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INDEX

Sr. No.	Title	Author	Subject	Page No.
1	Cost of capital: an empirical case study of hindustan unilever limited	Dr. Vinod K. Ramani	Accountancy	1-2
2	Self Revolution	Mohanapriya.P	Arts	3-4
3	Wound healing activity of Cestrum elegans	V. Subhaa, Dr. D. Sukumarb, Dr. V. Elangoc	Chemistry	5-6
4	Anti Bacterial Activity of Apigenin 7-0-(6"caffeoyl) neohesperidoside from chrysanthemum indicum	M.Jerome Rozario, Dr.A.John Merina, Dr.V.Srinivasana	Chemistry	7-10
5	Adsorption Studies of Cu (II) and Cr (VI) from metal solution using crosslinked chitosan-g-acrylonitrile copolymer	Shankar.P, Gomathi T., Vijayalakshmi.K, Sudha P.N	Chemistry	11-13
6	An Insight into Derivative Markets: Indian Perspective	Dr. C.Shobha, Dr. T. Hanumantha raya	Commerce	14-16
7	Vision and Planning	Dr. J. K Sehgal	Commerce	17-18
8	An Analytical Study of Employee's Productivity in Some Selected Nationalized Banks of India	Dr. Jyotindra M. Jani, Manish B. Raval	Commerce	19-20
9	New Products of Tourism in India	Dr. M. K. Maru	Commerce	21-22
10	Inventory Management in Sugar Mills - A Comparative Study	Promila	Commerce	23-25
11	Price -Mix Straregy of Jammu and Kashmir Co-Operatives Supply and Marketing Federation Limited in Jammu District of J&K State	Tarsem Lal	Commerce	26-28
12	Warehouse Management Information System: A New Perspective in Supply Chain Management	Dr. Vipul Chalotra	Commerce	29-30
13	A Study on Consumer Satisfaction of Aavin Milk in Salem City	Dr.A.Vinayagamoorthy, Mrs. M.Sangeetha, C.Sankar	Commerce	31-33
14	Hybrid Attribute Selection Process for Decision Tree Based Classification Algorithms	Mr. A. Jebamalai Robinson, Mrs. S. C. Punitha, Dr. P. Ranjit Jeba Thangaiah	Computer Science	34-36
15	Visualizing the validation of UML diagrams	Lavleen Kambow	Computer Science	37-38
16	Effectiveness of coconut palm insurance scheme in the coastal belts of India-A SWOT analysis	Prof. (Dr.) D. Rajasenan, Bijith George Abraham	Economics	39-41
17	An Analysis of the Efficiency of Selected Public and Private Banks in India during 2005-2011	Dr.Dinesh Kumar, Sanjeev	Economics	42-44
18	Measurement of Emotional Development of the Students	Dr. Nivedita K. Deshmukh	Education	45-46
19	A comparative study of effect of method of lecture and dramatization of Marathi teaching	Dr. Nivedita K. Deshmukh	Education	47-48
20	Peer pressure-problems and solutions	V.Vaithyanathan, Dr.P.Sivakumar	Education	49-50
21	Language Anxiety In Indian L2 Learners: Male or Female Learners - Who Scores High?	S. Gandhimathi, Dr.R.Ganesan	Education	51-52

