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APPLICATION OF ADVANCED NUCLEAR AND INSTRUMENTAL ANALYTICAL TECHNIQUES FOR CHARACTERISATION OF ENVIRONMENTAL MATERIALS

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Increasing realisation about the toxic effects of metal ions in environmental materials has given an impetus to research on analytical techniques for their characterization. The large number of analytes present at very low levels has necessitated the use of sensitive, selective and element specific techniques for their characterization. The concern about precision and accuracy on such analysis, which have socio-economic bearing, has emphasized the use of Certified Reference Materials and the use of multi-technique approach for the unambiguous characterization of analytes. The recent work carried out at Analytical Chemistry Division, BARC on these aspects is presented in this paper.

Increasing use of fossil fuels has led to the generation of large quantities of fly ash which pose problems of safe disposal. The utilization of these materials for land filling is an attractive option but the presence of trace amounts of toxic metals like mercury, arsenic, lead etc may cause environmental problems. In view of the inhomogeneous nature of the material, efficient sample processing is an important factor, in addition to the validation of the results by the use of proper standards. Analysis was carried out on flyash samples received as reference materials and also as samples from commercial sources using a combination of both nuclear techniques like INAA and RNAA as well as other techniques like AAS, ICPAES, cold vapour AAS for mercury and hydride generation technique for arsenic. Similar analysis using nuclear techniques was employed for the characterization of air particulates.

Biological materials often serve as sensitive indicator materials for pollution measurements. They are also employed for studies on the uptake of toxic metals like U, Th, Cd, Pb, Hg etc. The presence of large amounts of organic materials in them necessitate an appropriate sample dissolution procedure. In view of the possibility of loss of certain analytes like Cd, Hg, As, by high temperature dry ashing, the use of a wet ashing procedure is also important for proper sample dissolution. Both Bethge digestion and microwave assisted dissolution are attractive options but have their inherent limitations. The role of nuclear and allied spectroanalytical techniques was assessed for the analysis of biological samples for various critical impurities of environmental significance. Analysis of standard reference materials like apple leaves, peach leaves was also employed for the analysis. The selection of sample dissolution procedure and analysis procedure was evaluated from the values obtained for the certified reference materials. The results demonstrated the application of both nuclear and spectrochemical techniques as appropriate analytical tools along with the use of primary or secondary standard reference materials for the validation of analytical procedures.