Total reflection X-ray fluorescence analysis of indoor aerosol samples – Influence of sampling time and comparison of different direct sampling methods

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An overview will be given about the latest results of the Atominstitut X-ray group’s work on the analysis of indoor aerosol samples with total-reflection X-ray fluorescence analysis (TXRF). Samples were taken in different laboratory and office rooms inside the Atominstitut building using three different cascade impactors.

TXRF analysis was performed using a laboratory-built low power spectrometer featuring an air-cooled 50W low power X-ray tube with Mo-anode (Oxford Instruments, Abingdon, Oxfordshire, UK), a Mo/Si multilayer monochromator (AXO Dresden, Germany) and a silicon drift detector (SDD) with an active area of 80 mm\(^2\) (KETEK, Munich, Germany). The spectrometer is suitable for TXRF sampling substrates with a diameter of 30 mm. Reflectors with smaller diameters can be introduced into the spectrometer using an appropriate adapter piece, so that the sample is centered, when pressed into position, which makes this TXRF spectrometer very versatile.

A comparison of three different impactor types was carried out. Samples were taken inside a climatized and air-filtered laboratory room, offering clean and nearly constant environmental conditions. The Dekati™ PM 10 impactor (Dekati, Tampere, Finland), is equipped with three stages (> 10 µm; 2.5 to 10 µm, coarse fraction; 1 to 2.5 µm, fine fraction) and operated at a constant air flow of 10 L/min. As sampling substrates 30 mm diameter quartz reflectors coated with petroleum jelly (Vaseline) were used. The Sioutas Personal Cascade Impactor (SKC, Eighty-Four, PA, U.S.A.) has smaller dimensions, but offers four stages, reaching into the sub-µm range (Stages: A, > 2.5 µm; B, 1 to 2.5 µm; C, 0.5 to 1 µm; D, 0.25 to 0.5 µm). This impactor is operated at 9 L/min and can be carried directly on the body, if a small pump is used. The seven-stage PIXE impactor (PIXE, Tallahassee, FL, U.S.A.) covers a size range between 0.5 µm and particles larger than 16 µm, and operated at a sampling flow of 1 L/min. For the latter two impactors siliconized Si wafers of 25 mm and 23 mm diameter, respectively, were used as sampling substrates.

The influence of sampling time was analyzed using the Dekati™ PM 10 impactor, operated at the same sampling site as above. It could be shown that major contaminants (in the ng/m\(^3\) range), such as Ca, Fe and Zn, were detected after a sampling time as short as one hour. Optimum sampling conditions were reached after six hours for this clean test environment.

In addition, further comparative sampling results obtained at different sites will be presented.