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Electrochemical Treatment for Colour Reduction in Textile Wastewater

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Abstract: This work is focused on the reuse of textile wastewater with electrochemical process. The present study investigates the influence of operating parameters (electric potential , distance between the electrodes ,electrolysis time , etc.) on color , Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD) ,Total Dissolved Solids(TDS) ,Total Suspended Solids(TSS), hardness, removals. Experiment were carried out on laboratory scale on textile waste, with a variation of Aluminum, Stainless steel , Iron (Al, SS, Fe) electrodes in combination mode (Al-SS, Al-Fe). The results indicate that electrochemical treatment (EC) with Al-Fe electrodes gives better results as compared with Al-SS electrodes.
Keywords: Effluent, aluminum, stainless steel electrodes, COD, BOD, TDS, TSS, hardness.

I. INTRODUCTION

The textile industry occupies an important place in the economy of India and developing countries. Textile processing consumes enormous quantity of water and chemicals for various operations like washing, dyeing, etc [1]. Recently water consumption and waste generation have become considerable concerns for textile manufacturers and finishers [11,16].

The textile industries can be divided into drying processes and wet processing from a standpoint of water usage. The drying process uses a small amount of water and contributes an insignificant load to wastewater generation. On the other hand, the wet processing involves many operations such as preparation, dyeing, printing and finishing which consume large quantity of water and is, therefore, the major source of textile industry wastewater [4].

Waste stream generated in this industry is essentially based on water-based effluent generated in the various activities of wet processing of textiles. The main cause of generation of this effluent is the use of huge volume of water either in the actual chemical processing or during re-processing in preparatory, dyeing, printing and finishing. In fact, in a practical estimate, it has been found that 45% material in preparatory processing, 33% in dyeing and 22% are re-processed in finishing [2]. Wastewater from dyeing and finishing processes in the wet process constitute a substantial source of pollution which exhibits intense colour, high chemical oxygen demand, fluctuating pH and suspended particles [4, 19]. Textile wastewater must therefore be treated before final discharge to achieve legal and discharge standards. The reuse of wastewater has become an absolute necessity [4].It is essential that control measures be implemented to minimize effluent problems [17]. So far, several biochemical, chemical and physical treatment methods were applied to treat textile wastewater [5] .

Because of the large variability of the composition of textile wastewater, most of these traditional methods are becoming inadequate [6]. However, physical methods such as adsorption and precipitation are relatively time-consuming and costly, while most chemical methods such as additions of aluminum sulfate and chlorine can generate problems. Some other advanced technologies such as photo oxidation by UV/H2O2 or UV/TiO2 also generate secondary pollutants. Biological treatment of textile wastewater has low efficiency because of the toxicity of dye molecules to active microorganisms [11,13] . Electro coagulation (EC) is an attractive method for the treatment of various kinds of wastewater, by virtue of various benefits including environmental compatibility, versatility, energy efficiency, safety, selectivity, amenability to automation, and cost effectiveness [4].

Electrocoagulation offers some distinct advantages over existing processes such as ambient operability conditions, no threat of secondary pollution due to the absence of any extra chemicals. The electrocoagulation process is attractive due to its simplicity of operation, control and effective removal efficiency [13] .

The use of electrocoagulation for the treatment of wastewater has been reported by various authors. A literature survey indicated that electrocoagulation is an efficient process for different waste, e.g. soluble oils, liquid from the food,textile industries and effluents from the paper industry[4]. D. Ghosh, C.R. Medhi, H. Solanki, M.K. Purkait(2008) [12] reported study on decolorization of Crystal Violet Solution by Electrocoagulation using aluminum sheet as electrode. Important parameters (like; current density, initial dye concentration, initial pH, interelectrode distance and quantity of different salts) that affect the extent of crystal violet

