Abstract

In the present study, photocatalytic degradation process was used for degradation of synthetic and real textile wastewater using undoped and Ag^{+} doped micro TiO_2 under UV irradiation. The photocatalysts were characterized by FESEM, XRD, EDS, FTIR, DRS and micropore analysis. A cationic dye (methylene blue) and an anionic dye (methyl blue) were degraded photocatalytically in a slurry type batch reactor. The influence of different parameters, i.e. photocatalyst loading, dye concentration, initial pH, temperature, depth of solution, interfering ions and electron acceptors on the dye degradation was investigated. Comparative analysis of degradation with Fe^{2+} and Fe^{3+} doped TiO_2 under UV and visible light was also carried out. The degradation products formed were identified using GC-MS analysis after photocatalytic degradation of the dyes for 180 minutes with Ag^{+} doped micro TiO_2. Ion chromatography analysis for anions was performed to identify the end products of degradation. Degussa P25 nano TiO_2 and Ag^{+} doped nano TiO_2 were found more efficient than corresponding micro sized photocatalysts in degradation of aqueous solution of methyl blue. However, cost comparison indicated that degradation with the micro sized photocatalysts was much cheaper than that with corresponding nano sized photocatalysts. Photocatalytic degradation of real textile wastewater from a fabric dyeing and finishing industry was studied in a batch reactor. Kinetic and error analysis (average relative error) of degradation was performed at different dilutions. Photocatalytic degradation of methylene blue, methyl blue and real textile wastewater with Ag^{+} doped TiO_2 was optimized using a combination of response surface methodology and Box-Behnken design of experiment. The individual and interaction effects of three operational parameters i.e. photocatalyst dose, initial dye concentration and pH, selected based on single factor study, on the color and COD removal of the dye were determined by fitting the results of the experiments to two quadratic polynomial models relating the parameters to the response variables. Photocatalytic degradation of aqueous solutions of methylene blue, mixture of dyes, synthetic wastewater and real textile wastewater from a composite textile mill was also studied in a continuous flow reactor modeled as a series of CSTRs considering reaction kinetics and mass balance concept.

Keywords: Decolorization, Mineralization, Response surface, Textile wastewater, Photocatalysis, ANOVA