

Source Identification by Pattern Recognition in River Elbe Sediments

K.-W. Schramm, K. Oxynos, B. Henkelmann, A. Kettrup
Institut of Ecological Chemistry
GSF, Ingolstädter Landstr. 1, D-8042 Neuherberg, Germany

Abstract

River Elbe sediments from 1991 were analysed for considering polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/F), hexachlorobenzene (HCB) and pentachlorobenzene (PeCB). The kind of source and the impact between two sample points are characterized by the difference of their single chemical pattern. Three main sources could be identified as sewage sludge, polychlorinated biphenyls (PCBs) and pentachlorophenol. The other pattern could not be clearly related to a single main source regarding the PCDD/F homologues.

Experimental

The analysis of PCDD/F was carried out using established extraction by soxhlet with toluene (24h), clean-up combining alumina-, mixed - and Olson-columns in series and detection using a Finnigan MAT 8230 mass spectrometer with an isomer specific capillary. HCB and PeCB were analysed as published by Oxynos et al.¹. The samples were taken in 1991 prepared and stored in connection with the activities of the German environmental specimen banking².

Results and Discussion

The pattern of the PCDD/F homologues are shown in Figure 1. These pattern are not the pattern of the samples itself but the difference of the particular downstream and the upstream pattern (diff.-pattern) of the samples. Thus these pattern are representing the input or output between two sampling sites. The first diff.-pattern Dresden-Schmilka (Fig 1.1) is very similar to the pattern of technical sodium-pentachlorophenolate (Na-PCP) as depicted in Figure 1.2. This observation is confirmed by the occurrence of high concentrations of HCB and PeCB. These compounds are known impurities during the manufacture of pentachlorophenol, in wood preservatives industry, etc.³. Obviously the diff.-pattern of Barby-Dresden (Fig.

FORM

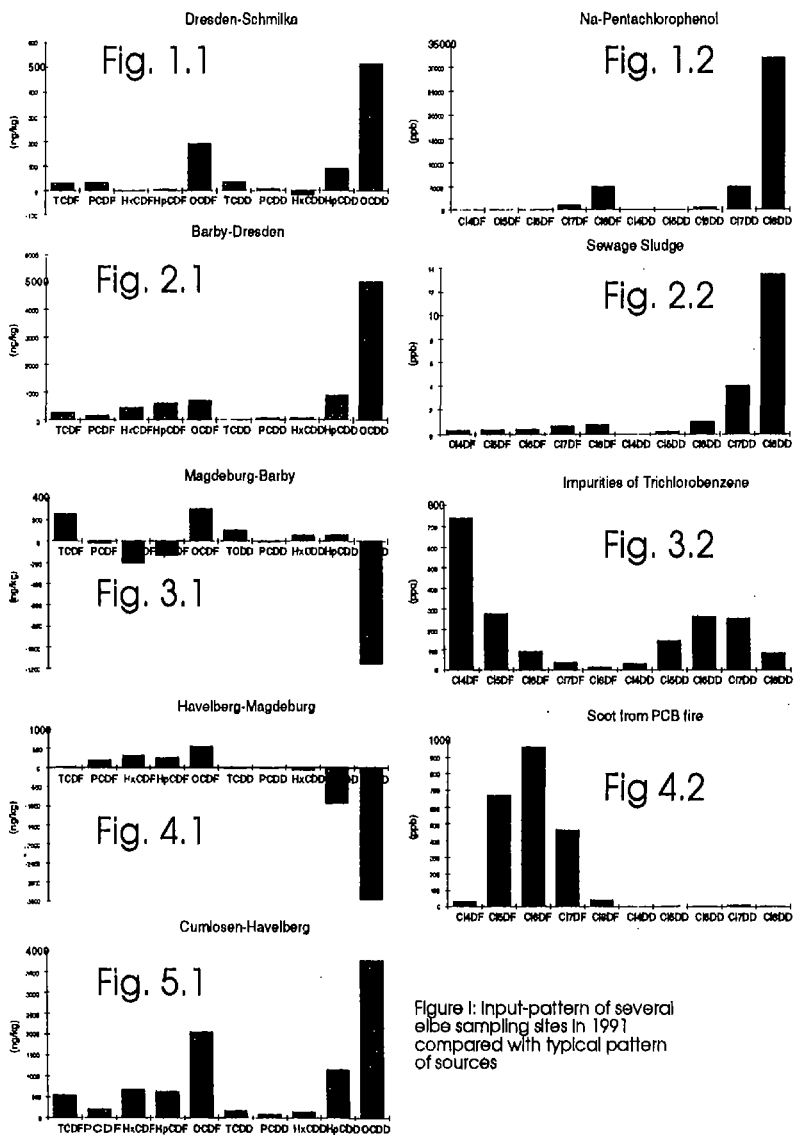
2.1) shows very high similarity to sewage sludge as shown in Figure 2.2. The diff.-pattern Magdeburg-Barby (Fig. 3.1) is contradictory but the high input of tetrachlorodibenzofurans (TCDF) could be related to the production of trichlorobenzenes. However, this assumption is rather uncertain but should show the possibilities of data generation and interpretation. The next downstream diff.-pattern Havelberg-Magdeburg (Fig. 4.1) shows an interesting picture. If one looks at the single sample pattern there is no chance to identify any single source but the diff.-pattern shows clearly a single input of polychlorinated biphenyls or its combustion products in comparison with Figure 4.2 together with losses of the chlorinated dibenzodioxin congeners. However, the last obtainable diff.-pattern Cumlosen-Havelberg (Fig. 5.1) did not allow to assume a single source although single elements of the above discussed sources seem to be present. The authors recognize that the chemical pattern could further be altered by formation, degradation and partition. These processes are not significant in the case of large contamination. This could be confirmed by the low degradation rates of the analysed compounds. Downstream losses could only be observed for the higher chlorinated PCDD/F and are attributed to adsorption.

