use of D4, D5 and D6**

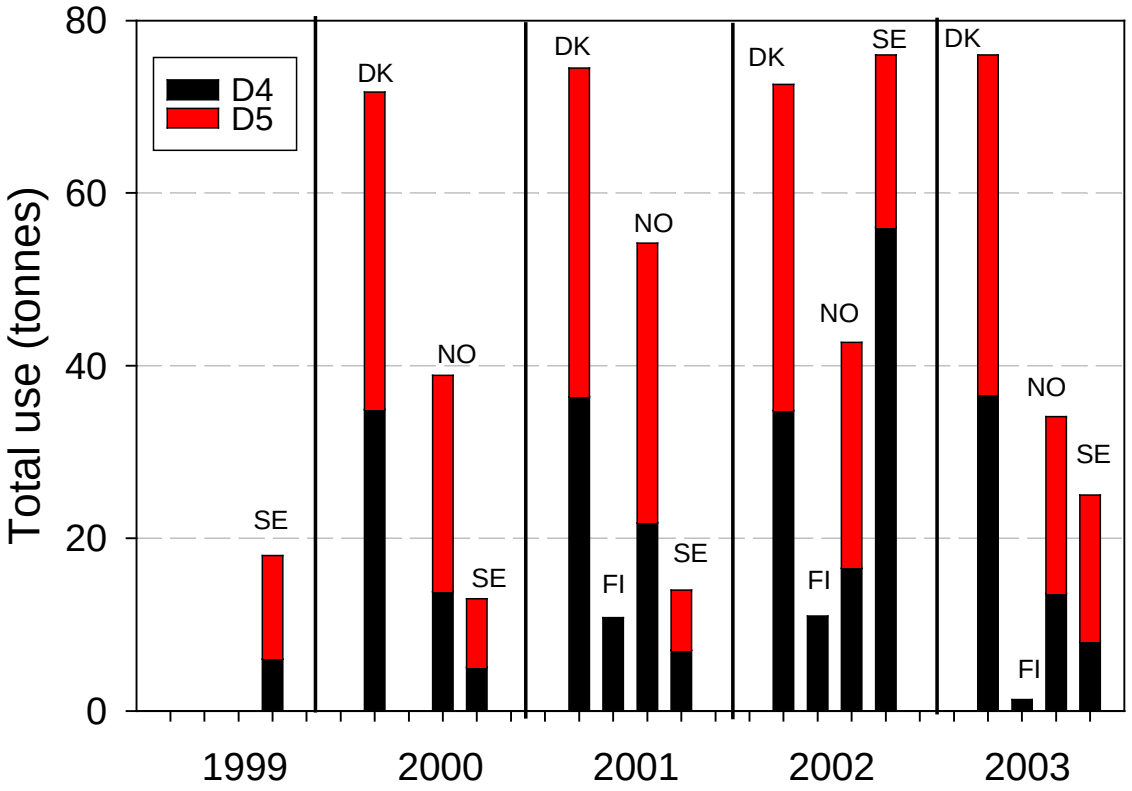


Swedish use of D4, D5 and D6

SPIN*, 2005

*SPIN Substances in preparation in the Nordic countries. The figures from the database only represent the registered use in chemical products

Siloxanes widely used chemicals



Use of D4 and D5 in the different Nordic countries

SPIN, 2005

Screening of siloxane

A sampling strategy was designed in order to determine the concentrations of the selected siloxane

- Background areas
- Point source
- Diffusive sources
- Accumulation in the ecosystem
- Human exposure

- Air
- Water
- Sediment
- Municipal sludge
- Biota
- Breast milk

Analytical methods

Air samples

The samples were collected on adsorbent tubes, Tenax™. The adsorbent tubes were analyzed using the thermal desorber and GC-MS

