Uptake of dioxin and dioxinlike compounds from sediments by mussels and crabs. Part II.

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At DIOXIN '81 in Arlington, Virginia (USA) it was shown for the first time that a series of 2,3,7,8-substituted PCDDs and PCDFs could be identified in fish samples. It was suggested that this was due to a diminished ability to metabolize PCDDs and PCDFs with the chlorines in the 2,3,7,8-positions[1]. A similar residue pattern of PCDFs was found in samples from the Japanese Yusho patients, and the same explanation was given for this observation[2]. Now numerous reports have confirmed that the toxic 2,3,7,8-substitututed congeners are the dominating isomers in fish samples from all over the world as well as in samples from fisheating birds and mammals[3].

In the present study blue mussels (Mytilus edulis) and spider crabs (Hyas araneus) were exposed to two different sediments, one collected at a distance of 4 km from the Iggesund pulp mill located on the Swedish coast of the Bothnian Sea. The other sediment was a control sediment collected at a distance of 65 km from Iggesund. The contaminated sediment proximal to the pulp mill is dominated by 2,3,7,8- and 1,2,7,8-tetraCDF, 2,3,7,8-tetraCDD and a series of methyl- and dimethyl substituted PCDFs[4].

Experimental

The sediments were supplied suspended in 10 L tanks of circulating seawater to make them available to the filter-feeding mussels. The turbidity in the tanks was 12 ±2 mg/L and the water flow 70 mL/min. The exposure time for the mussels was 14 days and 52 days for the crabs. The crabs were exposed both via the water and the food, the food consisting of blue mussels.

At the end of the experiment the whole soft tissue of the mussels and the hepatopancreas and ovaries of the crabs were sampled and frozen at -20°C and then shipped frozen to the analytical laboratory. The extraction, clean-up, and instrumental analyses (VG 70-250S) followed a protocol earlier described in detail, which allows the identification of all tetra- through octa-substituted PCDDs and PCDFs[5].

Results

A series of PCDDs and PCDFs were found in the sediments and in the tissue samples. An examination of the individual chromatograms reveals that there is a very good correlation between the patterns found in the sediments and in the tissue samples. The greatest difference between the two sediments was found for the tetraCDFs and tetraCDDs. The Iggesund samples were dominated by the specific isomers correlated to pulp bleaching: 2,3,7,8-tetraCDD, 2,3,7,8- and 1,2,7,8-tetraCDF. The background samples have much more of all the other congeners which are correlated to normal combustion, as seen in Figure 1. In this figure we also show the curves for pentaCDFs, which are very much the same for the exposed and background samples. PentaCDFs have not been correlated to pulp bleaching.

High levels of alkyl-substituted PCDFs were found in the Iggesund sediment[4]. In Figure 2 we have collected the curves for m/e 334 where we can see the 13C 2,3,7,8-tetraCDD and dimethyl-tetra CDFs. The uppermost curve is the sediment, the middle the mussel, and the bottom curve is from crab hepatopancreas. In comparing the sediment and the mussel, the difference is seen to be quite small. However, most of the dimethyl-tetra CDFs have disappeared in the crab, showing one major peak only (unknown isomer).

Conclusion

It has been demonstrated that PCDDs and PCDFs are taken up by mussels and crabs. The mussels are shown to be useful study organisms for uptake of the alkyl-substituted PCDFs.

The study shows that 2,3,4,7,8-pentaCDF is not associated with effluents from pulp mills. From a toxicological point of view this is the dominating congener in fish and mammals from the Baltic Sea as well as in human fat samples from N. Europe, including Scandinavia. Consequently the ultimate source of this congener has to be found elsewhere.