22	Topological Characteristics of ECG Signal using Lyapunov Exponent and RBF Network	Abinash Dahal, Deepashree Devaraj, Dr. N. Pradhan	Engineering	53-55
23	Development of slicing package of solid model for cone and sphere in rapid prototyping	Dineshkumar M. Patel, Prof. P.D.Solanki	Engineering	56-58
24	Hardware modeling Simulation with COSSAP	Krunali Amrutlal Ratanpara, Devendra Soni, Shrenik Rajesh Golwelkar	Engineering	59-61
25	Coordination Of Pss And Statcom To Enhance The Power System Transient Stability	Lalit K. Patel, Kaushik M. Sangada, Sunil S. Changlani , Ankit M. Patel	Engineering	62-64
26	Cooling Performance Analysis of Heat Sink	Mr. Pritesh S. Patel, Prof. Dattatraya G. Subhedar, Prof. Kamlesh V. Chauhan	Engineering	65-57
27	Thermal Modeling and Analysis of Friction Stir Welding	Rankit Patel, Prof. Bindu Pillai	Engineering	68-70
28	Review on shrinkage defect – A case study	Mr. Ravi N. Kalotra, Mr. Gajanan Patange, Mr. J.K. Gohil	Engineering	71-75
29	Stream Function Formulation of Lid Driven Cavity	Mr. Zankhan C. Sonara, Prof. Dattatraya G. Subhedar, Mr. Kartik Patel	Engineering	76-78
30	Implementation of ABT (Availability Based Tariff) - its Treatment & Proceedings	Dilip m.Bhankhodiya, Dipak t. Vaghela	Engineering	79-82
31	Active Filters for Power Quality Improvement	Dipak t. Vaghela, Dilip m. Bhankhodiya	Engineering	83-87
32	Design and Analysis of Air Bearing using Orifice and Feed Hole Pocket	Nileshkumar T. Raval, Prof. M.Y.Patil	Engineering	88-90
33	Drip irrigation technique enhancing water and fertiliser use efficiency in cauliflower	Dr. S.S. Yadav, Dr. R.S. Meena	Engineering	91-92
34	Experimental and FEA Evaluation of Hybrid Joint Strength of Single Lap joint.	S. S. Kadam, P. A. Dixit	Engineering	93-96
35	CFD Analysis of Mixed Flow Submersible pump Impeller	Mitul G Patel, Subhedar Dattatraya, Bharat J Patel	Engineering	97-100
36	EVA: An Innovative Parameter for Shareholders' Wealth Measurement	Shri. Arvind A. Dhond	Finance	101-103
37	Profitability and consistency analysis of Textile Sector in India	Dr. K. S. Vataliya, Rajesh Jadav	Finance	104-107
38	Harmonious Relationship between Art and Music Critical vision (comparison)	Dr. Marwan Imran	Fine Arts	108-109
39	Land Use Pattern and Crop Combination Region in Satara District : A Geographical Study	Dr. Rathod S. B., Mane-Deshmukh R. S.	Geography	110-111
40	Garlic---Benefits and Uses	Dr. Sneh Harshinder Sharma	Geography	112-114
41	An Assessment of Thermal Comfort Zones in Terms of Tourists: A case study of Karveer Tehsil	Mr. Prashant Tanaji Patil, Miss. Mane madhuri maruti, Miss. Mugade Nisha Ramchandra	Geography	115-117

