

**EVALUATION OF EFFICIENCY OF ULTRASONIC EXTRACTION
OF HEAVY METALS FROM TECHNOGENICALLY POLLUTED SOILS
OF THE DNEPROVSK REGION**

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Environmental degradation in Ukraine as a whole and in large industrial centers, such as the Dnipropetrovsk region, in particular, requires strict control of the content of heavy metals (HM) in soils, since this environmental object has the maximum technogenic load. Heavy metals in various forms are able to be absorbed by plants and migrate to adjacent environments, therefore, the determination of their content is a priority when conducting monitoring studies. Assessment of the degree of soil pollution can be carried out on the basis of the results of determining the gross content of heavy metals and the number of their mobile forms.

The use of ultrasound to obtain soil solutions in assessing the gross content of HM and their mobile forms can significantly reduce the time of sample preparation. By varying the frequency, intensity and time of ultrasonic processing of samples, the optimal parameters of the experiment can be selected.

We used ultrasound at the stage of obtaining soil extracts in the determination of Cd, Co, Cr, Cu, Ni, Pb, and Zn. The following solutions were used as solvents: 1.0 and 0.5 M HCl, 1.0 M HNO₃, 1.0 M CH₃COOH, and an ammonium acetate buffer solution with a pH 4.5. The analysis of the content of gross and mobile forms of elements in soil samples taken in different places of the city of Dnepropetrovsk was carried out by the atomic absorption method in an acetylene-air flame using an S-115 PKS spectrophotometer. To obtain ultrasonic vibrations, ultrasonic dispersers UZDN-1 and UZDN-1M were used. The ultrasonic processing parameters varied in the following ranges: time – from 1 to 15 minutes, intensity – from 1.48 to 5.07 W/cm², frequency – from 18 to 47 kHz.

It was shown that the parameters of ultrasound (frequency and intensity), as well as the duration of exposure, significantly affect the degree of extraction of heavy metals in appropriate solvents when determining mobile forms and their total content. The optimal conditions for ultrasonic extraction of elements into solvents are selected. The conditional dissolution rate constants of metals and their maximum degrees of extraction into each solvent are calculated. It was found that both indicators depend on the frequency, intensity and time of exposure to ultrasound, the nature of the solvent used and the element being determined. Accelerated soil analysis techniques have been developed to determine the gross content of heavy metals and their soluble forms in soil extracts, which include ultrasonic influence on the analyzed sample and the next signal recording by atomic absorption methods. The methods are characterized by higher reproducibility of the results compared to the known ones used in environmental monitoring, reducing the time of sample preparation when obtaining soil extracts, and also increasing the degree of extraction of elements during gross analysis.

The results of the determination of HM in soils using the proposed methods suggest that in some soils of the city of Dnepropetrovsk the contents of cadmium, lead and copper are overestimated.

The presence on the territory of cities of large industrial enterprises leads to an increase in the content of heavy metals in the soil, which also contributes to pollution by vehicle exhaust gases.