International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

DEGRADATION OF DISTILLERY SPENT WASH USING ANODIZED ALUMINIUM ELECTRODES IN ELECTROCOAGULATION PROCESS

Shital Zalaki[1], Shashank B P[1], Santosh[1] , Priyanka Bajantri[1] , Tejaswini M[2]

[1], UG Scholler, Department of Civil Engineering, Dayananda sagar college of engineering, Bangalore, Karnataka, India. [2]Professor, Department of Civil Engineering, Dayananda sagar college of engineering, Bangalore, Karnataka, India

---***---

Abstract - The distillery industry is one of the oldest industries that is very complex and characterized by high BOD, COD, Total Solids, Odor and Color. Untreated distillery wastewater, when discharged directly into water bodies or into the field, causes irreversible damage to the environment. Electrocoagulation is one of the most significant electrochemical treatment utilized in modern wastewater treatment to diminish suspended and colloidal materials, Color, COD in wastewater. During the last decade, Electrocoagulation in industrial wastewater treatment. Electrocoagulation is used as point-of-use technology in developing communities, since they are relatively more effective compared to chemical coagulants. In the Present Research work Electrocoagulation treatment has been adopted to study the removal efficiency of Color, COD, TDS, EC and Turbidity with variable parameters viz., the Voltage, Electrode Distance and Electrolysis time. The experiments were carried out using Al-Al, Fe-Fe and aluminium oxide as anodic and cathodic electrodes. . The influence of various operating parameters on the COD removal of biomethanated distillery waste wash was investigated in this study utilising Anodized Aluminium electrodes. Operating parameters were optimized for Anodized aluminium electrodes by using previous researches and are predicted using regression analysis tool maximum Color, TDS and COD removal efficiency.

Key Words: Electrocoagulation, Distillery wastewater, Aluminum oxide and Anodization process.

1.INTRODUCTION (Size 11 , cambria font)

Electrocoagulation (EC) is a technique used for wastewater treatment, wash water treatment, industrially processed water, and medical treatment. Electrocoagulation has become a rapidly growing area of wastewater treatment due to its ability to remove contaminants that are generally more difficult to remove by filtration or chemical treatment systems, such as emulsified oil, total petroleum hydrocarbons, refractory organics, suspended solids, and heavy metals. There are many brands of electrocoagulation devices available and they can range in complexity from a simple anode and cathode to much more complex devices with control over electrode potentials, passivation, anode consumption, cell REDOX potentials as well as the introduction of ultrasonic sound, ultraviolet light and a range of gases and reactants to achieve so-called Advanced Oxidation Processes for refractory or recalcitrant organic substances. Electrocoagulation ("electro", meaning to apply an electrical charge to water, and "coagulation", meaning the process of changing the particle surface charge, allowing suspended matter to form an agglomeration) is an advanced and economical water treatment technology. It effectively removes suspended solids to sub-micrometre levels, breaks emulsions such as oil and grease or latex, and oxidizes and eradicates heavy metals from water without the use of filters or the addition of separation chemicals [2]

A wide range of wastewater treatment techniques are known, which includes biological processes for nitrification, denitrification and phosphorus removal, as well as a range of physico-chemical processes that require chemical addition. The commonly used physico-chemical treatment processes are filtration, air stripping, ion exchange, chemical precipitation, chemical oxidation, carbon adsorption, ultrafiltration (UF), reverse osmosis (RO), electrodialysis, volatilization, and gas stripping.

Treatment of wastewater and wash water by EC has been practiced for most of the 20th century with increasing popularity. In the last decade, this technology has been increasingly used in the United States, South America and Europe for treatment of industrial wastewater containing metals.[3] It has also been noted that in North America EC has been used primarily to treat wastewater from pulp and paper industries, mining and metal-processing industries. A large one-thousand gallon per minute cooling tower application in El Paso, Texas illustrates electrocoagulations growing recognition and acceptance to the industrial community. In addition, EC has been applied to treat water containing foodstuff waste, oil wastes, dyes, output from public transit and marinas, wash water, ink, suspended particles, chemical and mechanical polishing waste, organic matter from landfill leachates, defluorination of water, synthetic detergent effluents, and solutions containing heavy metals.

