ABSTRACT

Fenton and Fenton-like processes are efficient advanced oxidation processes (AOPs) for degradation of persistent organic pollutants (POPs). Heterogeneous Fenton and Fentonlike methods are in focus in recent years. In the present study, we have prepared a new heterogeneous photo Fenton-catalyst, where Co(II) is adsorbed on a solid support, which is surfactant-modified alumina (SMA). The surfactant used here is sodium dodecyl sulfate (SDS), which has negative charge. Under suitable conditions it forms bilayer on alumina surface which has the potential to uphold positively charged ions, such as Co(II). The asprepared material, where Co(II) is adsorbed on SMA is designated as Co-SMA. Co-SMA has been characterized by SEM, FTIR, DRS, XPS, pHzpc analyses. A cationic dye (methylene blue) and an anionic dye (methyl orange) are degraded by photo-Fenton process in presence of H2O2 and visible light using Co-SMA as catalyst. Methylene blue (MB) is first adsolubilized on Co-SMA surface. MB gets fully adsorbed on Co-SMA surface because of ionic interaction and then degradation has been initiated by addition of H_2O_2 and exposure of visible light. The percentage degradation is measured by extraction of the dye from the reaction system. The reaction follows zero order which depicts that it is truly a surface catalysed reaction. This is the first report of adsolubilization-based photo-Fenton process. On the other hand, methyl orange (MO) does not get entirely adsorbed on Co-SMA surface. The degradation of methyl orange follows first order kinetics. The influence of different parameters such as, initial concentration of dye, dose of Co-SMA, H_2O_2 concentration and light intensity is studied in case of both the dyes (i.e. MB and MO). Box-Behnken design of response surface methodology (RSM) is used to analyze the interactive effects among the independent variables on percentage decolorization of MB and MO, and finally the process is optimized. Decolorization of real textile wastewater has been explored by photo-Fenton process using Co-SMA in batch study. The COD removal of real textile wastewater is found to be ~71% within 90 min reaction. Degradation of MO and real textile wastewater has also been studied in a continuous flow reactor. Finally the cost analysis of the process for degradation of textile wastewater is done.

Keywords: Cobalt loaded surfactant modified alumina; Modified Fenton; Methylene blue; Methyl orange; Real textile wastewater