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Treatment of textile dyeing wastewater using advanced photo-oxidation processes for decolorization and COD reduction

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ABSTRACT

In this study, advanced oxidation processes were applied to the treatment of a textile dyeing wastewater. The effluent presents a dark blue color, with a maximum absorbance peak at 594 nm, alkaline pH (pH = 12.4), high organic contents (COD = 1,400 mg L^{-1}). Experiments were conducted on a lab-scale prototype using UV lamp as light source and pillared natural clay with Fe and Al as catalyst. All the processes examined lead to an effective decolorization and mineralization, but the most efficient process was the photo-Fenton, contributing to 93% decolorization and 88.8% mineralization after 3 h of reaction under UV irradiation. Characteristics of wastewater after treatment were COD below 250 mg L^{-1}, pH 8.5 and uncolored. Thus the resultant water has conditions that are suitable for releasing in public sewage systems.

Keywords: Textile dyeing wastewater; Photo-Fenton; UV-light irradiation; COD mineralization; Decolorization; FeAl-pillared clay

1. Introduction

Today, the high pressure on freshwater sources leads to their contamination by various pollutants. Industrial sector was considered the principal source of contamination because of the generation of various types of pollution [1,2]. Industries such as petrochemicals, food, and textile produce huge quantities of effluents that are highly charged, hardly biodegradable and generally bio-recalcitrant [3]. Textile industry is one of the most water-consuming industries [3]. It consumes an average of 10.5 billion L of water per day and it is responsible for 17%–20% of water pollution in the world [4] with an annual production of nearly 800 tons [5]. This industry generates recalcitrant and toxic organic molecules, which are responsible for organoleptic and aesthetic pollution, health problems and contamination of groundwater, soil and vegetation [6,7].

The treatment of industrial waste is, however, difficult because organic dyes cannot be degraded by conventional means (biological treatment). To reduce these processing difficulties, several physical processes have been envisaged, in particular membrane filtration [8], precipitation/coagulation of dyestuffs [9] and adsorption on activated carbon [10]. But, these methods have the disadvantage of moving simply pollution in large amounts of sludge, to be ineffective for certain types of specific dyes and to be relatively expensive [11]. It is, therefore, necessary to create and implement simple and inexpensive solutions in order to treat industrial effluents.

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