# SOURCE IDENTIFICATION OF PCDD/Fs IN A SEWAGE TREATMENT PLANT OF A GERMAN VILLAGE

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## Introduction

PCDD/F levels in sewage sludge have been of much concern in Germany because of the potential risk for contaminating agricultural soils during sludge recycling. Regulatory measures resulted in lower PCDD/F levels in the sewage sludge. Commonly, the PCDD/F content in sludge nowadays reaches between 10 and 100 pg I-TEq/g. Nevertheless, the levels in sludges of some sewage treatment plants are still above the limit value for land application of 100 pg I-TEq/g.n this study, we investigate the PCDD/F sources in the sewage of a village in North-East Germany. The sludge levels were above the limit value. Here, we separate between influxes from the sewer net and from the inlet of faecal tanks. The role of potential source categories is discussed.

## Materials and Methods

Three samples were taken in April 1998 in a village in North-East Germany: A sludge sample from the sewage treatment plant, a sewer biofilm sample from the pumping station, and a sample from the biological matrix of the faecal storage tanks. Two separate influxes are relevant for this treatment plant: The sewer net of the village passing through the pump station, on the one hand, and the faecal tanks transported by lorries to the faecal inlet passing through the storage tanks, on the other hand. Fig. 1 gives an overview of the inlets to the treatment plant.

PCDD/Fs analysis was performed on 8 – 10 g of freeze-dried samples, spiked with a mixture of 17 $^{13}C_{12}$ standards, and extracted in a pressurized fluid extractor with toluene. Clean-up was performed as previously described [1]. It consisted of a multicolumn clean-up including alumina-, mixed-silica-, Bio Beads™- and micro-alumina-columns. Resolution and quantification of PCDD and PCDF were performed on a HRGC-LRMS (Fisons MD800 and GC8000). A fused silica capillary column SP 2331 (60 m x 0.25 mm i.d. x 0.20 µm film thickness; Supelco) was used. Helium was the carrier gas. Method blanks were routinely analyzed, and no contributions were detected. The PCDD/F contents are given on dry weight basis.

The results were evaluated statistically using Statgraphics Plus v4.0 and SPSS v8.0. The data was centred. Values below detection limit were set to zero, the data was not transformed.

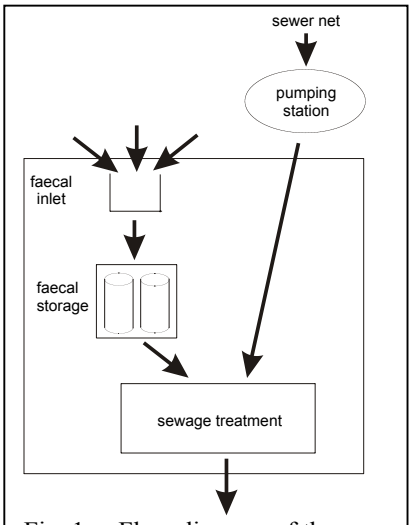


Fig. 1: Flow diagram of the sewage treatment plant

**Results and Discussion**

The PCDD/F level of the sludge was 58.7 ng/g and 105 pg I-TEq/g. This was substantially lower than earlier reports [2] for this treatment plant (see Fig. 2), but still slightly above the limit value for soil application. A repeated sampling in December 1998 found a PCDD/F concentration of 37 pg I-TEq/g [2].

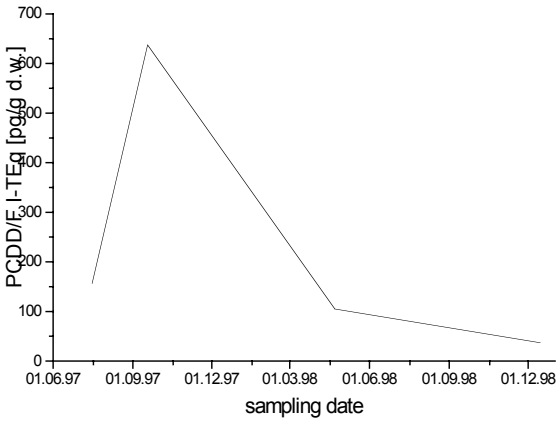


Fig. 2: Time trend of the PCDD/F I-TEq content in the sewage sludge

The PCDD/F levels in the biofilm of the pumping station and in the biological matrix of the storage tanks were 0.3 ng/g and 7.8 ng/g, 0.5 pg I-TEq/g and 18 pg I-TEq/g, respectively. This indicates that effluents collected in the sewer net can be excluded as a relevant PCDD/F source for the sludge. The faecal tanks contribute more substantially to the PCDD/F contamination in the sludge. Because the temporal trend showed a peak in the second half of 1997, we suggest a peak discharge from the final emptying of an old faecal tank highly contaminated with PCDD/F. In the period between mid 1997 and April 1998, the biological matrix at the surface of the storage tanks may have been diluted with low level faecal sewage. This may explain the higher PCDD/F level found in the sludge compared to the level in the storage tanks.The homologue profile for the three samples was dominated by OCDD (see Fig. 3). This type of homologue profile is commonly found in sewage sludge. A very similar homologue profile is also found for pentachlorophenol PCP [3].

