هشتمین کنفرانس بین المللی شیمی، مهندسی شیمی و نفت #8
8th International Conference on Chemistry, Chemical Engineering and Petroleum Engineering

Sonocatalytic degradation of organic dye pollutants from aqueous solutions using MIL-101 (Cr)/CuO/MgFe2O4 heterojunction nanocatalyst

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Abstract
In this study, a novel magnetic MIL-101(Cr)/CuO/MgFe2O4 nanocomposite catalyst was successfully fabricated by the hydrothermal route for the sonodegradation of organic dye pollutants from aqueous solutions. The structural, morphological and magnetic features of the nanocomposite were characterized by means of XRD, FESEM, EDS, VSM and BET analyses. To investigate the sonocatalytic performance of
the as-manufactured MIL-101(Cr)/CuO/MgFe2O4 nanocomposite, the H2O2-assisted degradation of organic dyes like methylene blue (MB), Rhodamine B (RhB) and methyl orange (MO) in aqueous solution were studied under ultrasound irradiation. The gained results illustrated that the ternary MIL-101(Cr)/CuO/MgFe2O4nanocomposite had better activity for sonodegradation of these dyes than MIL-101(Cr)/MgFe2O4, bare MIL-101(Cr), CuO or MgFe2O4. The enhanced sonocatalytic activity of the synthesized nanocomposite could be related to the fast generation and separation of electrons and holes in MgFe2O4, CuO and MIL-101(Cr). Plus, the relatively high specific surface area of the MIL-101(Cr)/CuO/MgFe2O4 and magnetic feature of MgFe2O4 improve the degradation yield of the organic dyes. The separation of the magnetic sonocatalyst from aqueous solutions could be easily achieved applying an external magnetic field.
The several parameters on the sonocatalytic activity, including irradiation time, dye type, catalyst amount and initial dye concentration were also evaluated. The trapping experiments displayed that .OH free radicals are the significant reactive species in the dye degradation. Additionally, the recyclability experiment, was also implemented to ensure the stability of the used sonocatalyst.

Keywords: MIL-101 (Cr)/CuO/MgFe2O4, nanocomposite, sonocatalyst, organic dyes