Environmental Engineering and Management Journal xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

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DEVELOPING MULTI-CRITERIA DECISION ANALYSIS AND TAGUCHI METHOD TO OPTIMIZE CIPROFLOXACIN REMOVAL FROM AQUEOUS PHASE

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Abstract

In this research, optimization of Homogeneous Fenton process was performed using Multi-Criteria Decision Analysis (MCDA) and Taguchi method to remove Ciprofloxacin (CIP) from an aqueous phase. Analytic Hierarchy Process (AHP) is one of the most comprehensive systems designed for multi-criteria decision making. In this study, paired comparisons based on the AHP method were performed for three criteria including (i) CIP removal, (ii) COD removal and (iii) Sludge to iron ratio (SIR) to select the best catalyst among $FeSO_4.7H_2O$ and $FeCl_2.4H_2O$. Taguchi method was used to optimize parameters and their levels via Minitab16® Software. Influence of different parameters including initial CIP concentration, Fe (II) concentration, H_2O_2 concentration, pH, and reaction time on CIP removal from the aqueous phase were investigated. Using Expert Choice® Software, and based on sensitivity analysis results, importance percentages for $FeCl_2.4H_2O$ and $FeSO_4.7H_2O$ were estimated as 63% and 37%, respectively. Taguchi optimal analysis indicated that a high S/N response ratio may be obtained with an initial CIP concentration of 10 mg/L, Fe^{2+} concentration of 50 mM, H_2O_2 concentration of 20 mM, pH of 3.5, and a reaction time of 20 min; making significance levels of the parameters as 81.63, 76.13, 75.13, 75 and 79.25, respectively. Analysis of variance (ANOVA) under Taguchi method showed that CIP concentration has the most impact on CIP removal with the highest sum of squares and lowest p-values (0.004). The maximum removal efficiency for two objectives, the antibiotic and COD, were 89.5% and 48%, respectively.

Key words: Analytic Hierarchy Process, Ciprofloxacin, Homogeneous Fenton process, Multi-Criteria Decision Analysis, Taguchi method

Received: July, 2017; Revised final: June, 2018; Accepted: July, 2018

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