

# HUMAN SOURCES AND ACTIVITIES - POSTERS

## PCDD/F-Emissions from Road Traffic obtained by Tunnel Experiments

Wolfgang Moche, Gerhard Thanner

Federal Environment Agency, Spittelauer Laende 5, 1090-Vienna, Austria

### Introduction

Since it is well known that incomplete combustion in the presence of chlorine can cause formation of PCDD/F also motor vehicles have to be considered as dioxin emission sources. Beginning in the late 1980'ies several studies have been undertaken to estimate the contribution of road traffic to overall PCDD/F emissions. These studies showed that combustion motors fueled with unleaded gasoline or diesel could be considerable emission sources for PCDD/Fs<sup>1,2,3,4,5</sup>. These measurements also showed considerable uncertainty especially for the estimation of emissions for heavy duty diesel truck resulting in emission factors differing by a factor of 200.

Beginning in 1995 the Federal Environment Agency – Austria carried out three tunnel experiments to achieve data about PCDD/F emissions from road traffic in Austria. The tunnel experiment approach had been chosen because it offers the sampling of traffic emissions from an average car pool under real world driving conditions. Similar experiments have been described previously<sup>6,7</sup>.

### Sampling and Analysis

Three highway-tunnels have been chosen as sampling sites. The measurements consisted of the PCDD/F-immission-measurement inside the tunnel and one outside near the tunnel entrance. Traffic data have been obtained by automatic counting devices. In the following a short description of the tunnels will be given:

- 1) Golling-tunnel: highway-tunnel approx. 1,2 km long with two lanes; sampling site in the southbound tube, reference site near the tunnel entrance.
- 2) Plabutsch-tunnel: highway-tunnel 9,8 km long with two lanes and oncoming traffic, part of the beltway of Graz; sampling site in the middle of the tube, reference site near the tunnel observation point at the south entrance, second reference site (Eisteichgasse) in the eastern district of Graz.
- 3) Tauern-tunnel: highway-tunnel 6,4 km long with two lanes and oncoming traffic; sampling site in the middle of the tunnel, reference site at the southern tunnel entrance

At the Golling and Plabutsch tunnel the experiments had been carried out during weekends. At the Tauern tunnel two experiments, weekdays and during weekend, had been carried out.

Air had been sampled with a two-stage high volume air sampler. The particle-bound PCDD/F were collected on a glasfibre-filter, while the gaseous PCDD/F

# HUMAN SOURCES AND ACTIVITIES - POSTERS

were adsorbed on a polyurethan foam plug. The sampler flow rates were adjusted to 14m<sup>3</sup>/h. Samples were taken over 72-hour periods resulting in air volumes in the order of 1000m<sup>3</sup>.

The analysis of the air samples were carried out seperately for gaseous and particle-bound PCDD/F. The methods for sampling,<sup>8</sup> cleanup and detection (HRGC/HRMS) have been described in detail previously.

## Results and Discussion

The measured PCDD/F-concentrations are shown in Table 1. Average traffic data are given in Table 2. The automatic counting devices recorded vehicles less than 6m long as passenger cars. Vehicles longer than 6m have been assumed to be low duty vehicles (LDV) or heavy duty diesel vehicles (HDDV) respectively.

The results show that the PCDD/F-concentrations at the tunnel sampling sites are always higher than the concentration at the reference sites, but there is no apparent correlation between traffic density and PCDD/F concentrations in the tunnel air. The highest concentration of PCDD/F in tunnel air has been measured in the Tauern tunnel which had the lowest traffic density. At the Tauern tunnel experiments no significant increase of PCDD/F-concentrations in tunnel air due to higher percentage of LDVs and HDDVs could be observed.

The results of the tunnel experiments show that there is still measurable PCDD/F-emission from road traffic, but this emission appears to be a very small contribution to the overall emission rate of 28,7 g I-TEQ/year estimated for Austria. These results are in good agreement with recently published measurements and reevaluations of emission factors for road traffic<sup>10</sup>.

Table 1 PCDD/F-immission concentrations

	Tunnel fg I-TEQ/Nm <sup>3</sup>	Reference-Site fg I-TEQ/Nm <sup>3</sup>
Golling tunnel 25.8. - 28.8. 1995 (weekend)	14.2	8.5
Plabutsch tunnel 24.5. - 27.5 1996 (weekend)	34.0	20.0 (Tunnel observation point) 13.3 (Eisteichgasse)
Tauern tunnel 29.9. - 2.10. 1997 (weekdays) 2.10. - 5.10. 1997 (weekend)	50.6 55.1	0.6 10.7

# HUMAN SOURCES AND ACTIVITIES - POSTERS

Table 2 Average traffic data during tunnel measurements

Sampling Site / Sampling Date	passenger cars		LDV+HDDV	
	vehicles	%	vehicles	%
Golling 25.8. - 28.8. 1995 (weekend)	93105	91.9	8192	8.1
Plabutsch 24.5. - 27.5 1996 (weekend)	56650	88.9	7057	11.1
Tauerntunnel 29.9. - 2.10. 1997 (weekdays)	23559	69.4	10377	30.6
2.10. - 5.10. 1997 (weekend)	36665	83.3	7373	16.7

## References

1. Haglund P., Egebäck K. E., Jansson B; Analysis of Polybrominated Dioxins and Furans in Vehicle Exhaust; *Chemosphere*, Vol 17, 2129-2140, 1988.
2. Hagenmaier H., Dawidowsky N., Weberuss U., Hutzinger O., Schwind K.H., Thoma H., Essers U., Bühler U. und Greiner R.; Emissions of Polyhalogenated Dibenzodioxins and Dibenzofurans from Combustion Engines; *Organohalogen Compounds*, Vol. 2, 329-334, 1990.
3. Hagenmaier H.; Contributions of Diesel-Powered Vehicles and Wood Burning to overall PCDD/PCDF Emissions; *Organohalogen Compounds*, Vol. 20, 267-270, 1994.
4. Jones K.; Diesel Truck Emissions, an Unrecognised Source of PCDD/PCDF Exposure in the United States; *Risk Analysis*, 13, 245-252, 1993.
5. Märklund S., Andersson R., Tysklind M., Rappe C., Egebäck K. E., Björkman und Grigoriades V.; Emissions of PCDDs and PCDFs in Gasoline and Diesel Fueled Cars; *Chemosphere*, Vol 20, 553-562, 1990.
6. Oehme M., Larssen S. und Brevik E.M.; Emission Factors of PCDD and PCDF for Road Vehicles obtained by Tunnel Experiment; *Chemosphere*, Vol. 23, Nr. 11-12, 1699-1708, 1991.
7. Wevers M., De Fré R., Rymen T.; Dioxins and Dibenzofurans in Tunnel Air; *Organohalogen Compounds*, Vol. 9, 321- 324, 1992.
8. Thanner G., Moche W.; Dioxine in der Luft von Ballungsräumen, Meßergebnisse aus Graz, Linz, Steyregg und Wien, Teil 1; Monographie Bd. 50, *Umweltbundesamt Wien*, 1996
9. König K., Radunsky K., Ritter M; Austrian Air Emission Inventory 1994; *Umweltbundesamt-Wien*, Reports R-140 1997.
10. Geueke K.-J., Gessner A., Quass U., Bröker G., Hiester E.; PCDD/F Emissions from Heavy Duty Vehicle Diesel Engines; *Chemosphere*, Vol. 38, 2791-2806, 1999.