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Perspective

Deployment of the Electrodialysis Technique for the Treatment of Dairy Industrial Effluents

Ahmadu Ukattah*

Department of Pharmaceutics, Covenant University, Ota, Nigeria

DESCRIPTION

High Biological Oxygen Demand (BOD_5), Chemical Oxygen Demand (COD), and other pollutant loads are characteristics of dairy sector effluent. This study's goal was to look at how real dairy wastewater going through the electrocoagulation process would be affected by operating parameters such applied voltage, number of electrodes, and response time. Aluminum electrodes were employed for this purpose along with potassium chloride electrolytes. It has been demonstrated that as the applied voltage and reaction duration were raised, the removal efficiency of COD, BOD_5, and TSS rose as well. The findings show that electrocoagulation is effective and capable of removing 98.84% COD, 97.95% BOD_5, 97.75% TSS, and >99.9% bacterial markers at 60 V for 60 minutes.

The trials proved that electrocoagulation methods for treating dairy wastewaters were effective. A dependable method for removing contaminants from dairy wastewaters, electrocoagulation utilizing aluminium electrodes was shown to be technically feasible by the results.

Strong wastewater produced by the food processing industry, which has a high Biological Oxygen Demand (BOD5) and Chemical Oxygen Demand (COD), causes serious environmental issues. The dairy industry is generally regarded as the largest source of food processing wastewater in many countries. The dairy industry generates approximately 0.2 L-10 L of effluent per litre of processed milk, making it the most polluting among the food industries both in terms of effluent volume and characteristics. Water is required in every stage of the dairy industry's operations, including cleaning, sanitization, heating, cooling, and floor washing, consequently, the sector has a substantial water requirement.

Generally speaking, wastes from the dairy processing industry have significant concentrations of suspended solids and suspended oil grease, as well as high BOD_5 and COD levels, proteins, carbs, and lipids. Depending on the season or the stage of the product cycle, the BOD_5 concentrations in the effluent from dairy factories might fluctuate significantly. For instance, it has been observed that BOD_5 levels in cheese manufacturers range from 588 mg/L to 5000 mg/L, and BOD_5 levels in cream factories range from 1200 mg/L to 4000 mg/L. For each of these, particular remedies are needed in order to avoid or reduce environmental issues. Wide variations in flow rates are another characteristic of Dairy Wastewaters (DWs), which are linked to discontinuity in the production cycles of various products. Therefore, from the perspective of the dairy industry's need for water and the environment, dairy wastewater treatment is crucial.

The majority of the time, biological technologies such the activated sludge process, aerated lagoons, aerobic bioreactors, trickling filters, Sequencing Batch Reactors (SBR), upflow anaerobic filters, and biocoagulation are used to treat dairy effluent. Aerobic biological methods require a lot of energy, but anaerobic treatment of dairy wastewater exhibits relatively low nutrient removal, necessitating extra treatment for the effluents produced. Coagulation and flocculation, on the other hand, are physical/chemical techniques that have been successful in the past.

Because of the increased environmental constraints on effluent wastewater in recent years, research has concentrated on the treatment of wastewaters utilizing Electrocoagulation (EC). A successful electrochemical method for treating contaminated water is Electrocoagulation (EC), which has been used to treat soluble or colloidal pollutants such as wastewater from slaughterhouses, vegetable oil refineries, dairy industries, slaughterhouses, nitrate-bearing wastewater, wastewaters containing heavy metals, pesticides, and phenolic compounds, as well as drinking water to remove fluoride and humic acid.

By electrically dissolving either iron or aluminium ions from iron or aluminium electrodes, respectively, electrocoagulation includes the production of coagulants *in situ*. At the anode, metal ions are produced, and at the cathode, hydrogen gas is liberated. The flocculated particles would also be helped to float out of the water by the hydrogen gas. Both monopolar and bipolar arrangements of the electrodes are possible. The materials can be

Correspondence to: Ahmadu Ukattah, Department of Pharmaceutics, Covenant University, Ota, Nigeria; E-mail: ukattah594@gmail.com

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scraps like steel turnings and millings or aluminium or iron in plate form.

The local dairy industry in Iran's Sistan and Baluchestan province, with a processing capacity of 25,000 (mean value) kg milk per day, provided the wastewater utilized in this project. Although the effluent's quality was inconsistent, it was coloured milk, and common traits of raw dairy wastewater. Polypropylene bottles were used to collect samples, which were then maintained at 4°C until usage and delivered chilled. Before beginning the studies, the storage period ranged from one day to six weeks. Throughout this study, the effluent was sampled at various intervals, and the original features changed over time. High amounts of soluble and suspended materials were present in this effluent at first.

After a 12-hour settling period, wastewater (supernatant) was put into an electrocoagulation cell for each run. Six aluminium electrodes were connected in parallel across a bipolar batch reactor, which was used for all tests. Only the outer electrodes were wired to the power source, and as the current flowed through the electrodes, anodic and cathodic reactions took place on the surfaces of the inner electrode. The cell's effective capacity was 2000 cm^3, and its internal dimensions were 15 cm by 15 cm by 25 cm. Each batch's solution had a Volume (V) of 2 L. Each electrode (plate) had an active surface that measured 14 cm by 20 cm (submerged region), for a total size of 280 cm^2. The electrodes were spaced 2 cm apart.

CONCLUSION

To assess the effects of several experimental parameters, such as applied voltage and electrolysis time, on the removal of contaminants from dairy effluent, batch electrocoagulation studies were carried out. The outcomes of this study have demonstrated the usefulness of electrocoagulation in the real-world wastewater treatment of the dairy industry. It was demonstrated that as the applied voltage and reaction time increased, the treatment rate did as well. The energy usage did, however, rise as the applied voltage rose. In fact, the fastest treatment with the most efficient reduction in COD, BOD_5, and bacterial indicators (TC and FC) concentration was achieved at the highest voltage. Therefore, it can be concluded that the effluent from the dairy industry can be effectively treated utilizing electrocoagulation, which uses aluminium electrodes to remove COD, BOD_5, and other contaminants.