CSIR-ASPIRE

DETAILED RESEARCH PROPOSAL

Your description should be comprehensive and brief and should in no case exceed 10mb.

Information to be given below must illustrate the research ground to be covered through this project. The research objectives and the scientific perspective against which the project has been conceived should be clearly mentioned to enable the Referees to arrive at a scientific judgement.

Give the particulars in the format shown below and **upload the PDF file** on the portal.

1. Name and Official Address of the Principal Investigator(PI):

Name	**Dr.P.SARITHA**		
Designation	Associate Professor	Date of joining	23-06-2014
Appointment Type	Regular		
Department & Address	Civil Engineering, Malla Reddy Engineering College, Maisammaguda, Secunderabad, Telangana State, India		
Qualifications	PhD- Environmental Science & Technology		
Experience in years	Teaching-9yrs	Research-10yrs	
Other Information	1. DST WOS-A from May 2009-2012 2. CSIR RA From April 2012-May 2014 3. UGC-Minor Project completed March 2020		

2. Title of the project: **Treatment of Electroplating wastewater using Electro coagulation**

3. Aims and significance of the project (Include the current status of work in area, both in India and abroad, with appropriate reference list at the end; identify lacunae, define question to be investigated; list briefly specific objectives of investigation. (**Ethical clearance** be enclosed where necessary).

Introduction:

The rapidly growing world population with increasing level of pollution and continuous need for energy and food is forcing the exploration of the wastewater recycling and resource recovery. Due to the fact that water is a limited and vital resource, it should not be wasted after having been used in industrial processes. The need for clean water is particularly critical in Third-World Countries. Rivers, canals, estuaries and other water-bodies are being constantly polluted due to indiscriminate discharge of industrial effluents as well as other anthropogenic activities and natural processes. Even the highly developed countries are also experiencing a critical need for wastewater cleaning because of an ever-increasing population, urbanization and

climatic changes. Thus, the reuse of wastewater has become an absolute necessity and, henceforth, an urgent need to develop innovative, more effective and inexpensive techniques for treatment of wastewater.

Electroplating industry is one of the big industries in India mainly represented by small scale units having distinct features such as tiny, family owned jobber units, practices old and obsolete technologies, having unskilled or semiskilled power, located in unplanned and unauthorized areas with lack of industrial infrastructure facilities, working in small shop area most of the unit operates in an operating area of 10-25 sqm. Electroplating wastewater is variable in character and alkaline in nature. It gives rise to obnoxious smell. The color imparts visible pollution, which persist for long distance in river stream.

Significance of the project:

Electroplating industry consumes and discharge large volumes of wastewater. Use of various chemicals and metal salt creates pollution problems. Electroplating wastewater contains highly toxic cyanide, cyanide complexes and metal ions that make treatment a complex problem. As the electroplating industries are located in tiny and unorganized sectors in India the problem becomes graver. Due to lack of technology, Automation and process control, there is considerable change in the effluent coming from these industries. Therefore the effluent exerts variable characteristics. Hence, greater efforts shall be required to reduce the pollution problems. Proper treatment has to be provided for the safe discharge of electroplating effluent.

Conventional techniques such as adsorption, air stripping, ion exchange, chemical oxidation etc., have limitations such as the addition of chemicals etc. A host of very promising techniques based on electrochemical technology are being developed, of which, Electrocoagulation (EC) has the potential to extensively eliminate the disadvantages of the classical treatment techniques. The EC technology offers an alternative to the use of metal salts or polymers and poly-electrolyte 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.

Hence, in the preset study, an attempt will be made to design an Electrocoagulation system for the treatment of electroplating metal wastewater.

Objectives:

Theoretical Framework:

Electrocoagulation (EC) is based on the principle of introducing an electrical current to induce a chemical reaction in water. This reaction causes the destabilization of most suspended particles, bacteria, viruses and cysts, dissolved materials, metals, most hydrocarbons and many organics. Once destabilized, positively charged ions react with negatively charged particles in the water resulting in floc precipitates that approach a highly stable state. Because the floc created is highly stable it can then be easily separated from the water by a number of conventional secondary separation techniques.

