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Multi-objective optimization of electrocoagulation-flotation (ECF) process for treatment of real dairy wastewater

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ABSTRACT

The present work reports treatment of real dairy products wastewater by electrocoagulation–flotation (ECF). The process was performed in a batch stainless steel reactor equipped with aluminum electrodes. The model attributed to batch ECF process was optimized employing response surface methodology (RSM) via operating variables viz. pH, current intensity, and electrolysis time in view of chemical oxygen demand (COD), total kjeldahl nitrogen (TKN), total phosphorus (TP), and turbidity, as well as fat-oil-grease (FOG) removal from wastewater. Sludge settling characteristics, specific electric energy consumption (SEEC), and biodegradability of treated effluent were also analyzed. The *p*-values with low probability (<0.05), determination coefficient (R^2 = 0.61–0.97) and the non-significant lack of fit ($p > 0.05$) showed quadratic models with a good fit with experimental terms. The process was favored at pH, 8; current intensity, 3A; and electrolysis time, 45 min. Under optimized conditions, removal of COD, TKN, TP, and FOG were 66%, 73%, 98%, and 97%, respectively. The results further indicated an improved biodegradability of treated effluent in terms of BOD_5/COD ratio (0.79 as compared to 0.41 in raw wastewater) under optimum conditions. Moreover, sludge volume index and SEEC were ~86 mL/g and 0.069 kWh/kg COD, respectively. The enhanced performance of this promising electrochemical process in the treatment of real dairy wastewater might be explained by a combination of direct coagulation/floatation of suspended organics/inorganics and indirect oxidation–reduction of dissolved chemicals by oxygen bubbles in the anode and hydrogen in the cathode, rendering it amenable to the final aerobic treatment.

Keywords: Dairy wastewater; Electrocoagulation–flotation (ECF); Energy consumption; Biodegradability; Response surface methodology (RSM)

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