

Pollutant Type:
Pollutants

Particulate

Pollutant/Metric Name: **Non-C-Elemental Composition**

Measurement Technology: **X-ray fluorescence spectrometry**

X-ray fluorescence spectrometry is one of the standard methods to analyse PM samples for their elemental composition. The method is based on excitation of inner shell electrons by high-energy x-ray radiation. When the inner shell is filled up again by outer shell electrons an element-specific x-ray spectrum is emitted. The fluorescence spectra are detected by energy-dispersive detectors. Using fitting algorithms and single element reference spectra stored in a database the measured spectrum is de-convoluted for quantification of the specific element. Quantification is made by comparison with calibration filters with known element concentrations.

Favourably the method is applied to thin films of bulk material in order to reduce matrix effects (e. g. in-bulk absorption of emitted fluorescence radiation, in-bulk secondary excitation). Therefore, membrane type filter materials should be used to ensure particle deposition solely on the filter surface. Moreover, low elemental blank values in the filter material are a crucial condition.

Recently, the manual filter method has been developed into an automated instrument. Since this instrument, is the only x-ray based automated monitor for elemental composition known so far, all technical data reported in this document is taken from information on this device.

In this instrument PM samples are collected onto a filter tape for a predefined sampling time (15 min to 4 h). After completion of sampling the filter tape is moved forward and the sample is analyzed. Simultaneously the next sample is collected. Thus, in this default operation mode sampling time and analysis time are identical. Prolonged sampling times therefore increase the signal-to-noise ratio, since more mass is collected and counting statistic is improved. Calibration of the analyzer is done manually by special calibration plates which can be manually inserted into the analyzer.

Several field test runs carried out in the US [Petterson and Cooper 2009, Yadav et al 2010, MDNR 2010] demonstrated good to acceptable agreement of results when compared to off-line methods (either off-line XRF from low volume filters or Lab ICP-MS from High-Volume filters). While precision was found to be better than for the of-line XRF method, a positive bias was observed for a number of elements (10-20 %) [Petterson and Cooper 2009].

References

- Petterson, K A and Cooper J A (2009): Field Bias and Precision Demonstration of a Near-Real-Time Multi-Metals Ambient Fence Line Monitor. Report submitted to MACTEC Federal Programs; Research Triangle Park, NC.
- Yadav, V, Turner, J, Petterson, K, Cooper, J (2010): Cooper Environmental Services Field Performance Evaluation of the Cooper Environmental Services Ambient Metals Monitor (Xact 620) for Near-Real Time PM10 Metals Monitoring. Presentation at AAAR 2010, Portland , Oregon.
- MDNR 2010 (Missouri Department of Natural Resources, Air Pollution Control Program and Environmental Services Program): Advanced sampling and data analysis for Source Attribution of Ambient particulate Arsenic and Other Toxic Air Metals in St. Louis. Final Technical Report, 2010; US EPA Grant XA987912-01.

Description of Automated Technologies for Air Pollutants and Air Quality Metrics

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