removal were studied in detail. The results showed that 99.75% of crystal violet was decolorized for initial dye concentration of 100 mg/L with the current density of 1112.5 A/m^2, solution conductivity of 1.61 S/m and initial pH of 8.5 at the end of 1hr of operation.
Arslan-Alaton , I. Kabdaslı and Y. Sahin (2008) [5] reported study on Effect of Operating Parameters on the Electrocoagulation of Simulated Acid Dyebath Effluent with aluminum (Al) and stainless steel(SS) electrodes.
The results indicatesmaximumremoval of (100% for EC with SS electrodes) color and partial (around 50% for EC with SS electrodes) COD removal could be achieved *via* electrocoagulation using Al as well as SS electrodes once working conditions were optimized.
The study also revealed that electrocoagulation with SS electrode was more attractive both in terms of treatment performance as well as electrical energy and sludge handling costs; the electrical energy requirement and sludge production rate.
Khanittha Charoenlarp and Wichan Choyphan (2009) [4] studied the reuse of dye wastewater by removing its colors with the electrochemical process Experiments were carried out on a laboratory scale on two types of dyes, namely, reactive dye and basic dye, with a variation of two types of electrode, namely, aluminum and iron. It was found that the electrode materials had influence on the dye removal efficiency.
The aluminum electrode with 20 volts and 180 minutes of electrolysis was efficient in removing 96.05% of reactive dyes and 35.18% of dissolved solids, while the iron electrode with 25 volts and 180 minutes of electrolysis could reduce almost 85.61 % of basic dye, 30.67 % of dissolved solids, 66.67% of suspended solids, 20.61% of turbidity and 79.51% of COD.
Mehmet Kobya , Orhan Taner Can, Mahmut Bayramoglu(2003) [21] reported study on Treatment of textile wastewaters by electrocoagulation using iron and of aluminum electrode materials The effects of relevant wastewater characteristics such as conductivity and pH, and important process variables such as current density and operating time on the chemical oxygen demand (COD) and turbidity removal efficiencies have been explored. The results show that iron is superior to aluminum as sacrificial electrode material, from COD removal efficiency and energy consumption points.
In present study work has been carried out on textile effluent by electrolytic treatment and effects of experimental parameters on chemical oxygen demand (COD), biological oxygen demand (BOD) ,total dissolved solids(TDS) ,total suspended solids(TSS) ,hardness removal were studied and optimized.

II. MATERIALS AND METHODS

A. Materials

Advanced analytical instruments like electrolytic cell (1000ml capacity),
Plate type aluminum, stainless steel and iron electrodes (150x50x2mm. dimensions),
Digestion flask, conical flasks, glass bottle with stopper, pH meter, incubator,etc.

B. Chemicals

Potassium dichromate, Silver sulphate, Ferrous ammonium sulphate, Conc. Sulphuric acid, Phenonthroline monohydrate, Ferrous sulphate, etc.
Industrial composite effluent from textile processing unit from Ichalkaranji ,Kolhapur.

C. Experimental Method

The effluent was collected and treated as per the following sequence

1) The electrodes are placed inside the beaker (acting as an undivided electrolytic cell).of 1000ml capacity.
2) The electrodes in the cell connected to a digital dc power supply (0-30V, 2Amp).
3) The electrolysis was carried out for different time intervals by varying the voltage.
4) Combination of electrodes Al-Fe and Al-SSwere used by varying distance between electrodes as 4cm & 6cm.
5) Floating sludge was removed from the top and settling sludge was allowed to settle completely before filtration.
6) .Filtering the treated effluent from the cell and can be sent to further treatment.
7) Carrying out testing method for raw effluent as well as treated effluent for the parameters like COD, TDS, pH, TSS, BOD etc.

D. Testing and Analysis.

Chemical oxygen demand (COD), biological oxygen demand (BOD) ,total dissolved solids(TDS) ,total suspended solids(TSS) ,hardness measurements were according to the Standard Methods. [8]

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III. RESULTS AND DISCUSSION

Table No.1 -Effect of distance between the electrodes, type of electrode, voltage and time of electrolysis on Chemical Oxygen Demand (COD)

Time (Min.)	COD Value before treatment (mg/l)	Values of COD after treatment(mg/l)											
		5 V				7.5 V				10 V			
		Al-Fe		Al-SS		Al-Fe		Al-SS		Al-Fe		Al-SS	
		4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.
5	427	241	231	247	235	230	230	230	230	225	241	231	240
20		241	232	247	232	231	228	231	227	227	239	220	231
60		237	220	242	220	231	228	231	227	220	239	220	230
70		237	221	241	221	230	226	227	225	221	240	221	231

