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Initial turbidity, pH, dosage of alum and paddles type optimization of efficiency removal by using response surface methods (RSM)

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ABSTRACT

Response Surface Methods (RSM) and desirability functions are good examples of data-based multivariate methods that can be used to study coagulation treatment optimization. This study examined and optimized the efficacy of turbidity reduction, under the operating conditions of initial turbidity T_{in} (50–200 NTU), pH (5–9), and alum dose (50–250 mg/L) for two types of fan (two paddles and four paddles) using Face-Centered Central Composite Design F-CCCD of RSM. The experimental results of F-CCCD were fitted to the second-order quadratic model for the two types of fans in order to formulate the impacts of each element and their interactions on the response of interest in a mathematical connection. The results showed that at optimal operating conditions for a fan with two paddles of T_{in}, pH and alum dose of 87.76 NTU, 8.86 and 170.43 mg/L, respectively, the predicted values of turbidity removal efficiency (E%) was 85.92% and for four paddles fan type when T_{in}, pH and alum dose of 156.58 NTU, 8.93, and 138.7 mg/L, respectively, the predicted values of turbidity removal efficiency (E%) was 93.71, with the desirability of 1.000. This study showed how well F-CCCD works with a desirability function to find the best conditions for the process (T_{in}, pH, and alum dosage) of coagulation for the turbidity removal efficiency E%. A four-paddle fan type provided the best removal efficiency. Instead of jar testing, drinking water treatment companies might utilize the findings of this study as a starting point for their work.

Keywords: Flocculation, Efficiency removal, Coagulation, Central composite design, Response surface method, Optimization network (ANN).

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1. INTRODUCTION

Turbidity is a way to measure how many particles are in the water, and too many particles can make the water unsafe for drinking, swimming, and aquatic life. Turbidity removal is the process of lowering the amount of these particles in water to a level that is acceptable. By getting particles to stick together, chemical processes like coagulation and flocculation can make physical processes work better. The connections between raw water and process factors are complicated and not straight lines. Changes in the chemical make-up of raw water and the physical properties of the coagulation-flocculation event can affect how water is treated. Silicate, pH, temperature, the amount of coagulant used, natural process conditions, and the hydraulic dynamics of the treatment water flow are all significant factors in the water treatment process (Shi et al., 2007; Xiao et al., 2009; Miron et al., 2010).

The effectiveness of the selection and usage of coagulants for the treatment of water has been evaluated using the jar test technique. Because it does not examine the complete practical space for the interactions of all factors that impact coagulation, this experimental procedure is constrained in identifying the ideal circumstances for therapy