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Coagulation is one of the most important physio-chemical reactions used in water treatment. Ions (heavy metals) and colloids (organic and inorganic) are mostly held in solution by electrical charges. The addition of ions with opposite charges destabilizes the colloids, allowing them to coagulate. Coagulation can be achieved by a chemical coagulant or by electrical methods. Alum [$Al_2(SO_4)_3 \cdot 18H_2O$] is such a chemical substance, which has been widely used for ages for wastewater treatment.

The mechanism of coagulation has been the subject of continual review. It is generally accepted that coagulation is brought about primarily by the reduction of the net surface charge to a point where the colloidal particles, previously stabilized by electrostatic repulsion, can approach closely enough for van der Waals forces to hold them together and allow aggregation. The reduction of the surface charge is a consequence of the decrease of the repulsive potential of the electrical double layer by the presence of an electrolyte having opposite charge. In the EC process, the coagulant is generated in situ by electrolytic oxidation of an appropriate anode material. In this process, charged ionic species—metals or otherwise—are removed from wastewater by allowing it to react with an ion having an opposite charge, or with floc of metallic hydroxides generated within the effluent. Electrocoagulation offers an alternative to the use of metal salts or polymers and polyelectrolyte addition for breaking stable emulsions and suspensions. The technology removes metals, colloidal solids and particles, and soluble inorganic pollutants from aqueous media by introducing highly charged polymeric metal hydroxide species. These species neutralize the electrostatic charges on suspended solids and oil droplets to facilitate agglomeration or coagulation and resultant separation from the aqueous phase. The treatment prompts the precipitation of certain metals and salts.

"Chemical coagulation has been used for decades to destabilize suspensions and to effect precipitation of soluble metals species, as well as other inorganic species from aqueous streams, thereby permitting their removal through sedimentation or filtration. Alum, lime and/or polymers have been the chemical coagulants used. These processes, however, tend to generate large volumes of sludge with high bound water content that can be slow to filter and difficult to dewater. These treatment processes also tend to increase the total dissolved solids (TDS) content of the effluent, making it unacceptable for reuse within industrial applications."

"Although the electrocoagulation mechanism resembles chemical coagulation in that the cationic species are responsible for the neutralization of surface charges, the characteristics of the electrocoagulated flock differ dramatically from those generated by chemical coagulation. An electrocogulated flock tends to contain less bound water, is more shear resistant and is more readily filterable"

1.1 Industrial waste water

Industrial wastewater is produced by industries as an undesirable by-product. After treatment, the treated industrial wastewater (or effluent) may be reused or released to a sanitary sewer or to a surface water in the environment.

1.2 Distillery waste water

Distillery industry is recognized as one of the most polluting industries (17th position), and waste in the form of ‘‘spent wash’’ is among the worst pollutants produced by distilleries both in magnitude and strength. Most of the distilleries in India use cane molasses, a by-product of sugar industry as raw material.

2. OBJECTIVES

The objectives of the present work are as follows:

- To Optimize the Operating Parameters viz, Electrolysis duration, Voltage and Electrode distance.
- To Evaluate the Removal efficiency of Pollution Parameters : COD, Colour,TDS.
- To Evaluate the cost analysis ratio.

3. LITERATURE REVIEW

Table -1: literature review

SL NO	TITLE OF THE PAPER	PUBLICATION	JOURNAL NAME	AUTHORS
1	Electrocoagulation of Distillery Spentwash for Complete Organic Reduction.	Sphinx knowledge house Chem Tech	International Journal of ChemTech Research	V.Khandegar Anil.K.Saroha
2	Treatmet of Distillery wastewater by Electrocoagulatio using Alumiium electrodes.	IJMTER	International Journal of Modern Trends in Engineering and Research	Kaustubh S Sasane Sandip R Korke

