

Ambient Air Concentrations of Dioxins during Stable Weather Conditions

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1. Introduction

Previous measurements in three Austrian conurbations ¹⁾ showed rapidly increasing concentrations of PCDD/F in ambient air during stable weather conditions in winter. The observed concentrations were twice to three-times higher than the average winter levels. Owing to these results in winter 1993/94 and 1994/95 respectively the Austrian Federal Environment Agency started two monitoring programmes in the conurbations Graz and Linz. Further objectives were to achieve concentration profiles over the city area by simultaneous sampling at various sites. During the first programme, undertaken in Graz, also a differentiation into daytime and nighttime PCDD/F levels could be achieved.

2. Sampling

In Graz, see Figure 2, one sampling site was located in the centre of the town (Graz-Centre) characterized as city residential area. Two sampling sites, one in the south (Graz-South) and one in the east (Graz-East) of the centre were located in suburbs with residential areas. The fourth sampling site was situated at the east fringe of Graz on a hill (Graz-Lustbühel) surrounded by residential and recreational areas. All four sites were investigated simultaneously, with each sampling period lasting for three consecutive days. The samples were taken between 8 a.m and 8 p.m and at Graz-South one additional during the whole sampling period (day + night).

In Linz, see Figure 1, the sampling sites were selected with the intention to get a concentration profile as well. At the east fringe of Linz there is a great industrial centre with steelworks and chemical production plants, which had to take in account. Therefore the sampling sites were located as followed: the first in the centre of Linz (Linz-Ursulinhof), the second between the city centre and the industrial area (Linz-ORF-Centre), both are residential areas, and the third on the slope east of Linz (Steyregg) opposite the industrial area, which was surrounded by agriculture and family-homes. The fourth sampling site lay in a suburb south of the centre (Linz-Kleinmünchen), the fifth on an hill in an altitude of 230m above the city in the northwest of the centre (Linz-Pöstlingberg) surrounded by recreational area. Samples were taken between 8 a.m and 8 p.m during three consecutive days. From the second sampling period only three results could be obtained.

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3. Methods

Air has been sampled with a two-stage high volume air sampler. The analyses of the air samples were carried out separately for gaseous and particle-bound PCDD/F by HRGC/HRMS. The methods for sampling and analysis are described in a previously published report¹⁾.

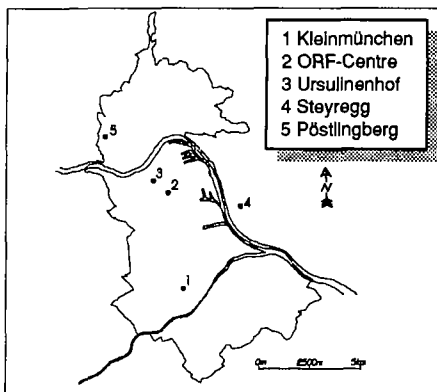


Figure 1 Sampling Sites in Linz

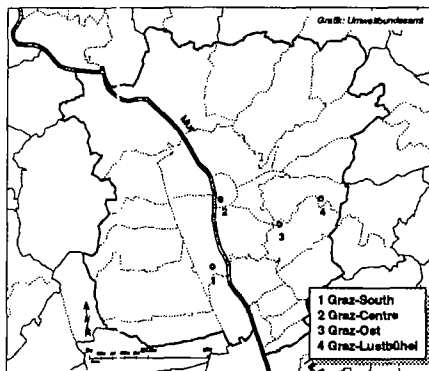


Figure 2 Sampling Sites in Graz

4. Results

For the measuring programme in Graz²⁾ the results, see also Figure 3, can be summarized as follows:

- During winter time inversions the ambient air concentrations of PCDD/F at the sampling-site Graz-South lay clearly higher than the average winter level (222 fg TEQ/Nm³) measured in 1992/93.
- The ambient air concentrations of PCDD/F clearly decreased from sampling-site Graz-South to Graz-Lustbühel during all sampling periods. This corresponds with the characteristics of the surrounding area of the sampling-sites.
- At the sampling site Graz-South the additional sampling cycle, which was carried out from 8 a.m. of the first day until 8 p.m. of the third day of each sampling-period, showed higher ambient air concentrations of PCDD/F during daytime for the first and second sampling-period.
- A comparison of the ambient air concentrations of dioxin with those of SO₂, NO₂ and particulate matter showed that the data sets obtained - as already observed in earlier measurements - are in good agreement. Assuming that there exists a correlation between ambient air concentrations of particulate matter and PCDD/F the different day/night levels of PCDD/F mentioned above could be explained.

- No variation of the homolog profiles during all sampling periods could be observed. The distribution of homologues, similar to those obtained during previous measurements, indicates that in winter the ambient air concentration of PCDD/F in Graz, a city with only a few industrial areas, is mainly influenced by domestic heating.
- A detailed evaluation of the results showed that they more or less correspond with the concentrations measured during winter 1992/93, which indicates that there have been no major changes of emissions in the area of Graz.