Graph-1

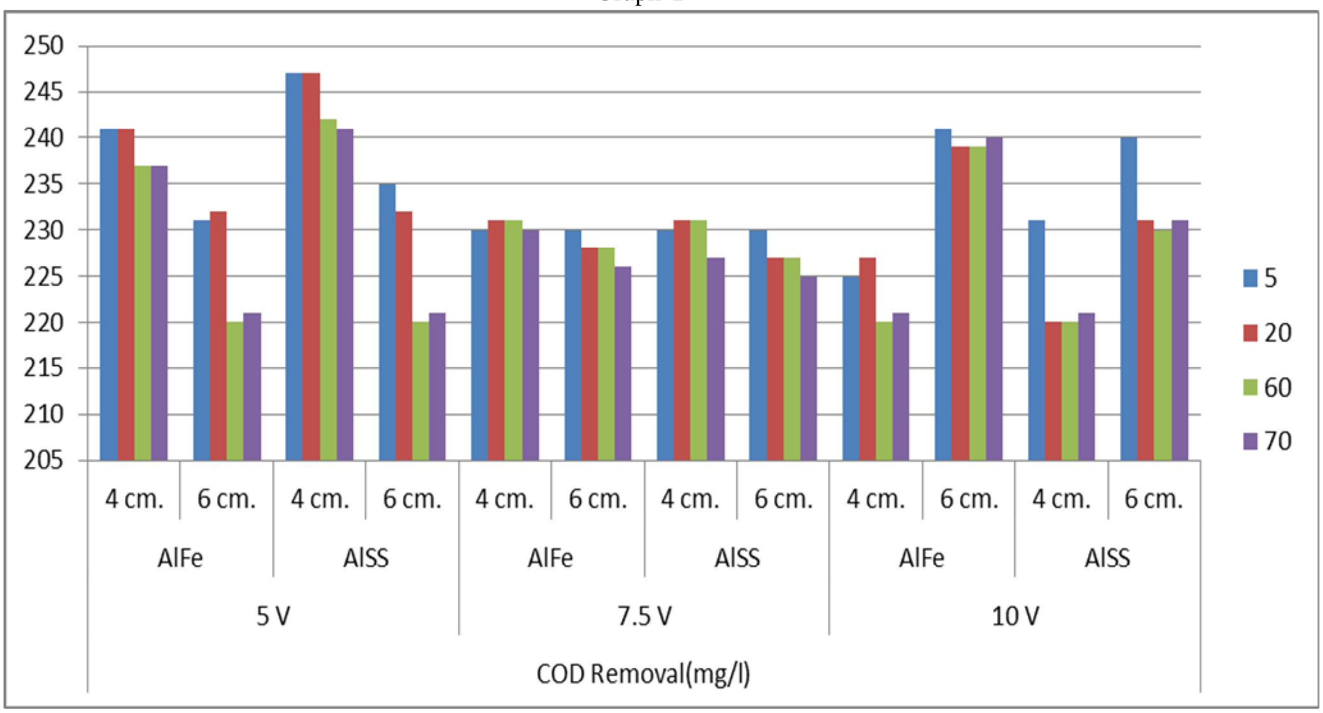

Table no.1 and graph 1 , indicates the value of COD which was 427 mg/l before treatment and after electrolysis with 5V current by using Aluminum and Iron electrode with 4cm. distance between electrodes . The COD values were found to be 241 mg/l at 5 minutes electrolysis time and as the time increases from 5 minutes to 20 minutes, 60 minutes and 70 minutes the corresponding values were found to be 241 mg/l, 237 mg/l and 237 mg/l. The values indicates the marked reduction in COD values before and after electrolysis and is in the range of 43.56% and 44.5% respectively and the values were well within the permissible limits laid down by Pollution Control Board. As compared to type of electrodes with Iron and Stainless steel the reduction in COD values were not much significant. The distance between the two electrodes i.e. 6cm. gives somewhat better results as compared to 4cm. As regards voltage 7.5V current gives slightly enhanced results when compared with the COD values of 5V and 10V .The variation in time of electrolysis shows no significant difference in COD values, however 60 minutes time of electrolysis gives better results of reduction in COD values as compared to 5 minutes, 20 minutes and 70 minutes.

