Società Chimica Italiana
Divisione di Chimica
Ambiente e Beni Culturali

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CONTRIBUTI SCIENTIFICI

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Il contributo, presentato in lingua inglese, dovrà essere al massimo di 2 pagine, figure e bibliografia comprese, formattato secondo il facsimile riportato nella pagina successiva.

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Valutazione di fenomeni di contaminazione ambientale. Monitoraggio e bonifica di siti contaminati	☐
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A multi-analytical approach for the chemical characterization of incinerator bottom ash aimed at assessing hazardous properties (HP14)

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1. Introduction

A large quantity of bottom ash, the main residue of municipal solid waste incineration (MSWI), is produced all over the world. Consequently, the impact on landfilling or recycling of this residue is large. The incinerator bottom ashes (IBA) are currently defined as "non-hazardous" but this classification could change following the application of the incoming European regulation which indicates how to define the waste features HP14 (ecotoxicity). The new Regulation (EU) 2017/997 for the assignment of the HP14 "ecotoxic" characteristic and which will come into force in all the Member States from next 5 July 2018, introduces new criteria for the assessment of ecotoxicity with respect to current national standards in force, the law n. 125/2015. According to the wastes hazardous properties (HP), HP14 includes waste that presents or may present immediate risks for one or more environmental compartments.
The bottom ashes characterization, generated by the main Italian plants in the last few years, revealed a substantial classification as "non-hazardous", with specific reference to the evaluation criteria in force. However, in light of the more recent developments of the EU Regulation, with particular reference to the hazard characteristic HP14, it will be useful to be able to evaluate the specific chemical forms.
In the present project bottom ashes coming from a waste energy plant, considered as representative of the average composition obtainable from incineration of municipal solid urban waste, is chemically characterized in order to establish an analytical protocol allowing to improve the classification methodology.
In Italy about 18% of the collected MSW is incinerated [1]. In 2013, considering about 6,000,000 tons of wastes sent for incineration, 939,700 tons of bottom ashes were produced in Italy and characterized as non-hazardous waste, while 54,900 tons of bottom ashes as hazardous waste [1].
Currently about 70.7 % of the bottom ash is treated in bottom ash treatment plants resulting in different fractions. At present IBA are re-used for road construction, embankment, pavement, aggregate and filler for concrete [2].
In this study the speciation of Cu and Zn that are, in some of their compounds, classified as ecotoxic, will be investigated using a combination of XRPD (X-ray powder diffraction), SEM-EDX (electron microprobe coupled with energy dispersive spectroscopy) and FT-IR spectroscopy, both on the IBA and on the residues from their sequential dissolution; metal contents are determined by XRF and ICP-OES. This multi-analytical approach turned out to be useful also in the case of fly ash speciation [3].

2. Results and Discussion

In order to identify the chemical species present, a series of IBA samples has been analyzed. Besides the ash sample, also the leachates and the residues of IBA coming from sequential dissolutions (water, till neutrality, NaOH or NH_3, and mineral acids) are investigated. In particular, the solid residue after each leaching treatment, less complex than the original, should allow to better clarify IBA composition through analytical surface techniques.

Semi-quantitative mineralogical and speciation analyses have been performed on real IBA, standard samples appropriately reconstructed on the base of IBA composition and samples spiked with known amounts of copper and zinc species (i.e. Cu and Zn oxides, sulphates and chlorides).
The semi-quantitative approach by XRD analysis could turn out very challenging since the concentration limits required by the new European regulation are near the instrumental limit of detection.
By means of SEM-EDS analysis the average composition of each sample (real and reconstructed) has been determined by acquiring spectra on a large number of windows (more than 10); furthermore the analysis of the single particles allowed to study the correlation among elements and to formulate some hypothesis on their chemical speciation. At this purpose a statistical approach already applied for the study of fly ash is applied [4].

3. Conclusions

In the present study the development of an analytical protocol for the chemical characterization of IBA, regarding Zn and Cu species, has been considered. The set-up of a protocol is challenging because these species concentrations, with regard to the surfaces analyses, are near the limit of detection; nevertheless the investigation carried out in association with the sequential dissolution procedure, could give first, but not conclusive, results. A characterization of bottom ash by chemical investigations is surely mandatory but it should be integrated with specific tests regarding risk assessment of this kind of waste.

References

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