The evaluation of the data obtained from the measuring programme undertaken in Linz³⁾, see also Figure 4, yields the following picture:

- The homologue profiles clearly varied from the first sampling period to the third sampling period, obviously caused by a change in the main wind direction during the sampling periods. During the third sampling period at all sampling sites, with the exception of Steyregg which lies east of the industrial area along the River Danube, higher amounts of tetra- and pentachlorinated Furans could be observed. The predominant wind direction during this sampling period was east. This indicates a strong influence by the emissions from the industrial area.
- At the first measuring period the concentration at Linz-Pöstlingberg was very low compared with the other sampling sites. The reason for this phenomena was that the air stratum of temperature-inversion layed between altitudes of 350m and 500m, which hindered the vertical dilution of air pollutants.
- Unlike the situation in Graz no decrease of ambient air concentrations of PCDD/F from the city-centre to the outskirts could be observed. This may be explained by the different geographical situation of Linz compared to Graz.
- Although periods with stable weather conditions have been chosen the ambient air concentrations of PCDD/F only slightly exceeded the winter levels measured previously.

In summary it can be said that stable weather conditions, as known from other air pollutants, lead to increasing PCDD/F levels in ambient air. Due to a combination of intensified domestic heating, because of low temperatures, and unchanged industrial emissions air quality rapidly deteriorates.

5. References

- 1) Thanner, G.; Moche W. (1994): Dioxine in der Luft von Ballungsräumen; Meßergebnisse aus Graz, Linz, Steyregg und Vienna; Teil I. Monographie Bd. 50, Umweltbundesamt (Austria), Vienna.
- 2) Thanner, G.; Moche W. (1995): Dioxine in der Luft bei Inversionswetterlagen: Ergebnisse von vier Meßstellen in Graz. Report UBA-95-113, Umweltbundesamt (Austria), Vienna.
- 3) Lorbeer, G.; Moche W.; Thanner, G. (1995): Dioxine in der Luft bei Inversionswetterlagen, Meßergebnisse von fünf Meßstellen in Linz. Bericht UBA-BE-045, Umweltbundesamt (Austria), Vienna..

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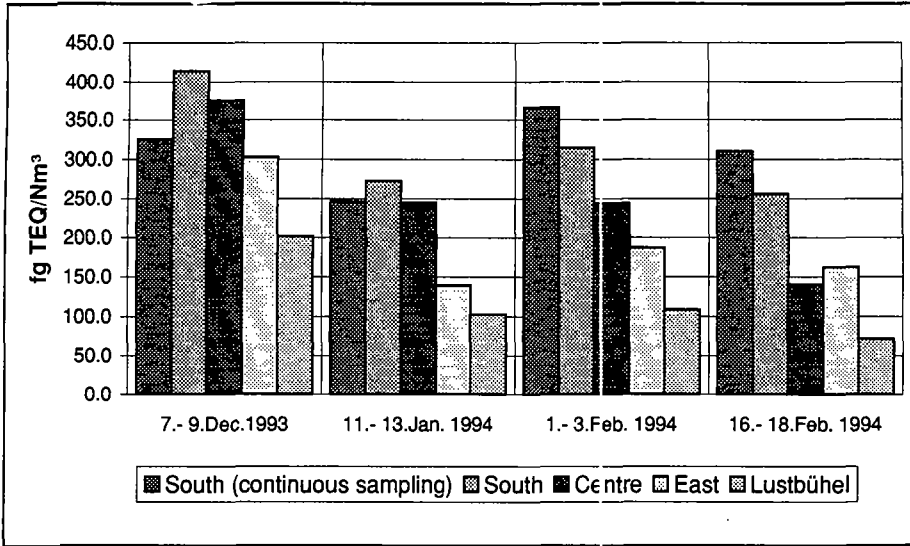


Figure 3 Ambient air concentrations of PCDD/F in Graz, Winter 1993/94

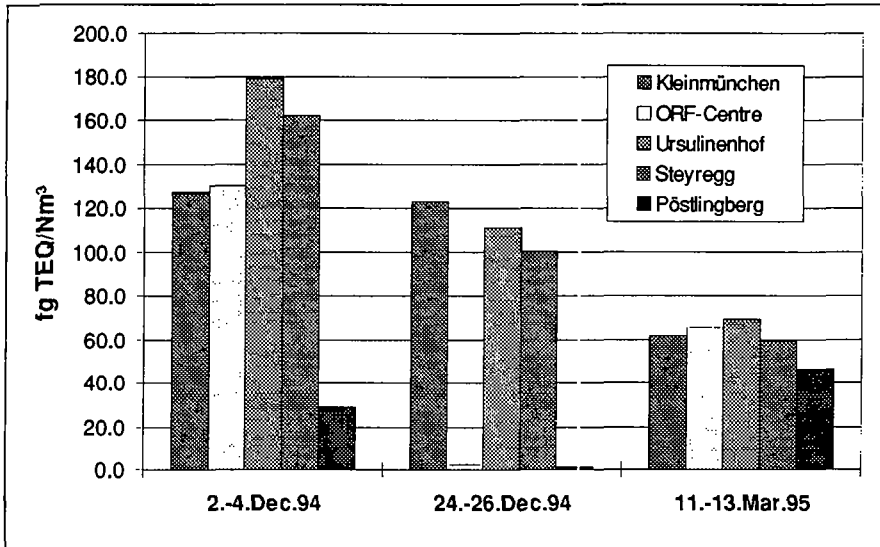


Figure 4 Ambient air concentrations of PCDD/F in Linz, Winter 1994/95