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# Treatment of the OUED SMAR town landfill leachate by an electrochemical reactor

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The electrocoagulation process is an effective, fast and economic technique for the treatment of water and wastewater. In this paper, electrocoagulation (EC) has been used for the removal of COD, total nitrogen, color, turbidity and bacteria from the Oued Smar (north of Algeria) town landfill leachate, characterized by high chemical oxygen demand, high concentration of nitrogen and black color. Firstly, the effects of process variables such as inter-electrode distance, magnetic stirring speed, current density and electrode material on the treatment efficiency, sludge volume production, pH and temperature evolution during the EC process were studied. Secondly, energy consumption and operating costs were calculated with aluminium and iron electrodes under the same experimental conditions.

The findings, in this study show that an increase in current density (125-500 A/m$^2$) enhanced the speed of treatment significantly, the inter-electrode distance was 2.8 cm and the stirring speed was 150 rpm for the studied leachate. The removal efficiencies of COD, total nitrogen, color and turbidity were respectively 70%, 24%, 56%, and 60% with Al electrodes and 68%, 15%, 28%, and 16% with Fe electrodes. Electrical energy consumption and operating cost with Al electrodes were 0.022 (kWh/L), 0.54 (US$/m$^3$$_{leachate\ treated}$), respectively, and 0.019 (kWh/L), 0.47 (US$/m$^3$) with Fe electrodes.



## 1. Introduction

One of the most important problems with designing and maintaining a landfill is managing the leachate that is generated when water passes through the waste. The leachate consists of various organic and inorganic compounds which may be either dissolved or suspended. These compounds are a potential pollution problem for ground and surface waters. The removal of these compounds from leachate is the usual prerequisite before discharging the leachate into natural waters.

Conventional landfill leachate treatments can be classified into four major groups: (a) leachate transfer: recycling and combined treatment with domestic sewage [1,2], (b) biodegradation: aerobic and anaerobic processes [3,4], (c) chemical and physical methods: chemical oxidation [5], Fenton's oxidative treatment [6] adsorption [7], chemical precipitation [8], coagulation/flocculation [7,9] sedimentation/flotation and air stripping [9,10], (d) membrane processes: nanofiltration [11–13], microfiltration [13], ultrafiltration [14] and reverse osmosis, [15,16].

Electrocoagulation is a simple and efficient method where the coagulating agent is generated in situ by dissolving electrochemically either aluminium or iron ions from respectively aluminium or iron electrodes. In this process the treatment is done without adding any chemical reagent, thus reducing the amount of sludge which must be disposed [17]. Its advantages include high particulate removal efficiency, compact treatment facility, relatively low cost and possibility of complete automation [18].

In this study, a pretreatment method involving electrocoagulation process is proposed and investigated. Electrocoagulation is the process of destabilizing suspended, emulsified, or dissolved contaminants in an aqueous medium by introducing an electric current into the medium. In its simplest form, an electrocoagulation reactor may be made up of an electrolytic cell with one anode and one cathode. The conductive metal plates are commonly known as 'sacrificial electrodes' and may be made of the same or different materials (anode and cathode) [19].

Electrocoagulation has been successfully used for the treatment of wastewaters such as electroplating wastewater [17], chemical mechanical polishing wastewater [19,20], laundry wastewater [21], pulp paper mill industry [22-24] and wastewater textile [25-27] and water purification [28] and urban wastewater [29], water defluorida- tion [31] and industrial water defluoridation [32], olive mill wastewater [33–35], and tannery wastewater [36], and baker's yeast wastewater [37] and slaughterhouse wastewater [38]. It has also been used to treat the leachate by some researchers [39–41].

In the present work, the efficiency of electrocoagulation in removing COD, turbidity, color, total nitrogen and bacteria from leachate of OUED SMAR town landfill was reported. The effect of operational parameters such as current density, inter-electrode distance, magnetic stirring speed and electrode material on the process efficiency, sludge production, pH and temperature evolution

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