State of the art:

EC is one of the simple and efficient electrochemical methods for the purification of many types of water and wastewaters [Un et al., 2006]. This technique is characterized by its simple equipment, easy operation, and decreased amount of sludge. The coagulant in this technique is generated by electrolytic oxidation of an anode material which, at appropriate pH forms insoluble metal hydroxide capable of removing a large variety of pollutants [Adhoum *et al*., 2004]. These metal hydroxide species neutralize the electrostatic charges on the pollutants/contaminants to facilitate agglomeration or coagulation and resultant separation from the aqueous phase [Feng et al., 2003]. It was found to be effective to treat dyes wastewater (Kim *et al*., Kobya *et al*., 2006a), arsenic containing wastewater (Kumar *et al*., 2004), phosphate containing wastewater (Bektas *et al*., 2004), electroplating wastewater (Adhoum *et al*., 2004), metal finishing effluents (Khelifa *et al*., 2005), poultry slaughterhouse wastewater (Kobya *et al*., 2006b) and textile wastewater (Kobya *et al*., 2003). Konstantinos et al., (2011) studied the performance of electrocoagulation with aluminum electrodes for simultaneous removal of nickel, copper, zinc and chromium from synthetic aqueous solution and actual electroplating wastewater. Zhang et al. (2009) determined that 97% color removal was obtained after 10 minutes electrolysis time, with an electrical potential of 20 V, current of 0.4 A, electrode distance of 2.5 cm, concentration of 500 mg/L, KCl concentration of 0.5 g/L , and a pH of 3.0 for the purpose of treating methyl orange simulate dye wastewater by electrocoagulation. Ghosh et al. (2008) observed a 99.75% crystal violet removal by electrocoagulation when initial treatment concentration was 100 mg/L, current density 1,112.5 A/m2, solution conductivity of 1.61 S/m, pH of 8.5, and 1 hour of electrolysis time. It was also noticed that the cost for optimum treatment was 0.2141 US$/$m^3$. El-Naas et al. (2009) concluded that through batch experiments it was proven that the most effective treatment for petroleum refinery wastewater was using aluminum electrodes. Factors that were discussed included current density and initial concentration of the wastewater, where the temperature was 25 degrees Celsius and pH of 8. Chatzisyneon et al. (2009) concluded that by using electrochemical oxidation of olive mill wastewater (OMW) with a TiO_2 anode, it was noticed that the oxidation of OMW at 43 Ah/L, 80 degrees Celsius, and 5 mM NaCl can completely remove color, phenols, ecotoxicity, and low 30% COD removal with a 50 A/cm^2 current density. Katal and Pahlavanzadeh (2011) determined that by using aluminum and iron electrodes for electrocoagulation, optimum pH between 5 and 7, current density of 70 mA/cm^2 was capable of efficiently treating the wastewater at a low cost. In addition, temperature relationship also poorly affects the performance. Heidmann and Calmano (2008) was capable of treating galvanized wastewater by successfully reducing heavy metals of Cr and Cu by over 99% and 90% of Ni, as long as optimum conditions of a PH were greater than 5, 0.2 A for Fe electrodes, 1.5 A for Al electrodes, and a power consumption of 9.0 kWh/m^3. Qui et al.(2009) concluded that having a pH of 4, voltage 2.5 V, hydraulic retention time of 15 minutes, current density of 25 A/m^2, removal rate could be achieved at 99.5%, when treating electroplating wastewater by pulse electrocoagulation.

Electroplating industry consumes and discharge large volumes of wastewater. Use of various chemicals and metal salt creates pollution problems. Major pollution caused by rinse water, spray losses and solution dumping and leakages. Valuable metals and

cyanide along with different chemicals used are lost in wastewater. Hence, the main objective of the present study is to design and develop Electrocoagulation system for the treatment of electroplating wastewater.