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Table No.2 - Effect of distance between the electrodes type of electrodes, voltage and time of electrolysis on Total Dissolved Solids (TDS) –

Time (Min.)	TDS value before treatment (mg/l)	Values of TDS after treatment(mg/l)											
		5 V				7.5 V				10 V			
		Al-Fe		Al-SS		Al-Fe		Al-SS		Al-Fe		Al-SS	
		4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.
5	4300	2620	2523	2701	2610	2179	2101	2199	2143	2095	2093	2131	2097
20		2612	2501	2700	2610	2170	2101	2190	2144	2095	2090	2131	2093
60		2510	240	2695	2595	2125	2097	2177	2110	2070	2071	2120	2091
70		2410	2407	2695	2590	2125	2097	2172	2109	2070	2069	2121	2090

Graph-2

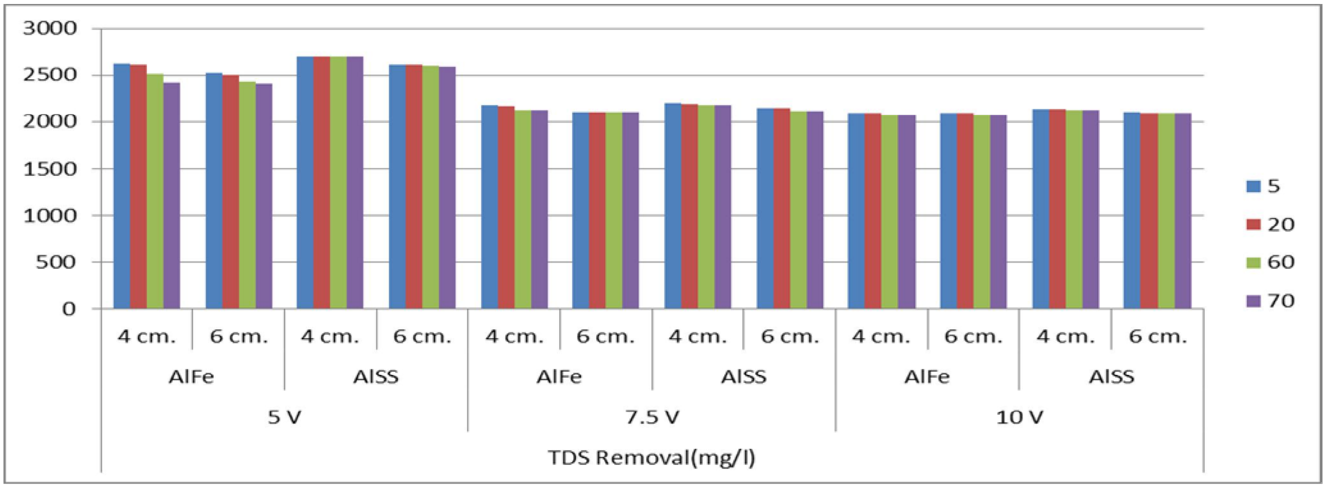

Table no.2 and graph 2 , indicates the value of TDS which was 4300 mg/l before treatment and after electrolysis with 5V current by using Aluminum and Iron electrode with 4cm. distance between electrodes . The values of TDS were found to be 2620 mg/l at 5 minutes. electrolysis time and as the increases from 5 minutes to 20 minutes, 60 minutes and 70 minutes the corresponding TDS values were found to be 2612 mg/l, 2510 mg/l and 2410 mg/l. The value indicates the marked reduction in TDS values before and after treatment and is in the range of 37.07% and 43.95% respectively.The 10V current of electrolysis with Aluminum-Iron as against Aluminum-Stainless steel shows the TDS values as 2095 mg/l for both 5 minutes and 20 minutes and 2070 mg/l for both 60 minutes and 70 minutes respectively and these results are well within the norms prescribed by Pollution Control Board. The reason behind this may be attributed to the fact that Iron electrodes gives better electrolysis results due to which effluent get discharged and gives lowest TDS when compared with Stainless steel which may be because of mixture of alloys which results in inferior values.

Table No.3 - Effect of distance between the electrodes, type of electrodes, voltage and time of electrolysis on Biological Oxygen Demand (BOD)-

Time (Min.)	BOD Value before treatment (mg/l)	Values of BOD after treatment(mg/l)											
		5 V				7.5 V				10 V			
		Al-Fe		Al-SS		Al-Fe		Al-SS		Al-Fe		Al-SS	
		4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.
247	247	23	23	27	25	20	20	23	23	19	19	21	20
247		21	20	25	23	20	19	23	23	19	19	20	20
60		21	20	23	21	19	19	23	23	19	19	21	20
70		20	20	23	21	19	19	23	23	19	19	21	20