Sludge, sediment, breast milk and water

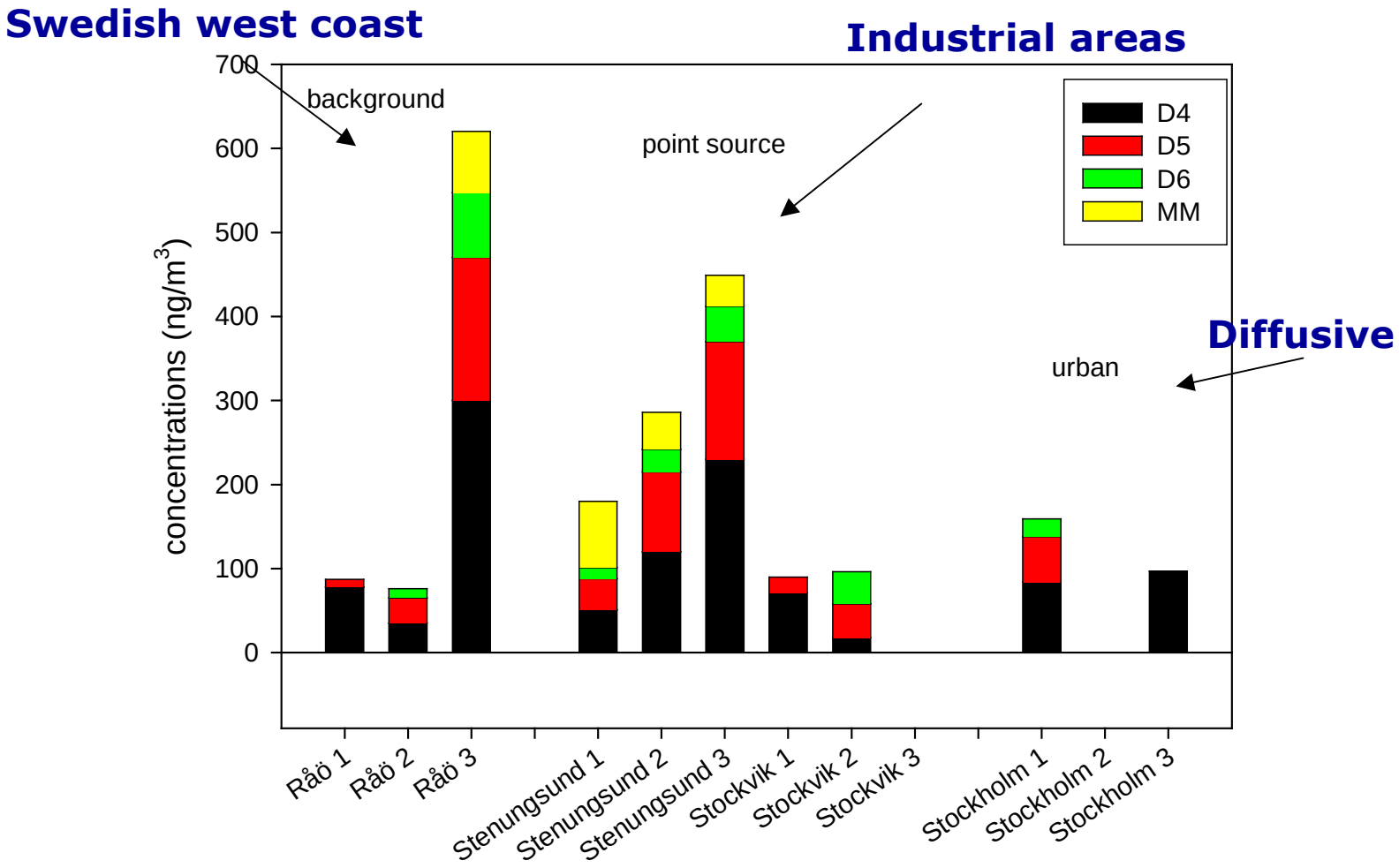
The samples were diluted with water and purged with a gas stream passing through an adsorbent Tenax™ and thermally desorbed and analysed by GC-MS "purge and trap"

