

Distribution and migration of trace elements in industrial soils studied by neutron activation analysis and X-ray fluorescence analysis

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Heavy metals and toxic elements originated from natural and anthropogenic sources are widespread in all the environmental compartments, including soil, and can be transferred in food chains and human body through bioaccumulation and bioconcentration, affecting people's health. Moreover, their migration in soil depth in the regions affected by metallurgical industry could have important impact on underground water and aquatic resources. Thus, the management of soil quality in industrial areas is very important for ecosystems and human health and, for this aim, sensitive techniques should be employed for precise assessment of chemical elements in soil.

In this paper two analytical techniques: instrumental neutron activation analysis (INAA) and X-ray fluorescence analysis (XRF) were used in combination for the determination of total concentrations of 43 major, minor and trace elements (Na, Mg, Al, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Co, Cu, Zn, As, Br, Rb, Sr, Y, Zr, Nb, Mo, Sb, I, Cs, Ba, La, Ce, Nd, Sm, Eu, Tb, Dy, Tm, Yb, Hf, Ta, W, Au, Hg, Pb, Th and U) in soils located around a large integrated steelworks in Romania.

INAA was applied at IBR-2 nuclear reactor of Frank Laboratory of Neutron Physics (FLNP), Joint Institute of Nuclear Research (JINR) at Dubna, Russian Federation and XRF (Genius spectrometer, Skyray Instruments Inc.) at INPOLDE interdisciplinary international research center of "Dunarea de Jos" University of Galati (UDJG), Romania. Experience in applying non-destructive nuclear analytical technique INAA in industry, geology, materials science and environmental studies was presented in previous joint scientific contributions and Romania-JINR project reports.

The obtained results for various depths were used to assess the migration degree of selected elements in the soil matrix along the depth (0-30 cm) and distribution patterns.

On-going work is carried out to enlarge the elemental range in industrial soils using complementary nuclear and atomic techniques, such as atomic absorption spectroscopy, inductively-coupled plasma mass spectrometry and ion beam techniques.