42	Hematological changes due to the impact of Lead nitrate on economically important estuarine fish <i>Mystus gulio</i>	Dr.S.Palani Kumar	Horticulture	118-119
43	Stress Management level in the employees of Manufacture Industries By considering key parameters with reference to Bhavnagar city	Dr. K. S. Vataliya, Adv. Ajay H. Thakkar	Human Resource	120-122
44	The Case of ABC Group-A Case on Performance Appraisal System	Shivani Sah	Human Resource Management	123-124
45	A Study On Performance Appraisal of Employees in Health Care Industry in a Private Multi-Speciality Organization	Dr. C. Swarnalatha, T.S. Prasanna	Human Resource Management	125-126
46	(Upnyas - Jansi ki Rani Laxmibai (vrundavanlal varma)	Dr. Sneh Harshinder Sharma	Literature	127-128
47	"Educational Technology for Professional Development of English Teachers: A Case Study of the College Teachers of English in Jammu Province"	Dr. Wajahat Hussain	Literature	129-130
48	The Reality of Sultana's Dream: A step towards success Rokeya Sakhawat Hossein	Riju Sharma, Ruchee Aggarwal	Literature	131-132
49	Road blocks of Match Industry in Andhra Pradesh: Certain Issues and Concerns	Anuradha Averineni	Management	133-134
50	Government's Assistance Towards the Development of Small Scale Industries in India with Special Reference to Krishnagiri District	B. Mohandhas, Dr. G. Prabakaran	Management	135-140
51	Effects of Role Stress on Employee Job Satisfaction and Turnover	Dr. T.G.Vijaya, R.Hemamalini	Management	141-144
52	"MNP – A major concern of Telecom Operators in Gujarat"	Mohsinali Momin, Dr. Deepak H. Tekwani	Management	145-147
53	A Study on Fiscal Support Provided by Vijaya Bank to Msme in Coimbatore City	Mrs. G. Murali Manokari, Mr. G. Lenin Kumar, Mrs. G. Sathiya	Management	148-150
54	Competencies for HR Professionals	GAYATHRI. M	Management	151-153
55	Cost and Strategic Management - Application, Framework and Strategies for the Growth of Sme Sector	Manisha gaur	Management	154-156
56	Development of Management Education System in India	Mr. Goudappa Malipatil	Management	157-158
57	Study on Volatility and Return of Major Indices of Indian Stock Market with Reference to Sensex And Nifty	Mr. Mukesh C .Ajmera	Management	159-160
58	A Need for an Epitome Shift in Management Education A study on Conceptual Teaching practices	Mrs. Vanishree K. Jamashetti, Mr. Sanjeev Rathod	Management	161-162
59	Personal Social Responsibility – A novel thought	Parul Jain, Dr. N.C Pahariya	Management	163-164
60	Green Marketing – A Consumer's Perspective in the Indian Scenario	Nidhi Srivastava, Preeti Pillai	Management	165-166
61	Challenges and Opportunities of Mobile Banking - An Indian Scenario	Sandhya.Ch.V.L	Management	167-169
62	A pragmatic study of civilizing amortment among The diverse countries	Mr. Vimal P. Jagad, Mr Mukesh .C Ajmera	Management	170-171
63	Celebrity Endorsement in India An Effective Tool of Sales Promotion	Piyush Shah, Dr. N C Pahariya	Management	172-176

64	A Study of Prominent Character Strengths and Their Relationship with Well Being Among Business Management Students	GarimaKamboj, DikshaKakkar	Management	177-180
65	Coffee Consumption in India: An Exploratory Study	Shri. Arvind A. Dhond	Marketing	181-183
66	Applicability of Retail Service Quality Scale (RSQS) in India	M. Ramakrishnan, Dr. Sudharani Ravindran	Marketing	184-186
67	Account Holders perceptions towards Self Service Technologies: a study of selected Private Sector Banks	Dr A Kumar, Prof Ankur Gangal	Marketing	187-189
68	Impact of Sales Promotion on Sales figures of Select International FMCG Brands	Dr.Sharif Memon	Marketing	190-193
69	Factors Affecting Green Product Design: Marketing Professional's Perspective	D. S. Rohini Samarasinghe	Marketing	194-196
70	The Impact of 'Ambience' and Variety on Consumer Delight: A Study on Consumer Behaviour in Ahmedabad	Dr A Kumar, Prof Vineeta Gangal	Marketing	197-200
71	Co-Relation of Social Justice with Human Rights: A Review	Dr. Monica Narang	Marketing	201-202
72	Study of Iron Status and Free Radical Activity in Plasmodium Falciparum and Plasmodium Vivax Malaria Infection	Sangita M. Patil, Ramchandra K. Padalkar	Medical Sciences	203-205
73	GOAL SETTING TENDENCIES, COMMUNICATION SKILLS AND WORK MOTIVATION VIS-À-VIS AGE DIFFERENCE – A STUDY ON PUBLIC SECTOR ORGANIZATION	Dr. Swaha Bhattacharya, Dr. Monimala Mukherjee	Psychology	206-208
74	Role of NGOs in Social Mobilization in the context of SGSY	Dr.Veershetty C. Tadalapur	Sociology	209-211
75	Age at menarche and its secular trend in rural and urban girls of bathinda district	Jyoti Sharma, Dr. Ajita	Sports Science	212-213
76	Effect Of Resin Finishing On Stiffness And Drape Of Khadi Fabric	Dr. Suman pant, Ms. Noopur Sonee	Textiles	214-216



