Neutron activation analysis of samples difficult to assay by other methods

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There are several specimen types that are difficult to assay by conventional analytical techniques requiring the complete sample decomposition. Three such cases are presented as examples: (i) biochar, (ii) single-wall carbon nanotubes (SWCNT), and (iii) uranium materials for nuclear forensics. Biochar is obtained by pyrolysis of sewage sludge (SS) and can be used as a soil amendment and fertilizer. However, biochar can contain, in addition to numerous nutrients, also potentially toxic elements and compounds and therefore its composition needs to be investigated to assure its safe use in agriculture. We compared biochar analysis results by ICP-OES after various digestion procedures and by instrumental neutron activation analysis (INAA) and found significant differences in contents of several elements, as well as differences in certified values of one SS certified reference materials (CRM). The use of INAA for elemental characterization of Canadian CRM SWCNT-1 led to an extension of certified values of mass fractions for 13 additional elements on top of 5 elements determined by ICP-MS, and INAA of commercial SWCNT samples revealed low recoveries of several elements when ICP-OES following alkaline oxidation as a digestion method was used. Finally, a new NAA procedure with pre-irradiation separation was tested for determination of elemental impurities in uranium materials for nuclear safeguards and nuclear forensics purposes. The advantageous role of NAA in the elemental characterization of materials that are difficult to bring into a solution without contamination and/or analyte losses during preparation of the test portion for subsequent analysis by different analytical techniques has again been demonstrated.