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

3	Treatment and characterization of phosphorous from syntetic wastewater using aluminium plate electrodes.	BMC Chemistry		Dessie Tibebe Yezbie Kassa Ashok N. Bhaskarwar
4	A comprehensi ve review of electrocoagulation for water treatment: Potentials and challenges	ELSEVIER	Journal of Environmental Management	Dina T. Moussa Mustafa Nasser Mohammed J.
5	Electrocoagulation – Science and applications	ELSEVIER	Journal of Hazardous Materials	M.Yousuf A.Mollah David L.Cocke
6	Pre-Treatment of pistachio processing industry wastewaters by Electrocoagulation using AI electrode	Seperation Science and Technology		Serkan Bayar Alper Erdem Yilmaz Baybars Ali Fil
7	Electrocoagulation in Wastewater Treatment		Water	Erik Butler Yung-Tse Hung
8	Electrochemi cal Oxidation of Dye by using Graphite and Titanium Based electrodes	IJASRE	IJASRE	Pavitra M. P
9	The use of Al, Cu, and	Hindawi	Journal of Chemistry	Carlos E. Barrera Diaz
	combined electrocoagulation-electroflotati on reactor		science pollution Research	M.A. Rodrigo
12	Treatment of textile wastewaters by electrocoagulation using iron and aluminium electrodes	ELSEVIER	Journal of Hazardous Materials	Mehmet Kobya Orhan Taner Can Mahmut Bayramoglu
13	Performance and mechanistic study on electrocoagulation process for municipal wastewater treatment by bipolarelectr ode		Environmental Science and Enineering	Zhenlian Qi Shijie You Ranbin Liu
14	Application of electrocoagulation process using Iron and Aluminium electrodes for Fluoride removal from Aqueous environment	World wide web	Environmental journal of chemistry	Edris Bazrafshan Amir Hossein Mahvi Kamal Aldin ownagh

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

	Integrated Electrocoagulation-Ozonation process			Nelly Gonzalez-Rivas
10	Reduction of COD and TSS from paper Industries Wastewater using Electrocoagulation and chemical Coagulation	Seperation Science and Technology		Mohammad Al.Shanag Walid Lafi Fawzi Gharagheer
11	Optimization of a lation using monopolar and bipolar electrode connections	CrossMark	Environmental	C.Jimenez C.Saez

Table -1: Methods and Instruments used for Analysis.

Sl. No	Parameters	Methods	Equipment Used
1	pH	Electrometric	pH Meter
2	TDS	Electrometric	TDS Eco tester
3	Turbidity	Nephlometer	Turbidity Nephlometer
4	Conductivity	Electrometric	Conductivity meter
5	Color	Electrometric	Spectrophotometer
6	BOD	Wrinkler's Iodometric	Volumetric glassware
7	COD	Open Reflux	Volumetric glassware

4. SUMMARY INFERANCE

- Performance and mechanistic study on electrocoagulation Process for municipal wastewater treatment based on Horizontal bipolar electrodes ;- In this study, an EC system was augmented with BPEs to Enhance pollutant removal and reduce energy consumption For real municipal wastewater treatment.
- Treatment of wastewater by electrocoagulation: The electrolysis technology is an essential and significant Discipline in many sectors of wastewater treatment including Clean synthesis, monitoring of removal efficiency of contaminants, water sterilization, clean energy conversion, and efficient storage and

15	Electrocoagulation treatment of raw and autoclaved landfill leachate with aluminium electrodes	CrossMark	ICAGE	Amjad Kallel Anis Attour Ismail Trabelsi
16	Treatment of fluoride containing drinking water by electrocoagu	ELSEVIER	Chemoshere	D. Ghosh C.R. Medhi M.K.Purkait

utilization of electrical energy. Simple equipment, convenient operation, and nonrequirement of chemicalSubstances for the sedimentation and floc generation are the Advantages of this process

- Application of Electrocoagulation Process Using Iron And Aluminum Electrodes for Fluoride Removal from Aqueous Environment ;- The maximum efficiency of fluoride removal for various initial Concentration of fluoride was obtained in constant electrolysis voltage of 40 V and reaction time of 60 min.
- It can be capable of being effective treatment process as convential method such as chemical coagulation. It is observed that it is remove is capable of having high removal efficiency of colour, COD,BOD
- It is observed that by using this method, It is observed that shows more accurate results then the conventional method. The effect of different of P^{H} , Voltage and hydraulic retention time were studied.
- Effects of P^{H} : In this it is studied that the rate of hardness removal increases with increase in P^{H} Value.
- Effect of electrical potential: It is studied that when electric current applied the efficiency of hardness removal also increases. When the voltage is high the size and growth flow increases which in turn increases the efficiency of the process increases.

