PCBs IN UK URBAN AIR

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ABSTRACT

Polychlorinated biphenyls have been monitored in UK urban air at 4 urban sites since the beginning of 1991. The general trends are presented here for 2 of these sites - Manchester and Cardiff. Mean ΣPCB concentrations (Σ = congeners 28, 52, 77/110, 101, 118, 153, 138, 180) for 1991 were 520 and 590 pg/cu. m. PCBs 28 and 52 were the dominant congeners, comprising >80% of the ΣPCB content. Air concentrations in the summer were roughly double those in the winter. Volatilisation of PCBs from the soil is the likely major source contributing to this seasonal pattern. Separation of the high-volume air sample into the component associated with the filter ('particulate phase' PCB) and that with the polyurethane foam (PUF) plug ('vapour phase') showed the vapour phase to be dominant throughout the year (ca. 80% in winter; >95% in summer).

INTRODUCTION

The UK Department of the Environment has been funding the Toxic Organic Micro-Pollutants (TOMPS) programme since the beginning of 1991, to make ambient measurements of PCBs, PAHs and PCDD/Fs in UK urban centres, and to consider their possible sources. This paper presents a summary of some of the PCB data, from two of the sites being studied.

Weekly high volume air samples (ca. 500 cu. m. of air) have been collected every other week in Manchester and Cardiff city centres, along with monthly samples of bulk deposition. Under the TOMPS programme PCB congeners 28, 52, 77, 101, 118, 153, 138 and 180 are analysed at all the sites; the sum of these is therefore referred to as the ΣPCBs. In addition, we have also been acquiring data for a fuller range of congeners.

RESULTS

Table 1 summarises the mean atmospheric concentrations of these compounds and the ΣPCB. Several other PCB congeners were also routinely detected in air. The mean concentrations in Manchester in 1991 of the low molecular weight

Table 1: Mean atmospheric PCB concentrations at the 2 urban sites (pg/m^3)

Congener	Manchester	Cardiff
28	136	233
52	109	138
77/110	80	68
101	85	75
118	21	18
153	40	24
138	26	23
180	21	15
ΣPCB	518	594

congeners 18, 44 and 66 (not included in the TOMPS ΣPCB), for example, were 220, 115 and 106 pg/cu. m respectively. Many of the higher chlorinated species were routinely detected in the 1 - 10 pg/cu. m range.

These concentrations fall within the range typically found in other European and American cities, although it should be noted that the number and range of congeners quantified by other groups varies considerably.

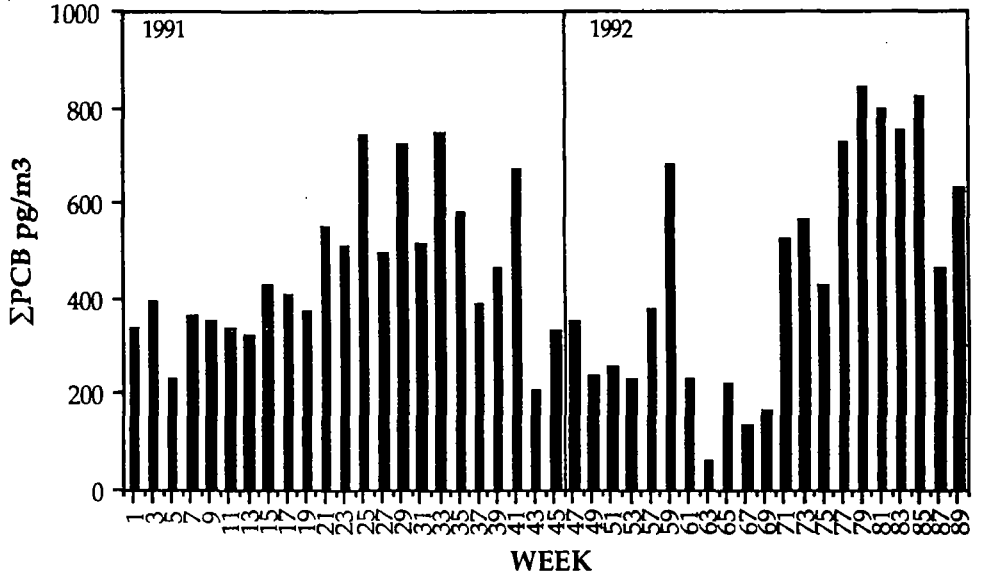
Congeners 28 and 52 dominated the air mixture, comprising more than 80% of the ΣPCB content. These lower chlorinated species obviously have a greater propensity to volatilise than the heavier PCBs. The mixture of PCB congeners is very different in other environmental matrices. Biological samples, for example, contain a much higher proportion of the more recalcitrant, higher chlorinated homologues.

