Photocatalytic Performance of Fe2O3/Clay Fenton Heterogeneous Catalyst with High Degradation Efficiency Toward Congo Red

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Abstract:

Water contamination is a major problem, and water quality is now a major environmental issue [1]. Dyes are extensively used for many industries, including the textile, paper, plastic, wood and food industries [2]. Clay minerals are considered as promising supports due to their interesting inherent properties, namely their adsorption capacity, and their ability to be bounded to chemical compounds [3]. Fenton technology is a well known process and has been reported as an effective alternative for the treatment of the industrial wastewater containing non-biodegradable organic pollutants. Fenton reagents involve the generation of hydroxyl radicals via homogeneous reaction between hydrogen peroxide and ferrous ion [4]. Volcanic clay from Aïn Ouarka south west of Algeria (CA) was applied to remove malachite green (MG). This material was purified (CAP) and characterized by different techniques such as Brunauer, Emmett and Teller (BET), scanning electron microscopy (SEM), X-ray diffraction (XRD), thermal analytical techniques (ATG-ATD) and Fourier Transform Infrared Spectroscopy (FT-IR). The cation exchange capacity (CEC) was also determined. This clay was modified with F2O3 by impregnation (Fe-CAP). The applicability of iron-CAP as a heterogeneous Fenton-type catalyst for the elimination of the RC dye as a model pollutant has been investigated. The influence of operating parameters such as different mass of catalyst, initial concentration of H2O2, and initial pH. The Fe–CAP has been proved to be a superior heterogeneous catalyst for elimination of RC in an aqueous solution. The best operation parameters for the Fenton oxidation of RC were 5 wt.% of iron ions loading, 0.66 g/L of catalyst dosage, and 39.1 m.mol of H2O2 for 71 µmol /L initial RC concentration at an initial pH 2.5 with 27 ◦C temperature. Under these conditions, 90% decolorization efficiency of RC in aqueous solution was achieved within 60 min of reaction time.