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"Gheorghe Asachi" Technical University of Iasi, Romania

OPTIMIZATION OF THE ELECTRO-FENTON PROCESS FOR TREATING DISTILLERY SPENT WASH USING VARIOUS ELECTRODES: A RESPONSE SURFACE METHODOLOGY APPROACH

Lohith Halekoppalu Dyavegowda*, Rashma Shetty, Lokeshappa Basappa, Pooja Palakshi Naik, Bhoomika Veeranna Kubasad

Department of Studies in Civil Engineering, University B.D.T College of Engineering, Davanagere-577004, Karnataka
A Constituent college of Visvesvaraya Technological University, Belagavi-590018, Karnataka, India

Abstract

The distillery industry, an aggro-based sector, generates approximately 8–10 liters of spent wash per liter of alcohol produced. This effluent is highly concentrated and poses significant environmental challenges. In this study, the Electro-Fenton (EF) process was employed for the treatment of distillery spent wash using various combinations of iron, aluminum, and zinc electrodes in a batch reactor setup. Response Surface Methodology (RSM) was applied to optimize process parameters and evaluate the removal efficiencies of Chemical Oxygen Demand(COD), color, and Total Dissolved Solids(TDS). The key variables analyzed were electrolysis time (30, 75, 120 minutes), electrode distance (1.5, 2.0, 2.5 cm), voltage (10, 20, 30 V), and agitation speed (300, 600, 900 RPM). Among the electrode combinations tested, iron–iron (Fe–Fe) plane-punched electrodes demonstrated the highest COD removal efficiency of 92.27% at 75 minutes, 1.5 cm spacing, 30 V, and 600 RPM. Aluminum–Aluminum (Al–Al) plane-punched electrodes showed superior performance in removing color (95.73%) and TDS (92.88%) under conditions of 120 minutes electrolysis time, 2.0 cm electrode spacing, 30 V, and 600 RPM. On comparing Zn–Zn electrodes with Al–Al and Fe–Fe electrodes, the latter showed significantly better removal efficiencies. Notably, the iron electrode system also generated a considerable amount of sludge. The results indicate that the EF process is effective for initial treatment of distillery spent wash, particularly in reducing high organic loads. However, due to incomplete degradation of pollutants, additional treatment steps are recommended prior to final discharge into the environment.

Key words: distillery spentwash, electro-fenton, electrode distance, electrolysis time physicochemical treatment

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* Author to whom all correspondence should be addressed: e-mail: lohithhssharath@gmail.com; Phone: 9113081092