J. Environ. Science & Engg. Vol. 56, No. 4, p. 453-458, October 2014

Decolorizing Kinetics of Reactive Blue 13 Azo Dye by *Proteus mirabilis*

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A dye decolorizing bacterium, *Proteus mirabilis*, isolated from soil was used in batch experiments for decolorization of the sulphonated dye, Reactive blue 13. Effects of initial substrate (dye) and bacterial cell mass concentrations on the specific decolorization rate and extent of dye decolorization were investigated. Aeration as against agitation increased the decolorization rate by 4-fold. The dependence of the decolorization rate on initial dye concentration essentially followed Monod-type kinetics and the maximal rate occurred with the dye concentration 382.98 mg/L. The decolorization rate by *Proteus mirabilis* was found to follow half (0.5498) and first (1.0977) order kinetics with respect to dye concentration and cell mass concentrations respectively. The specific decolorization rate estimated from the experimental data was 37.03 mg/L/h/g dry cell mass (DCM), and the value of the apparent K_m was 284.76 mg/L. This study showed that the strain of *Proteus mirabilis* has potential in wastewater color removal.

Key words: *Kinetics, decolorization, Proteus mirabilis, aeration, azo dyes, Reactive Blue 13*

1. Introduction

The structural and functional diversity of azo dyes have resulted in serious environmental pollution. Azo dyes are chromophogenic compounds, characterized by one or more azo groups (-N=N-). More than 2,000 azo dyes are currently being used to dye various materials such as textiles, leather, plastics, cosmetics and food[1]. Reactive azo dyes form the largest class of water-soluble synthetic dyes with the greatest variety of colors and structures, and are generally recalcitrant to oxidative decolorizations[2]. Although most of these dyes are not toxic to the environment, the color in water streams may reduce light penetration hence making aquatic life more difficult[3].

Methods that have been used in the treatment of textile effluents include physiochemical methods such as filtration, specific chemical oxidation, reverse osmosis, coagulation-flocculation, adsorption and photo-degradation etc[4-6]. Some of these methods are effective but with serious limitations such as sludge formation, formation of more toxic by-products and high cost of implementation[2,7-8]. Microbial decolorization, however has proved to be a relatively cheaper and eco-friendly alternative[9].

Over the years, microbial removal of colors from textile wastewaters has focused on anaerobic systems. Anaerobic color removal results in toxic end products, aromatic amines, which have been reported to be more toxic than the dyes themselves, mutagenic to humans and cannot be degraded further under the same condition[3, 10-11]. Although the aromatic amines can be degraded under aerobic conditions, treatments have received serious criticisms because of poor extend of decolorization[12]. Combined anaerobic/aerobic treatment has recently been suggested[12]. This requires two separate phases: decolorization and detoxification; thus requiring longer period of treatment.

Recently, aerobic bacteria that can both decolorize azo dyes and degrade the aromatic amines formed from such decolorization have been reported[13-15]. In such researches, the effectiveness of such organisms was reported in terms of percentage decolorization and incubation times, with slight references made of the concentration of the dyes and the organism used. Furthermore, little attention has been given to the study on biodecolorization/biodegradation kinetics[16]. Kinetics studies could be more helpful in comparing the affinity of organisms to dye, pollutants or effluent. Such studies can also be used to optimize the applied substrates and biomass, thereby reducing the cost of biotreatment.

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