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COMPARATIVE ASSESSMENT OF IRON AND ALUMINIUM ELECTRODE FOR TREATMENT OF DISTILLERY SPENT WASH BY ELECTRO COAGULATION METHOD

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ABSTRACT

Distillery industry is one of oldest industries which is highly complex and characterized by high BOD, COD, suspended solids, dissolved solids, total solids, and color. Untreated distillery spent wash when discharged directly into the water bodies or into open lands cause irreversible damage to environment. Coagulation-flocculation is one of the most important physicochemical treatment steps employed in industrial wastewater treatment to reduce suspended and colloidal materials responsible for turbidity of wastewater. In the present study electro-coagulation treatment is carried out by using different combination of aluminum and iron electrodes in a batch reactor. Maximum 97.64% colour removal was obtained by using Al-Al electrodes for pH 9 and maximum COD removal was obtained 98.39 % by using Al-Al electrodes for pH 9 at electrode distance of 3cm. Keywords— Iron, Aluminium , Distillery Spent Wash

I. INTRODUCTION

Water covers 71% of the Earth's surface. It is vital for all known forms of life. On Earth, 96.5% of the planet's crust water is found in seas and oceans, 1.6% in groundwater, a small fraction in other large water bodies, and 0.001% in the air as vapor, clouds (formed of ice and liquid water suspended in air), and precipitation. Only 2.5% of this water is freshwater, and 98.8% of that water is in ice (excepting ice in clouds) and groundwater. Less than 0.3% of all freshwater is in rivers, lakes, and the atmosphere, and an even smaller amount of the Earth's freshwater (0.003%) is contained within biological bodies and manufactured products. A greater quantity of water is found in the earth's interior.

The production of by product from sugarcane includes white crystalline sugar, Ethanol, Potable liquor, Industrial alcohol etc. India produced a total of 8.6 million MT of molasses in year 2006, which is used to produce ethanol and potable liquor. During the wastewater is generated in various manufacturing processes like fermentation, distillation column and rectification column etc. The byproduct of sugar cane molasses like

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potable liquor and industrial alcohol are derive fractional distillation of residual part of sugarcane juice after extraction of crystalline juice and hence it contains the major polluting parameter like Chemical oxygen demand, Biological oxygen demand, total solids, Chlorides and Sulphate. The place into soil and water therefore most efficient treatment for such wastewater is required so as to reduce the concentration of the parameter up to the limits specified by the central pollution board. The conventional physio chemical treatment used by the distillery units for treatment of wastewater may be Chemical coagulation, flocculation, Adsorption, Oxidation, anaerobic lagoon, membrane filtration etc. but as these treatment having cost, maintenance and requires a high detention time which ultimately increases the overall treatment process time. To overcome the limitation and disadvantage of the conventional treatment unit treatment can be used to archive maximum removal efficiency. Nowadays a new sustainable technology is replacing the conventional treatment unit which is based on the electrochemistry.

In the conventional chemical coagulation are added water-soluble inorganic salts containing hydrolysable metal cations, usually are used aluminum sulfate or ferric chloride. In the electrocoagulation technique these cations are generated in situ through the electrolytic dissolution of sacrificial anodes, usually iron or aluminum plates are used. This cell arrangement provides a simple set-up, which facilitates easy maintenance. In this arrangement the sacrificial electrodes are positioned between the two parallel electrodes without any electrical connection. Not more than two monopolar electrodes are connected to the electric power supply without any interconnections among the sacrificial electrodes. The neutral sides of the conductive plate will be changed to charged sides when current is passed through the two electrodes. This side has opposite charge contrast to the corresponding side near it. The sacrificial electrodes in this scenario are called as bipolar electrodes.

A. Materials

In the conventional chemical coagulation are added water-soluble inorganic salts containing hydrolysable metal cations, usually are used Aluminum sulphate or ferric chloride. In the electrocoagulation technique these cations are generated in situ through the electrolytic dissolution of sacrificial anodes, usually iron or Aluminum plates are used. This cell arrangement provides a simple set-up, which facilitates easy maintenance. In this arrangement the sacrificial electrodes are positioned between the two parallel electrodes without any electrical connection. Not more than two monopolar electrodes are connected to the electric power supply without any interconnections among the sacrificial electrodes. The neutral sides of the conductive plate will be changed to charged sides when current is passed through the two electrodes. This side has opposite charge contrast to the corresponding side near it. The sacrificial electrodes in this scenario are called as bipolar electrodes.