Biota (fish) samples

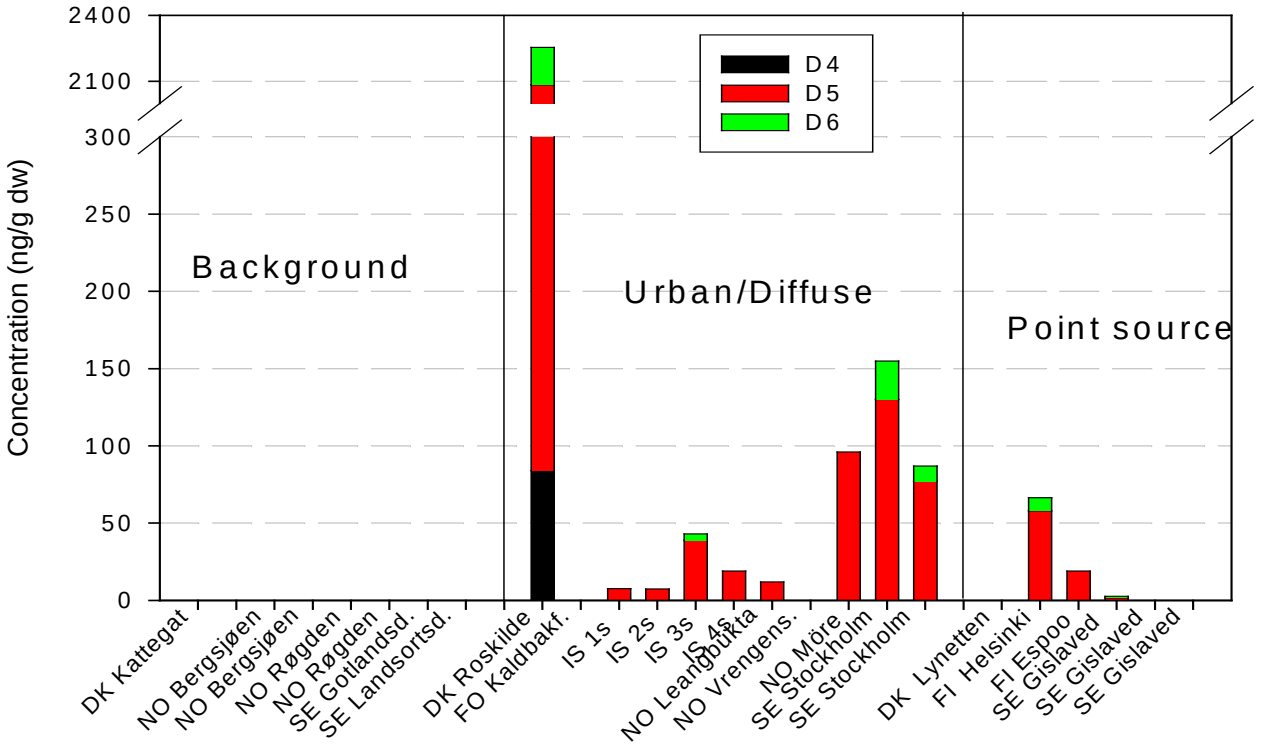
A very short and comprehensive sample preparation was used. The sample was homogenised and mixed with 1 mL n-hexane and analysed on a GC-HRMS system

Due to the ubiquity of the siloxanes great care was given to reduce the risk for contamination of the samples with siloxanes through direct contact with the lab staff, the equipment used for sample storage, preparation, and extraction.

