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Hydrothermal Synthesis of Fe-TiO_2-Ag Nano-Sphere for Photocatalytic Degradation of 4-Chlorophenol (4-CP): Investigating the Effect of Hydrothermal Temperature and Time as well as Calcination Temperature

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Abstract

This work aimed to synthesize Fe-TiO_2-Ag nano composite by a novel ultrasonic assisted hydrothermal method followed by evaluation of its efficiency for photocatalytic degradation of 4-chlorophenol (4-CP) in aqueous solution. X-ray diffraction (XRD), Scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR) and N_2 adsorption-desorption (BET) methods were performed to characterize the as-prepared materials. The catalysts with different ratios of Fe and Ag were synthesized and evaluated based on photocatalytic activity for 4-CP removal under UV irradiation. Response surface methodology (RSM) was used to determine the effect of operational parameters for photocatalytic degradation of 4-CP under UV irradiation. The optimum values of Fe and Ag were chosen as 0.3 and 2 %wt. Fe-TiO_2-Ag photocatalyst showed considerable enhancement in the degradation of 4-CP compared to bare nano TiO_2. The optimum conditions for maximum degradation of 4-CP and minimum dosage of catalyst were obtained via the RSM to be the time of 165 min, pH of 4.86, $C_{4\text{-}CP}$ of 40.4 mg/L and $C_{cat.}$ of 1.5 g/L. Degradation at the optimum condition correlated 95.25% compared with the experimental amount of 97.12%, which illustrated the good accuracy. Furthermore, the stability and reusability of the synthesized catalysts was studied and demonstrated only 3% decrease in removal efficiency after five cycles.

Keyword: Photocatalytic degradation**,** Fe-Ag doped TiO_2, Hydrothermal synthesis, 4-Chlorophenol, UV irradiation, Response surface methodology