Adsorption Studies of Cu (II) and Cr (VI) from metal solution using crosslinked chitosan-g-acrylonitrile copolymer

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ABSTRACT

A basic investigation on the removal of Cr (VI) and Cu (II) ions from metal solution using crosslinked chitosan-g-acrylonitrile copolymer was conducted in a batch adsorption system, for finding the effect of various parameters such as initial concentration of the metal solution, contact time, adsorbent dose and pH. The results show the adsorption efficiency of the prepared novel adsorbent for the heavy metal treatment. A pH 5.0 was found to be an optimum pH for both Cr (VI) and Cu (II) adsorption. The adsorption data have been explained in terms of Langmuir and was found to be fit well with the Langmuir isotherm model. The maximum adsorption capacities for Cu (II) and Cr (VI) ions were 230.79 mg/g and 122.83 mg/g, respectively. From the above results it was concluded that under optimum conditions, the chitosan grafted poly AN was found as an effective adsorbent for copper.

Keywords : Heavy metal, Adsorption, Equilibrium model

Introduction

Polymers are playing an important role in all branches of industry today (Guru et al., 2008). Recently the environmental pollution has become one of the most important problems threatening our world. Heavy metals are often problematic environmental pollutants, with well-known toxic effects on living systems (Toony et al., 2011).

In recent years, the removal of toxic heavy metal ions from sewage, industrial and mining waste effluents has been widely studied. Their presences are responsible for several types of health problems in animals, plants and human beings (Clement et al., 1995). Most of the commonly used adsorption methods suffer from some drawbacks such as high capital and operational costs and problem of disposal of residual metal sludge. Among the various methods for removing metal ions, adsorption process was found more promising. The adsorbents play the vital role in the process efficiency. Most adsorbents with active functional groups were developed to rely on their interactions with metal ion and hence, the functional groups have important effects on the effectiveness, capacity and reusability of the adsorbents.

Widely available biopolymers are being used for sorption due to their cheap resource (Niu and Volesky, 2003). The deacetylated product, chitosan a biopolymer was used in this present study. Chitosan has an amine functional group, which is strongly reactive with metal ions. To improve chitosan's performance as an efficient adsorbent, crosslinking reagents were used and grafting was done.

The current work is aiming to modify chitosan using grafting phenomenon. The cross linked chitosan-g-acrylonitrile copolymer adsorbent was prepared using ceric ammonium nitrate initiator for the removal of heavy metal ions such as Cr⁶⁺ and Cu²⁺. Batch studies were used to observe the sorption behavior of Cr⁶⁺ and Cu²⁺ on to the prepared grafted copolymer.

Materials and Methods

Materials

The chitosan was kind gift from Indian Sea food, Cochin, Kerala, India. The monomer acrylonitrile and the cross

linking agent glutaraldehyde were obtained from Central Drug House Private Ltd, Mumbai. Ceric ammonium nitrate Ce(NH₄)₂(NO₃)₆ and nitric acid used were of analytical grade reagents from Thomas Bakers Chemical and Company.