To investigate potential sources of the sewage related samples, cluster analysis was applied for pattern recognition. The relative content of PCDD/F homologues and 2,3,7,8-substituted congeners was compared with potential sources and similar matrices: PCP [3,4], textile dyes [5], faeces [6] and historical London sewage sludges [7]. Fig. 4 shows the corresponding dendogram.

The early London sewage samples (L1, L2) and the faeces samples (F1-F4) build a cluster separate from the other samples. The samples of this sewage treatment plant are most similar to the recent London sewage sludges (L3-L7) and to the PCP (P1, P2, P4, P5). The sample of the faecal storage tank is much more similar to the sludge sample than the sample of the pumping station. PCP is the source most likely being responsible for this sewage contamination. It is most similar to samples of this sewage treatment plant.

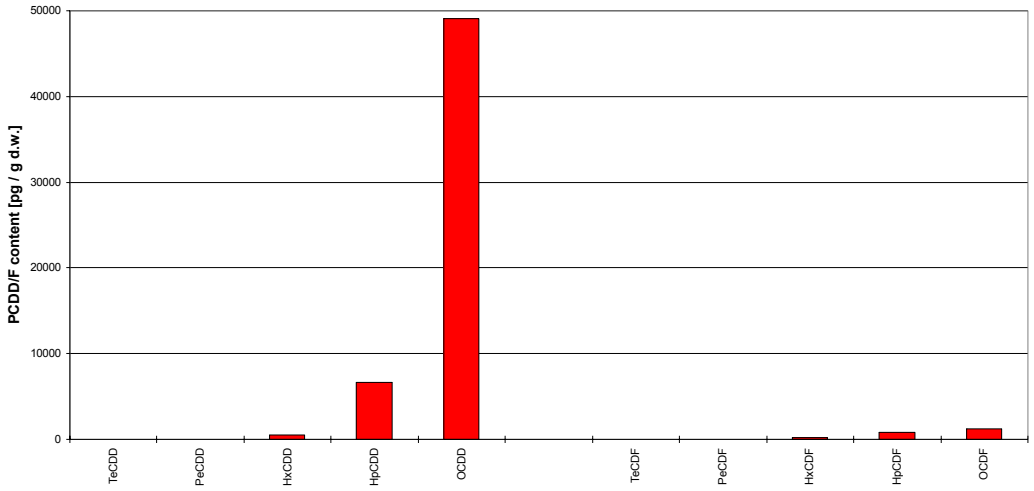


Fig. 3: Homologue profile of PCDD/Fs in the sewage sludge

**Conclusions**

The PCDD/F contamination of this sewage treatment plant has been caused by a discharge from faecal tanks, probably the final emptying of an old closed-down tank. The patterns and profiles suggest a PCP-related source. In the former GDR, PCP was heavily applied.

**Acknowledgements**

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**References**

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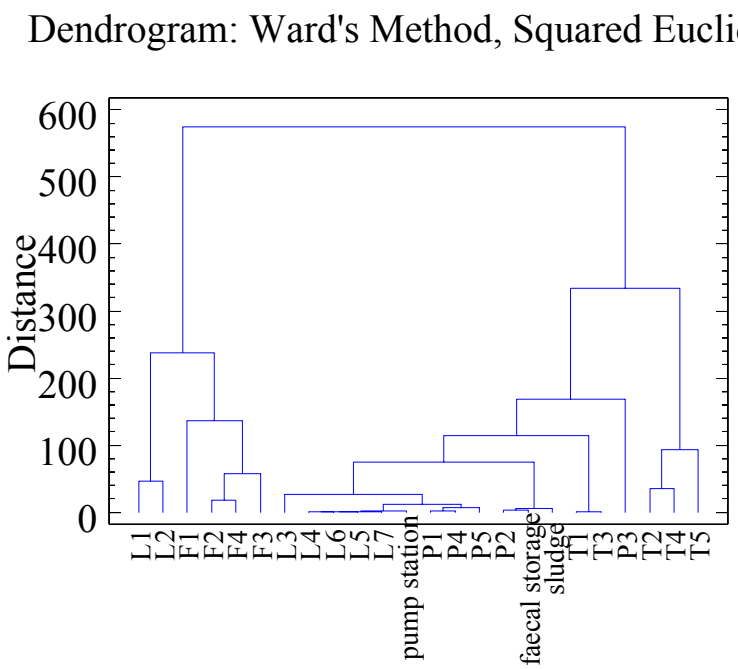


Fig. 4: Dendogram of PCDD/Fs in samples from this sewage treatment plant compared with potential sources and related matrices: PCP (P1-P5) [3,4], chloranil dyes (T1-T5) [5]; faeces (F1-F4) [6], and historical London sewage sludges (L1-L7) [7]