Treatment of whey wastewater by electrocoagulation and electro-Fenton methods in batch mode

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\textbf{A B S T R A C T}

In the present study, real cheese whey wastewater was treated using a uniquely designed batch-type electrocoagulation reactor with a horizontal rotating screw type iron anode. The treatment efficiency and energy consumption under different operational conditions including current density (30, 35 and 40 mA/cm\textsuperscript{2}), initial pH (3, 5, 7 and 9), supporting electrolyte type and concentration (NaNO\textsubscript{3}, KNO\textsubscript{3}, KCl, NaCl, Na\textsubscript{2}SO\textsubscript{4} and K\textsubscript{2}SO\textsubscript{4} at 0.1, 0.15 and 0.20 M) were investigated. The effect of electro-Fenton by addition of hydrogen peroxide (0.05, 0.10 and 0.20 M) was also determined. The best performing operating condition was obtained at pH 3 and current density of 40 mA/cm\textsuperscript{2} with the addition of 0.20 M Na\textsubscript{2}SO\textsubscript{4} and 0.20 M H\textsubscript{2}O\textsubscript{2}. The initial chemical oxygen demand (COD) concentration of 15,500 mg/L was reduced to 1,408 mg/L with the removal efficiency of 90.92% after 90 min of the reaction demanding 10.60 kWh per kg of removed COD. In addition, the sludge obtained after electrocoagulation was analyzed to determine its characteristics using X-ray diffraction and X-ray florescence. It was revealed that hematite (Fe\textsubscript{2}O\textsubscript{3}) and magnetite (FeO.Fe\textsubscript{2}O\textsubscript{3}) phases were present in the dried sludge. It is concluded that the proposed configuration can be applied as an effective pretreatment step for the treatment of cheese whey wastewater and the obtained sludge can be used as an iron source in other applications.

\textit{Keywords:} Whey wastewater; Electrocoagulation; Iron electrode; Batch-type reactor; Electro-Fenton

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