4. Plan of work, methods and techniques to be used:
   Detailed methodology:

   - Collection and initial characterization of the effluent sample
   - Treatment of the electroplating effluent will be carried out using electrocoagulation in the existing lab reactor with aluminium, iron and combination of Al-Fe as the sacrificial anodes.
   - Optimization of process parameters such as effect of pH, conductivity of wastewaters, effect of current density and effect of operating time on electrocoagulation in terms of COD and turbidity removal.
   - Optimization of the above process parameters in terms of color removal, COD and heavy metal removal in electroplating wastewater will be evaluated
   - Energy consumption along with cost estimates will also be evaluated for this methodology in the treatment of different wastewaters.

   Finally, based on the lab scale experimental results, pilot scale reactors of 100 and 500 L capacity will be designed for the treatment of industrial wastewaters.

5. Time-table or milestones:

Activities	**1 Year**			**2 Year**		
	I	**II**	**III**	**I**	**II**	**III**
Collection & Characterization of the effluent						
Optimization of experimental conditions for the treatment of effluent using Electrocoagulation						
Evaluation of the performance of the treatment method in terms of COD, turbidity and heavy metals						
Evaluation of energy consumption along with cost estimates for the treatment method						
Designing of pilot & semi-commercial reactors based on lab scale results						
Data compilation						
Publication of results	*3-4 International papers with high impact factor*					

6. Deliverables(Apart from reports/papers; identify any products, systems, hardware, software, synthesized compound etc. to be delivered at the end of the project):

   - Designing of pilot scale& semi-commercial reactors for various industries can be done.
   - Reuse of the water can be more than 80%

7. Justification of Budget (For each position, item of equipment, and contingencies. Quotation for equipment should also be enclosed):

(A) Budget Estimates – Non Recurring **Total Rs. 15,00,000-00**

Proposed equipment/s	Specifications	Cost in Rs.	No of units	Justification
Electrocoagulation Reactor Cell	100l tank capacity 30A- 40V (1200 W power)&43 x 36 x 13 dimensions (cm) 500l tank capacity 100A- 40V (4000 W power)&43 x 50 x 27 dimensions (cm)	15,00,000-00	1	• Reactor tank • Power supply-pulsed DC regulated system • Floc generation tank • Clarifier • Ozone pretreatment • Equalization tank

(B) Budget Estimates– Recurring **Total Rs. 10,00,000-00**

	Estimate for Year 1	Estimate for Year 2
AMC/Service charges	Nil (warranty period)	1,00,000-00
Consumables & Contingencies	3,75,000-00	3,75,000-00
Other	75,000-00	75,000-00
Total	**4,50,000-00**	**5,50,000-00**
Grand Total		**10,00,000-00**

(C) Total Budget = Rs. 25,00,000-00 (Rupees Twenty Five Lakhs)

8. If the project has any industrial significance, give names and addresses of 3 industries that may be interested in the project:

Hyderabad, the largest metropolis and capital city Telangana State, India, has rapidly developed due to industrialization. The Telangana State Industrial Infrastructure Corporation Ltd., (TSIIC) has established Industrial Estates and Industrial Development parks in Balanagar, Medak, Bollaram and Patancheru areas of Hyderabad. One such industrial area, Balanagar, has come up in north-western part of the Hyderabad city with industries like electroplating, steel manufacturing, battery manufacturing, petrochemical, pharmaceuticals, etc. The electroplating units in Balanagar were found to be releasing effluents into the Kukatpally Nala, which in turn flows into the Hussain Sagar. According to the Telangana State Pollution Control Board (TSPCB) official, several electroplating industries were issued closure notice for violating pollution control norms as they directly released effluents into the Nala.

