

Bioleaching of sulfide copper-nickel ores

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Motivation and Aim: Significant reserves of the most important types of mineral raw materials are concentrated in the Murmansk Oblast, and large number of deposits of sulfide copper-nickel ores have been discovered in this region. At the same time, there are a number of deposits in the region that are not exploited due to the low content of valuable components and of small reserves. Bioleaching is a simple, environmentally friendly and cost-effective approach to process sulfide ores, including low-grade ones. The goal of this work was to perform laboratory trials to determine the possibility of extracting Cu and Ni from copper-nickel ores using the heap bioleaching method.

Methods and Algorithms: Ores from the Sopcha and Nud II deposits were objects of the study. The main ore minerals were pentlandite, chalcopyrite, pyrrhotite. The ores were crushed to –5+1 mm. The Sopcha ore sample contained 0.39 % Ni and 0.27 % Cu; the Nud II ore sample contained 0.72 % Ni and 0.20 % Cu. Mixed culture of acidophilic microorganisms was used. The tests were carried out at three temperatures: at 25, 35 and 45 °C, since heap bioleaching processes are characterized by self-heating of the ore pile and it is important to evaluate the possibility of the bioleaching at different temperatures. Solid to liquid ratio in the percolators was 1:1. The duration of experiments with Sopcha ore was 159 days, with Nud II ore – 138 days.

Results: The extraction of metals into solution from ore Sopcha ore at different temperatures was: at 25 °C – 19.4 % Ni and 7.54 % Cu, at 35 °C – 15.1 % Ni and 5.6 % Cu, at 45 °C – 13.0 % Ni and 4.5 % Cu. Extraction of metals into solution from ore Nud II at different temperatures was: at 25 °C – 17.3 % Ni and 4.96 % Cu; at 35 °C – 24.53 % Ni and 6.64 % Cu; at 45 °C – 30.58 % Ni and 10.43 % Cu. At the end of the experiment, during the bioleaching of Sopcha ore, uncultivated representatives of Acetobacteraceae bacteria of the genera *Leptospirillum* and *Ferrimicrobium*, archaea of the genus *Cuniculiplasma* and *Ferroplasma*, and uncultivated representatives of *Thermoplasmataceae* predominated in microbial populations at all temperatures. During the bioleaching of Nud II ore, representatives of the genera *Leptospirillum* and *Ferrimicrobium* dominated in microbial populations at 25 and 35 °C, and *Acinetobacter* and *Staphylococcus* dominated at 45 °C.

Conclusion: The results of the experiments demonstrated the possibility of long-term bioleaching of the studied ore to extract non-ferrous metals, while the extraction of nickel may be of greater practical interest due to its higher cost and higher leaching rate.

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