

AperTO - Archivio Istituzionale Open Access dell'Università di Torino

Development of a suitable sequential extraction procedure for the assessment of the availability and reactivity of metal species in Arctic PM10 samples

This is the author's manuscript

Original Citation:

Availability:

This version is available <http://hdl.handle.net/2318/1659571> since 2018-02-05T18:05:13Z

Publisher:

Università di Salerno

Terms of use:

Open Access

Anyone can freely access the full text of works made available as "Open Access". Works made available under a Creative Commons license can be used according to the terms and conditions of said license. Use of all other works requires consent of the right holder (author or publisher) if not exempted from copyright protection by the applicable law.

(Article begins on next page)

Development Of A Suitable Sequential Extraction Procedure For The Assessment Of The Availability And Reactivity Of Metal Species In Arctic PM₁₀ Samples

Eleonora Conca^a, Mery Malandrino^a, Agnese Giacomino^b, Andrea Ruo Redda^b, Sandro Buoso^a, Marco Grotti^c, Ornella Abollino^a, Roberto Udisti^d

^a Department of Chemistry, University of Turin, via Giuria 5, 10125, Turin, Italy;

^b Department of Science and Pharmaceutical Technology, University of Turin, via Giuria 5, 10125, Turin, Italy;

^c Department of Chemistry and Industrial Chemistry, University of Genoa, via Dodecaneso 31, 16146, Genoa, Italy;

^d Department of Chemistry, University of Florence, via della Lastruccia 3-13, 50019, Sesto Fiorentino, Florence, Italy;
econca@unito.it

Most of the studies on the atmospheric particulate matter (PM) trace metal content consist of the determination of the total concentrations, without distinguishing between the various chemical forms of each element. This procedure does not give any information on the different sources of PM and often provides an overestimate of potential metal toxicity, as only the soluble fraction is likely to interact with the environment and living beings. Unfortunately, the chemical complexity of PM, the extremely small particle sizes and the small quantity of sample typically collected can pose significant problems for metal speciation. In many cases the exact distribution of an element among well-defined chemical species is impossible to determine, due to the large numbers of individual species and to the lack of a universal analytical technique able to both identify and quantify all of them. Alternatively, fractionation procedures are often applied, and the classification of analytes is made according to physical (e.g., size, solubility) or chemical (e.g., bonding, reactivity) properties. This kind of classification is a valid instrument for both the identification of emission sources¹ and the evaluation of health and environmental impact².

Many researchers have worked on the design of extraction schemes for the sequential solubilization of metals from sediments, leading to the development of the commonly accepted three-steps BCR protocol. The adaptation of this extracting scheme to PM samples led to the development of two-steps procedures, considered a good compromise among costs, analytical times and achievable information. However, different extracting solutions, different extraction methods (ultrasounds, microwave, stirring, prolonged contact) and different techniques for the separation of the extract from the solid residue (filtration, centrifugation) are used, thus reducing the possibility to compare the results³.

In this study the most common extracting solutions for PM fractionation have been compared: i) deionized water, due to its high representativeness of the natural solubility processes taking place in the environment; ii) diluted acetic acid, also reported in the BCR fractionation protocol, allowing a good control of the external factors that could influence the extraction and iii) a buffer solution, (ammonium acetate buffer, pH 4.5), able to maintain a good pH control throughout the extraction; the selected pH is very similar to the PM spontaneous one, in order to mime the interactions naturally occurring in the environment⁴. A two-step sequential extraction scheme was optimized by using three Certificate Reference Materials (BCR176 “City waste incineration ash”, NIST1648a “Urban particulate matter” and BCR701 “Lake sediment”) and comparing the results obtained applying different extraction methods and different extracting solutions. The optimized procedure was then applied to some Arctic PM₁₀ samples.

References

1. Canepari S., Pietrodangelo A., Perrino C., Astolfi M.L. and Marzo M.L., *Atmos Environ*, 2009, 43 (31), 4754-4765.
2. Pelfrène A., Cave M.R., Wragg J. and Douay F., *Int J Env Res Pub He*, 2017, 14 (112), 1-15.
3. Dabek-Zlotorzynska E., Kelly M., Chena H. and Chakrabarti C.L., *Anal Chim Acta*, 2003, 498 (1-2), 175-187.
4. Canepari S., Astolfi M.L., Moretti S. and Curini R., *Talanta*, 2010, 82 (2), 834-44.