REFERENCES

[1] Al-Shannag, Mohammad, et al. "Reduction of COD and TSS from paper industries wastewater using electrocoagulation and chemical coagulation." Separation Science and Technology 47.5 (2012): 700-708.

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

[2] Barrera Díaz, Carlos E., and Nelly González-Rivas. "The use of Al, Cu, and Fe in an integrated electrocoagulationozonation process." Journal of Chemistry 2015 (2015).

[3] Bayar, Serkan, et al. "Pre-treatment of pistachio processing industry wastewaters (PPIW) by electrocoagulation using Al plate electrode." Separation Science and Technology 49.7 (2014): 1008-1018.

[4] Bazrafshan, Edris, Kamal Aldin Ownagh, and Amir Hossein Mahvi. "Application of electrocoagulation process using iron and aluminum electrodes for fluoride removal from aqueous environment." E-Journal of Chemistry 9.4 (2012): 2297-2308.

[5] Butler, Erick, et al. "Electrocoagulation in wastewater treatment." Water 3.2 (2011): 495-525.

[6] Ghosh, D., C. R. Medhi, and M. K. Purkait. "Treatment of fluoride containing drinking water by electrocoagulation using monopolar and bipolar electrode connections." Chemosphere 73.9 (2008): 1393-1400.

[7] Jiménez, Carlos, et al. "Optimization of a combined electrocoagulation-electroflotation reactor." Environmental Science and Pollution Research 23.10 (2016): 9700-9711.

[8] Kallel, Amjad, Anis Attour, and Ismail Trabelsi. "Electrocoagulation treatment of raw and autoclaved landfill leachate with aluminum electrodes: case study of Djebel Chakir (Tunisia)." Arabian Journal of Geosciences 10.4 (2017): 1-8.

[9] Khandegar, V., and Anil K. Saroha. "Electrocoagulation of distillery spentwash for complete organic reduction." International Journal of ChemTech Research 5.2 (2013): 712-718.

[10] Khandegar, V., and Anil K. Saroh. "Treatment of distillery spentwash by electrocoagulation." Journal of Clean Energy Technologies 2.3 (2014): 244-247.

[11] Kobya, Mehmet, Orhan Taner Can, and Mahmut Bayramoglu. "Treatment of textile wastewaters by electrocoagulation using iron and aluminum electrodes." Journal of hazardous materials 100.1-3 (2003): 163-178.

[12] Mollah, M. Yousuf A., et al. "Electrocoagulation (EC)—science and applications." Journal of hazardous materials 84.1 (2001): 29-41.

[13] Moussa, Dina T., et al. "A comprehensive review of electrocoagulation for water treatment: Potentials and challenges." Journal of environmental management 186 (2017): 24-41.

[14] Qi, Zhenlian, et al. "Performance and mechanistic study on electrocoagulation process for municipal wastewater treatment based on horizontal bipolar electrodes." Frontiers of Environmental Science & Engineering 14.3 (2020): 1-10.

[15] Tibebe, Dessie, Yezbie Kassa, and Ashok N. Bhaskarwar. "Treatment and characterization of phosphorus from synthetic wastewater using aluminum plate electrodes in the electrocoagulation process." BMC chemistry 13.1 (2019): 1-14.

[16] Umadevi, Mohandas, et al. "Application of ElectroChemical Oxidation for the Treatment of Reactive Red 195 using Graphite Electrode." Asian Journal of Biological and Life Sciences 10.3 (2022): 620-625.