

Photocatalytic degradation of textile dye CI Basic Yellow 28 wastewater by Degussa P25 based TiO₂

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Abstract. Wastewaters of textile industry cause high volume colour and harmful substance pollutions. Photocatalytic degradation is a method which gives opportunity of reduction of organic pollutants such as dye containing wastewaters. In this study, photocatalytic degradation of C.I. Basic Yellow 28 (BY28) as a model dye contaminant was carried out using Degussa P25 in a photocatalytic reactor. The experiments were followed out at three different azo dye concentrations in a reactor equipped UV-A lamp (365 nm) as a light source. Azo dye removal efficiencies were examined with total organic carbon and UV-vis measurements. As a result of experiments, maximum degradation efficiency was obtained as 100% at BY28 concentration of 50 mgL⁻¹ for the reaction time of 2.5 h. The photodegradation of BY28 was described by a pseudo-first-order kinetic model modified with the langmuir-Hinshelwood mechanism. The adsorption equilibrium constant and the rate constant of the surface reaction were calculated as $K_{dye} = 6.689 \cdot 10^{-2} \text{ L mg}^{-1}$ and $k_c = 0.599 \text{ mg L}^{-1} \text{ min}^{-1}$, respectively.

Keywords: photocatalytic degradation; Degussa P25; textile dye wastewaters; Basic Yellow 28; Langmuir-Hinshelwood mechanism

1. Introduction

Synthetic dyes are widely used in the textile, biomedical or dyestuff industries for textile dyeing, paper printing, cosmetics, pharmaceutical and color photography. Dyehouse effluents from the textile and the dyestuff industries cause serious environmental problems by destroying many life forms and consume dissolved oxygen due to its strong color, a large amount of suspended solids and highly fluctuating pH (Vandevivere *et al.* 1998, O'Neill *et al.* 1999).

There are more than 100,000 commercially available dyes and more than 7×10^5 metric tons of dyes are produced worldwide annually (Nigam *et al.* 2001, Pearce *et al.* 2003). Recent studies indicate that approximately 12% of synthetic dyes are lost during manufacturing and processing operations and that 20% of the resultant color enters the environment through effluents from industrial wastewater treatment plants (Essawy *et al.* 2008). Dyes are organic compounds with a chemical complex structure that are stable to light and heat, and resistant to aerobic digestion (Sun

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