Aluminum is a chemical element in boron bunch with image Al; it is a light metal and a gleaming white, delicate, nonmagnetic bendable metal. It is the third most plenteous component in the world's hull. Aluminum is a decent warm and electrical conduit; additionally it is fit for being a superconductor. Erosion resistance is incredible because of a meager surface layer of Aluminum oxide that structures when it is presented to air.

Iron is the most common element on the earth, which can be easily available. Iron electrodes have been preferred over Aluminum due to their durability and low cost. Taner can et al., (2003) studied that iron is superior to Aluminum as sacrificial electrode material, from COD removal efficiency and energy consumption view. All chemicals used were of analytical reagent (AR) grade from NICE Chemicals, Bangalore. Stock solution of their agents of 1000 mg/L was prepared. The chemicals included sodium thiosulfate, sulphuric acid,

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alkali iodide azide,sodiumsulphide, manganoussulfate, ferroin indicator, ferrous ammonium sulphate, mercuric sulphate, sodium chloride, silver nitrate, calcium carbonate, silver sulphate ,potassium dichromate, potassium chromate, sodium hydroxide, EDTA, ammonium chloride, Erichrome Black T Indicator, phenolphthalein Indicator were used to analyse the parameters of distillery spent wash.

B. Methods

For batch electrocoagulation studies the reactor will be made up of acrylic material with the total working volume of 2 liter Capacity. The electrocoagulation unit will be consisting of two electrodes in the reactor and DC power supply. The DC source of 0-30V and 0-2A will be used as power supply to this system. Iron and aluminium will be used as electrode having dimensions of 5 mm thickness and 150 mm x 50 mm measurements.

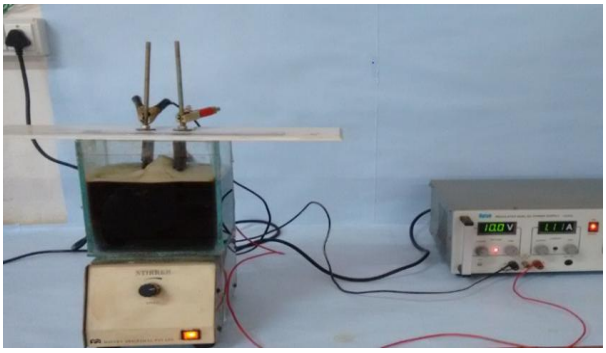

Figure 1. Photographic representation of experimental setup

II. RESULTS AND DISCUSSION

2.1 Characteristics of Distillery Spent Wash

The initial characteristics such as pH, Turbidity, BOD_5, COD, TDS, and color of Distillery spent wash as shown in Table 1.

Table 1 Initial Characteristics of Distillery Spent Wash

Sl No.	Parameter	Unit	Values
1	pH	-	4.15
2	TDS	mg/L	12,300
3	Turbidity	NTU	15880
4	Conductivity	µs/cm	22470
5	TDS	mg/L	12300
6	Color	PtCo	316000
7	BOD_3	mg/L	59072
8	COD	mg/L	132000
9	Total Nitrogen	mg/L	29300

Table 1.1 and Figure 1.1 shows the Variation of Parameters at Optimum pH=9, D=3cm, V=15v using Fe-Fe Electrodes.

Sl no	parameters	Unit	Before EC	After EC	% of Removal efficiency
1	COD	mg/L	134000	7200	94.63
2	BOD	mg/L	59072	3333.3	94.36
3	TDS	mg/L	12300	2225	81.91
4	Colour	Pt.co	316000	81996	74.05
5	EC	uS/cm	22470	4090	81.80
6	Turbidity	NTU	15880	1084	93.17

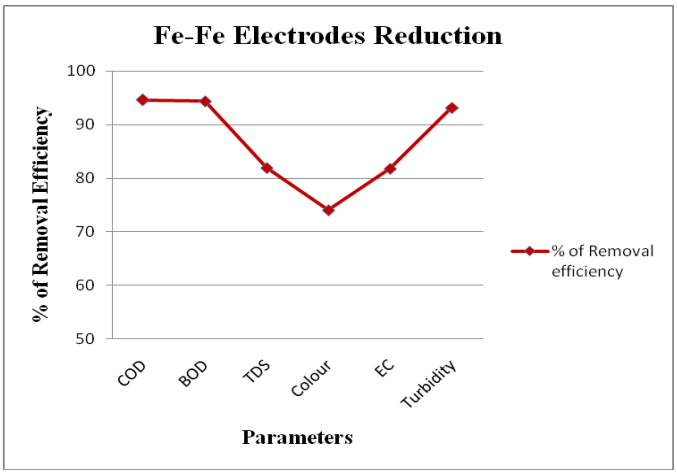

Figure 1.1 Shows the Various Parameters at Optimum Condition.

