Air pollution in Helsinki using Lead-210 as a tracer

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Airborne ^{210}Pb is a decay product of ^{222}Rn emanating from the soil. Due to its long half-life (22.3 y) ^{210}Pb accumulates relatively slowly into the atmosphere and it can be used as an atmospheric tracer for long-range transported air masses. Anthropogenic lead emissions are characterized by low content of ^{210}Pb, decreasing thus the specific activity of ^{210}Pb in the atmosphere (the ratio of ^{210}Pb activity concentration to the total concentration of stable lead).

Finnish Meteorological Institute has been monitoring airborne radioactivity by collecting aerosol samples with air filters. A high-volume air sampler has been used and the concentrations of ^{210}Pb in air filters during the period 1980-2005 have been determined. Daily concentrations of ^{210}Pb have been compared with the elemental lead and other metals concentrations, determined by EDXRF technique in the Environmental Radioactivity Laboratory, "Demokritos". The study of weekly cycles of air pollution and the use of ^{210}Pb as a tracer, reveals several features of air pollution in central Helsinki. The correlation of air temperature and precipitation with heavy metals and ^{210}Pb concentrations is also examined.

In Helsinki metropolitan area, vehicular traffic is the most significant local particle source affecting urban air quality. Also, the effects of wood combustion can be considerable. Additionally, a large portion of fine particles originates from long-range transport in the Helsinki area. Southern Finland is strongly affected by deposition from central Europe and domestic emissions, whereas in central and northern Finland deposition levels are much lower and dominated by long-range transboundary air pollution.

The observed average concentration of lead, equals with 39,3 ngr m^{-3}, reveals a decrease of the order of one magnitude since '70s. Pb concentrations are partly associated with long-range transport to southern Scandinavia from the heavily industrialized areas in Central and Eastern Europe and partly with pollution from local emissions. Regarding the local traffic pollution, Zn, Cu and Pb, can be characterized as being road-specific heavy metals, mainly derived from combustion residues and losses from fuels and engine, transmission oils and abrasion from tires. The simultaneous decrease over the time of all these metals is an index of decreasing traffic pollution at Helsinki, while on average the TSP has decreased almost 1 μg m^{-3} per year for the study period. The TSP decrease has been steeper than the decrease of TSP/^{210}Pb ratio, indicating that the contribution of local sources to TSP has decreased more rapidly than the long-range transported component. Finally, the observed values of specific activity ^{210}Pb/Pb vary between 1.63-85.59 kBq g^{-1}, showing a decrease in values of local Pb about 200 ng m^{-3}.

[1] J. Paatero *et al.*, Report Series in Aerosol Science No. **83** (2006), p. 276-279.