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Graph- 3

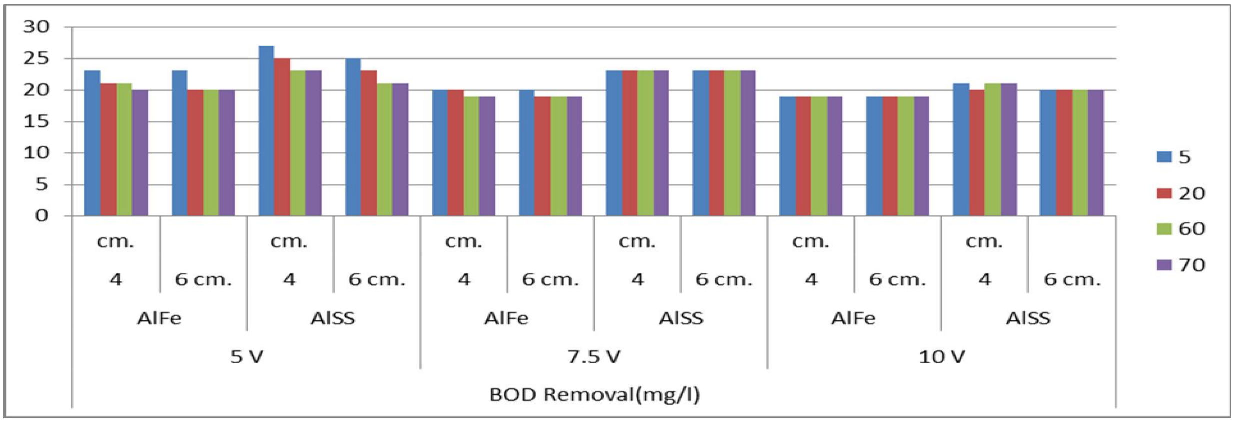


Table no.3 and graph 3, indicates the value of BOD was 247 mg/l before treatment and after electrolysis with 5V current by using Aluminum and Iron electrode with 4cm. distance between electrodes . The values of BOD were found to be 23 mg/l at 5 minutes. electrolysis time and as the increases from 5 minutes to 20 minutes, 60 minutes and 70 minutes the correspondent BOD values were found to be 21 mg/l, 21 mg/l and 20 mg/l respectively. The 5V current of electrolysis with Aluminum-Stainless steel at 4cm. distance between the electrode BOD values were found to be 27 mg/l , 25 mg/l for 5 minutes and 20 minutes respectively and 23 mg/l for both 60 minutes and 70 minutes respectively and these results are well within the norms prescribed by Pollution Control Board. In this results voltage difference and type of electrode and distance has not played any significant role in results. However, 10V and Aluminum-Iron electrodes at all times has gives lowest possible values of BOD.

Table No. 4 - Effect of distance between the electrodes, type of electrodes, voltage and time of electrolysis on Total Suspended Solids (TSS)

Time (Min.)	TSS Value before treatment (mg/l)	Values of TSS after treatment(mg/l)											
		5 V				7.5 V				10 V			
		Al-Fe		Al-SS		Al-Fe		Al-SS		Al-Fe		Al-SS	
		4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.
247	1325	121	120	125	123	94	91	99	93	91	91	97	91
247		120	113	125	115	94	91	99	93	90	91	95	91
60		97	97	98	100	91	91	97	89	89	89	92	90
70		90	89	98	97	92	91	97	89	89	92	92	91

