

EGU2020-17865

<https://doi.org/10.5194/egusphere-egu2020-17865>

EGU General Assembly 2020

© Author(s) 2022. This work is distributed under the Creative Commons Attribution 4.0 License.



Fly ashes bulk chemistry: a new approach for XRF measurements

Renzo Tassinari¹, Riccardo Guida¹, Caterina Caviglia², Enrico Destefanis², Costanza Bonadiman¹, Valentina Brombin¹, Davide Bernasconi², and Alessandro Pavese²

¹University of Ferrara, Department of Physics and Earth Sciences, Ferrara, Italy

²Department of Earth Sciences, University of Torino, Torino, Italy

In this contribution we present the first results for proposing an analytical protocol to analyze fly ashes (FA) with XRF.

Fly ashes resulting from the incineration of municipal solid waste (MSW) should be considered as a hazardous material, mainly due to its potential high heavy metal content. Therefore, they have to be chemically fully characterized to facilitate primarily their safety storage and subsequently the recovery as second raw material resource. It's worth noticing that fly ashes bulk chemistry (including volatile contents) depends on many types of variables [i.e.: geography; air pollution control devices (APCDs) and sampling sites], all related to the nature of the waste. On the basis of available data from different European waste-incineration plants, the bulk major elements contents are: Al <0.1-4.6 wt%; Ca 23.7-38.9 wt%; Fe 0.20-2.17wt%; K 0.1-2.4 wt%; Mg 0.5-1.7 wt%; Mn 0.02-0.12 wt%; Na <0.15-2.5 wt%; P <0.02-0.92wt%; Si 0.2-8.7 wt% Cl, 7.5-28.3wt%, with volatile contents (tested by Loss of Ignition) in the range of 15-40 wt% (De Boom e Degrez, 2012; Bodénan and Deniard, 2003).

If we consider fly ashes as “rock type” material, x-ray fluorescence (XRF) is used effectively for determining the major rock-forming elements. However, the lack of standard calibration for this material suggested us to adopt a different strategy of calibration, using the method of Standard Addition (SA) to determine SiO₂ and Al₂O₃ having similar mass absorption coefficients (<https://physics.nist.gov/PhysRefData/XrayMassCoef/tab3.html>).

The SA method was originally designed to determine trace elements contents by addition of comparative amounts of analytes. In order to keep the characteristics of bulk chemistry invariant, in this modified calibration procedure we prepared eleven pressed powders by adding several known aliquots of SiO₂ and Al₂O₃ (“excipients”) to the same amount of unknown FA in the constant proportion of 10% and 90%, respectively.

Plotting together the intensity values of the two analytes with the various percentages by weight of “excipients”, it was possible to generate calibration lines and acquired the percentage by weight of the two analytes in the unknown material. The Si and Al contents obtained by the calibration lines are 1.93 wt% and 1.64 wt%, respectively.

These values are different from those (2.86 wt% and 1.40 wt% for Si and Al, respectively), obtained

by measurements of pure FA with routine XRF standard calibrations for silicatic rocks (Franzini et al. 1975). More measurements are needed to evaluate the accuracy of the method, however, the results presented here are promising, and hint that XRF may be used efficiently to measure FA major element chemistry, by applying the modified standard addition calibration.

References:

Bodénan, F. and Deniard P. (2003). *Chemosphere*, 51; 335-347

De Boom A. and Degrez M. (2012). *Waste Management*, 32; 1163-1170

Franzini M., Leoni L. and Saitta M. (1975). *Rend. S.I.M.P.*, 31: 365-378.