SUBMISSION OF UGC
MAJOR RESEARCH PROJECT FINAL REPORT

ENTITLED

Production of activated carbon from agricultural by-products and evaluation of their chemical and adsorption properties on the removal of anionic dyes from aqueous solution

(F. NO. 41.266/2012 (SR) Dated 13.07.2012 and Dated 12.05.2015)

To

University Grants Commission (UGC)
BAHADUR SHAH ZAFAR MARG
New Delhi- 110 002

By

Dr. N. Thinakaran
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UNIVERSITY GRANTS COMMISSION (UGC)
BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110 002

Proforma for submission of information at the time of sending the final report of the work done on the project

1	Title of the Project	Production of activated carbon from agricultural by-products and evaluation of their chemical and adsorption properties on the removal of anionic dyes from aqueous solution
2	Name and address of the Principal Investigator	**Dr. N. Thinakaran** Assistant Professor, PG & Research Department of Chemistry, Alagappa Government Arts College, Karaikudi - 630 003, Tamil Nadu.
3	Name and address of the Institution	Alagappa Government Arts College, Illuppakudi village, Karaikudi - 630 003, Tamil Nadu.
4	UGC Approval No. & Date	**F. NO. 41.266/2012 (SR) Dated 13.07.2012**
5	Date of Implementation	**01.07.2012**
6	Tenure of the project	Three Years from **01.07.2012** to **31.06.2015** **Extended upto 31.12.2015**
8	Total grant allocated	**Rs. 5,13,000**
9	Grants Received	1st Installment : **Rs. 3,83,000 (11.09.2012)** IInd Installment **:Rs. 1,04,000 (07.09.2015)** **Total grant Received = Rs. 4,87,000**
10	Final expenditure	**Rs. 5,05,500**
11	Title of the Project	Production of activated carbon from agricultural by-products and evaluation of their chemical and adsorption properties on the removal of anionic dyes from aqueous solution.
11	Objectives of the Project	Annexure I.
12	Whether objectives were achieved	Yes
13	Achievements from the project	Annexure II
14	Summary of the findings	Annexure III
15	Contribution to the society	Annexure IV
16	Whether any Ph.D. enrolled/produced out of the project	No
17	No. of publications out of the project	2 research papers published (Annexure VI)

Financial Assistance Provided/ Expenditure incurred

Sl. No	Items	Amount Approved	Grant Received as First installment	Grant Received as II installment	Total grant received	Total Grant Utilized
1	Books & Journal	Rs. 30,000	Rs. 30,000	-	Rs. 30,000	Rs. 30,000
2	Equipments	Rs. 2,00,000	Rs. 2,00,000	-	Rs. 2,00,000	Rs. 2,00,000
3	Honorarium	Nil	NIL	-	-	Nil
4	Contingency	Rs. 60,000	Rs. 30,000	Rs. 24,000	Rs. 54,000	Rs. 57,500
5	Travel/fieldwork	Rs. 30,000	Rs. 15,000	Rs. 12,000	Rs. 27,000	Rs. 27,000
6	Chemicals & Glassware	Rs. 1,50,000	Rs. 75,000	Rs. 60,000	Rs. 1,35,000	Rs. 1,50,000
7	Hiring Services	Rs. 20,000	Rs. 10,000	Rs. 8,000	Rs. 18,000	Rs. 18,000
8	Overhead	Rs. 23,000	Rs. 23,000	-	Rs. 23,000	Rs. 23,000
9	Interest received **(Rs. 11,000)**	Nil	Nil		-	-
Total		**Rs. 5,13,000**	**Rs. 3,83,000**	**Rs. 1,04,000**	**Rs. 4,87,000**	**Rs. 5,05,500**
Amount to be refunded = ((Total grant received + Interest received from the bank) – Grant utilized) =(487000 + 11000 - 5,05,500)						**Rs. 7,500**

It is certified that the grant of **Rs. 4,87,000 (Rupees Four Lakhs Eighty Seven Thousand only)** received from the University Grants Commission under the Scheme of support for Major Research Project entitled ***"Production of activated carbon from agricultural by-products and evaluation of their chemical and adsorption properties on the removal of anionic dyes from aqueous solution"*** vide UGC Letter No. **F. NO. 41.266/2012 (SR) dated 12.05.2015** has been fully utilized for the purpose for which it was sanctioned and in accordance with the terms and conditions laid down by the University Grants Commission.

