Chapter 9
Chemical and Biological Treatment of Dyes

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ABSTRACT

Life of living or non-living being depends on water; in short, water is life. But these days, with the growing industrialization, it is spoiling a lot. Wastewater contains contaminants like acids, bases, toxic organic and inorganic dissolved solids, and colors. Out of them, the most undesirable are colors caused mainly by dyes. Color and other compounds present in water are always not desirable for domestic or industrial needs. The wastes of dyes are predominant amongst all the complex industrial wastewater. This water is dark in color and highly toxic, blocking the sunlight and affecting the ecosystem. Among all the dyes, azo dyes contribute to commercial dyes used widely in textile, plastic, leather, and paper industries as additives. The removal and degradation of azo dyes in aquatic environment is important because they are highly toxic to aquatic organisms. For every industry, clean technology has become an important concern. In this chapter, the authors discuss about existing processes as well as promising new technologies for textile wastewater decolorisation.

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INTRODUCTION

The consumption of water and chemicals in textile industries is tremendous for the wet processing of textiles. The reagents used varies from inorganic or organic compounds to polymers (Mishra & Tripathy, 1993; Juang et al. 1996). The low concentration of dye effluent presence in water is visible and not desirable (Nigam et al. 2000). Almost there are more than 100,000 dyes are available commercially and over tons of dye-stuff are produced annually (Meyer, 1981). Dye has complex structure and due to that they are resistant for degradation to light and also to many chemicals (Poots & McKay, 1976a). The dyes according to structural varieties are classified as acidic, basic, disperse, azo, diazo, anthroquinone based and metal complex dyes. Municipal sewerage systems are not effective in decolouration of textile dye effluent (Willmott et al. 1998). There are other varieties of dyes like cationic, nonionic or anionic type. Anionic dyes are the acid, direct as well as reactive dyes. The most problematic are those dyes which are bright in colour, water-soluble, reactive and acid dyes because they are unaffected by the conventional treatment systems. The general aerobic municipal treatment systems are not effective in removal of these dyes (Moran et al. 1997). The nonionic dyes are disperse dyes as they do not ionise in an aqueous medium. There is great concern because most of the dyes used in textile industry are highly carcinogenic such as benzidine and other aromatic compounds (Baughman & Perenich, 1988). Azo and nitro-compounds are reduced in sediments (Weber & Wolfe, 1987) and similarly (Chung et al. 1978) illustrated their reduction in the intestinal environment, resulting in the formation of toxic amines. Because of fused aromatic ring structure the anthroquinone-based dyes are most resistant to degradation. The ability of some disperse dyes for bioaccumulation has also been demonstrated (Baughman & Perenich, 1988).

CHEMICAL TREATMENT OF DYES

By Fenton’s Reagent

Fenton Process

Henry John Horstman Fenton discovered Fenton’s reagent which is a solution of hydrogen peroxide and ferrous ions reported in 1894 that this solution in acid medium had high oxidizing power (Fenton, 1894). The use of Fenton’s reagent in oxidation processes to destroy toxic organic compounds has been reported (Neyens & Baeyens, 2003). This classic reactive system discovered by Fenton in the last century, now today is underlined by a significant number of investigations.
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Industrial Wastewater Management in the Context of Climate Change Adaptation in Selected Cities of India: A Business Approach