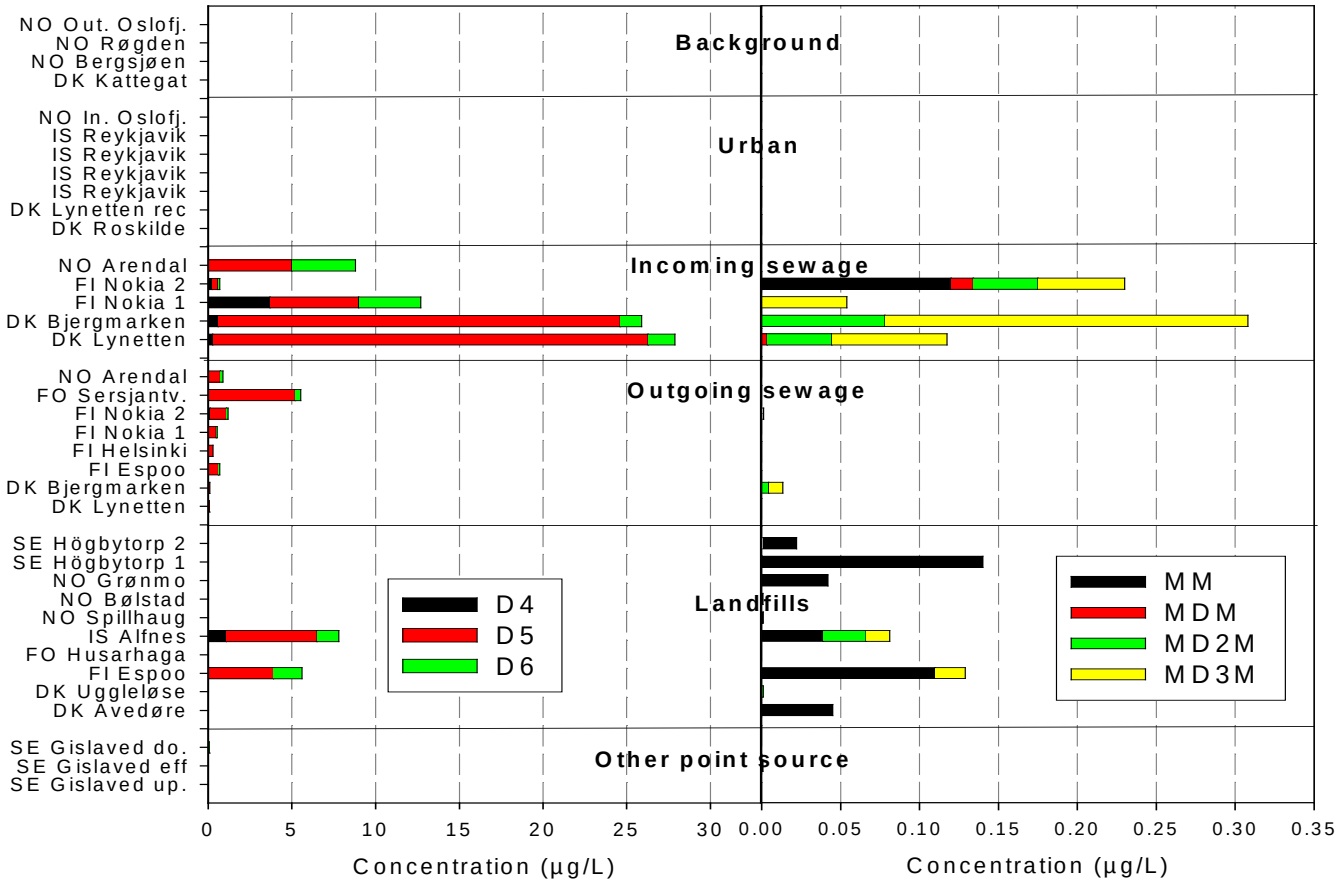
Concentrations of siloxanes in air in Sweden



Concentrations of cyclic siloxanes (ng/g dw) in sediment from the Nordic countries



Concentrations of cyclic (left) and linear (right) siloxanes in water (pg/l)



