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ADSORPTION OF Cr^{+3} FROM WASTE WATER BY THE ADSORBENT PREPARED FROM WASTE CAJANUS CAJAN PEELS

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ABSTRACT:

Nowadays heavy metal contamination in water leading to pollution of water is one of the serious problems. Heavy metals like lead, nickel, cobalt, copper, chromium causes problems to humans and aquatic life. Several methods are used for removal of heavy metals from water but adsorption is the easy and cheapest method for the removal of heavy metal ions. This paper deals with the removal of Copper ions from waste contaminated water. Cajanus cajan peels powder and its activated charcoal is used for adsorption. Photocalorimeteric technique is used for study. The decrease in concentration shows good adsorption of metal ions.

Key words: Adsorption, photocalorimeteric technique, Cajanus cajan (tur legume) peels.

INTRODUCTION:

Due to rapid industrialization and urbanisation in developing countries like India water pollution is a serious problem nowadays. Pollution of surface and ground water caused by human and industrial activities has been recorded as a major problem worldwide. Several industrial, agricultural process and mining activities have increased the concentration of toxic metal contamination all over the world. Every day there are thousands of chemicals discharged directly and indirectly into water sources without further treatment for elimination of included harmful compounds. Many industries like metal plating, mining operations, tanneries, radiator manufacturing, smelting, alloy industries and storage battery industries etc. release these severely toxic heavy metal ions in their waste waters contaminating natural streams, which is a major concern due to toxicity to many life forms. Heavy metals are without doubt well is the most hazardous and harmful metals even if they present as traces, since they accumulate in the tissue of living organisms. Many technologies like adsorption, precipitation, membrane filtration and ion-exchange have been used to remove metal pollutants from water. However adsorption has proven to be economical and efficient for removing heavy metals, organic pollutants and dyes from polluted water. Several adsorbents such as activated carbon, silica and grapheme can be used in the purification of water. Acute heavy metal intoxications may damage central nervous function, the cardiovascular and gastrointestinal (GI) systems, lungs, kidneys, liver, endocrine glands and bones. Chronic heavy metal exposure has been implicated in several degenerative diseases of these systems and may increase the risk of some cancers.

MATERIAL AND METHODS:

The waste peels were collected, washed several times with water then dried till the moisture is completely removed. Fine powder was prepared. Activated charcoal was prepared by carbonisation and activation by $CaCl_2$. Some part of the powder was used as non activated powder without any treatment. Photocalorimetric Technique is used for study.

Photocalorimetric Technique

Photocalorimetric Technique is used for determination of colour. The intensity of colour of the substance is directly proportional to its concentration. The solutions of different concentrations were prepared. By adding non activated powder and activated charcoal in a solution of chromium shaking for 15 minutes after filtration optical density and pH of the solution was recorded. Concentration of unknown solution can be determined as follows.

$$\frac{\text{Concentration of solution II}}{\text{Concentration of solution II}} \times \text{Initial concentration of the solution}$$

RESULT & DISCUSSION:

The above experimental analysis shows that the non activated powder of Cajanus cajan (tur legume) peel powder which is a biosorbent can be used for the adsorption of Cr^{+3}. The activated charcoal prepared from this peel powder shows very good adsorption. Not only activated charcoal but powder also shows adsorption. The pH also found to be increased from 2.6 to 3.6 before adsorption and 4.1 to 5 after adsorption indicating decrease in acidity of solution in case of tur peel powder. Activated charcoal shows change in pH from 4.5 to 5.5 Hence powder of Cajanus cajan and activated charcoal prepared from it can act as very good adsorbent for heavy metal ions.

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Table 1- Determination of optical density of solutions before and after adsorption at different wavelengths for tur peel powder

