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Comparison of multiple X-ray fluorescence techniques for elemental analysis of particulate matter collected on air filters.

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Abstract

This work reports on qualitative and semi-quantitative elemental analysis of particulate matter (PM) collected on PTFE membrane filters, for a source apportionment study conducted in Brescia (Italy). Sampling was undertaken in a residential area where an increase in Mn emissions has been highlighted by previous studies. Filters are measured by means of X-ray Fluorescence (XRF) based techniques such as micro-XRF and grazing incidence XRF using synchrotron radiation, Mo or W excitation sources, after applying an automatized sample preparation method. A heterogeneous distribution in PM shape, size and composition was observed, with features typical of anthropogenic sources. XRF measurements performed at various incidence angle, on large areas and different experimental setup were reproducible. The results demonstrate a successful comparison of the various XRF instrumentation, and the decrease in Mn content with the distance away from the identified emission source. This work highlights the potentialities of the presented approach to provide a full quantitative analysis, and ascertain its suitability for providing a direct, fast, simple and sensitive elemental analysis of filters in source apportionment studies and screening purposes.

Keywords

Particulate matter, membrane filters, X-ray Fluorescence techniques, manganese, air pollution, direct analysis

Introduction

Air pollution monitoring and control is one of the major concerns in European and fast developing countries (Fenger, 2009) due to related severe health effects that may affect the population, especially the weaker part. On this purpose, reference methods were established by European Directives ("Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air," n.d., "Directive 2008/50/EC of the European Parliament and the Council of 21 May 2008 on ambient air quality and cleaner air for Europe," n.d.) and several international standards (EN 12341, 1998;

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