

Levels and Patterns of Polychlorinated Dibenzo-*p*-dioxins and Dibenzofurans in Sediments from Korean Coast

Hyo-Bang Moon, Hee-Gu Choi, Sang-Soo Kim, Seung-Ryul Jeong
and Pil-Yong Lee

Marine Environment Management Division, National Fisheries & Development
Institute, Busan 619-902, Korea

Introduction

PCDDs and PCDFs are very stable chemicals and have very long residence times in the environment and in organisms, including humans. Their hydrophobicity promotes accumulation in sediments and organisms, resulting in high concentrations in both sediments and organisms. Among toxicological effects reports are teratogenicity, reduce reproduction, liver toxicity, decreased growth rate and behavioral changes (Zeise et al., 1990; Huff, 1992). PCDDs/DFs are inadvertently produced from various combustion sources and manufacturing processes, such as municipal solid waste incineration (Olie et al., 1977), motor vehicles (Marklund et al., 1987), steel mills (Tysklind et al., 1989), and chemical production processes (Hutzinger et al., 1985). These contaminants are mainly transported to aquatic systems through the atmospheric deposition or directly via rivers. Since PCDDs/DFs and other hydrophobic organic microcontaminants tend to be strongly associated with particulate matter, their final sink is thought to be the bottom sediments. Therefore, sediment is a deposition place that provides a valuable record of the recent input of contaminants to the marine environment. The objective of this investigation was to assess the contamination levels and patterns of PCDDs/DFs in sediments of Korean coast.

Materials and methods

Surface sediments (0-5 cm) were sampled at 19 stations in Korean coast during the period of February to July 2000. Sediments were collected using a box-corer sampler and then kept frozen at -20°C until analysis. They were freeze-dried and sieved at 2 mm. 20 g of sediments were extracted in a soxhlet apparatus with 200 ml of toluene for 20 hours, then the volume was reduced to 1-2 ml in a rotary evaporator. The extract was transferred to *n*-hexane and internal standard (EDF

8999, Cambridge Isotope Laboratories, Inc.) was spiked. After pre-cleaned up with a multi-layer silica gel column, the extract was cleaned up on an activated neutral alumina column chromatography. The HRGC/HRMS analyses were carried using an HP6890 Plus gas chromatography coupled to a JMS 700D mass spectrometer at a resolution of 10,000 (10% valley) in selected ion monitoring (SIM) mode, and a 60 m SP 2331 (Supelco 0.25 mm ID, 0.25 μm film thickness) and 60 m DB 5MS (J&W 0.25mm ID, 0.25 μm film thickness) was used for the separation of compounds.

Results and discussion

PCDDs concentrations in marine sediments collected from Korean coasts ranged from 7 to 563 pg/g dry weight and PCDF levels varied from 8 to 240 pg/g dry weight. I-TEQ levels were 0.1 to 5.5 pg/g dry weight. Station 8 from South Sea represented the highest value, whereas Station 2 and 3 from East Sea were the lowest levels. All stations showed a similar homologue profile of PCDDs/DFs. Octachlorinated dibenzo-*p*-dioxin (OCDD) was a predominant congener. The primary contribution of PCDDs/DFs contamination in Korean coast was atmospheric deposition of particulate matters generated from various combustion processes by some local sources. Grain size and total organic carbon (TOC) distribution were important factors governing PCDDs/DFs levels in this study.

References

- Huff, J. E., 1992. 2,3,7,8-TCDD; A potent and complete carcinogen in experimental animals. *Chemosphere*, 25, 173-176
- Hutzinger, O., Blumich, M. J., Berg, M. v. d. and Olie, K., 1985. Sources and fate of PCDDs and PCDFs: An overview. *Chemosphere*, 14, 581-611
- Knezovich, J.P., Harrison, F.L. and Wilhelm, R.G. 1987. The bioavailability of sediment-sorbed organic chemicals: A review. *Water, Air and Soil Pollution*, 32, 233-245
- Marklund, S., Rappe, C., Tsyklind, M. & Egebak, K. E. 1987. Identification of polychlorinated dibenzofurans and dioxins in exhausts from cars run on leaded gasoline. *Chemosphere*, 16, 29-36
- Olie, K., Vermeulen, P. L. and Hutzinger, O., 1977. Chlorodibenzo-*p*-dioxins and chlorodibenzofurans are trace components of fly ash and flue gas of some municipal incinerators in the Netherland. *Chemosphere*, 8, 455-459
- Tsyklind, M., Söderström, G., Rappe, C., Hägerstedt, L.-E. and Burström, E. 1989. PCDD and PCDF emissions from scrap metal melting processes at a steel mill. *Chemosphere*, 19, 705-710
- Zeise, L., Huff, J., Salmon, A. and Hooper, K. 1990. Human risks from 2,3,7,8-tetrachlorodibenzo-*p*-dioxins. *Adv. Mod. Environ. Toxicol.*, 17, 293-342