

INVESTIGATION OF THE DEGREE OF DECOMPOSITION OF NITRIC ACID POLYHALITE BASED ON A COMPLETE FACTOR EXPERIMENT

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Let us consider the problem of filling in the experiment planning matrix, based on the results of which the regression dependence of the degree of decomposition of nitric acid polyhalite is constructed.

Polyhalite is a mineral of the sulphate class ($K_2Ca_2Mg(SO_4)_4 \cdot 2H_2O$) – a raw material for the production of mineral fertilizers. The following parameters were chosen as factors: z_1 – process temperature, °C; z_2 – duration of interaction of reagents, min; z_3 is the concentration of nitric acid, mass percent.

The following parameters are considered as output variables: y_1 – degree of extraction K_2O , mass percent; y_2 is the degree of extraction of MgO , mass percent.

Zero level of the plan (center of the plan) and variation intervals: $z_1^0 = 30$ °C; $\Delta z_1 = 6$ °C; $z_2^0 = 14$ min; $\Delta z_2 = 3$ min; $z_3^0 = 12,5$ %; $\Delta z_3 = 5$ %.

The number of experiments (the number of possible combinations of factor levels) N for a complete factorial experiment is 2^k , which in the case of three factors is: $N = 2^3 = 8$.

The linear model has the following form:

$$\hat{y} = 78,6 - 1,62x_1 + 2,12x_2 - 3,87x_3.$$

After eliminating the insignificant coefficient, the regression equation takes the following form:

$$\hat{y} = 78,6 + 2,12x_2 - 3,87x_3.$$

To calculate the model defined by the equality:

$$\hat{y} = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_{12}x_1x_2 + b_{13}x_1x_3 + b_{23}x_2x_3$$

an extended planning matrix is compiled, containing additional columns for determining the coefficients for paired interactions.

The coefficients , b_{12} , b_{13} and b_{23} are equal, respectively:

$$b_{12} = \frac{\sum_{i=1}^8 (x_1x_2)_i y_i}{8} = 8,37, \quad b_{13} = \frac{\sum_{i=1}^8 (x_1x_3)_i y_i}{8} = 1,375, \quad b_{23} = \frac{\sum_{i=1}^8 (x_2x_3)_i y_i}{8} = -1,375.$$

Obviously, of the three coefficients for pair effects, only the coefficient b_{12} is significant. The regression model has the following form:

$$\hat{y} = 78,6 + 2,12x_2 - 3,87x_3 + 8,37x_1x_2.$$