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Studies on three-phase three-dimensional hybrid electrochemical reactor for treating textile effluent

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ABSTRACT

In this study, a bipolar airlift type three-phase three-dimensional electrode reactor was used to investigate the colour removal of Acid Black 210 dye and overall chemical oxygen demand (COD) in the simulated textile effluent. Polyvinyl alcohol (PVA) beads containing activated carbon (AC) are used for the fabrication of three-dimensional electrodes in the reactor. The experimental results show that the removal efficiency depends on the initial dye concentrations, bead loading, supporting electrolyte concentration, applied cell voltage, initial pH, air flow rates and AC (wt%) in beads. The results reveal that the three-phase three-dimensional electrodes effectively remove the colour of 100 ppm Acid Black 210 dye and overall COD by 100 and 92.1%, respectively, at optimum operating conditions (bead loading: 30.0 g L^{-1}; NaCl: 2000 ppm; cell voltage: 20.0 V; pH: 7.0; air flow rate: 4.0 L min^{-1}; 1.25 wt% of AC) within 10 min. The colour and COD removal efficiencies of the three-dimensional reactor were higher compared to those of a two-dimensional reactor at similar reaction conditions (i.e., 72.92% of colour removal efficiency and 64.16% of COD removal efficiency for a two-dimensional reactor). The results also indicate that the optimum conditions for colour removal may not be necessarily the same as those of overall COD. The rates of COD and colour removal were very well-fitted with pseudo-first order kinetics.

Keywords: Electrochemical treatment; Three-phase three-dimensional electrode; Hybrid beads; Textile effluent

1. Introduction

Textile industries use an enormous amount of water and chemicals for the wet processing of textiles. They also use various types of dyes to give attractive colours. The wastewater from textile industries generally contains about 10% of dyes used for textile colouration. These dyestuffs include various types of acidic, basic, azo, reactive, and anthraquinone based compounds. Frequent changes of dyestuff employed in the dying process cause considerable variation in wastewater characteristics, particularly in colour, pH and COD value.

Traditional methods used for the treatment of textile wastewater include biological, physical, chemical and their various combinations [1–3]. Electrochemical oxidation of industrial effluents can take place through two different

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