Synthesis and characterization of Fe3O4@SiO2 -supported metal–organic framework PAEDTC@MIL-101 (Fe) for degradation of chlorpyrifos and diazinon pesticides

Fatemeh Zisti", Farhan Jasim Mohammed Al-Behadili®, Mahsa Nadimpour, Rozzagh Rahimpoor", Nezamaddin Mengelizadeh.", Ali Alsalamy, Ahmed olawadi". Murtadha Doghiam Abdullah", Dovoud Balarak'

Abstract

In this study, a new core-shell Fe_3O_4@SiO_2/PAEDTC@MIL-101 (Fe) photocatalyst was prepared by sol-gel method and used to degrade diazinon (DZN) and chlorpyrifos (CPS) from aqueous solutions. The characteristics analyzed by various techniques indicate that the core-shell photocatalyst with a specific surface area of 992 m^2/g, pore size of 1.35 nm and saturation magnetization of nanocomposite was 12 emu/g has been successfully synthesized and can be separated from the reaction solution by a magnetic field. The maximum efficiencies of DZN (98.8%) and CPS (99.9%) were provided at pH of 5, photocatalyst dosage of 0.6 g/L, pollutant concentration of 25 mg/L, radiation intensity of 15 W, and time of 60 min. The presence of anions such as sulfate, nitrate, bicarbonate, phosphate, and chloride had a negative effect on the performance of the photocatalysis system. Compared to the adsorption and photolysis systems alone, the photocatalytic process based on Fe_3O_4@SiO_2/PAEDTC@MIL-101 (Fe) under two UV and visible light sources showed a high efficiency of 90% in the reaction time of 60 min. The BOD_5/COD ratio improved after 50 min to above 0.4 with TOC and COD removal rates >80%. Scavenging tests showed that ·OH radical, hole (h^+), electron (e^-), and $O_2^{\cdot-}$ anion were produced in the reaction reactor, and the ·OH radical was the dominant species in the degradation of DZN and CPS. The stability tests confirmed the recyclability of the photocatalyst in 360 min of reactions, with a minimum reduction of 7%. Energy consumption for the present system during different reactions was between 15.61 and 25.06 kWh/m^3 for DZN degradation and 10–22.87 kWh/m^3 for CPS degradation.