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Distillery Wastewater Treatment by Electrocoagulation Process

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Abstract: ***In the present study biodigester effluent (BDE) is treated through electrocoagulation (EC) using aluminium electrode in a batch reactor. EC process is well applicable to treat BDE in term of COD and color removal. from the BDE. The effect of operating parameters including pH, current density, inter electrode gap, and reaction time has been analysed. The COD removal of86% and color removal of 63% were achieved at the optimum condition (pH 8 and CD of 153 A/m^2).***

Keywords: Biodigester effluent, COD reduction, electrocoagulation, aluminium electrode

1. Introduction

Water is indispensable for the existence of all living species in this biosphere, especially human being. It is required for domestic, industrial and commercial uses. Out of the total water used**,** only 10% water was used for the industrial application in the year 1950, which increased to 70% in 2010 [1]. The demand of water is increasing day by day; therefore number of countries are facing the problem of accessibility of clean water. The WHO has predicted that in next 25 years, the availability of fresh water will become a global challenge. India has only 4% of the water resources for sustaining 18% of the world's population [2]. Hence optimized usage of water resources is the need of the hour.

Distillery industries represent an important segment of the world economy and are amongst the highest polluting industries after the paper industry [3]. For the production of single unit of ethanol, 15-unit fresh water is required [4]. Environmental issues have become one of the important factors controlling the growth of distillery industries during recent years [5]. So, it is very necessary to treat effluent from the distillery in a manner that the effluent generated can be reused again for the process.

2. Experimental Section

Wastewater sample

The wastewater sample (BDE) is supplied by the CADIA Pvt Ltd Raipur (India). The different parameters of BDE are characterized by the standard methods of analysis [7]and are presented in Table 1. Chemicals like H_2SO_4, NaOH, and anhydrous alcohol used in experimental work are of analytical grade (AR) and supplied by Merck Company.

Table 1: Characteristics of rice grain based biodigester effluent

Parameter	Range
pH	7.2
COD (mg/dm^3)	4189
BOD (mg/dm^3)	617
TDS (mg/dm^3)	12102
TSS (mg/dm^3)	5312
Conductivity (milli mho)	6.3
Cl^-(mg/dm^3)	139
Color (PCU)	401

Experimental Setup

The electrocoagulation reactor (EC) that fabricated by perspex glass and offered in Figure 1. The size of EC reactor is 10.7 × 10.7 × 13.7 cm. Aluminium electrode size of 8 × 7 cm (four electrode) are put in EC reactor with proposed gap. Solution contained in EC reactor is agitated by magnetic stirrer. A distance of 3 cm was kept between the electrode and the bottom of the reactor for the mixing of solution. Direct current (DC) is provided through DC supplier that belong to the current range of 0-5A and voltage range of 0-30 V. The current is controlled through regulator.15 ml sample is collected at fixed time intervals and filtrated by Whatman filter paper of size 42 for COD and color analysis.