Graph-4

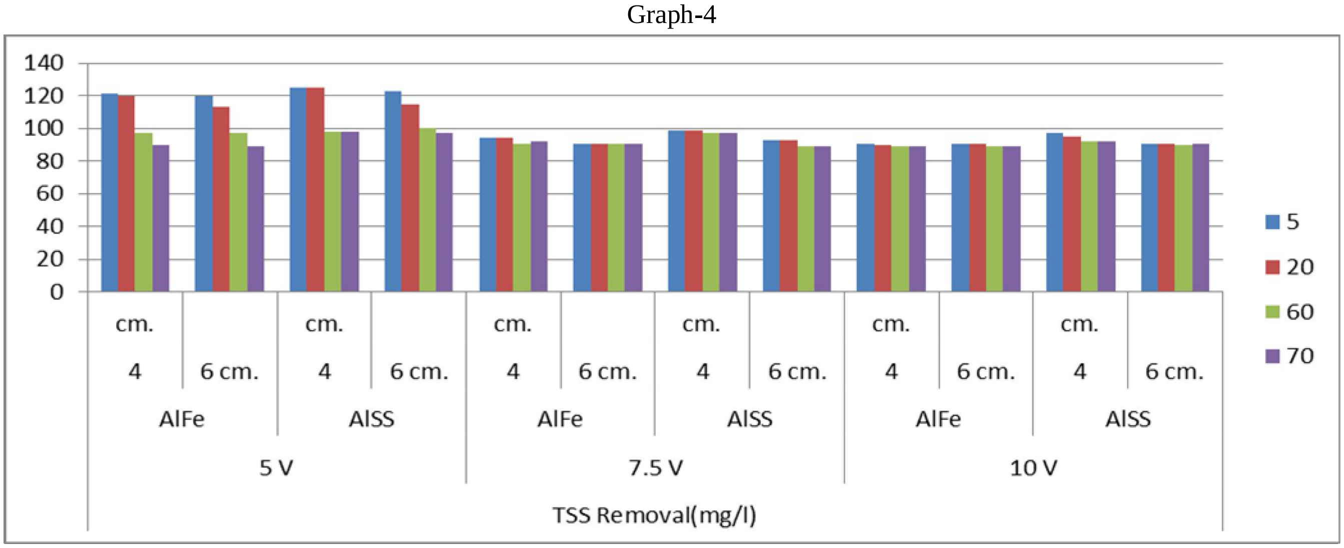
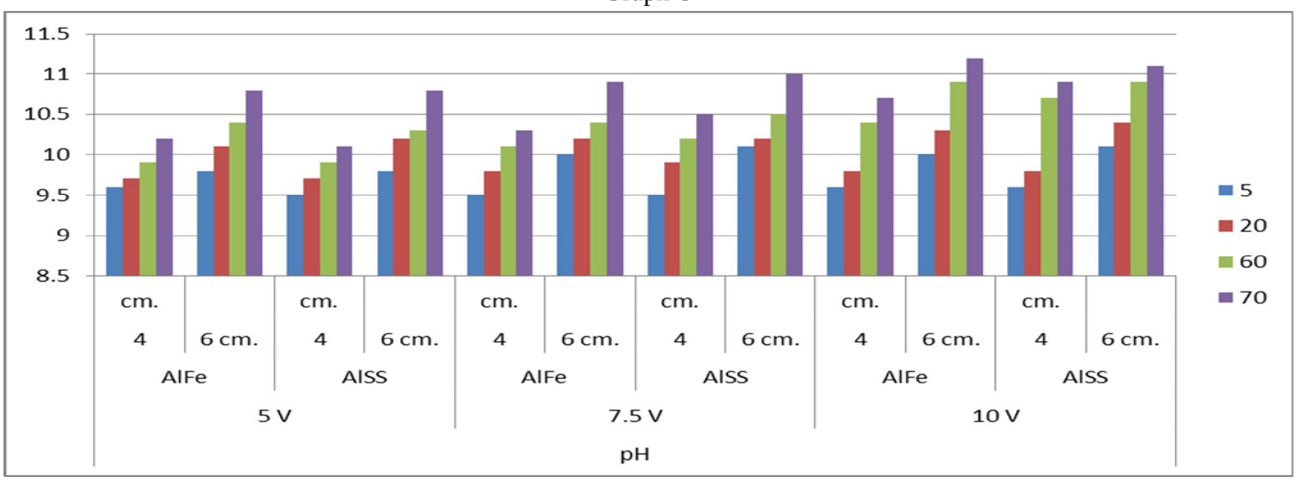


Table no.4 and graph 4 , indicates the value of TSS was 1325 mg/l before treatment and after electrolysis with 5V current by using Aluminum and Iron electrode with 4cm. distance between electrodes . The values of TSS were found to be 121 mg/l at 5 minutes. electrolysis time and as the increases from 5 minutes to 20 minutes, 60 minutes and 70 minutes, the correspondent TSS values were found to be 120mg/l 97 mg/l and 90 mg/l. The value indicate the marked reduction in TSS values before and after treatment and is in the range of90.86% and 93.28% respectively. The 7.5V current of electrolysis with Aluminum-Stainless steel at 4cm. distance between the electrode TSS values were found to be 99 mg/l for 5 minutes and 20 minutes respectively and 97 mg/l for both 60 minutes and 70 minutes respectively and these results are well within the norms prescribed by Pollution Control Board. The similar trend was found in TSS with 10V and Aluminum-Iron electrodes.