Samples were collected in different water types in the Nordic countries

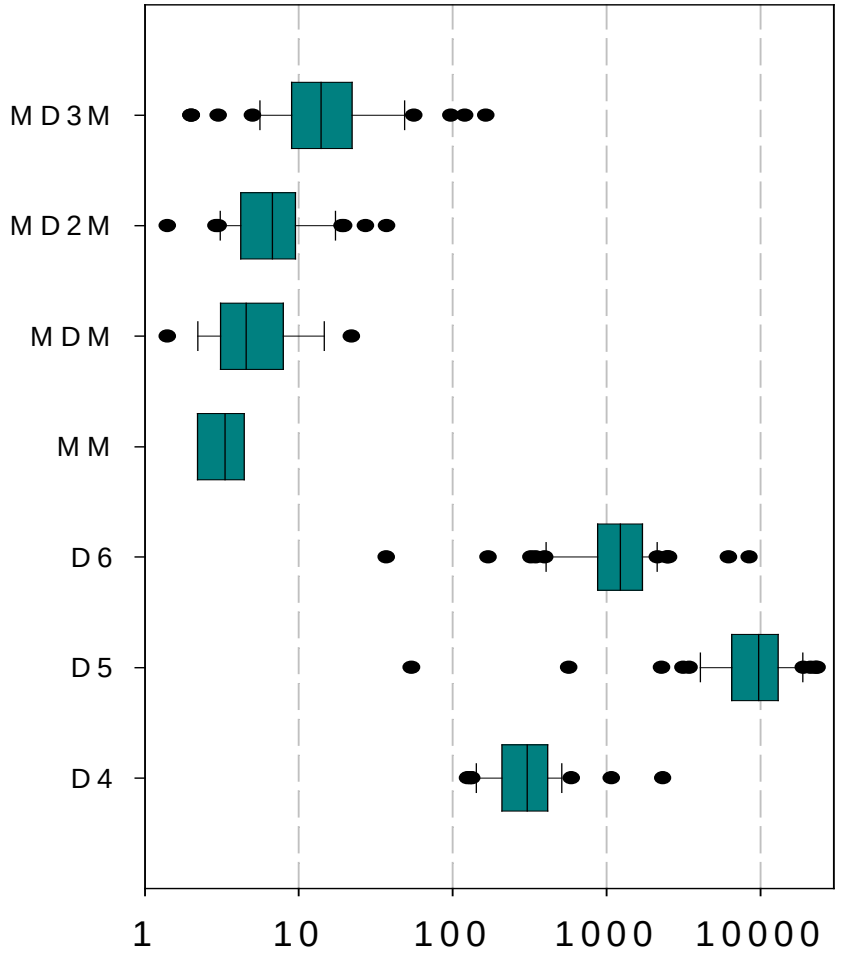
Note the different scales on the x-axes

Concentrations of siloxanes in sludge from municipal STPs in Sweden (ng/g DW)

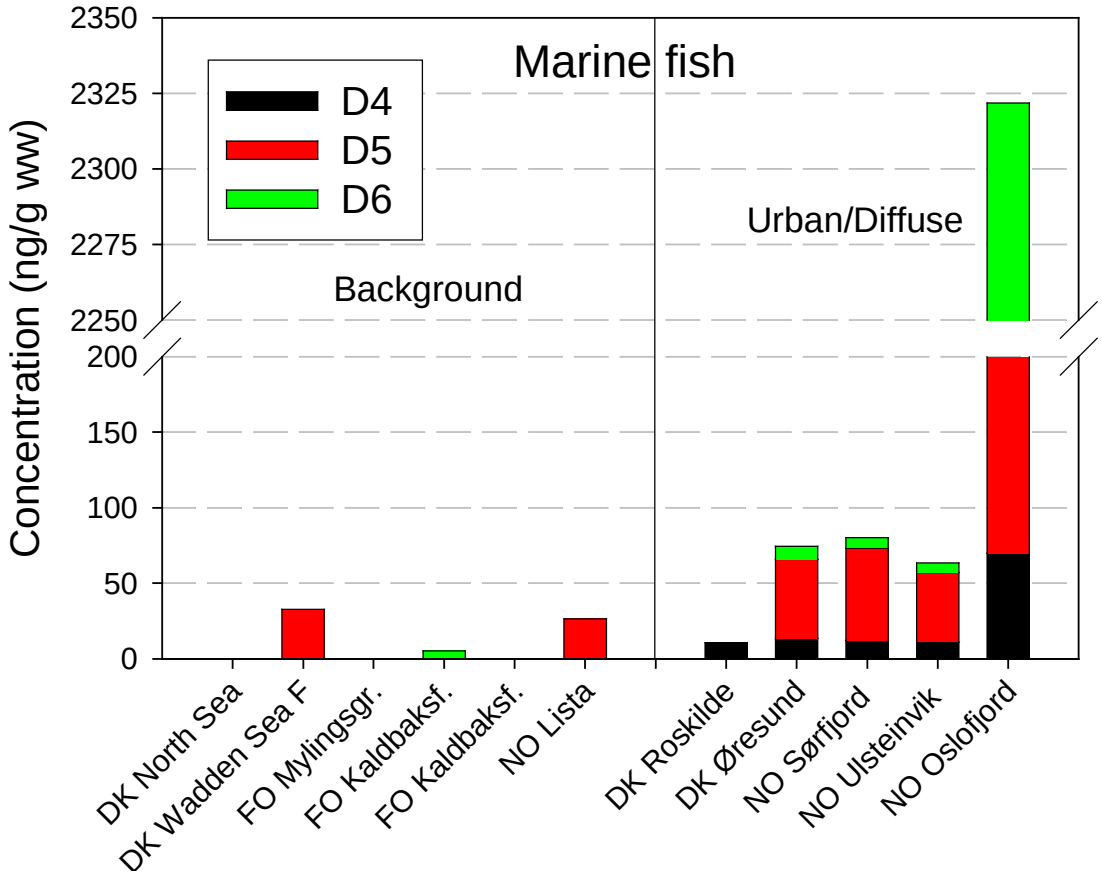
Siloxanes were detected in all 52 samples

