UNIVERSIDAD TÉCNICA DEL NORTE

FACULTAD DE INGENIERÍA EN CIENCIAS APLICADAS

TECHNICAL REPORT

DESIGN AND CONSTRUCTION OF A REACTOR ELECTROCOAGULATION FOR THE STUDY OF WASTEWATER TREATMENT OF TEXTILE DYEING AND FINISHING

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INTRODUCTION

Environmental standards, regulates discharges of wastewater effluent, as in the case of textile industries which have dyeing process, have a high environmental impact. This study is an alternative to treat the waste effluent. Alternative that based in water electrolysis.

Better not mess is cleaned and any preventive initiative is useful if you start the process by avoiding the excessive use of water, with initiatives such as reduced liquor ratio, supported by machine technology, reduced dye rinses using more efficient dyes , auxiliary less harmful to the environment and the removal of dye agility that I can not be part of the textile, avoiding rework, doing the right first, and this effluent resulting after all these initiatives, electrocoagulation is an alternative. Electrocoagulation is necessary to put the effluent as possible, with activities such as filtration simples the process of dyeing machines in a post before harvesting tank to retain large particles can be separated by filtering (using strainers lint), control of potential hydrogen, oxygenation that can be exploited also for homogenization. And after electrocoagulation separation of pollutant is the can do for methods such as decantation or the same filtration which was employed for the development of trials prior to characterization.

The theoretical part begins with an analysis of the water situation, traditional methods of purification for liquid effluents from the textile industry waste, and studied the electrolysis is the theoretical basis of the proposal in this thesis.
The practical part important to consider the design and construction activity electrocoagulation reactor, description of equipment and accessories used in the study, analysis of electrocoagulation and its inherent physical and chemical phenomena, and later with the testing and analysis of the characterizations, is justified and meets the objectives.

WATER.

The chemical formula for water is H2O. Also, water is a natural resource essential for most activities that the human being, among these are: power generation, fish farms, navigation, forestry, mining and recreation. In the textile industry it is used from agriculture to the cultivation of natural fibers such as cotton, jute, abaca, etc.., Also it is used as transport medium heat, cooling, auxiliary solvent, systems aqueous finishing and dyeing of textiles, etc.

The conditions of residual liquid effluent of a textile industry that processes cotton poly must meet parameters shown in the following table, to be evicted:

PARAMETERS	EXPRESSED AS	UNITS	Maximum permissible limit
Biochemical Oxygen Demand (5 days)	$D.B.O_{5.}$	mg/l	120 (A) 70 (C,)
Chemical Oxygen Demand	D.Q.O.	mg/l	240 (A) 123 (C,)
SUSPENDED SOLIDS	S.S.	mg/l	95 (A) 53 (C,)
FLOW	Q	l/kg de producción	140

Note. (A) Sewage and (C) Channel water.

RESIDUAL LIQUID EFFLUENT TREATMENT.

The reason for a treatment process is to modify the physicochemical and biological characteristics of the wastewater to those established by the

legislation concerned, considering the receiving environment, and especially considering that every effort, preventive action, efficient, and Debug has its impact on the preservation of the Environment, and also impact on the final cost of the product which was built on the water.

Physical-chemical treatment

Chemical physical treatment of wastewater, has the purpose, by adding certain chemicals, alteration of the physical state of these substances that would remain indefinitely stably to convert them into particles likely to separation by sedimentation. By this treatment eliminated can reach 80 to 90% of the total suspended matter, 40 to 70% of BOD5 and 30 to 40% of COD.

This type of treatment consists of:

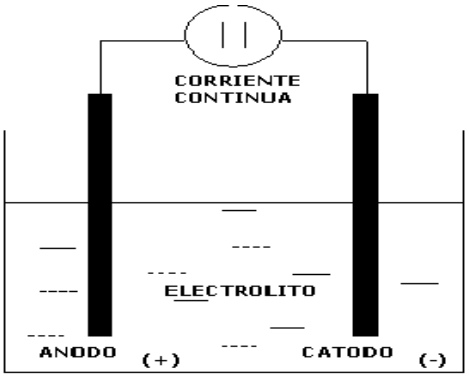
- Removal of solids.
- Removal of sand.
- Precipitation with help of coagulants or flocculants.
- Separation and filtration of solids.

