MATHEMATICAL MODELING OF NICKEL REMOVAL BY COAGULATION AND FLOCCULATION PROCESS

Tijana Đuričić[1*], Dajana Dragić[1], Sanda Pilipović[1], Aleksandra Borković[1], Dijana Drljača[1], Draženko Bjelić[1], Borislav Malinović[1]

[1] *University of Banja Luka, Faculty of Technology, Stepe Stepanovića 73, Banja Luka, Bosnia and Herzegovina, tijana.djuricic@tf.unibl.org**

Abstract

In this study, the effects of coagulant and flocculant concentrations, as well as their interaction on the efficiency of Ni removal through the coagulation and flocculation process of real wastewater from the metal industry were examined. A 3^2 factorial design was used for the design of the experiment, with two independent variables: coagulant concentration (Factor A) and flocculant concentration (Factor B), each factor at three concentration levels. The dependent variable that was monitored after the treatment was the Ni removal efficiency (%) (Response – R_1). In the coagulation/flocculation wastewater treatment, ferric chloride (80 mg/L, 120 mg/L, 160 mg/L) was used as the coagulant, and polyacrylamide Superfloc A-110 (5 mg/L, 10 mg/L, 15 mg/L) was used as the flocculant. Statistical analysis of the results, analysis of variance (ANOVA), showed that there was no statistically significant interaction between the two factors in the tested concentration range in the case when precipitation at pH 10 was previously performed on the sample of wastewater. A linear empirical model was developed for the coagulation and flocculation process to estimate Ni removal efficiency. The addition of flocculant had a greater effect on Ni removal efficiency compared to the coagulant concentrations used in the process. This was also confirmed by the residual Fe concentration in the samples of water after the treatment. The developed linear model and graphical representation of developed model allowed the determination of optimal conditions for Ni removal efficiency through the coagulation and flocculation process. The maximum overall Ni removal efficiency of 96.55%, for an initial Ni concentration of 7.07 mg/L in wastewater, was achieved by applying the optimal $FeCl_3$ dose of 80 mg/L, with an optimal flocculant concentration of 15 mg/L, under the following conditions of coagulation/flocculation treatment: pH 8, temperature 19.5°C, with prior precipitation at pH 10 and separation of the primarily formed sludge.

Keywords: *coagulation, flocculation, empirical model, Ni removal, three-level factorial design, wastewater.*