Preparation of crosslinked chitosan copolymer

2g of chitosan was dissolved in 2% aq. acetic acid solution with constant. A required amount of glutaraldehyde was added to the chitosan solution, then stirred for 20 minutes using magnetic stirrer. To this crosslinked chitosan solution, 0.1 M ceric ammonium nitrate (CAN) in 10 ml of nitric acid was added followed by a known amount (1 g in 50 ml of water) of acrylonitrile drop by drop with continuous stirring. The temperature of reaction was maintained at 70 °C for 45 minutes. After the completion of addition of monomer the product was precipitated by using sodium hydroxide solution with vigorous stirring. The precipitate was washed with distilled water several times to remove homopolymer formed and it was then filtered.

Experimental

Adsorption experiments were carried out by a batch study varying the concentrations of potassium dichromate and copper sulphate. The extent of removal of the two metals was investigated separately by changing the adsorbent dose, pH of the solution and time of shaking the adsorbent metal solution mixture. A sample of 1 g of chitosan-g-acrylonitrile copolymer was treated with 100 ml of potassium dichromate (200mg of Cr/L) and copper sulphate (200mg/L) solutions separately. It was then agitated at 30°C using orbital shaker at fixed speed of 160 rpm. After attaining the equilibrium adsorbent was separated by filtration using filter paper and aqueous phase concentration of metal was determined with atomic adsorption spectrophotometer (Varian AAA 220FS).

Effect of adsorbent dose

The adsorption of chromium and copper ion by cross linked chitosan-g-acrylonitrile copolymer (adsorbent) was conducted by varying the adsorbent ranging from 1g to 6 g separately, while keeping other parameters (pH, and contact time) constant. The figure 1 indicates that the percentage removal of chromium and copper generally increases with increase in the adsorbent dosage. This is due to the greater availability

of the exchangeable sites or surface area at higher dose of the adsorbent (Jameel Dhabab et al., 2011). The maximum % removal of Cr (VI) was about 84% at the dosage of 6 g, while for Cu (II) it was 86% at the dosage of 6 g.

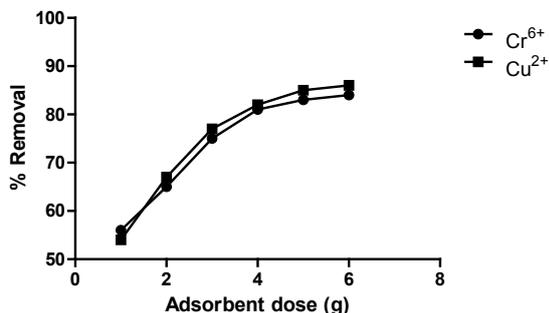


Figure 1: Effect of adsorbent dose on the removal of Cr⁶⁺ and Cu²⁺

Effect of contact time

The plot (figure 2) revealed that the rate of percent copper and chromium removal are higher at the beginning. This was probably due to larger surface area of the graft copolymer being available at beginning for the adsorption of Cu²⁺ and Cr⁶⁺ ions (Ali Shafagat et al., 2012), after some extent further increase in contact time shows a decrease in the uptake which may be due to the decrease of the easily available active sites for adsorption till the equilibrium is reached. The results indicated that for the metal ion Cr (VI), the rate of removal was increased with the increase in the contact time up to 360 min and then remained constant (78.5%). Similarly, Cu (II) removal was increased from 15 to 70% with the contact time variation from 30 to 300 min, respectively. From the results it was concluded that the optimum contact time for both metals are 360 min.

