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Lithium (Li) in coal seams of Western Donbas

Lithium is classified as a light, rare element [1]. The rapid development of green energy technologies, electric vehicle manufacturing, and energy storage systems has driven an unprecedented surge in global demand for lithium (Li). Within the context of the energy independence strategy and the implementation of the EU Critical Raw Materials Act, the search for alternative, unconventional sources of this metal has become of strategic importance for Ukraine.

Despite regional differences, the lion's share of global lithium consumption (88%) is accounted for by batteries, while the remainder is distributed among the production of glass and ceramics (4%), lubricants (2%), medicine, air purification systems, and casting powders (1% for each sector) [2]. The rapid growth in demand within the battery sector is driven by the popularity of electric vehicles, energy storage systems, and portable

electronics, whereas in the glass industry, lithium is often used in the form of direct mineral concentrates. According to the United States Geological Survey, global demand for lithium jumped by 20% in 2025, reaching 263,000 tons compared to 220,000 tons in 2024 [2].

Given the current scale of coal mining and processing, as well as the high content of associated components within the coal, there is a clear need for targeted technological research to identify methods for the comprehensive utilization of this raw material.

The coal seams of the Western Donbas are of significant interest as an alternative source of lithium. In certain coal seams, maximum concentrations reach up to 300 g/t, which exceeds the lithium crustal abundance (clarke) by nearly 10 times. This stands in contrast to the average lithium content in coal seams, which ranges from 2 to 30 g/t-values that mostly align with or fall slightly below clarke levels. At the maximum content of 300 g/t, the lithium concentration coefficient K_k is 9.37, indicating a significant anomalous concentration relative to the Earth's crust and pointing to the presence of local geochemical enrichment processes within specific areas of the coal seams.

The distribution of lithium in coal of the Western Donbas was investigated through density fractionation followed by mineralogical analysis of the heavy fractions. The assessment was based on the extraction coefficients of elements in monomineralic fractions and fractions of varying densities $<1,6 \text{ g/cm}^3$, $1,6-2,1 \text{ g/cm}^3$, $>2,1 \text{ g/cm}^3$.

Fractional analysis of the coal is shown in Fig. 1. and demonstrates a predominance of lithium in the light fraction with a density of $<1,6 \text{ g/cm}^3$ at a level of 41%, compared to 28% for the intermediate fraction and 31% for the heavy fraction. This element belongs to the group of elements with a low total extraction coefficient of less than 50%.

The coal seams of the Western Donbas represent a promising alternative source of lithium. The identified anomalous concentrations, which exceed the lithium crustal abundance (clarke) by nearly tenfold, indicate intensive processes of local geochemical enrichment within the coal-bearing strata.

Further research into the geochemistry and extraction technologies of lithium should be considered within the strategy for the integrated development of coal deposits. Since coal within the Western Donbas is often enriched not only with lithium but also with a range of other strategically important microelements (such as germanium, gallium, scandium, etc.), transitioning to the integrated joint extraction of associated components will significantly reduce the cost of the final product. Combining the extraction of energy raw materials with the simultaneous recovery of a group of critical metals will ensure high economic profitability for projects, making coal mining, the processing of coal preparation waste, and combustion an investment-attractive direction for the post-war recovery of Ukraine's industry.

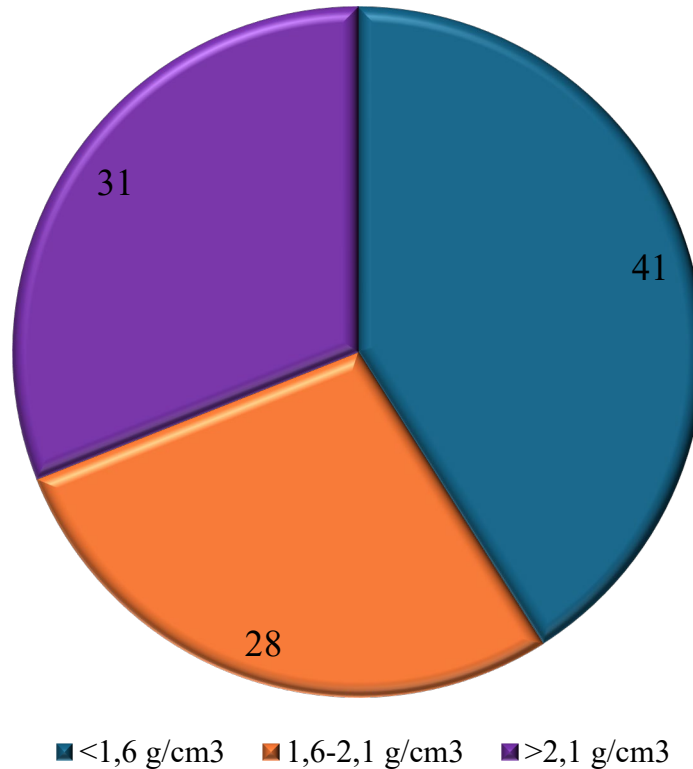


Fig. 1. Extraction of lithium from coal fractions of varying densities

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