Chapter 14

Decolorization of Direct Blue: 14 Dye by Thermoalkalophilic Aerobic Bacillus sp.

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ABSTRACT

A thermo-alkalophilic bacterium isolated from textile mill effluent samples and identified as a Bacillus sp., on the basis of biochemical tests. The selected bacterium showed high decolorization activity in static condition as compared to shaking condition and the maximum 1000 mg l\(^{-1}\) Direct Blue-14 dye decolorization was takes place in 72 h. The optimum physical parameters such as temperature 40-50 °C, pH 8.0 with 2.5% (w/v) of nitrogen source and 4% (w/v) glucose were required for the decolorization of Direct Blue-14 from this bacterium. UV–Visible analyses and colorless bacterial cells suggested that Bacillus sp. exhibited decolorizing activity through biodegradation, rather than inactive surface adsorption. The degraded dye metabolites are analyzed by TLC and diazotization, carbarylamines, Ames test for individual metabolite indicates biotransformation of Direct Blue-14 into aromatic amine and non-toxic aromatic metabolites. These results suggest that the isolated organism Bacillus sp. as a useful tool to treat waste water containing azo dyes at static condition.

INTRODUCTION

Synthetic dyes have a wide application in the food, pharmaceutical, textile, leather, cosmetics and paper industries due to their ease of production, fastness, and variety in colour compared to natural dyes. More than 100,000 commercially available dyes are known and close to one million tons of these dyes are produced annually worldwide (Adedayo et al., 2004, Saratge et al., 2011). Azo dyes are the largest group of dyes used in textile industry constituting 60-70% of all dyestuffs produced. They have one or
Decolorization of Direct Blue

more azo groups having aromatic rings mostly substituted by sulfonate groups. These complex aromatic substituted structures make conjugated system and are responsible for intense color, high water solubility and resistance to degradation of azo dyes under natural conditions. Disposal of these dyes into the environment causes serious damage, since they may significantly affect the photosynthetic activity of hydrophytes by reducing light penetration (Aksu et al., 2007) and also they may be toxic to some aquatic organisms due to their breakdown products (Hao et al., 2000; Mate & Pathade, 2012; Sahasrabudhe & Pathade, 2012; Madhuri et al., 2014).

Dyes can be removed from waste water by chemical and physical methods including adsorption, coagulation–flocculation, oxidation and electrochemical methods (Lin & Peng, 1994; Lin & Peng, 1996). However, both the physical and chemical methods have many disadvantages in application, such as high-energy costs, high-sludge production, formation of by-products (Sarioglu et al., 2007). Conversely, bioprocessing can overcome these defects because it is cost saving and environmentally benign. Fungi (Acuner & Dilek, 2004; Jadhav et al., 2007; Asgher et al., 2008) and algae (Mohan et al., 2002; Daneshvar et al., 2007) have been used in dye decolorization. Adsorption rather than degradation plays a major role during the decolorization process by fungi and algae, as a result, the dyes remain in the environment. It is well known that bacteria can degrade and even completely mineralize many reactive dyes under certain conditions (Chen et al., 2003; Moosvi et al., 2005; Asad et al., 2007; Kapdan & Erten, 2007; Praveen and Bhat, 2012; Saratale et al., 2011). Even better, the products of intermediate metabolism during the decolorization process, such as aromatic amines, can be degraded by the hydroxylase and oxygenase produced by bacteria (Pandey et al., 2007; Saratale et al., 2011; Shah, 2014).

In this study, a thermo-alkalophilic bacterium *Bacillus sp.* capable of decolorizing Direct Blue-14 was isolated and in addition, the effects of various physical parameters (such as initial glucose concentration, dye concentration, pH and temperature etc) on dye decolorization by the bacterium and qualitative tests of dye metabolites were investigated (see Figure 1).

**Materials and Methods**

The azo dye Direct Blue-14 (DB-14) was obtained from Shailaja textile Industry Sholapur, Maharastra, India.

**Isolation of Dye Decolorizing Microorganisms**

Dye decolorizing bacteria were isolated from different samples such as dye amended soil, Textile mill effluents and other soil samples. The 1g of soil dissolved in physiological saline and inoculated into Bushanell-Hass (BH) containing 0.1 g of dye DB-14 (MgSO₄·7H₂O 0.2, CaCl₂ 0.02, KH₂PO₄ 1, K₂HPO₄ 280

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**Figure 1. Direct Blue-14 (DB-14)**

![Direct Blue-14 (DB-14)](image)
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