

ESTIMATION OF HEAVY METAL SOIL POLLUTION IN THE IMPACT AREA OF A CEMENT ENTERPRISE USING THE METHOD OF X-RAY FLUORESCENCE SPECTROSCOPY

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The possibility of applying of the fundamental parameter method, which is one of the methods of X-ray fluorescence analysis, as an express method for determining the content of heavy metals in the soil at a cement industry enterprise, is assessed.

Keywords: heavy metals, soil pollution, X-ray fluorescence spectroscopy, fundamental parameter method.

Among a large number of soil pollutants heavy metals (Pb, Cd, Hg, As, Cu, Zn, Ni, Co, Sn, Se, Te, Bi, Sb, Mn, etc.) deserve special attention, because when getting into the soil they are able to accumulate and migrate to adjacent environments, having a complex effect on ecosystems and humans.

Among various anthropogenic sources of heavy metals the cement industry, which productivity increases every year, is of particular interest. Studies on this industry impact on the environment have shown the presence of heavy metals such as Hg, Cd, As, Cr, Zn, Ni, Cu, Pb in the emissions. These metals are part of natural raw materials, fuels and corrective additives, primarily pyrite cinders containing significant amounts of mercury, lead, copper, nickel and zinc [1]. Soil assessment has been carried out on the cement plant sites and adjacent territories and its results indicate the formation of positive geochemical anomalies consisting of Zn, Pb, Cd, Cu, As [2, 3].

Various analytical methods are currently used to estimate the content of heavy metals in soil, among which the most popular method is atomic spectroscopy, characterized by relative simplicity, accuracy and relatively short analysis time.

In order to assess the possibility of using one of the methods of atomic spectroscopy, namely X-ray fluorescence analysis (XRF) as an express method for determining total heavy metals in soil the analysis of soil samples taken in the cement enterprise influence area using one of the XRF sub-methods namely fundamental parameter method (MFP) is made. This method based on the use of tabulated parameters refers to standardless methods and does not require special sample preparation (it is possible to use tableted and powder soil samples) [4].

The analysis, statistical processing and verification of the result acceptability shows that this method is not fully suitable for determining the content of elements such as V, Cr, Co due to high measurement errors; it is difficult to draw an adequate conclusion on the suitability of the method for determining Se, Nb, In, W, Ag, Au, Cd, Tl, Hg, Ba, Bi, Mo, Ni in view of the lack of reliable results with exceeding the detection limit of these elements in soils in concentrations less than 10 mg/kg; Sb and Sn are observed in unreasonably high concentrations in all samples, presumably related to an irremovable background component. The method may be suitable for determining high (more than 10 mg/kg) concentrations of Cu, Zn, As, Rb, Y, Pb. To determine Ti, Mn, Fe, Zr, more than 2 consecutive measurements are needed to achieve the convergence of the results.

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