Table 1.2 and Figure 1.2 Shows the Variation of Parameters at Optimum pH=9, D=3cm,V =15v using Al-Al Electrodes.

Sl no	parameters	Unit	Before EC	After EC	% of Removal efficiency
1	COD	mg/L	134000	2156	98.39
2	BOD	mg/L	59072	1437	97.57
3	TDS	mg/L	12300	1979	83.91
4	Colour	Pt.co	316000	7450	97.64
5	EC	uS/cm	22470	3486	84.49
6	Turbidity	NTU	15880	182	98.85

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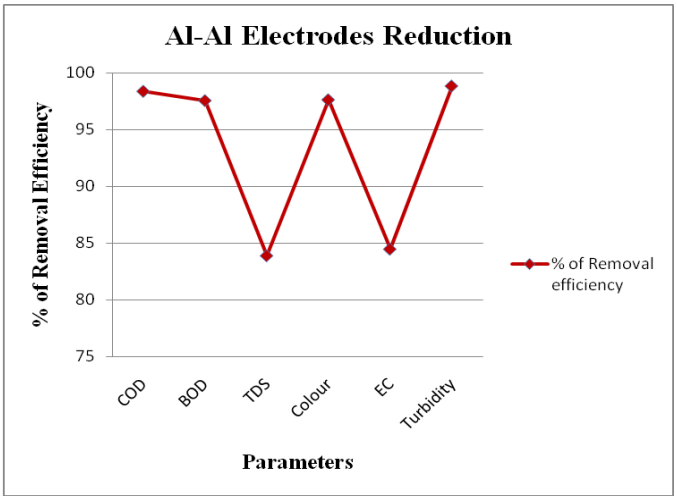

Figure 1.2 Shows the Various Parameters at Optimum Condition.

The electrocoagulation method was carried out batch mode of operation by using Fe-Fe electrode and results were obtained as show in the table 1.1 and removal efficiency of distillery spentwash parameters are representing by plotting the graph parameter verses percentage of removal efficiency as show in the figure 1.1. The maximum removal COD, BOD, TDS, Colour, EC and Turbidity of 94.63%, 94.36%, 81.91%, 74.05%, 81.80% and 91.17% respectively were obtained operating parameters of a distance of 3cm, 90 minutes contact, and voltage of 15V and pH of solution 9. Similarly, Al- Al electrodes are using in electrocoagulation process and results are show in the table 1.2 and graph were plotted parameter verse percentage removal efficiency as show in the figure 1.2. The maximum removal COD, BOD, TDS, Colour, EC and Turbidity of 98.39%, 97.57%, 83.91%, 97.64%, 84.49% and 98.85% respectively were obtained operating parameters of a distance of 3cm, 90 minutes contact, and voltage of 15V and pH of solution 9.

2.2 Comparison of the electrodes

It can be noticed that the parameters of distillery spentwash viz, COD, BOD, TDS, Colour, EC and Turbidity removal efficiency of Al-Al electrodes is higher as compared to the Fe-Fe electrodes.

III. CONCLUSION

The distillery spentwash treated by electrocoagulation method was carried out using Al-Al and Fe-Fe electrodes in batch mode of operation and the optimum values of various operating parameters were obtained. The optimum value of voltage was found to be 15V at pH of the solution 9, The batch studies revealed that maximum removal COD, BOD, TDS and Turbidity of 98.39%, 97.57%, 83.91% and 98.85% respectively were obtained at an optimum operating parameters of 90 minutes of contact, voltage of 15V, at distance of 3cm and pH of 9 by using Al-Al electrodes. Optimum decolourization of spent wash found to be 97.64% for 15 volt at a distance of 3cm. So it can be concluded that the electrocoagulaton technique can be successfully employed for the treatment of distillery effluent having high organic content.

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