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The assessment of different fractionation methods applicability at polluted soil and its reclamation

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Sequential fractionation can assess the relative mobility of heavy metals and their forms bonds with soil components. The use of procedures with different stages, reagents, and extraction conditions showed that the obtained results are difficult to compare. Therefore, the search for new optimal methods of extracting metal compounds from the soil and increasing the selectivity of extractants remains of current interest. Zn is a priority pollutant in the south part of Russia that's why it is very important to study the relative mobility and forms of metal. The main objectives of this work were to compare results of Zn fractional distribution in artificially contaminated Haplic Chernozem and in the soil after reclamation (Miller (1986) and Tessier (1979)). The experimental design included the control (original uncontaminated soil), treatments with the addition of Zn at a rate of 300, 2000 mg kg–1 with and without biochar reclamation (1% and 5% by weight of soil).

The results obtained by two sequential fractionation methods are largely analogous. A substantial part of the Zn is fixed in the fraction of primary and secondary minerals (up to 72%). In the uncontaminated soil, the organic fraction appreciably contributes to Zn fixation; however, nonsilicate Fe compounds become the main Zn-sorbing component under contamination conditions. With increasing rate of biochar concentration, the relative content of metal in the residual fraction increases (up to 82%), and the percentage of the most mobile Zn fractions decreases to control variant (from 12- 16% to 1-3%), regardless of the extraction method.

However, the Zn content in different soil fractions vary depending on the used methods. This is related to the higher extraction capacity of the solution used in the Tessier method than in the Miller method. Therefore, the content of the metals in the residual fraction determined by the Tessier method is lower than that determined by the Miller method. The differences in the fractional distribution of metal at the use of different fractionation methods are most manifested in the contaminated soil.

The fractionation of Zn before and after the removal of soil components (carbonates, nonsilicate Fe compounds, and organic matter) showed an almost complete absence of extracted metal (0,1 – 3.0 %) in the fraction bound to the removed component, which indicates a high selectivity of the used extractants. The reagents are most selective for carbonates. The content of Zn in the fraction bound to the removed component obtained by the Tessier method are lower than by the Miller method.

Thus, the Tessier method is more applicability for the separation of the total technogenic component from contaminated soils. The Miller method is more informative at the determination of loosely bound HM compounds because of the use of weaker extractants.

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