Application of Electrochemical Method for Removing Anionic Surfactant from Laundry Wastewater

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Index Terms **- COD, Electrocoagulation, LAS, Surfactant**

I.INTRODUCTION

The greywater mainly contains kitchen wastewater, laundry wash water and wastewater from bathrooms. The kitchen wastewater can be reused for irrigation in the kitchen garden itself. But the in the case of wastewater from bathrooms, usually people were reluctant to reuse it. So, among these, the wastewater that can be treated and reused is the laundry wastewater. But as there is increased population and industrialization, the quantity of these kind of wastewater is very huge, so its treatment become very challenging considering the health and cleanliness of the society. The characteristics of domestic wastewater play a significant character when they are evaluated for its reuse capacity, as we can reduce the fresh water consumption. Considering the quantity of greywater, one of the major components in it is the laundry wastewater, mainly in case where the washing was done using washing machines. Laundry water mainly contains suspended solids, organic matter, nutrient content like sulphate and nitrates, pathogens found in clothes, detergent content and pieces of fabrics. This creates a perilous situation with regard to environmental health and environmental protection. An economically suitable and highly efficient waste management method has to be developed to treat the wastewater. Surfactants are commonly used product in all over the world, it is widely present in municipal wastewater and streams.

Surfactants contain dilute and water-soluble components. These are highly soluble and so it will be difficult to remove from the water. As the washing power comprises of huge quantity of surfactants, which leads to the production of concentrated wastewater, which may affect aquatic plants and animals. Huge quantities of surfactants are used in residential as well as industrial purposes every day, and it is dispersed in different environmental cubicles like soil, water and atmosphere. Surfactants are considered as one of the most unwanted pollutants detected in the water and land environment. The aim of this study is to find the removal efficiency of anionic surfactant in wash water and allow the wash water for reuse for another washing purposes in water scared areas.

II. OBJECTIVES

- To determine feasibility of using iron electrodes in removing surfactant and COD from laundry waste water by electrochemical coagulation.
- To determine effect of parameter such as surfactant concentration, NaCl concentration, electrolysis time, current density.

III. METHODOLOGY

A. Electrode

The electrode used in this study is the iron electrode. The rectangular piece of electrode was used with the dimension of 10×2.5×0.2cm. At cathode iron electrode was used and at anode a piece of iron was dipped with spacing 2cm.

B. Preparation of synthetic laundry wastewater

The synthetic laundry wastewater was prepared as a stock solution by mixing suitable chemicals with ordinary tap water at a temperature of approximately 27°C. Laundry detergent –0.2g, boricacid-0.086g, kitchen effluent-4ml, tap water –1.5 litre were mixed to represent greywater strength, and stirred by a magnetic stirrer for one hour at 1000 rpm and stirred for a further 20 minutes before the start of subsequent experiments.

C. Experimental Procedure

The treatment of wastewater containing LAS was carried out in 1000 mL glass beaker using a magnetic stirrer for mixing the solution. A batch electrochemical unit with an electrode was consisting of an electrochemical cell, Direct current power supply with 220 volt and electrodes. Electrodes material used was Iron. The electrode had the dimension of (10×2.5×0.2cm) by spacing of 2cm between them. The electro-coagulation of the synthetically prepared laundry wastewater was carried out in 1000 ml beaker using a magnetic stirrer to provide vigorous mixing in the solution with 300rpm speed. The experiments were carried out at a temperature of 27°C. The Direct current source was supplied to the system with a variation of 12 to 18 V voltage and a current density variation of 0 to 3 A. The pH and conductivity of the solution was evaluated before the start of each experimental trial and it should be adjusted to the desired value. The pH was adjusted using an acid or alkali, here used HCl solution and NaOH solution. We can increase the conductivity of solution by adding Sodium Chloride solution in sufficient quantity. The electrodes were placed into the baker with correct spacing. The chemical reaction was started when the direct current power supply was switched on. The percentage removal of the surfactant and COD was calculated.

IV. RESULTS AND DISCUSSIONS

A. Effect of conductivity on surfactant removal

Sodium Chloride solution was used to vary the conductivity in electro-coagulation process. Sodium chloride powder was added into the solution by varying concentration as 0.5 g/L to 2.0 g/L. The effect of Sodium Chloride concentration on the removal efficiency is shown in fig1. From literatures, it was proved that as the concentration of NaCl in wastewater increases, conductivity of the solution and the current density increases. The conductivity obtained for each sample is about 1.39 (mS/cm), 2.87 (mS/cm), 4.07 (mS/cm), 4.65 (mS/cm).

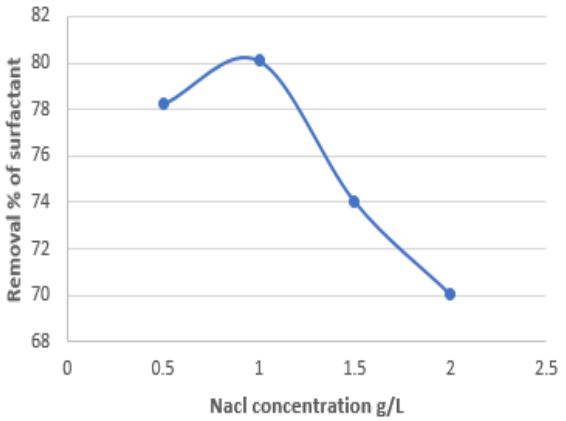

Fig. I Effect of conductivity on surfactant removal

NaCl solution can increases the conductivity of water. It can also contribute oxidising power to water. The percentage surfactant removal efficiencyof80% could be obtained by adding NaCl solution at the rate of 1 g/L.

