Advanced treatment of refractory sebacic acid wastewater

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ABSTRACT

Advanced treatment of refractory sebacic acid (SA) present in wastewater discharges from SA manufacturing industry (SAWW) is reported. Ion exchange (IE), electrochemical oxidation (EO), EO coupled with electrocoagulation (EO–EC), wet air oxidation (WAO), and catalytic wet air oxidation (CWAO) experiments were conducted. It is found that SA can be efficiently removed from aqueous solutions using a strong base anion-exchange resin (Amberlite IR 400), which showed a breakthrough capacity of 49.0 mg SA/mL resin (0.485 meq/mL). However, presence of inorganic anions (SO\textsubscript{4} \textsuperscript{2-}, PO\textsubscript{4} \textsuperscript{3-}, Cl\textsuperscript{-}, and NO\textsubscript{3} \textsuperscript{-}) is detrimental. Regeneration and reuse of spent resin, the effect of inorganic anions and morphology (SEM) of spent resin were also investigated. In addition, batch EO experiments conducted using Ti/RuO\textsubscript{2}-Pt anode and stainless steel (SS) cathode showed poor mineralization efficiency (8.4%). Pd\textsuperscript{2+}-catalyzed WAO experiments performed in a high pressure reactor (473 K, 0.689 MPa, 2 h) provided more efficient mineralization of SA (42.2%) compared with EO. The results constitute an important outcome which may be useful to SA manufacturing industry.

Keywords: Sebacic acid; Ion-exchange; Electrooxidation; Catalytic wet air oxidation; Mineralization

1. Introduction

Sebacic acid (SA), (decanedioic acid, HOOC–(CH\textsubscript{2})\textsubscript{8}–COOH) is a valuable raw material for production of nylon, alkyd resins, plasticizers, lubricants, cosmetics, and pharmaceuticals [1]. Nevertheless, there are concerns regarding its hazardous health effects and acute toxicity. Oral ingestion tests on rats revealed the acute oral toxicity (LD\textsubscript{50}) to be 6,000 mg/kg rat [2]. Though specific information on its ecological toxicity is scarce, the products of its biodegradation are reported to be more toxic [2]. The health and ecological concerns associated with SA assume significance in view of its solubility in water (0.10 g/100 ml) [3].

Presently, SA is manufactured from the caustic fusion of castor oil [4]. Highly saline (TDS = 82,000 mg L\textsuperscript{-1}) liquid effluent, which contains high concentrations of SA (300 mg L\textsuperscript{-1}) and phenol (2,500–3,000 mg L\textsuperscript{-1}), is

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