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ORIGINAL ARTICLE

Microbial decolourization of textile waste water

N.F. Ali [a,*], R.S.R. El-Mohamedy [b]

[a] *Dyeing and Printing Department, National Research Center, Dokki, Giza, Egypt*
[b] *Plant Pathology Department, National Research Center, Dokki, Giza, Egypt*

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KEYWORDS

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Abstract Six fungal isolates belong to *Aspergillus niger, Penicillium* spp., and *Pleurotus osstreatus* were used for decolourization activities of some acid and reactive dyes, after they screened for optimum efficiency and the condition for temperature and pH were optimized The results obtained indicated that *Pleurotus osstreatus* and *Aspergillus niger* 1 and 2 are more efficient than *Penicillium* spp., with the two kinds of dyes used. The results also revealed that, the maximum degradation activities of these isolates for acid dyes was at pH 5 after 9 days incubation period and at pH 5-6, for reactive dyes. Simulated and actual waste water samples were used in the experiments. Fungi decolourization of synthetic dyes according to their life state group 1: (living cells) to biodegradation and biosorb dyes. The major mechanism is biodegradation because they can produce the lignin modifying enzymes, lactose, manganese peroxides (Lip) to mineralize synthetic lignin of dyes. Group 2: dead cells (Fungal biomass) to adsorb dyes.

1. Introduction

The textile industry is one of the industries that generate a high volume of waste water and creates potential for water pollution. Among the many chemicals in textile waste water, dyes are considered as important pollutants (Huantian and Ian, 2001).

The removal of dye from textile effluents is one of the most significant environmental problems (Kim et al., 2004; Park et al., 2006). Dyes are used in large quantities in many industries including textile, leather, paper, printing, plastic, food, etc. to colour their products (Garg et al., 2004).

The extensive use of dyes often passes pollution problems. The presence of very low concentrations of dyes in large water bodies is highly visible and indisputable and also reduces light penetration and photosynthesis. In addition some dyes are either toxic or mutagenic and carcinogenic (Gong et al., 2005; Nigam et al., 2000; Birhanli and Oznen, 2005; Degon et al., 2005).

Dye wastewater from textile and dyestuff industries is difficult to treat. This is because dyes usually have a synthetic origin and complex aromatic structures which make them more

* Corresponding author. Tel.: +20 23370931; fax: +20 23370951.
E-mail address: aali_04@hotmail.com (N.F. Ali).

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stable and more difficult to biodegrade (Stolz, 2000). Azo dyes are the most widely used as they account for over 60% of the total number of dye structures known to be manufactured (Allen, 1971).

Recently, a number of studies have focused on microbial biodegradation of dye waste water. In this respect, Fu and Viraghavan (2002) reported that *Aspergillus niger* was capable of removing dyes from an aqueous solution and biosorption of dyes was influenced by the functional groups in the fungal biomass and chemical structure of the dyes. Donmez (2002) studied bioaccumulation of the reactive textile dyes Ramazol Blue, Reactive Black and Reactive Red by the yeast species *Candida tropicolis* growing in molasses medium and found that the increase in dye concentration inhibited growth of yeast and caused a long lag period (Chivukula and Renganathan, 1995).

Interest in the pollution potential of textile dyes depends on their possibility of toxicity or carcinogenity, cleavage of azo dyes into the corresponding amines many of which are carcinogenic (Chivukula et al., 1995; Chung and Stevens, 1995; Thurston, 1994). Azo reductases have been shown to be very specific enzymes thus cleaving only the azo bonds of azo dyes. In contrast the phenoxidases lignin peroxidase, manganese peroxidase and laccase act more unspecifically on the aromatic ring and have the potential to degrade a wide range of aromatic structures (Atlas, 1993).

A great number of white rot fungi have been reported to produce the lignin-degrading enzymes LiP, MnP, and laccase, or at least one of these enzymes (Fu and Tiraraghavan, 2001).

In this study, the acid, reactive and exhausted dyebaths were treated by microbial isolates from Egyptian soil. The decolourization efficiency for these dyes was investigated.

2. Experimental

2.1. Materials

2.1.1. Dyes

The dyes used in this study were: C.I. Reactive Blue 19, C.I. Reactive Blue 81, Acid Red 27, and C.I. Acid Red 151, the commercial names, the maximum wave length (λ_{max}) and the chemical structures of these dyes are illustrated in Table 1.

The dyes were added to cultures as aliquots of concentrated stock solutions. Decolourization was measured spectrophotometrically at the wavelength of peak absorbance of each dye using UV–Vis recording spectrophotometer.

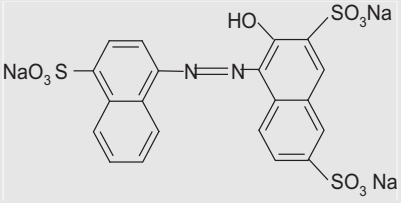
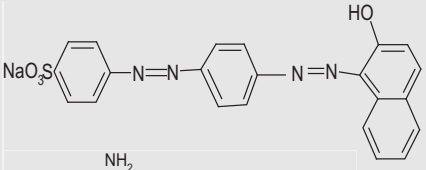
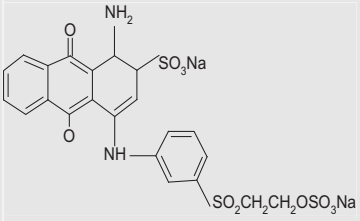
2.2. Preparation of dye solution

The dye stock solution was prepared by dissolving accurately weighed dyes in distilled water to the concentration of 500 mg/l. Different concentrations were prepared from the stock solution (0.02–0.1 g/l).

2.3. Fungal isolates

Six fungal isolates belong to *Aspergillus niger, Penicillium* spp., and *Pleurotus arteubus* were used in this study. *Aspergillus niger* isolate no. 1 and 2, *Penicillium* spp. isolate no. 1 and 2 were kindly obtained from plant pathology department, National Research Centre, Egypt. These isolates. Meanwhile isolate of *Plouritus arteubus* were obtained from Faculty of Agriculture, Ain Shames University, Egypt. The above fungal isolates were chosen for their high dye decolourization potential towards

Table 1 The commercial names, the maximum wave length (λ_{max}) and the chemical structures of the dyes under investigation.

The commercial names	λ_{max}	The chemical structure
C.I. Acid Red 27	520	
C.I. Acid Red 151	519	
C.I. Reactive Blue 19	583	
C.I. Reactive Blue 81	590