XRF FOUNDATION LECTURE
ENVIRONMENTAL ISSUES

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XRS has been of major importance in environmental analysis, and especially in aerosol analysis, during the last three decades. A short review of the literature will be given.
Concerning heavy metals in atmospheric aerosols, there are serious concerns whether WD-XRF, applied nowadays by several national environmental agencies in Europe, will be capable of providing the detection limits necessary for assessing the decreasing "limit values" imposed by national authorities or foreseen by the EU Directive 96/62/EC towards 2010. Conventional ED-XRF can normally not measure e.g. Cd and Hg via their less spectrally interfered K-lines. The potential of a new high-energy polarized-beam ED-XRF was therefore studied. The detection limits were around 1 ng/cm^2 for most heavy metals, i.e. sufficiently low to meet the European limits for e.g. Pb, Cd, As and Ni, with a 100-200 counting time, for common sampling conditions. Other analytes usually present in very low concentrations (e.g. V, Cr, Sb) could be assessed as well. The natural background levels of many heavy metals could be measured.
An issue that has become dramatically important recently is the effect of fine indoor aerosols (PM2.5; particulate matter with a diameter of less than 2.5 µm) on human health. This fine dust can penetrate deeply in the respiratory system, cause local inflammations, and lead to asthma attacks, bronchitis, lung cancer and heart diseases. From e.g. large scale studies on 500,000 patients in 51 US cities, it appeared that of all pollutants, PM2.5 is indeed the most menacing. We have recently measured indoor and outdoor particulate air pollutants, along with some gases, in the city of Antwerp and the Southern suburbs, in different seasons. The first study was organised in some 20 homes. The second study analysed the air quality in some 30 schools, to assess the daily exposure of 7-8 year old pupils. The chemical composition (using ED-XRF, and EPXMA) and soot content of PM2.5 were determined. In the residences, tobacco smoke appeared to be the most important in terms of PM mass, and the smallest fraction (PM1) appeared to be the most enriched. The indoor/outdoor (I/O) ratios of chemical elements indicated a unique micro-environment for each home. The results of the study in the schools showed a correlation between the indoor and outdoor atmospheric concentrations of soot, nitrogen oxides, sulphur dioxide and ozone, but not for PM2.5. Although for none of the elemental components of PM2.5, an indoor source was expected a priori, the I/O ratios were often much higher than 1. And the indoor concentrations of PM2.5 appeared to be much, up to a factor of 11, above the Flemish legal norm. It appeared from XRF and EPXMA that in class rooms with carpets, resuspension of soil dust by the children's movements was a major factor. Chalk dust appeared to contribute to the indoor PM2.5 too. In general, it appeared that both in the city centre and in the surrounding areas, the use of outdoor pollutant concentrations as indicators of indoor air quality and hence as a measure of the personal pollutant exposure in the class rooms, would lead to an underestimation of e.g. PM2.5 and the elements and particle types contained in it.