The lower and upper boundaries of the box represent the 25- and 75-percentiles, the line within the box is the median concentration.

The whiskers represent the 10- and 90-percentiles, and the dots are individual results outside this range.



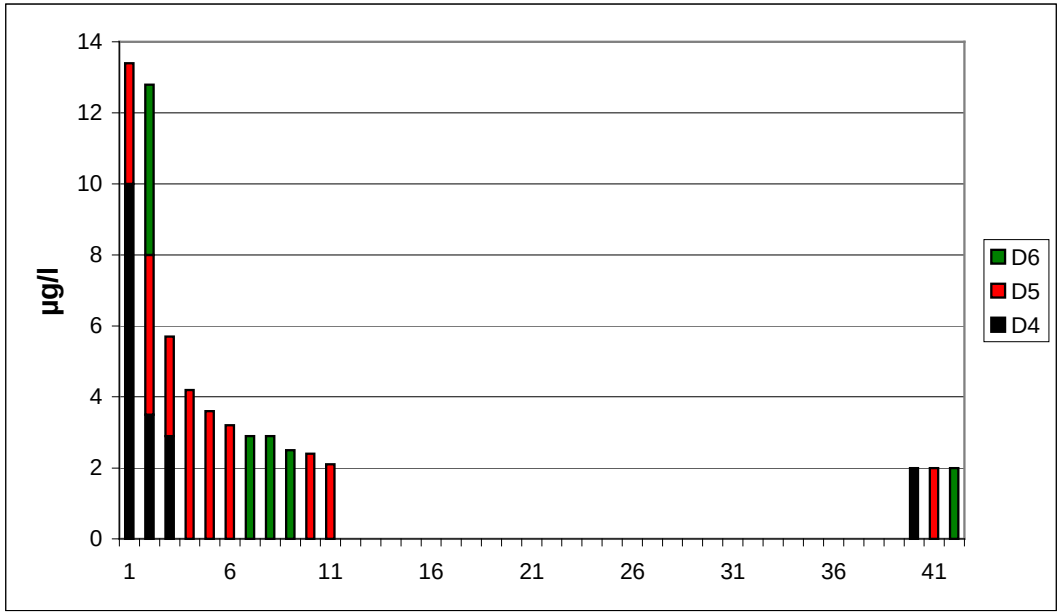
Concentrations and distribution of cyclic siloxanes in marine fish liver collected in the Nordic countries



Human Exposure of siloxanes

Concentrations of D4, D5 and D6 (µg/l) in breast milk

Swedish screening



The samples are sorted in decreasing order of concentration
Sample 12-39 were below the quantification limit
The bars to the right illustrate the quantification limits.

Conclusions of the screening

- Siloxanes were frequently found in most of the analysed media but there were a great variation in concentrations
- The cyclic siloxanes occurred in significantly higher concentrations than the linear siloxanes and D5 was the dominating siloxane in most samples while D4 mostly was highest in air
- Diffuse sources seemed to be most important for the observed concentrations of siloxanes in Sweden and in the Nordic environment.
- The siloxanes was also detcted in biota

Conclusions

The use of siloxanes is extensive and a continued use may lead to increased environmental levels. However the NOEC for D4 was only exceeded in one water sample, influent to STP

Follow

Morde data is needed to follow trends

Studies of the human exposure

2005-2006

Meaurements in sludge

Measurements in food

Evaluate the impotance of atmospheric transport

IVL Swedish Environmental Research Institute