

Major and trace elements in humic acid

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During the last decades large interest is turned to the use of humic acid. The aim of our recent research is the determination of the major and trace elements in humic acid measured by various physical methods.

The present measurements were carried out at the Prompt Gamma Activation Analysis (PGAA), and at the Neutron Activation Analysis (NAA) experimental stations of the Budapest Neutron Centre (BNC) [1]. Both nuclear analytical techniques provide quantitative elemental composition from the entire irradiated volume, based on the partial conversion of stable nuclei in the sample to radioactive nuclei by known nuclear reactions, and followed by the quantitation of the reaction products via their gamma radiations [2]. The major technical difference between PGAA and NAA originates from the gamma detection practice. PGAA is based on the on line detection of the prompt gamma rays, whereas NAA utilizes the delayed gamma rays observed after the irradiation, in a separate step. At the BNC both NAA and PGAA are using the k_0 -standardization method, which does not require a standard for analysis [3]. PGAA is

capable to quantify major components and a few significant trace elements, while NAA is especially suitable for trace element determination in $\mu\text{g/g}$ concentration range or below. In this humic acid sample we were able to identify and quantify low-Z elements (H, B, Mg, Al, Si, S, Cl, K, Ca), metals (Ti, V, Mn, Fe) and rare earth elements (Sm, Gd) by PGAA; while with NAA, we quantified 24 elements (Ca, K, Fe as major components; Ba, Sr, Nd, Na as minor components; some rare-earth elements: La, Ce, Sm, Eu; actinides: Th and U; transition metals: Co, Cr, Hf, Sc, Ta, Zn; alkali metals: Cs, Rb; nonmetals: As, Sb; and Br as halogene).

References

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