23/1/2018

PRINCIPAL INVESTIGATOR
(SIGNATURE WITH SEAL)

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UGC Major Research Project
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Annexure - I

Objectives of the project

Proposed Objectives

1) The objective of the present study was to prepare the activated carbon from low cost materials for the removal of anionic synthetic dyes from aqueous solutions.
2) The prepared adsorbents adsorption capacity is to be compared with commercial activated carbon and provide a sound basis for further modification and functionalization of the adsorbent to improve its adsorption efficiency.

The objectives can be achieved through

i) The prepared activated carbon materials are characterized by IR, SEM and BET methods.
ii) The morphology, pore size distribution and functional groups of the prepared carbons were compared with commercial activated carbons.
iii) The efficiency of the prepared carbons with various dyes such as Acid dyes, reactive dyes, direct dyes and dye mixtures were evaluated.
iv) Adsorption capacity of the prepared adsorbents can be determined through various adsorption isotherm studies.
v) To evaluate the adsorption mechanism and kinetic data is to be fitted with Pseudo I order, pseudo second order, and Elovich and Dubinin-Radushkovich models.
vi) Intra-particle diffusion studies are also to be carried out to evaluate the Pore diffusion mechanism of the adsorbent.
vii) In order to study the feasibility of the adsorption process thermodynamic studies are to be carried out
viii) The efficiency of the prepared activated carbons was tested with real textile effluents obtained from textile industries around Tirupur, Tamil Nadu, India.
ix) Desorption studies were also carried out with HCl, NaOH and Phosphoric acid.

Annexure II

Achievements from the project

Publications

The results of the study were published through paper presentation in National/ International seminars and also by sending research papers to National /International journals.

1) S.E. Subramani, D. Kumaresan, N. Thinakaran (2015), Application of activated carbon derived from waste Delonix regia seed pods for the adsorption of acid dyes: kinetic and equilibrium studies, Desalin. Water Treat., Vol. 57(16), pp. 7322–7333.

2) Subramani, S. E., & Thinakaran, N. (2017). Isotherm, kinetic and thermodynamic studies on the adsorption behaviour of textile dyes onto chitosan. Process Safety and Environmental Protection, 106, 1-10.

3) A research article has been communicated to Water and Environment Journal on 12th Nov 2016 entitle on " A Comprehensive Study on Adsorption Behaviour of Basic, Direct and Reactive Dyes on chitosan extracted from prawn shell waste"

4) 'Decolourization studies of reactive turquoise blue 13 G by functionalized activated carbon' a research article was presented in "International Conference on Advances in Textile and Electrochemical Sciences – 2013 (Rates-2013)", at Alagappa University, Department of Industrial Chemistry Karaikudi, Tamil Nadu on 21-23 March 2013.

5) On February 21- 22nd 2014, we presented a paper entitled on "Synthesis of ordered mesoporous carbon composite materials and its application to removal of synthetic dyes" in International Workshop on "Frontier areas in Chemical Technologies – 2014 (FACTs-2014) at Alagappa University, Department of Industrial Chemistry, Karaikudi, Tamil Nadu.

6) We got another opportunity to present another paper entitled, 'Uptake of reactive black 5 by functionalized activated carbon, chemistry and adsorption mechanism' to "National Conference on recent advances in Nanomaterials for Sensor applications (NANOSE-2014)" at Alagappa University, Department of Bioelectronics and Biosensors, on 6-7th March 2014.

Summary of the findings

1) Adsorption being a method for environmental remediation, systematic study was initiated with a relatively cheap adsorbent and the observations were interpreted. Various low cost waste materials such as Delonix regia seed pods, Cassia fistula seed pods, Bark of Prosopis Juliflora, were used to prepare activated carbon apart from the proposed studies. The prepared activated carbons have comparably high adsorption capacity than the commercial activated carbons. Because of the low price and effective adsorption of synthetic textile anionic dyes the prepared activated carbons are used to treat the industrial dye effluents.

2) A novel method has been used to synthesize natural bio polymeric material chitosan from crab shells. It has been used as an adsorbent for the removal of synthetic dyes. This study concludes that effective removal of anionic dyes compared to all other activated carbons studied in this research project and the commercial activated carbons.
3) The adsorbates used in this study was MG (Malachite Green), RR (Reactive Red), RB5 (Reactive Blue), DR (Direct Red), DY (Direct Yellow), RY44 (Reactive Yellow 44), AB7 (Acid Blue 7), RV 13 (Reactive Violet 13) and RR198 (Reactive Red 198). All these dyes are extensively used in the dyeing units in and around Tirupur, Tamil Nadu. The prepared activated carbons were tested with the above mentioned dyes.