BIOLOGICAL TREATMENT

Biological treatments, in which debugging the biodegradable organic matter of wastewater, is effected by the action of microorganisms (mainly bacteria), which are kept in suspension in water or adhere to a solid support forming a layer of growth.

ELECTROLYSIS.

Electrolysis is a process for separating a compound of the elements that comprise it, using this electricity.



When an electric current flows through the electrolyte, ions move in the solution. The anions are directed towards the anode and captions toward the cathode. One of the chemical compounds most frequently used in dyeing of cellulosic

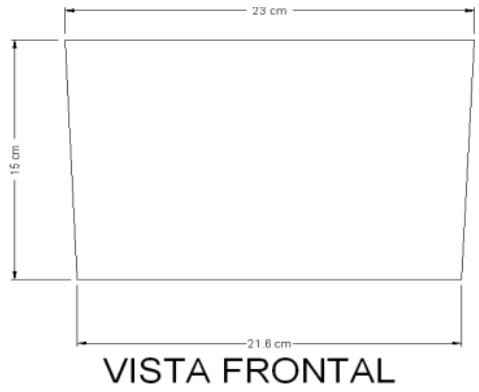
fibers, is the sodium chloride (NaCl). The electrolysis of molten sodium chloride is:

Na+ Cl-

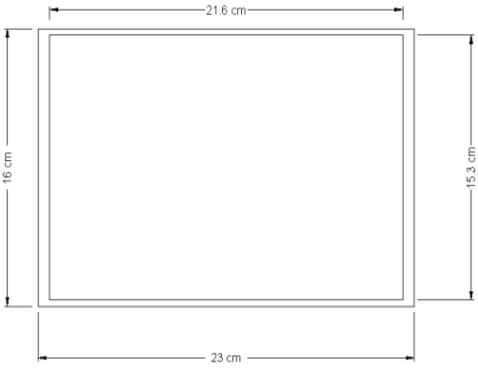
At the anode: Cl- ⟶ Cl + e

At the cathode: Na+ + e ⟶ Na

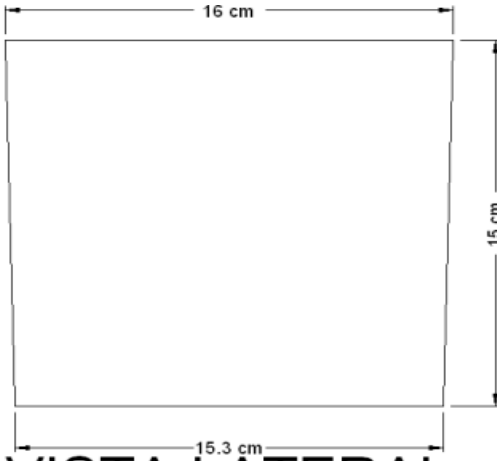
DESIGN AND CONSTRUCTION Dimensions of Cuba. The dimensions of the vessel containing the reactor are: In the base; 21.6 cm long by 15.3 cm wide; on top has: 23 cm long and 16 cm wide and has 15 cm high