Literature

¹Oxynos, K., Schmitzer, J., Dürbeck, H.W., Kettrup, A.: Analysis of chlorinated hydrocarbons (CHC) in environmental samples. In: Specimen Banking (Eds. Rossbach et al.) Berlin, Springer-Verlag, 127-137, (1992)

²BMFT : Umweltprobenbank, Berlin, Springer-Verlag, ISBN 3-540-18138-5, (1988)

³Verschueren, K.: Handbook of environmental data of organic chemicals, N. Y., Van Nostrand Reinhold, ISBN 0-442-28802-6, 712-713, (1983)



FORM

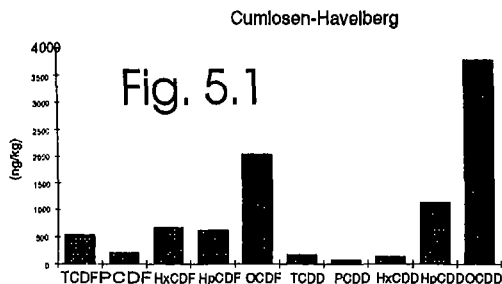
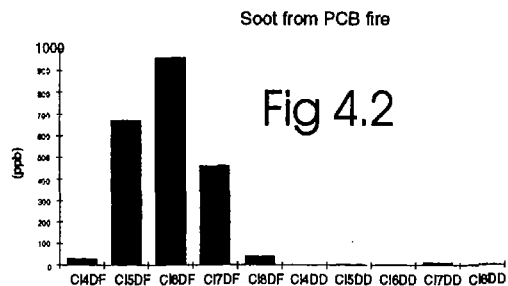
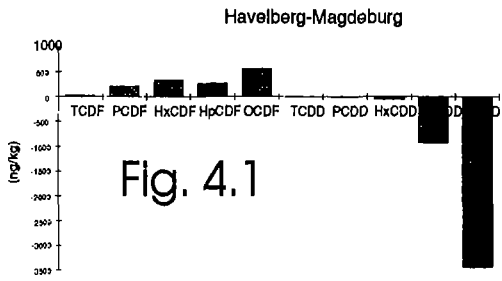
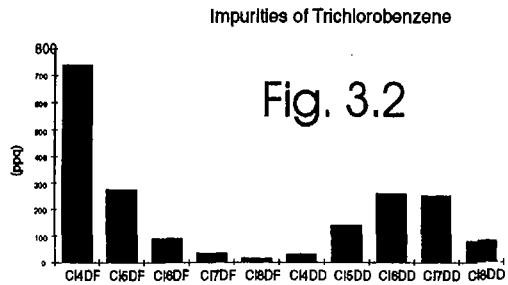
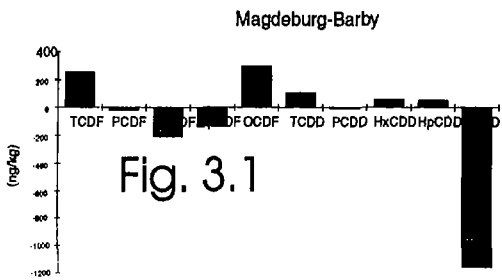
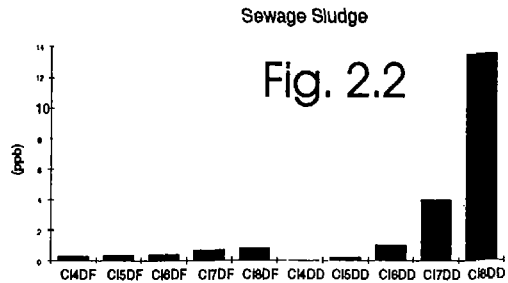
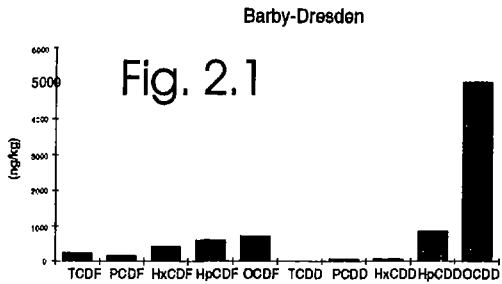
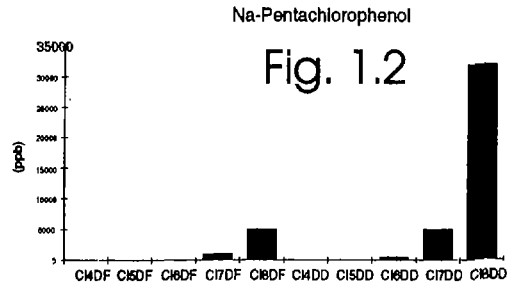
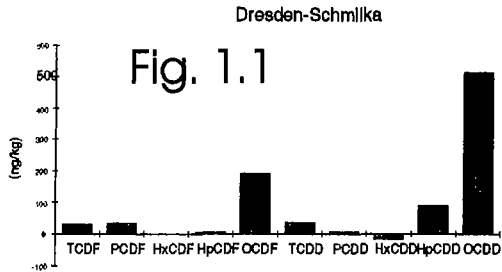


Figure 1: Input-pattern of several elbe sampling sites in 1991 compared with typical pattern of sources