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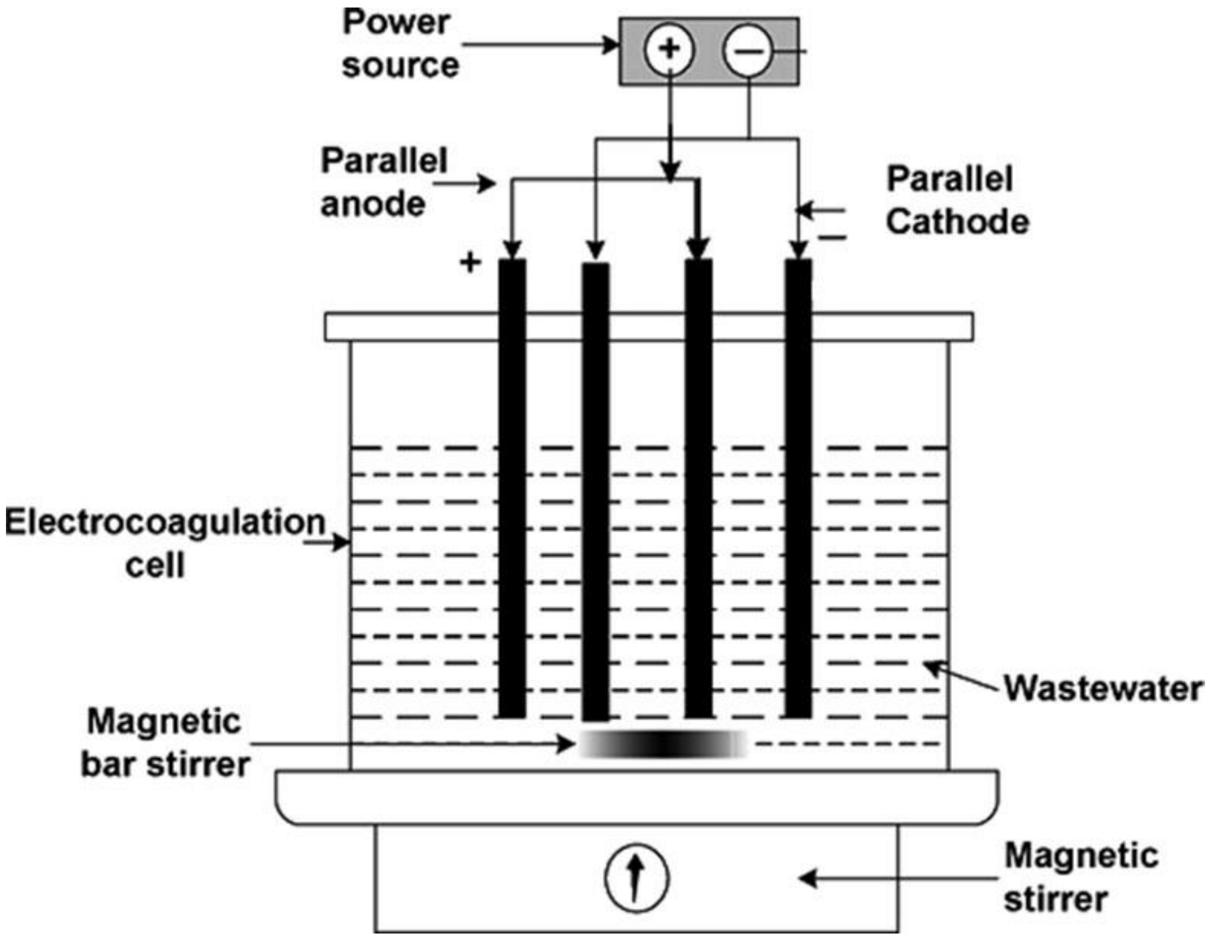

Figure 1: Schematic diagram of the experimental setup used for the electrocoagulation study

3. Results and Discussions

3.1 Mechanism of Electrocoagulation

EC process is based on the discharge of metallic ions through DC supplies on metal electrode. Metal ions added with negative ions that passes by colloids consequently effective size of particle enhances and settledown through the gravity [8].

3.2 Effect of pH

The pH of the solution is one of the very important parameter during the EC process. Hence the effect of pH on BDE is observed at varying pH range of 2-10 at current density of 102 A/m^2 and presented in Figure 2. The maximum COD and color reduction of 84% and 58% achieved at pH 8. This may be due to amount of metal ions generation and availability of negative ions that produced by colloids is balanced at this particular pH [9, 10]. Further increase or decrease in pH not significant COD and color has been observed.

