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Optimization of Electro coagulation on Removal of Wastewater Pollutants

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Abstract
In this work the performance of electro coagulation (EC) process was investigated and optimized under different operational conditions for the best removal of wastewater contaminants such as Nitrate, total hardness, Calcium and Magnesium. Samples were obtained from Gaza Wastewater Treatment Plant (GWWTP). Under the optimal condition (pH=7.45, inter-electrode spacing=1 cm, operating time=40 minutes and current density=3.18 mA/cm2), the results showed that the removal efficiency of total hardness, Calcium, Magnesium, Nitrate were 94.6%, 93.3%, 95.2% and 70.9% respectively by using stainless steel electrodes, while for aluminium electrodes the results were 92.83%, 93.33%, 92.30%, 50.43% respectively. For Iron electrodes, the removal efficiencies of contaminants were 87.84%, 88%, 87.64%, 57.26% respectively. In addition, the experimental results also showed that the effluent wastewater was very clear, odourless and its quality is fit for reuse.

Keywords
Electro coagulation; Removal efficiency\ Wastewater treatment; Electrodes types; Total hardness; Calcium; Magnesium; Nitrate

Introduction:
The reuse of wastewater has become an absolute necessity. Demands to the cleaning industrial and domestic wastewater to avoid environmental pollution and especially contamination of pure water resources are becoming national and international issues. The Gaza Strip is described as one of the most exploited places in the world where the level of demand on water and land resources exceed the capacity of the environment due to water shortage, contamination of water resources, densely populated area and highly intensive irrigated agriculture characterize. The water balance records revealed a water deficit. The use of wastewater as a supplemental source of irrigation is inevitable for increased agricultural production in the Gaza Strip, where irrigation supplies are insufficient to meet crop water needs.
Moreover, irrigation with treated wastewater is considered a promising practice that helps in minimizing the pollution of the ecosystem subjected to contamination by direct disposal of wastewater into surface or groundwater. The treated wastewater has several advantages over other sources of water, it minimizes pollution, augments groundwater resources by DrtificiDO recharge and it is a good nutrient source for landscape and farm irrigation. Different technologies have been reported for the treatment of water and wastewater such as: nanotechnology, Photo catalytic, Advanced Oxidation Processes and Solar Energy.

Experiment
Chemicals
Sodium chloride, sodium sulfate, sodium carbonate, potassium nitrate, sodium hydroxide, sulfuric acid and potassium dichromate, were of analytical grade and purchased for the preparation of standard solution from Merck. Standard solutions of potassium dichromate
(K2Cr2O7), sulfuric acid (H2SO4) reagent with silver sulfate (Ag2SO4) and Mercury sulfate (HgSO4) were prepared to measure the COD.

Equipment and procedure
For electrochemical tests in this work, different electrodes types were used such as stainless steel (Ss), iron (Fe) plate and aluminium (Al) electrodes. He total elective electrode area and the distance between electrodes, electrode type, electrode size, pH, current intensity and time were used as variable factors may Direct the pollutants removal efficiencies Before each run, electrodes were washed with Potassium Chloride solution to remove surface grease. At the end of each run, the electrodes were washed thoroughly with water to remove any solid residues on the surfaces and dried. The experiments were conducted in a 1000 ml glass beaker in batch mode of operation. The volume of wastewater sample was 600 ml.

Effect of electrodes materials
Electrode assembly is the heart of the present treatment facility. The most common electrode materials for electro coagulation are iron, aluminium and stainless steel [26]. The experimental removal efficiencies for Total hardness, Calcium, Magnesium, and Nitrate were (92.83%, 93.33%, 92.30% and 50.43%) respectively for aluminium electrode as shown in Figure 2 and for stainless steel electrode removal efficiencies of the above mentioned water quality parameters (Total hardness, Calcium, Magnesium and Nitrate) were 94.26%, 93.33%, 95.19% and 70.94%, respectively and for iron electrode were 87.84%, 88%, 87.64% and 57.26%, respectively. He effluent treated with iron electrode, appeared first\ greenish colour and then turned yellow colour and turbid in the first minutes.

Conclusion
The optimized conditions for this process were as follows: a current density of 3.18 mA/cm2, inter-electrode spacing of 1 cm, retention time of 40minutes and neutral pH (7.45). The diٴerent electrode materials had an eٴect on the eٴectiveness of wastewater treatment because of its mechanisms. Aluminum

electrodes marked the highest removal in turbidity (95.20%). Stainless steel electrodes marked highest removal of total hardness (94.26%), calcium (93.33%), and magnesium (95.19%), TDS (29.09%), nitrate (70.94%) and turbidity (94.56%). Iron electrodes have good removal efficienc\ and can also be applied for wastewater treatment as it is the cheapest one.

The results obtained Dier EC meet the Palestinian standards for wastewater reuse.

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