References

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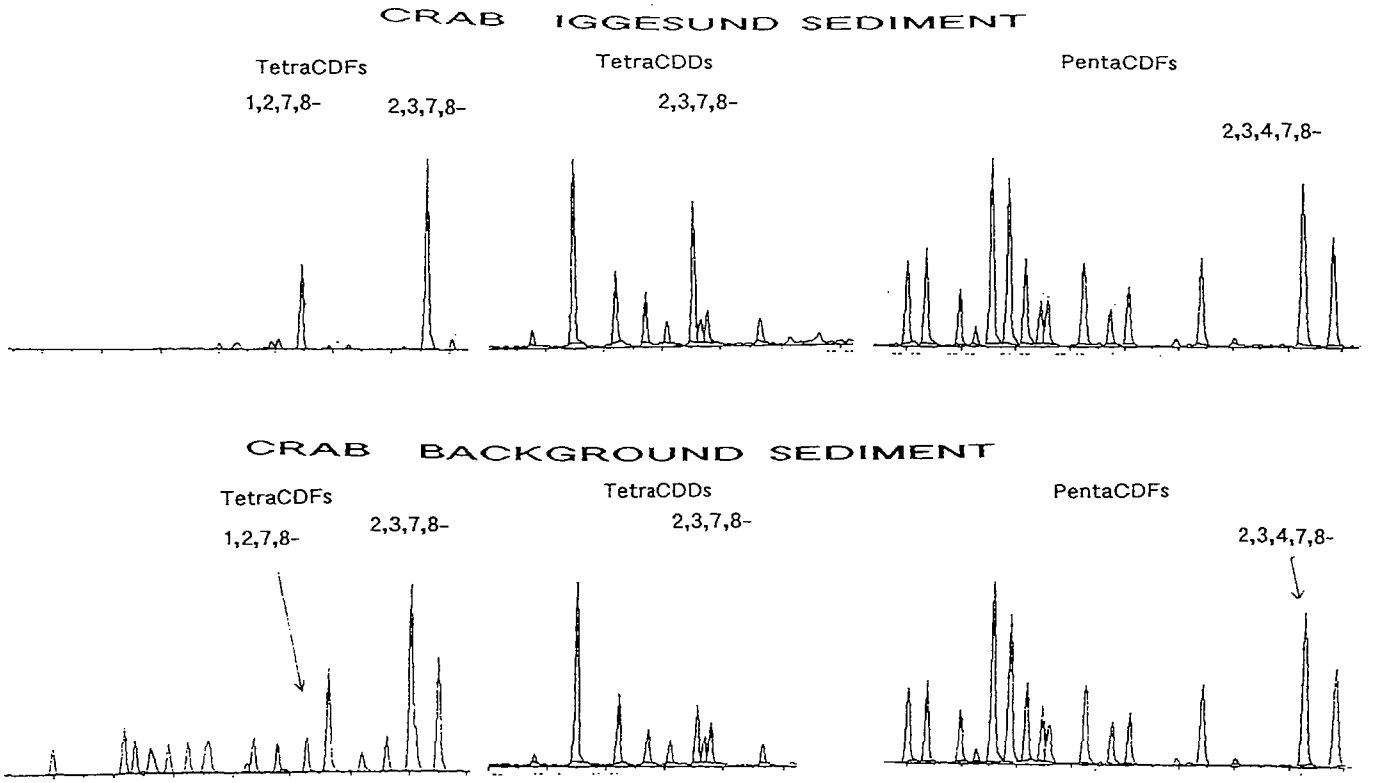
CRAB IGGESUND SEDIMENT
TetraCDFs
1,2,7,8-
2,3,7,8-
TetraCDDs
2,3,7,8-
PentaCDFs
2,3,4,7,8-
CRAB BACKGROUND SEDIMENT
TetraCDFs
1,2,7,8-
2,3,7,8-
TetraCDDs
2,3,7,8-
PentaCDFs
2,3,4,7,8-

Figure 1

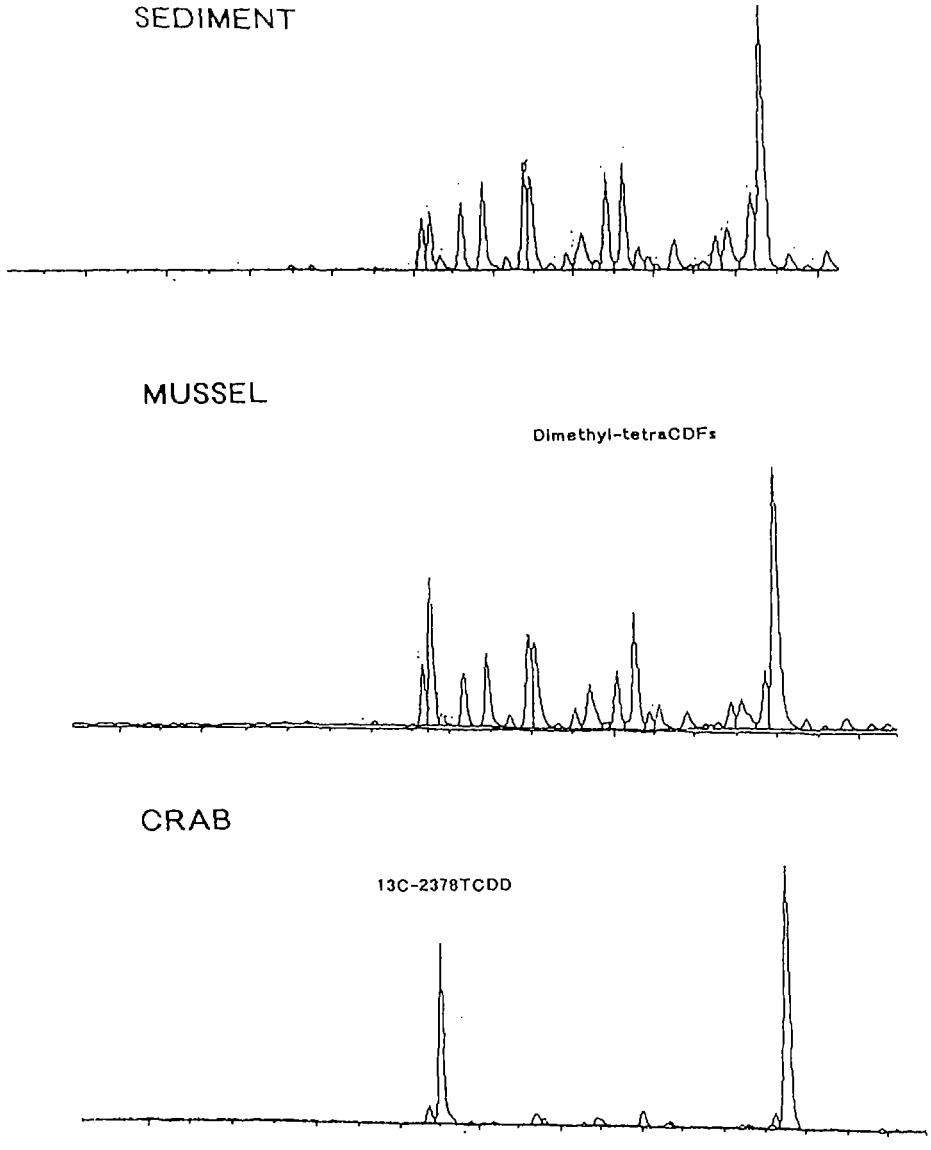

Figure 2