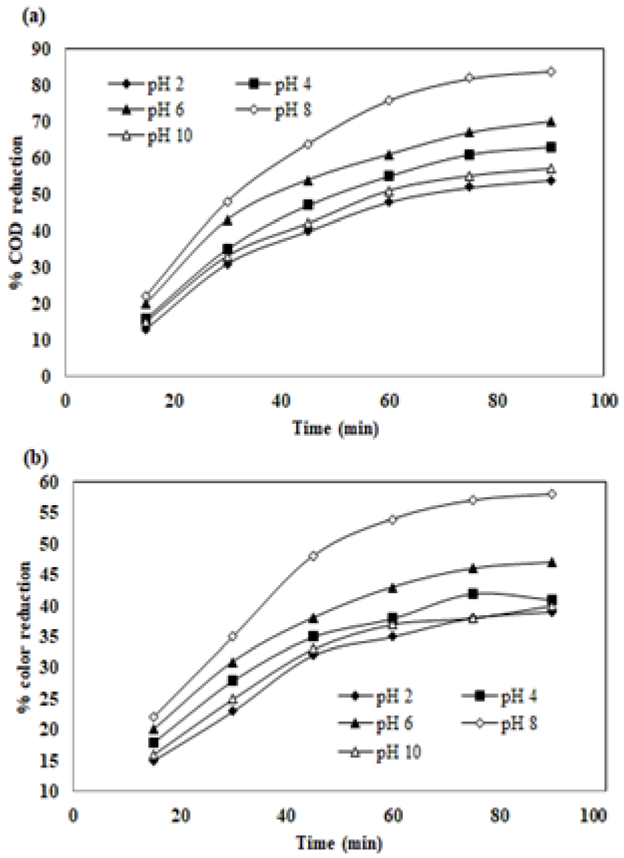

Figure 2: Effect of pH on (a) COD reduction and (b) color reduction

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3.3 Effect of current density

The current density is also a surrogate parameter during the EC process. Hence the effect of CD on BDE is examined at varying CD range of 51-204 A/m^2 at pH 8 and presented in Figure 3. The maximum COD reduction of 86% and color reduction of 63% are achieved at current density of 153 A/m^2. Further increase in current density, COD and color reduction decreases. Because at high current density amount of metal ions enhances that destabilizes the colloids [11-13].

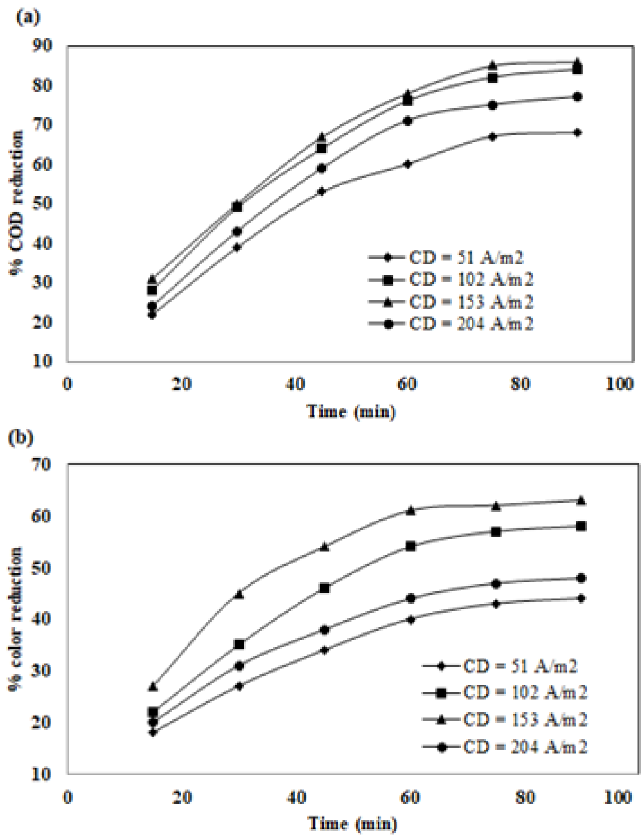

Figure 3: Effect of pH on (a) COD reduction and (b) color reduction

4. Conclusion

This work is oriented on the performance/optimization of EC processes for removal of COD and color removal from BDE. The effect of various operating parameters included pH and CD on EC treatment was studied. The maximum COD and color reduction efficiency of 86 % and 63 % was achieved at their optimum condition.

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