B. Effect of conductivity on COD removal

The synthetic laundry waste water was prepared by diluting concentrated detergent. The main composition in the detergent is LAS. The initial COD of the waste water is 250mg/L.COD value decreased continuously during this case maximum removal efficiency of 50% obtained at NaCl concentration 2g/100ml and conductivity 4.65 mS/cm. The COD value of wastewater could be reduced with the rise in conductivity of solution.

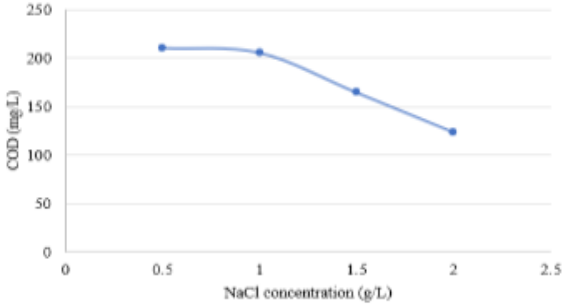

Fig. II Effect of conductivity on COD removal

C. Effect of current density

The current density has a major effect on the electrocoagulation process. Therefore, the efficiency of this parameter was studied on the LAS removal in various values 12volt, 14-volt, 16-voltand18 volts. It was discovered that higher surfactant removal of 92.30% is achieved by increasing current density up to 16 volts. The percentage removal of surfactant rate

was constant at higher values of current densities. It may be due to the increase in the current density could progress the creation of coagulant on anode and cathode, hence the removal efficiency was improved.

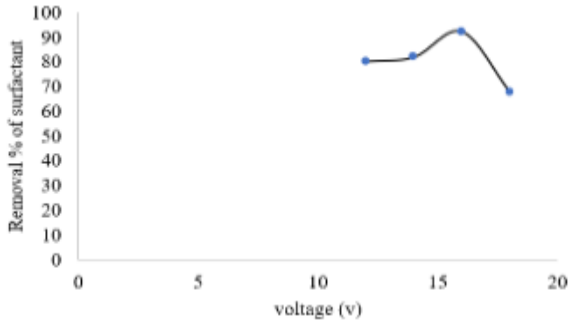

Fig. III Effect of current density on surfactant removal

D. Effect on electrolysis time on surfactant removal

The electrolysis time influences on the electrochemical process efficiency. This electrolysis time was varied in the range of 10 to 25min. Other operating conditions which were kept constant was initial concentration of surfactantof170mg/L; current densityof16 volts. During 15 min of treatment time, process efficiency reached to 96.09%. It might be due to increase in the quantity of metal hydroxide flocs which raises the removal efficiency via a coagulation followed by precipitation process.

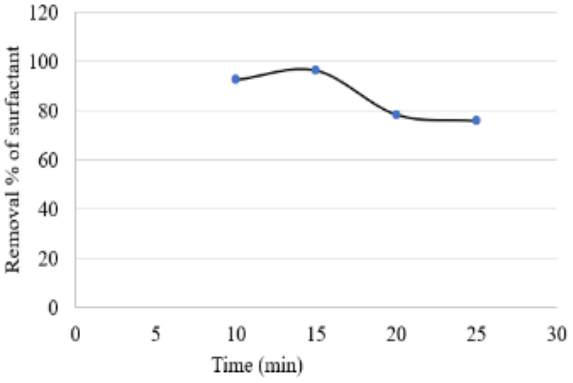

Fig. IV Effect of electrolysis time on surfactant removal

E. Effect of time intensity on COD removal

The initial COD of wastewater was 250mg/L. The removal efficiency is found by subtracting initial – final concentration by initial with 100 %. The COD value get decreased from 10 to 25min, the COD value is very low at 25 min.

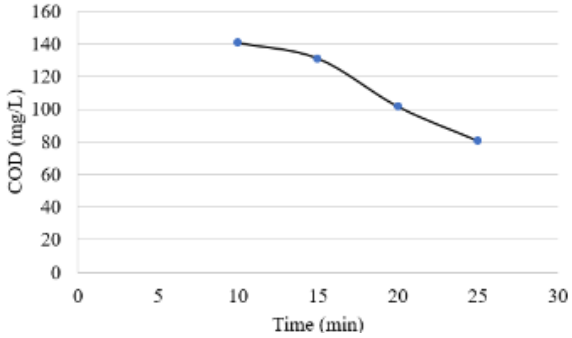

Fig. V Effect of electrolysis time on COD removal

The removal efficiency of COD from laundry wastewater has increased up to 67.73% while applying 18 volts of current at 25 min.

V. CONCLUSIONS

Surfactant consumption is increasing tremendously with no limits and restrictions, which are equally contributed by the domestic and industrial purpose. This kind of increase in such contaminants may affect the ecosystem and it will create environmental problems including toxic environment in terrestrial and aquatic ecosystem. In this study, the efficiency of iron electrode was checked in electrochemical coagulation process for LAS removal from aqueous solutions. Hence, the impact of multiple operating conditions such as direct current density (mA/cm^2), different initial surfactant concentrations, electrocoagulation time and Sodium chloride concentration using rectangular shaped iron electrode material. The experimental results show that the iron electrode is more efficient for LAS removal from wastewater. The appropriate conditions for electrochemical reaction were as follows:15 min retention time, 16-volt current density, 170mg/L initial surfactant concentration and 1.0 g/L Sodium Chloride concentration. Considering the optimum conditions,96.09% of surfactant was removed using iron as an electrode. It was found that the electrochemical reaction with iron electrode is an efficient in LAS removal from aquatic environments.

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