OPTIMIZATION OF CULTURE MEDIA BY DESIGN OF FULL FACTORIAL EXPERIMENTS METHODOLOGY

Vasyleva N.Yu., Kulya L.V.

I.I. Mechnikov Odessa National University, 2, Shampanskiy pereulok, 65058, Odessa, Ukraine

The objective of the present study was to produce an alternate culture medium for bacterial leaching of rare and nonferrous metals from industrial waste. A new culture medium was produced to activate the natural community of microorganisms inhabiting industrial waste, but not for a select group of microorganisms.

The alternative culture media were optimized according to orthogonal tests. In the orthogonal tests of composite plan of the second order an experimental design was employed for 4 independent variables each at 3 levels. The first 16 of experiments represent a full factorial experiment. It implements a plan of the first order. The entire plan consists of 25 experiments and refers to plans for the second-order. A total of 25 experiments were carried out simultaneously, each experiment with three replicates.

These parameters coded -1, 0, +1 for low, middle and high concentration respectively.

The behavior of the system was explained by the following second degree polynomial equation:

$$Y = \wedge 0 + E \quad E\ PiiXi^2 + E\ PyXiXj$$

where Y is the predicted response, P0 the offset term, Pi the coefficient linear effect, Pii the coefficient squared effect and Py the coefficient of interaction effect.

The MATLAB software package was used for regression analysis of the data obtained and to estimate the coefficients of the regression equation. This analysis included the Fisher's F-test (overall model significance), its associated probability P(F) and determination coeffcient of R^2 that measured the goodness of fit of the regression model. The analysis also included the Student's t-value for the estimated coefficients and associated probabilities, $P(_t)$.

Multiple regression analysis of the experimental data gives the following second-order polynomial equation: $Y= 1.23- 4.6x_1+6.05x2+0.9x3+0.16x4+ 0.45x_1x_2+2.58x_1x_3+0.32x_1x_4-1.03x_2x_3-0.26x_2x_4-0.06x_3x_4-3.02x_1^2-4.03x2^2- 1.27x_3^2+0.03x_4^2$

The method of Gauss for determining values of the equation roots was used. The optimized culture medium in the laboratory conditions to increase the percentage recovery of rare and nonferrous metals from the substrate in comparison with classical culture medium in 2.3 times.

Thereby, statistical optimization methods for bacterial leaching process could overcome the limitations of classical empirical methods and proved to be a powerful tool for the optimization of conditions of extractions rare and nonferrous metals from the substrate.