Comments on seasonal trends

Figure 1 shows the broad seasonal trends at Manchester through 1991/92. There was an increase in air concentrations during the summer; the summer 'highs' are roughly double the winter 'lows'. This increase in ambient air concentrations in the warmer months of July, August and September corresponds well with the work of Hoff *et al.* (1992) and Manchester-Neesvig and Andren (1989), who also found summer 'highs' in the ambient atmospheres of rural sites in southern Ontario and northern Wisconsin respectively.

Obviously the summer 'high' and winter 'low' pattern is indicative of the source(s) to the atmosphere. Over 90% of the contemporary UK environmental burden is thought to reside in surface soils (several hundred tonnes) and a fraction of this will be susceptible to release to the air (Harrad *et al.*, 1993). At any one time, only a few tens of kilogrammes will be present in the air above the entire UK surface (see Alcock and Jones; Harrad *et al.* - other papers in the proceedings of this meeting). Inputs from soil volatilisation are therefore the likely major source contributing to this seasonal pattern.

Figure 1: Seasonal pattern of PCBs in Manchester air (pg/m^3)



Particulate and vapour phase data from Manchester and Cardiff

The vapour phase was clearly dominant throughout the year. Even in the winter the vapour phase made up about 80% of the total burden in air, and this increased to consistently over 95% in the summer. The heavier congeners were predominantly associated with the PUF plug, although less so than for the lighter congeners. For example, the percentage of congeners 18, 28, 52, 118, 138, 153 and 183 in the vapour phase during the first 6 months of 1991 at Manchester

were 96, 95, 97, 93, 79, 84 and 85%, respectively.

Air temperature data were available for Manchester. The correlation between temperature and air concentration through 1991 and much of 1992 was rather weak, with an r^2 value of 0.368. Air PCB concentration is, of course, likely to be influenced by other factors too - the frequency and intensity of precipitation, for example. Presumably bulked weekly samples will therefore only give a broad indication of the influence of temperature.

Despite the dominance of the vapour phase, PCBs were still readily detectable in the particulate phase too. The particulate phase ΣPCB loadings generally vary between ca. 10 and 200 pg/cu. m. at both sites, with the seasonal trends in particulate PCB very different from that for the vapour phase. Winter concentrations have markedly exceeded summer ones. It should be noted that the total atmospheric particulate loading, at least in Manchester, has remained quite constant through the year. This imples that the seasonal trend in particulate PCB concentrations is primarily a function of compound partitioning between the particulate and vapour phase, which is presumably largely controlled by ambient temperature, rather than inputs of particulate bound PCBs to the atmosphere.

Fluctuations in air concentrations over much shorter timescales (hours/days) will enable specific air masses to be studied and back trajectory information to be obtained. This is particularly interesting for the UK, given the variable nature of the air mass inputs i.e. ocean-derived westerlies, continental air from central Europe, and colder northern air inputs *etc.* These are currently being studied to enable a better understanding of the processes controlling UK air PCB concentrations to be attained.

References

Alcock, R. E. *et al.*, Environ. Sci. Technol. 1993 (in press).
Harrad, S. J. *et al.*, Environ. Pollut. 1993 (in press).
Hoff, R. M. *et al.*, Environ. Sci. Technol. 1992, 26: 266.
Manchester-Neesvig, J. B. *et al.*, Environ. Sci. Technol. 1989, 23: 1138.

Acknowledgements
We are grateful to the U.K. Department of the Environment and the Warren Spring Laboratory for financial support on the TOMPS programme.