VISTA FRONTAL



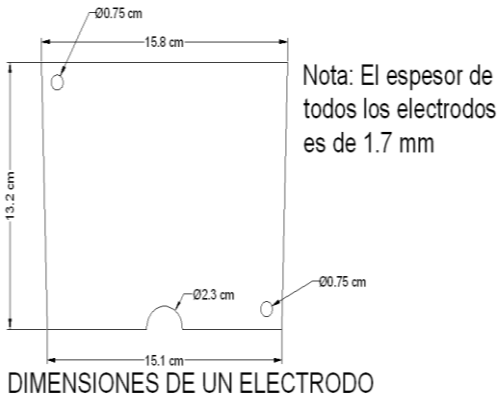
VISTA SUPERIOR



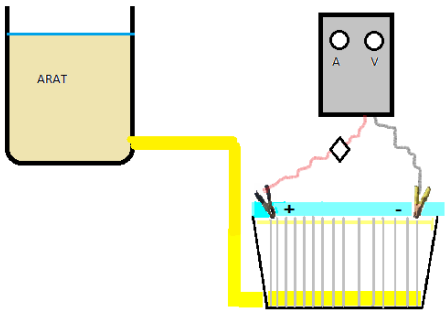
VISTA LATERAL

The electrodes have the following dimensions: 15.1 cm long at the base and 15. 8 cm long at the top, with a height of 13.2 cm. In the middle part of the base has a semicircle shaped groove with a diameter of 2.3 cm, which is designed to give accommodation to the cylinder feeder the effluent by treat, in a base end is located an orifice of 0.75 cm equal diameter and a perpendicular at the top,

which are crossed by a bar of polyurethane whose dimensions are given in relevant part.



DIMENSIONES DE UN ELECTRODO



ELECTROCOAGULATION

Coagulation occurs at this stage, specifically into the reactor of electrocoagulation with simultaneous destabilization and coagulation of colloids, product of applying a potential difference, through electrodes (cathode / anode) Iron immersed in an electrolyte and connected to a power source, which will bind by ionic bonds with oppositely charged colloids.

The mass of a product released in an electrode is proportional to the amount of current (ie: the current intensity and duration of electrolysis) and valence-gram of the product deposited:

$$m = K \frac{A}{n} It$$

The factor K depends on the units. If expressed I in amperes, t in seconds and $\frac{A}{n}$ in grams, K is equal to 96500, where you write Faraday's law:

$$m = \frac{1}{96500} \frac{A}{n} I t$$

From where it is understood that 96500 coulombs is needed to release an ion mass equal to the valence-gram $\frac{A}{n}$.

Also known to 96500C value as a Faraday (F).

PARAMETER MEASURED	DIMENSIONS	units	INITIAL VALUE	FINAL VALUE
Number of electrodes			27	-
potential hydrogen	pH	pH	6	7
temperature	degrees centigrade	ºC	45	46
tension	volt	V	64	65
intensity	amps	A	3	2
DBO_5	milligrams / liter	mg/l	313	110
DQO	milligrams / liter	mg/l	480	291
suspended Solids	milligrams / liter	mg/l	84	68

In the following table shows the values of removal after treat water with electrocoagulation applying an intensity of 6 amps with a voltage of 62 amps.

PARAMETER MEASURED	DIMENSIONS	units	INITIAL VALUE	FINAL VALUE
Number of electrodes			27	-
potential hydrogen	pH	pH	6	7
temperature	degrees centigrade	ºC	45	46
tension	volt	V	62	62
intensity	amps	A	6	6
DBO_5	milligrams / liter	mg/l	313	112
DQO	milligrams / liter	mg/l	480	227
suspended Solids	milligrams / liter	mg/l	84	71

The reactor built is appropriate to conduct the study water treatment, employing electrocoagulation as a means of debugging.

The separation of the electrodes of 0.57 cm, ensuring suitable agitation of effluent into treatment process, without reaching bindings product of incrustations, that

would affect the process yield.

Electrocoagulation.

Electrocoagulation is achieved with the destabilization of the contaminants in the effluent liquid in colloidal suspension (coagulation), for ease of removal and thereby improve their conditions before the evacuation.

OF EXPERIMENTS

Each of the tests gave different results and concludes the following:

By dividing into two camps electrode system increases the intensity at 6 amps with what we can improve clearance rates.

Determining the length between electrodes ranges between 0.5 cm and 0.8 cm, for the exclusive case of residual liquid effluent where the study is conducted, has an average conductivity of 1900 mS/cm2, the distance between electrodes is 0.57 cm, since this allows a good flow of ionized material with adequate agitation to achieve efficient use of destabilizing ions (which are carrying the current).

The following chart shows the level of compliance with the effluent on the current norm for shock after the effluent subjected to electrocoagulation.

