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Comparative Study of 4-dimensional DSA on Electrochemical Treatability of a Reactive Dye †

Priya Saxena [1,*], Jayesh Ruparelia [2], Parag Saxena [3]

[1] Associate Professor, Department of Chemical Engineering, Parul Institute of Technology, Parul University, Vadodara, Gujarat, India; priyasaxena2080@gmail.com (P.S.);
[2] Professor, Department of Chemical Engineering, School of Technology, Nirma University, Ahmedabad, Gujarat, India; jr@nirmauni.ac.in (J.R.);
[3] Head, Department of Chemical Engineering, Parul Institute of Technology, Parul University, Vadodara, Gujarat, India; parag.saxena8785@paruluniversity.ac.in (P.S.)
* Correspondence: priyasaxena2080@gmail.com (P.S.);
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Abstract: Electrochemical oxidation is an emerging advanced wastewater treatment technology for refractory organic wastewaters from industrial sources, including dyes, tannery, pharmaceuticals, landfill leachates, etc. The removal of dyes from textile wastewater before its discharge or reuse is a challenging task. The present study attempts to treat synthetic wastewater containing Reactive Black-5 (RB-5) dye by indirect electro-oxidation using Dimensionally Stable Anode (DSA) type working electrodes. In this study, four different 4-dimensional (D) DSAs tested for RB-5 electro-oxidation were indigenously fabricated in a laboratory using titanium (Ti) as substrate by thermal decomposition method. Effects of these freshly fabricated electrodes viz. Ti/ZrO-RuO_2-Sb_2O_5-SnO_2, Ti/CeO-RuO_2-Sb_2O_5-SnO_2, Ti/CoO-RuO_2-Sb_2O_5-SnO_2, and Ti/AgO-RuO_2-Sb_2O_5-SnO_2 were studied on percentage removal and decolorization of 500 mg/L of synthetic RB-5 dye solution. Laboratory scale batch reactor of 1 L capacity and a working volume of 500 mL was used under operating conditions of constant ionic strength at neutral pH, the current density of 50 mA/cm^2, an interelectrode distance of 8mm, and electrolysis time of 1 hr for all experiments. NaCl was used as a supporting electrolyte. Colour, COD, and TOC reduction were monitored at regular time intervals using UV-Vis spectrophotometer, COD reactor, and TOC analyzer, respectively. Surface morphology, coating microstructure, and composition of the best performing anode were characterized using SEM-EDX and XRD. Maximum color, COD, and TOC reduction attained were 99%, 80%, and 39%, respectively, employing Ti/ZrO-RuO_2-Sb_2O_5-SnO_2 electrode. Further detailed analysis was carried out for all tested anodes in terms of instantaneous current efficiency (ICE), energy consumption, and evaluation of kinetic rate constants.

Keywords: electrochemical oxidation; dimensionally stable anode; thermal decomposition method; reactive black-5; COD; TOC; colour; characterization; SEM; XRD.

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Conflicts of Interest

The authors declare no conflict of interest.