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Application of response surface methodology to optimize the coagulation-flocculation process using a microbial coagulant produced via solid-state fermentation for water treatment

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Abstract :

The present research aimed to optimize the coagulation-flocculation process using a microbial coagulant produced via solid-state fermentation for water treatment. The significant variables that affect the coagulation-flocculation process, including mixing speed, time, pH, microbial coagulant dose, initial turbidity, and settlement time, were analyzed for possible optimum range by using the OFAT approach. Further optimization was done by applying face-centered central composite design (FCCCD) under the response surface method (RSM) in jar tests. Results showed that the optimum turbidity removal of 96 % was obtained under 200 rpm rapid mixing speed during 2 min and 90 rpm slow mixing speed during 22 min; the optimum microbial coagulant dose and settling time for initial turbidity of 600 NTU were 12 ml and 30 mins, respectively. Analysis of variance ANOVA indicated that the established models were significant ($p < 0.05$). The study showed that the model was characterized by a good fit, justified by the very high adjusted coefficient of determination (R^2= 97 %, R^2Adj = 99 %. The lack of fit was found to be insignificant ($p > 0.05$), confirming the adequacy of the models. The model's validity and applicability were confirmed by a standard error of less than 10%, confirming the accuracy of the predicted models. This study provides valuable insights into optimizing the coagulation-flocculation process conditions using RSM to maximize turbidity removal while minimizing experimentation requirements, which contributes to sustainable water treatment practices and supports global efforts toward environmental awareness and the advancement of green technologies.

Keywords: microbial coagulant, turbidity removal, coagulation-flocculation process, RSM, water treatment.

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