1. Hyderabad Electroplating works
   F-3 & F-4, Satellite, Cooperative Industrial Estate,
   Balanagar, Hyderabad,
   Telangana 500037
2. Bright Electroplating works
   10-11-175/1 no.10, Skyline Complex,
   Balanagar Main Rd, Fish Market,
   Hyderabad, Telangana 500018
3. Sri Balaji Electro plating
   Gate no 2, C.61, APIE Balanagar
   Opp sbi bank lane, behind champion wire ind8,
   Balanagar, Telangana 500018

9. List of your publications, not more than 25, with full bibliographic details in the last 6 years (Use asterisks to identify publications relevant to this proposal):
   i. D. Bhagawan & **Saritha Poodari** & Tulasiram Pothuraju & D. Srinivasulu & G. Shankaraiah & M. Yamuna Rani & V. Himabindu & S. Vidyavathi, Effect of operational parameters on heavy metal removal by electrocoagulation, Environ Sci Pollut Res (2014) 21:14166–14173. ISSN: 1614-7499.
   ii. *D. Bhagawan, **Saritha Poodari**, Shankaraiah Golla, Vurimindi Himabindu & S. Vidyavathi, Treatment of the petroleum refinery wastewater using combined electrochemical methods, Desalination and Water Treatment (2014) 1–8 online: http://dx.doi.org/10.1080/19443994.2014.987175. IF-0.9.
   iii. Yamuna rani. M, Bhagawan. D, Himabindu.V, Venkateswara Reddy.V, **Saritha. P,** Preparation And Characterization Of Environmental Friendly Bricks From Pharmaceutical Industrial Wastes Environ Sci Pollut Res. ISSN: 1614-7499.
   iv. D. Bhagawan, **Saritha Poodari**, Gujarathi Ravi kumar, Shankaraiah Golla, Ch. Anand, Kumara Swamy Banda, Vurimindi Himabindu, et al. Reactivation and recycling of spent carbon using solvent desorption followed by thermal treatment (TR), Journal of Material Cycles and Waste Management (2015) 17:185–193.
   v. G. Shankaraiah, **Saritha Poodari**, D. Bhagawan, Vurimindi Himabindu, S. Vidyavathic, Degradation of antibiotic norfloxacin in aqueous solution using advanced oxidation processes (AOPs)—A comparative study Desalination and Water Treatment (2016) 1–12.

vi. Yamuna Rani M, Bhagawan D, Himabindu V, Venkateswara Reddy V, **Saritha P** (2017) Utilization of Polluted Dredged Sediment for Making of Bricks. JSM Chem 5(2): 1043.

vii. Dheeravath Bhagawan, **Saritha Poodari**, Narala Chaitanya, Surya Ravi, Yamuna M. Rani, Vurimindi Himabindu, S. Vidyavathi, Industrial solid waste landfill leachate treatment using electrocoagulation and biological methods, Desalination and Water Treatment, 68 (2017) 137–142.

viii. G. Shankaraiah, **P. Saritha**, D. Bhagawan, V. Himabindu, S. Vidyavathi, Photochemical oxidation of antibiotic gemifloxacin in aqueous solutions: A comparative study South African Journal of Chemical Engineering 24 (2017) 8-16.

ix. Yamuna R M, Bhagawan D, **Poodari S**, Himabindu V, Venkateswara R V (2017) Recovery of SiO_2 from Pharma Waste and its Application for Environmental Remediation. Chem Eng Process Tech 3(2): 1040.

x. Yamuna Rani M, Bhagawan D, **Saritha P**, V. Himabindu, V. Venkateswara Reddy, Treatment of Hazardous Solid Waste Using Solidification and Stabilization Technique American Journal of Environmental Protection 2017; 6(4): 94-100.

xi. *D. Bhagawan, **P. Saritha**, G. Shankaraiah, and V. Himabindu, Fluoride Removal from Groundwater Using Hybrid Cylindrical Electrocoagulation Reactor ISSN 1063_455X, Journal of Water Chemistry and Technology, 2019, Vol. 41, No. 3, pp. 164–169.

xii. **Saritha Poodari**, CM Vivek Vardhan, D Bhagawan, G Shankaraiah, Akella Naga Sai Baba Treatment Of Methylated Chloro Phenols Using Uv Mediated Oxidation Processes, Solid State Technology, 2020 63, 2s

xiii. Vivek Vardhan, **P Saritha**, Akella Naga Sai Baba Pharmaceutical Wastewater Treatment Using Natural And Chemical Coagulants, CM, Solid State Technology, 2020, 8360-8368