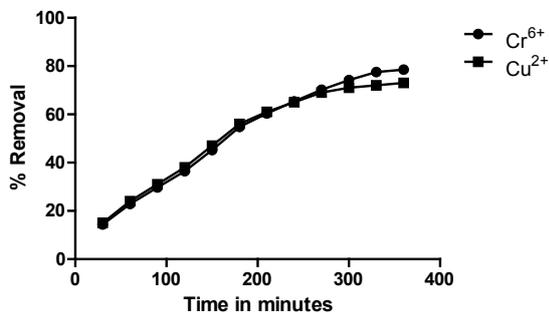


Figure 2: Effect of contact time on the removal of Cr⁶⁺ and Cu²⁺

Effect of pH

The pH value of the solution is an important controlling parameter in the adsorption process. A small variation in pH influences both the adsorbent surface and ionic species of metal ion in water. At different pH values, the protonation and deprotonation behaviors of acidic and basic groups would be influenced (Tooney et al., 2011). The dependence of amount of adsorption of Cr (VI) and Cu (II) ions on pH was shown in Figure 3. The adsorption increases with an increase in pH of the metal ion solution at first and then it shows a decrease. An optimum adsorption was obtained at pH 5 for both Cr (VI) ions and Cu (II) ions. The maximum removal at optimum pH was about 86%.

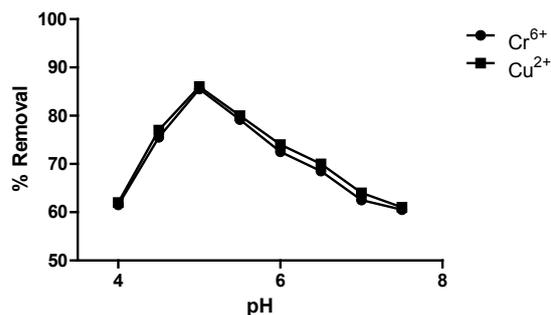


Figure 3: Effect of pH on the removal of Cr⁶⁺ and Cu²⁺

Langmuir isotherm model

The Langmuir isotherm represents the equilibrium distribution of metal ions between the solid and liquid phases. The Langmuir model assumes that the uptake of metal ions occurs on a homogenous surface by monolayer adsorption without any interaction between adsorbed ions. To get the equilibrium data, initial metal concentration were varied while the adsorbent mass in each sample was kept constant.

The linearised form of the Langmuir isotherm

$$C_{eq}/C_{ads} = bC_{eq}/K_L + 1/K_L \text{ ----- (1)}$$

$$C_{max} = K_L/b \text{ ----- (2)}$$

where

C_{ads} = amount of metal ion adsorbed (mg·g⁻¹)

C_{eq} = equilibrium concentration of metal ion in solution (mg·dm⁻³)

K_L = Langmuir constant (dm³·g⁻¹)

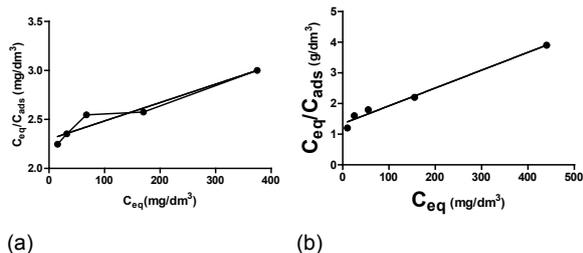
b = Langmuir constant (dm³·mg⁻¹)

C_{max} = maximum metal ion adsorbed (mg/g)

The constant “b” in the Langmuir equation is related to the energy or the net enthalpy of the sorption process. The constant K_L can be used to determine the enthalpy of adsorption (Schmuhl et al., 2001). The constants “b” and “K_L” are the characteristics of the Langmuir equation and can be determined from the linearized form of the Langmuir equation (1). A linearized plot of C_{eq}/C_{ads} against C_{eq} gives “K_L” and “b”.

In a solid liquid system, positive sorption results in the removal of solute from the bulk solution and the concentration at the surface of the solid, until the remaining solute in the solution is in dynamic equilibrium with the solute on the solid surface. At equilibrium there is a defined distribution of the solute between the liquid and the solid phases, which can generally be expressed by one or more isotherms (Findon et al., 1993). Figures 4 show that the isotherm of the sorption of chromium and copper ions by crosslinked chitosang acrylonitrile.

