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INAA and XRF Applications in the Assessment of Chemical Element Contents in the Topsoil of Moscow's Park

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Within recent years Moscow traffic increased greatly that made the ecological situation of the Russian capital much worse. According to prognosis in the nearest years this tendency to be continued, so the environmental monitoring is getting especially urgent. The topsoil is a strong absorber of many chemical elements keeping them in the surface, the most fertile layer. Thus, changes in the chemical contents of surface soil layer reflect adequately environmental cumulative alterations conditioned by the effect of both local and global factors.

The aim of the present study was to determine contents of some chemical elements in topsoil of the Wooded Experimental Dacha belonged to the Moscow Agricultural Academy (MAA) using instrumental neutron activation (INAA) and X-ray fluorescent analysis (WDXRF). In the early 20^{th} century the Dacha was a Moscow faraway suburb, but now, a hundred year later, it is a city park in fact densely surrounded by residential areas, industrial enterprises, highways and railroads.

A topsoil column of 6-8 cm width and 5-6 cm deep was cut along the whole thick of A-horizon. The air-dried soil samples were clear of roots, inclusions, new formations and turf. Then each sample was thoroughly mixed, homogenized, randomized, sieved and milled. A simultaneous analysis of the three samples prepared of the IAEA certified reference material, Soil-7, was used to estimate the method reproducibility and the accuracy of the obtained results.

It was shown that INAA allowed determining mass fraction of 26 chemical elements

such as As, Ba, Br, Ca, Ce, Co, Cr, Cs, Eu, Fe, Gd, Hf, La, Lu, Nd, Rb, Sb, Sc, Sm, Sr, Ta, Tb, Th, U, Yb, and Zn in the soil samples even at the natural (uncontaminated) levels. The method allowed estimate levels of Ag, Au, Cd, Hg, and Se in soils too if contents of these elements were higher detection limits, 1.0, 0.02, 2.0, 0.1, and 0.5 μg/g, respectively. The contents of 21 chemical elements such as As, Ba, Br, Co, Cr, Cu, Fe, Mn, Mo, Nb, Ni, Pb, Rb, Sr, Th, Ti, U, V, Y, Zn and Zr were measured by WDXRF. So, the contents up to 41 elements: Ag, As, Au, Ba, Br, Ca, Cd, Ce, Co, Cr, Cu, Cs, Eu, Fe, Gd, Hf, Hg, La, Lu, Mn, Mo, Nb, Nd, Ni, Pb, Rb, Sb, Sc, Se, Sm, Sr, Ta, Tb, Th, Ti, U, V, Y, Yb, Zn and Zr were measured by combination of INAA and WDXRF.

Contents of 40 chemical elements out of 41 in the topsoil of the MAA Wooded Experimental Dacha were in good correspondence with ranges of chemical element levels in the uncontaminated turf-podzol and loam soils of Europe and European part of Russia and countries of the former USSR. The mass fraction of U was an unexpected exclusion to be about 2-fold higher than the typical mean level. The total contents of all investigated chemical elements in the MAA Wooded Experimental Dacha topsoil were in the range characteristic for “norm” or “clean” soil and do not exceed environmental quality standards for soils of Russia. For example, mean level of Pb equal 17.9 mg/kg (range 12.5-24.8 mg/kg) was under Russian environmental standard limit (32 mg/kg) and more less than Pb level in park soil of many cities of West Europe and North America.