Desalination and Water Treatment
www.deswater.com
doi: 10.5004/dwt.2023.29139

281 (2023) 204–216
January

Optimization of chemical oxygen demand removal from petroleum refinery wastewater by electrocoagulation using tubular electrochemical reactor with a novel design

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Received 28 July 2022; Accepted 21 November 2022

ABSTRACT

In this study, removal of chemical oxygen demand (COD) from petroleum refinery effluent was investigated using a new tubular electrochemical reactor (TER) design which operated at a batch recycle model. The electrochemical reactor comprises of two concentric electrodes namely spiral aluminum rode anode and hollow cylindrical stainless steel cathode. Four parameters were investigated: current density, sodium chloride concentration (NaCl), pH, and flow rate on the COD removal efficiency, and optimized using response surface methodology. Results show that current density is the most influential parameter on removal percentage where increasing current density results in increasing the removal efficiency. Another effect of lowering flow rate resulted in high removal of COD due to the increased resistance time of effluent passing on the surface of the anode with the newly adopted design. Finding of laboratory work were obtained under optimal working conditions such as current density of 26 mA/cm^2, pH of 7.9, NaCl concentration of 1.1 g/L, and flow rate of 2 L/min. These were resulting in a COD removal efficiency of 73.36% with specific energy consumption of 30.61 kWh/kg·COD. Operating cost of the present system was found to be \$2.185 m^3 which is considered low and acceptable. Experimental results prove that the new design of TER is more efficient than the traditional design that uses in electrocoagulation system to treat wastewater generated from petroleum refinery plants.

Keywords: Electrocoagulation; Tubular electrochemical reactor; Spiral anode; Chemical oxygen demand removal; Petroleum refinery wastewater

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