



Performance of anaerobic sequencing batch reactor for treatment of wastewater containing azo dye Acid Red 18

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Abstract

The aim of present research was to investigate the performance of anaerobic sequencing batch reactor (An-SBR) for treatment of wastewater containing azo dye Acid Red 18 with the main focus on decolorization kinetic study. Three An-SBRs were operated with different initial dye concentrations of 100, 500 and 1000 mg/L. Up to 98% of the dye decolorization and more than 80% of the COD removal occurred anaerobically. The kinetic study showed that the AR18 decolorization in the reactor with 100 mg/L initial dye concentration followed first order kinetics with respect to the dye concentration. However, in the case of two other reactors with 500 and 1000 mg/L initial dye concentration, correlation of the dye decolorization data suggested two successive parts with two different reaction orders (zero and first order). The results of the UV-Vis analysis as well as the bio-sorption test proved that the AR18 decolorization was mainly due to the anaerobic azo bond reduction and contribution of physical absorption in AR18 decolorization was less than 10%.

Keywords: Performance, Decolorization, Anaerobic sequencing batch reactor, Azo dye, Kinetic

1. INTRODUCTION

Azo dyes which are aromatic compounds are the largest class of synthetic dyes as the annual world market for these dyes is estimated to be 0.7–1.1 million tones [1, 2]. Discharge of azo dye-containing wastewaters into the environment is undesirable, not only for aesthetic point of view but also because many azo dyes and their metabolites are toxic or mutagenic to life [3]. The color of azo dyes is due to azo bonds, the associated auxochromes and a system of conjugated double bonds. Removal of these dyes is still one of the most difficult tasks faced by wastewaters treatment plants (WTP) of textile industries. This is because of a high resistant of these compounds to degradation, allowing them to remain in the environment for an extended period of time [4].

Previous studies have shown that most azo dyes are generally persistent under aerobic condition. However, these dyes undergo reductive splitting of the azo bond relatively easily under anaerobic conditions releasing corresponding aromatic amines. Anaerobic digestion also is a promising alternative to the physicochemical processes facing several limitation including cost, energy consumption, generation of large amount of chemical sludge leading to secondary pollution and in some cases production of risky by-products need to be disposed safely [5-8]. Although, the phenomenon of anaerobic azo reduction is unanimously accepted, the details of decolorization remain to be clarified. Anaerobic treatment of azo dye-containing wastewaters have been considered for degradation of different azo dyes such as Reactive Black 5, Direct Red 28, Direct Black 38, Acid Orange 7, Acid red 266, Mordant yellow 10, etc [3, 9]. However, little attention has been paid to the anaerobic degradation of AR18.

The main objective of present study was to investigate the performance of anaerobic sequencing batch reactor (SBR) for treatment of wastewater containing azo dye Acid Red 18. For this purpose, the variation of effluent COD concentration as well as change in MLSS concentration was evaluated during the whole operation period of the reactors. In addition, in order to allow a better understanding of the most appropriate kinetic model of anaerobic AR18 decolorization, zero, first and second-order reaction kinetic models were investigated.