10. List of Patents with full bibliographic details:

S.No	Patent Title	Date of Filing of Application	Application Number	Publication Date
1	Application of Innovative Technology in the field of Agriculture	23-12-2021	202141060242 A	31-12-2021
2	Strengthening of Expansive Clayey Subgrade Pavement by using Admixture and Geosynthetic	22-02-2021	202141007413 A	26-02-2021

3	An efficient device and a methodology to identify the quality of construction materials	15-02-2020	202041006605 A	28-02-2020
4	System to collect Air Pollutant from Exhaust of a vehicle and further generates oxygen	30-05-2018	201841020231 A	08-06-2018

Signature of the PI

Signature of the Co-PI

SUSHEETRONICS

Plot No.44, DN-141, Devinagar 3rd Corss
R.K.Puram Post, Secunderabad-500056
MOBILE NO.9848162807
GSTIN NO.36ABHPV6501H1ZI

QUOTATION

No. 45 **Enq No. E-mail**
Date 15-04-2023 **Date: 10-04-2023**

The Principal
Mallareddy Engg. College
Kompally
Hyderabad

Description	HSN Code	Qty	Rate	Amount	Gross Amt.	GST	GST Amt.	IGST %	IGST Amt.
1 Electrocoagulation Reactor cell Tank Capacity : 100 Liter Power 1200W, 30A - 40V 43 x 36 x 13 CM Dimensions		1	450,000.00	450000.00	450000.00	18%	81000.00		
2 Tank Capacity : 500Liter Power 4000W, 100A - 40V 43 x 50 x 27 CM Dimensions		1	820,000.00	820000.00	820000.00	18%	147600.00		
Amount (in words):	TOTAL (in Rupees)			1270000.00	#########		228600.00		0.00

Rupees Fourteen Lakh Ninety Eight Thousand Six Hundred Only

Total Amt Before Tax	₹ 1,270,000.00
ADD:IGST	₹ 0.00
ADD:GST	₹ 228,600.00
Total Amt:GST	₹ 228,600.00
Grand Total	₹ 1,498,600.00
Round-Off	₹ 1,498,600.00

HDFC Bank,
Secunderabad
A/C.No.00422820000480
IFSC CODE:HDFC0000042

Authorised Signatory

For SUSHEETRONICS

V Srinivas

SUSHEETRONICS

Plot No.44, DN-141, Devinagar 3rd Corss
R.K.Puram Post, Secunderabad-500056
MOBILE NO.9848162807
GSTIN NO.36ABHPV6501H1ZI

QUOTATION

No. 48 **Enq No. Email**
Date 15-04-2023 **Date 10-04-2023**

The Principal
Mallareddy Engg. College
Kompally
Hyderabad

Description	HSN Code	Qty	Rate	Amount	Gross Amt.	GST	GST Amt.	IGST %	IGST Amt.
1 Ozone Pretreatment & Equalization Tank									
Inlet & Outlet Tank		1	350,000.00	350000.00	350000.00	18%	63000.00		
Pump		1	20,000.00	20000.00	20000.00	18%	3600.00		
Electrical		1	15,000.00	15000.00	15000.00	18%	2700.00		
Metal Framing		1	15,000.00	15000.00	15000.00	18%	2700.00		
Air compressor		1	25,000.00	25000.00	25000.00	18%	4500.00		
Amount (in words):	TOTAL (in Rupees)			425000.00	425000.00		76500.00		0.00

Rupees Five Lakh One Thousand Five Hundred Only

Total Amt Before Tax	₹ 425,000.00
ADD:IGST	₹ 0.00
ADD:GST	₹ 76,500.00
Total Amt:GST	₹ 76,500.00
Grand Total	₹ 501,500.00
Round-Off	₹ 501,500.00

HDFC Bank,
Secunderabad
A/C.No.00422820000480
IFSC CODE:HDFC0000042

Authorised Signatory

For SUSHEETRONICS

V Srinivas