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OPTIMIZATION OF THE COAL BACTERIAL DESULFURIZATION USING MATHEMATICAL METHODS

I. A. Blayda, N. Yu. Vasylieva, T. V. Vasylieva, L. I. Sliusarenko, O. I. Dzhambek

Abstract

The aim of the work was to optimize the process of bacterial desulfurization of energy coal, namely, to determine the influence of the component composition of the nutrient medium and the conditions of the process, which ensure the maximal development and activity of the aboriginal association of acidophilic chemolithotrophic bacteria and, as a consequence, the maximal index of sulfur decrease in coal in minimal time. We used the method of mathematical planning of the experiment adapted to the plan in Greek-Latin squares. The calculations in this approach are based on the analysis of variance (ANOVA). The formal planning of experiments has been carried out with four operating factors (nutrient medium components) at four levels (concentrations). The calculations were performed in Excel. The selection of operating factors and their combinations was made with the usage of unifactor ANOVA, correlation analysis and the method of principal components PCA. Researches were carried out in R 3.4.0 program and were founded on data of the preliminary evaluating experiments. *Acidithiobacillus ferrooxidans* Coal 17 aboriginal strain was used to obtain the most significant desulfurization effect. This strain was isolated from the investigated coal, studied and identified. The significance of the factor level for each nutrient medium component was analyzed using the Duncan's multiple range test, the uniformity of the variances was examined with the Cochran's test, and the significance of the factors was tested by the Fisher's criterion. As a result, for the optimal nutrient medium the next combination of factors and their levels, which corresponds to the composition, g/dm

3

, was recommended: (NH

4

)

2

SO

⁴
— 0.15; K

²
HPO

⁴
— 0.50; FeSO

⁴
.7H

²
O — 44.0; KCl — 0.10; MgSO

⁴
·7H

²
O — 0.10; Ca(NO

³
)

²
— 0.10; yeast extract — 0.025% (vol.); strain

A. ferrooxidans

Coal 17 (titre 1·10

⁸

CFU/ml) — 1.60% (vol.). This makes it possible to reduce the sulfur content in coal by 66.31% in a short period (seven days). This result could not be got before.

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