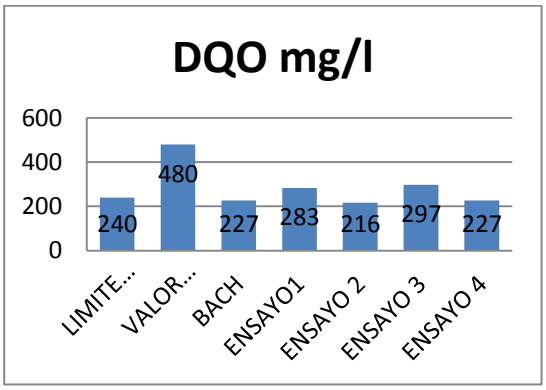
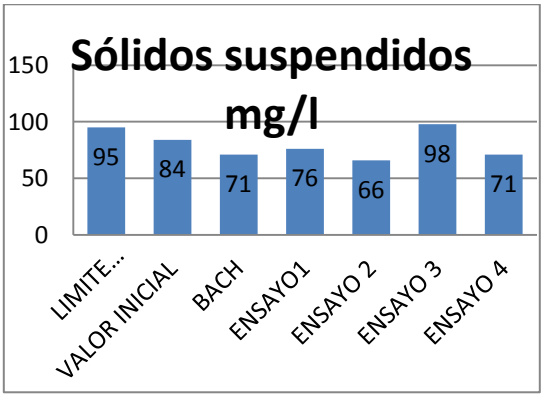


Chart 27. Comparative trials regarding removal of COD Standard.

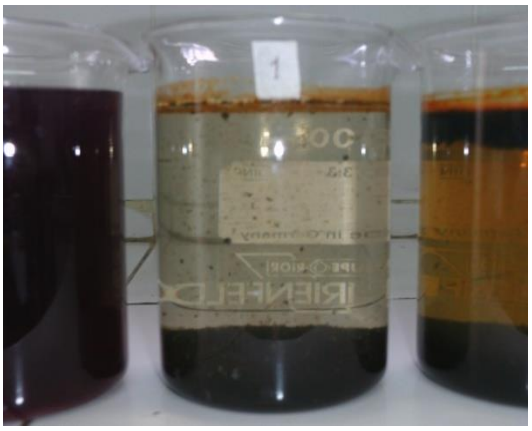
The first bar shows the maximum allowable level, the second indicates the location of the effluent prior to submission to electrocoagulation, the third bar indicates the level of debugging with a longer residence of the effluent, concluding that rotates once a colloidal phase load polluting, has no additional positive result. The assay two four

determine the connection more suited for treatment, taking shape in the assay four that is the facility that has the alternation of polarity in time periods of three minutes. The other parameter that is quantified in every trial, is that of suspended solids and can observe the level and extent of removal from the norm in the following graph.



Graph. Comparative trials regarding removal of SS Standard.

The right intensity to achieve the destabilization without actually represent increases unnecessary waste of energy, heat increment, is 4 to 8 amps (A) with a voltage of between 64 to 67 volts (V). The changeability of polarity of the electrodes is crucial, because it avoids salt deposits on the electrodes that would limit the exposure of this area, that is kept clean, just change the direction of electron flow. Electrocoagulation is based on the basic concept of using electrons as coagulating agent whose production is governed by the laws of electrolysis. Electrocoagulation is a viable and efficient to reduce the pollutant load of wastewater effluent from the host company. With respect to apparent color, with electrocoagulation is achieved up to 93% removal, providing a water that could be reused for rinses in dark colors



RECOMMENDATIONS

We recommend using electrocoagulation as a means of purification of wastewater to be treated liquid effluent from the

sponsoring company.

It is critical to preliminary studies in the laboratory as the present thesis, before deciding to implement this method of purification, since the conditions of dyeing plants are varied and respond to different realities and therefore the effluent also be varied.

Electrocoagulation is a recommendable alternative since the reactor would occupy very little space, compared with a chemical system of coagulation.

In the case of not reaching high levels of purification, electrocoagulation can be complemented with biological effluent treatment.

With respect to the characterizations, these are made in qualified laboratories as this is required by national law, and Universities in Quito can make them (those with certification). This could be an alternative to the Technical University of Northern and provide this service to the north of the country.

Should be supported in better technology: machinery, chemical dyes and auxiliaries and production processes to reduce water consumption, improve the performance of dyes.