Atmospheric bulk deposition of carcinogenic PAHs in a rural-industrial area in Southern Italy

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The measurement of the total deposition of seven PAHs of carcinogenic concern will be required in the Member States of the European Union, following provisions stated in the recent European Directive 2004/107/EC relating to PAHs and some metals in ambient air. Irrespective of concentration levels, one background sampling station will need to be installed every 100 000 km^2. At present, very few literature data are available regarding the deposition rates of PAHs in Europe. In this work we studied the deposition rates in a rural area in Southern Italy (50 km from the town of Potenza, Basilicata Region): some industrial plants were present in the area, including a waste incinerator which was likely the only plant potentially emitting PAHs. The atmospheric concentrations were also determined to compare the PAH patterns (in particular the BaP profiles, i.e., the concentration ratios between each PAH and BaP) in the depositions and in air. A review of the literature on deposition rates in Europe was made and our results were evaluated versus data collected at other sites. The PAHs were: benzo[a]pyrene (BaP), benz[a]anthracene (BaA), benzo[b+k+j]fluoranthenes (BFAs, determined cumulatively), indeno[1,2,3-cd]pyrene (IP) and dibenz[ah]anthracene (DBahA).

Depositions were collected using bulk samplers during December 2003 and January 2004 at seven stations covering a surface of about 70 km^2: three in the industrial area, one in a residential area possibly subject to any industrial fall-out, and three in background areas. Two monthly samples were collected at each station. After Accelerated Solvent Extraction, each sample was cleaned-up by thin-layer chromatography and analysed by GC/MS in Single Ion Monitoring mode. At two industrial and one background stations, 24-h air samples were collected on six events throughout the 2-month period. Air sampling was performed simultaneously at the three stations, using high-volume PM_{10} samplers. The six air samples of each station were combined for the extraction and treated as for deposition samples.

The deposition rates were in the order of a few ng/m^2d for BaA, BaP (2-7 ng/m^2d) and DBahA; they were in the order of some tenths of ng/m^2d for BFAs (up to 89 ng/m^2d) and IP. For each PAH, the rates at the seven sites were in a rather small range, with maximum:minimum ratios between 2.0 and 3.6: the lowest rates were measured at a background station and the highest at an industrial station but, in general, no clear relationship was observed between the type of station and the deposition rate. Overall, these results gave evidence of a rather uniform deposition, regardless of the location of the station. The BaP depositions were in the same order of magnitude of those previously measured at background sites (Venice lagoon, and EMEP sites in Sweden and Finland), and in a suburban forested zone in France with no significant PAH source nearby; they were roughly one order lower than at some rural German sites, and two orders lower than in two UK cities.

Atmospheric concentrations of BaP were in the range of 0.01-0.04 ng/m^3, quite consistently with previously reported background levels.

The BaP profiles in the depositions were significantly higher than the atmospheric BaP profiles constantly reported in literature, including those measured in this study; they were also higher than those previously reported in deposition studies. This finding suggests a possible BaP degradation during a 1-month deposition under the meteorological conditions typical of Southern Europe, which needs to be further investigated.