Table No.5 - Effect of distance between the electrodes, type of electrodes, voltage and time of electrolysis on pH-

Time (Min.)	pH Value before treatment	Values of pH after treatment											
		5 V				7.5 V				10 V			
		Al-Fe		Al-SS		Al-Fe		Al-SS		Al-Fe		Al-SS	
		4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.
247	8.9	9.6	9.8	9.5	9.8	9.5	10	9.5	10.1	9.6	10	9.6	10.1
247		9.7	10.1	9.7	10.2	9.9	10.2	9.9	10.2	9.8	10.3	9.8	10.4
60		9.9	10.4	9.9	10.3	10.2	10.4	10.2	10.5	10.4	10.9	10.7	10.9
70		10.2	10.8	10.1	10.8	10.5	10.5	10.5	11	10.7	11.2	10.9	11.1

Graph-5



The results from above Table no.5 and Graph 5 indicates that for Al-Fe & Al-SS electrode pH increases with time of electrolysis for both distance between the electrode 4cm. and 6cm.The result of electrolysis at all variations in time, distance between the electrodes and type of electrodes gives alkalinity due to the loss in metal due to heating of element.

Table No.6 - Effect of distance between the electrodes, type of electrodes, voltage and time of electrolysis on Hardness-

Time (Min.)	Hardness Value before treatment (mg/l)	Values of Hardness after treatment(mg/l)											
		5 V				7.5 V				10 V			
		Al-Fe		Al-SS		Al-Fe		Al-SS		Al-Fe		Al-SS	
		4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.	4 cm.	6 cm.
247	250	71	71	73	73	70	63	70	65	59	57	60	61
247		70	71	73	60	70	62	70	61	59	57	60	60
60		65	60	67	60	53	51	52	50	51	43	55	49
70		65	60	67	59	54	51	51	52	51	43	55	49

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Graph-6

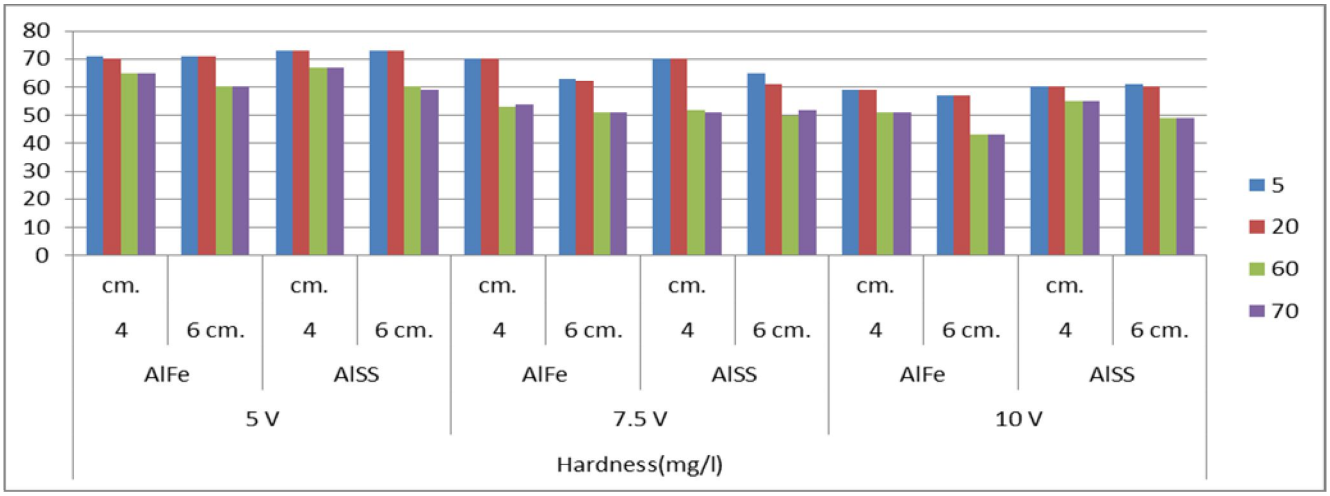

Table no.6 and graph 6 , indicates the value of Hardness before and after electrolysis . Due to electrolysis and current Calcium and Magnesium which are responsible for hardness may get dissociated and due to which hardness drops down. Here also 10V current and Aluminum-Iron electrode at 60 minutes and 70 minutes time gives least hardness. The value of Hardness was 250 mg/l before treatment and after electrolysis with 5V current by using Aluminum and Iron electrode with 4cm. distance between electrodes , the values of Hardness were found to be 71 mg/l at 5 minutes. electrolysis time and as the increases from 5 minutes to 20 minutes, 60 minutes and 70 minutes, the correspondent Hardness values were found to be 70mg/l, 65 mg/l and 65 mg/l. The values indicates the marked reduction in Hardness values before and after treatment and is in the range of 71.6% and 76% respectively. The 5V current of electrolysis with