The isotherm is characterized by the initial region, which is represented as being concave to the concentration axis. The isotherm is beginning to reach a plateau, which can typically be described by the Langmuir isotherm (Parfitt and Rochester, 1983)



(a) (b)
Figure 4: Langmuir isotherm for (a) Cr⁶⁺ and (b) Cu²⁺

Table 1: Langmuir constants and Cmax value

Metal ions	Langmuir constants		
	KL (dm ³ /g)	b (dm ³ /mg)	Cmax (mg/g)
Cr(VI)	2.297	0.0187	122.83
Cu(II)	1.343	0.005819	230.79

It is found that the adsorption of Cr (VI) and Cu(II) onto crosslinked chitosan-g-acrylonitrile copolymer correlates well with the Langmuir equation under the concentration studies. The values of RL indicates that the adsorption is favourable.

Conclusion

The capacity of crosslinked chitosan-g-acrylonitrile copolymer to adsorb Cr(VI) and Cu (II) ions from aqueous solutions was examined. The observed results showed that the change of adsorbent dose, pH and the contact time had a pronounced effect on the removal of Cr (VI) and Cu (II) ions from metal solution. The functional groups on the biosorbent surface were found to play a role in the entrapment of the target metal ions. Since biosorbent used in this work is freely, abundantly, locally available, and expected to be viable for removal of chromium ion from aqueous solution. The adsorption capacity of the metal ions was found to be as follows Cu(II)>Cr(VI). The adsorption isotherms could be well fitted by the Langmuir equation. This adsorbent is found to be favorable for the metal ions removal from the wastewater.

REFERENCES

- Ali Shafaghat, Farshid Salimi, Mahdi Valiei, Jaber Salehzadeh and Masoud Shafaghat "Removal of heavy metals (Pb²⁺, Cu²⁺ and Cr³⁺) from aqueous solutions using five plants materials" African Journal of Biotechnology Vol. 11(4), pp. 852-855, 12 January, 2012. DOI: 10.5897/AJB11.2060 | • Clement R.E, Eiceman G.A, Koester C.J. Environmental-analysis. Anal. Chem. 67 (1995) R221–R255. DOI: 10.1021/ac00108a012 | • Findon, A., McKay, G., and Blair, H. S. (1993). "Transport studies for the sorption of copper ions by chitosan", Journal of Environmental Science and Health, 28(1), pp 173-185. DOI: 10.1080/10934529309375870 | • Guru G.S., P. Prasanth, H.R. Shivakumar, S.K.Rai, Studies on the compatibility of Pullulan–Carboxymethyl cellulose blend using simple techniques" Malaysian Polymer found (MPJ) 3 (2), pp: 13-23, (2008). | http://www.cheme.utm.my/mpj/images/080302_2guru.pdf | • Jameel .M. Dhabab "Removal of some heavy metal ions from their aqueous Solutions by duckweed" Journal of Toxicology and Environmental Health Sciences Vol. 3(6) pp. 164-170, June 2011. <http://www.academicjournals.org/JTEHS> | • Niu, H., and Volesky, B. (2003). "Characteristics of anionic metal species biosorption with waste crab shells", Hydrometallurgy, 71, pp 209-215. DOI: 10.1016/S0304-386X(03)00158-0 | • Parfitt, G.D, and Rochester, C.H. (1983). "Adsorption from Solution at Solid/Liquid interface", Academic Press, London, pp 913. <http://www.getcited.org/pub/102235445> | • Schmuchl, R., Krieg, H. M., and Keizer, K. (2001) "Adsorption of Cu(II) and Cr(VI) ions by chitosan: kinetics and equilibrium studies, Water SA", 27(1), pp 18. <http://www.wrc.org.za> | • Toony, M.M, Abdel-Geleel, M, Aly, R.O and Ali H.F "Removal of Ag⁺, Co⁺⁺ and Cs⁺ From Wastewater Using Porous Resin Blend (Epoxy/PVA)" Nature and Science 2011;9(2). www.sciencepub.net/nature/ns0902/12_4629ns0902_82_89.pdf |



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