Chemical Engineering Journal 220 (2013) 302–310

Contents lists available at SciVerse ScienceDirect

Chemical Engineering Journal

journal homepage: www.elsevier.com/locate/cej

$CoFe_2O_4/TiO_2$ nanocatalysts for the photocatalytic degradation of Reactive Red 120 in aqueous solutions in the presence and absence of electron acceptors

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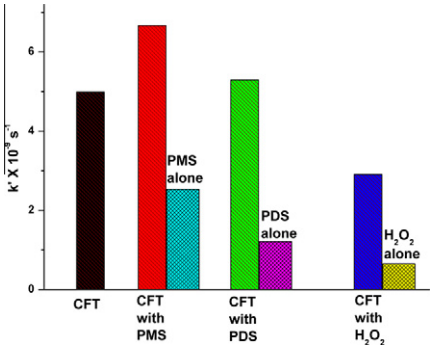
HIGHLIGHTS

- $CoFe_2O_4$ and $CoFe_2O_4/TiO_2$ nanocatalysts were prepared with more stable rutile phase of TiO_2.
- $CoFe_2O_4/TiO_2$ nanocatalyst was found to be suitable for the visible light induced photocatalytic degradation of RR120.
- Enhanced photocatalytic degradation of RR120 was observed by the addition of electron acceptors.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 17 August 2012
Received in revised form 17 December 2012
Accepted 10 January 2013
Available online 29 January 2013

Keywords:
$CoFe_2O_4/TiO_2$ nanocatalyst
Reactive Red 120
Photocatalytic degradation
Electron acceptors

ABSTRACT

Magnetic $CoFe_2O_4$ and $CoFe_2O_4/TiO_2$ nanocatalysts were prepared by a co-precipitation method in which $CoFe_2O_4$ induced the formation of thermodynamically more stable rutile phase of TiO_2. The structural and elemental analyses confirmed the formation of $CoFe_2O_4$ and $CoFe_2O_4/TiO_2$ nanocatalysts and the specific atomic ratios of Ti, Co, Fe, and O in these catalysts. The presence of Co^{2+} and Fe^{3+} cations in its oxide forms on the surface of TiO_2 led to visible light absorption in the wavelength range 550–650 nm. The band gap calculated by Tauc approach showed ~3.2, 1.1 and 2.8 eV for TiO_2, $CoFe_2O_4$ and $CoFe_2O_4/TiO_2$ nanocatalysts, respectively. The photocatalytic degradation of Reactive Red 120 (RR120) was studied by varying its concentration and the amount of nanocatalyst in order to attain a maximum degradation. The role of electron acceptors in the photocatalytic degradation of RR120 was studied in the presence of the magnetic nanocatalysts.

1. Introduction

Metal-oxide nanoparticles have been extensively utilized in various applications [1–8], including advanced oxidation processes (AOPs), due to their interesting physicochemical properties [9–12]. AOPs are promising techniques for the degradation of organic pollutants in aqueous environment. Among the various AOPs, heterogeneous photocatalytic degradation of organic contaminants in the presence of nanostructured semiconductor (e.g., TiO_2) materials attained the maximum efficiency of mineralization [13]. TiO_2 is chemically and biologically inert. Nevertheless, the separation of TiO_2 from the heterogeneous solution is found to be very diffi-

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http://dx.doi.org/10.1016/j.cej.2013.01.036