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The use of reactive index of hydroxyl radicals to investigate the degradation of Acid Orange 7 by Fenton process

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Abstract

This study suggested the amount of hydroxyl radicals (•OH) reacting with organics as a new index to evaluate the reaction efficiency (RE) of Fenton process, and used it to investigate the degradation mechanism of target pollution, Acid Orange 7 (AO7). The effects of initial concentrations of Fe(II), H_2O_2, and AO7 on RE were quantified by using response surface methodology (RSM). The main factors affecting RE were Fe(II), H_2O_2, and their interaction, and their percentage effects were 65.75, 11.99 and 22.23%, respectively. Moreover, based on the analysis result of RSM, a condition for good RE was proposed that it should ensure a higher amount of •OH reacted with organics, and reduce the amount of •OH scavenged by Fe(II). Liquid chromatography–mass spectrometry (LC/MS) analysis was used to identify the products of AO7 degradation in Fenton process, and there were three possible mechanisms to be observed, such as azo bond cleavage, hydroxylation, and oxidation of naphthalene ring. The trend of mechanisms might vary with the amount of •OH attacks, and therefore the use of estimated RE could provide more particular information to better understand the relationship between organic degradation and •OH attacks.

Keywords: Hydroxyl radicals; Reaction efficiency; Fenton; Degradation mechanism; Response surface methodology.