IV. CONCLUSIONS

Eletrocoagulation is responsible for reducing effluent characteristic parameters like COD, BOD, TSS, TDS and Hardness. Al-Fe electrode with 7.5V, 60 min. of electrolysis and 6 cm. spacing between electrode gives % removal of COD, BOD, TDS, TSS, Hardness as 47.07%, 92.3%, 51.23%, 93.13%, 79.6% respectively.

As compared to Stainless steel, Iron electrode gives better results. With 25V and 180 min. of electrolysis reduce almost 30.67% of dissolved solids, 66.67% of suspended solids, 79.51% of COD.

It is suggested to carry out this electrolysis method for colour removal especially reactive dyed effluent.

REFERENCES

[1] R. Baskar, K.M. Meera Sheriffa Begum, S.Sundaram Journal of the University of Chemical Technology and Metallurgy, 41, 4, 2006, 473 .
[2] Das Subrata, Asian Dyer,8(2007), 77.
[3] C.N. Sivramakrishnan, Colourage, 4, (2008), 58.
[4] Khanittha Charoenlarp and Wichan Choyphan, Asian Journal on Energy and Environment , 2009, 10(04), 250 .
[5] Arslan-Alaton , I. Kabdaslı and Y. Sahin, The Open Environmental & Biological Monitoring Journal, 2008, 1, 1-7
[6] Usha N Murthy, H.B.Rekha, and J.G.Bhavya , International Journal of Environmental Science and Development, Vol. 2, No. 6, December 2011, 484.
[7] P. C. Mouli , S.V. Mohan , and S.J.Reddy, Journal of Scientific & Industrial Research, Vol.63 ,1/2004, 11-19.
[8] Prof. K.B. Krishanakumar ,Pollution in Textile Industry ,1st Edn. ,S,S.M.I.T.T &Students, Valayakaranoor , Komarapalayam , (2001).
[9] W. Miled, A.Haj Said and S. Roudesli ,Journal of Textile and Apparel ,Technology And Management , 2010 ,Vol. 6,1.
[10] C. Phalakornkule, S. Polgumhang, and W. Tongdaung , World Academy of Science, Engineering and Technology 57, 2009 ,277.
[11] M.F.Ni'am, F.Othman, J.Sohaili and Z.Fauzia, Electrocoagulation Water Science and Technology,2007, Vol.56, No.7,47.
[12] D.Ghosh, C.R. Medhi, H. Solanki, M.K. Purkait, Journal of Environment Protection Science, Vol.2, 2008, 25.
[13] M.Kashefialasl, M.Khasravi, R.Marandi and K.Seyyedi, International Journal of Environmental Science and Technology(2006), Vol.2, No.4, 365.
[14] Chen-Lu Yang, Jared McGarrahan, Journal of Hazardous Materials, B 127 (2005), 40.
[15] O. L. Shanmugasundaram , The Indian Textile Journal , Apr 2007 , 63.
[16] B.Ramesh Babu, A.K. Parande, S Raghu, and T. Prem Kumar, Journal of cotton science, Vol.11, 3 (2007), 141.
[17] H. Gurumallesh Prabu & K. Bharathimohan , Colourage , Apr 2003,41.
[18] K.Chithra, R. Thilakavatti, A.Arul Murugan, C.Mori Muthu, N. Balasubramanian, Modern Applied Science, Vol.2, No.4, 7(2008), 38.
[19] . K. Chithra , N. Balasubramanian Journal of Modelling and Simulation of Systems (Vol.1-2010/Iss.2), 124.
[20] . Daneshava, N., Oladegaragoze, A. and Djafarzadeh, N. , Journal of Hazardous Materials,2005, (129), 116 .
[21] Mehmet Kobya , Orhan Taner Can, Mahmut Bayramoglu, Journal of Hazardous Materials B100, (2003) ,163.