Initial conc.	0.5 M		0.25 M		0.125 M		0.06 M	
Wavelength	**Before**	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**
400	1.304	1.065	0.607	0.334	0.321	0.252	0.12	0.087
420	1.619	1.201	0.774	0.457	0.39	0.269	0.159	0.102
440	1.563	1.113	0.749	0.51	0.371	0.241	0.152	0.094
460	1.203	0.823	0.856	0.524	0.283	0.141	0.111	0.071
480	0.807	0.535	0.375	0.201	0.19	0.104	0.068	0.039
500	0.577	0.398	0.26	0.121	0.139	0.088	0.043	0.021
520	0.636	0.466	0.292	0.134	0.155	0.096	0.052	0.025
540	0.907	0.657	0.43	0.322	0.219	0.161	0.087	0.062
560	1.26	0.879	0.612	0.491	0.299	0.185	0.133	0.109
580	1.509	1.024	0.742	0.617	0.397	0.32	0.16	0.131
600	1.525	1.014	0.752	0.608	0.353	0.309	0.159	0.134
620	1.325	0.87	0.65	0.491	0.307	0.269	0.139	0.102
640	1.041	0.666	0.509	0.405	0.24	0.19	0.106	0.072
pH	2.7	4.1	2.9	4.4	3.3	4.7	3.6	5

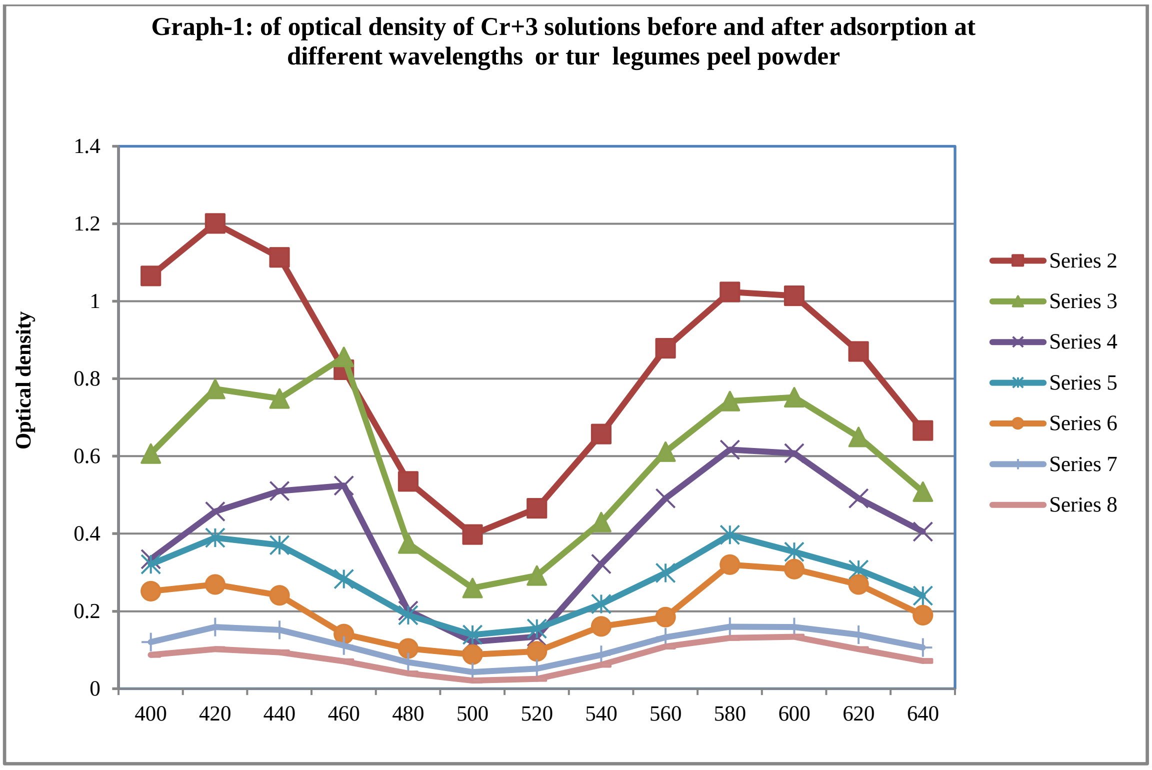

Table 2 - Determination of concentration of solutions after adsorption

Initial conc.	0.5 M	0.25 M	0.125 M	0.06 M
Wavelength				
400	0.408	0.137	0.098	0.045
420	0.370	0.147	0.086	0.040
440	0.356	0.170	0.081	0.038
460	0.342	0.153	0.062	0.039
480	0.331	0.134	0.068	0.035
500	0.344	0.116	0.079	0.031
520	0.366	0.114	0.077	0.030
540	0.362	0.187	0.091	0.044
560	0.348	0.201	0.077	0.051
580	0.339	0.207	0.010	0.051
600	0.332	0.202	0.011	0.052
620	0.328	0.188	0.011	0.045
640	0.319	0.198	0.098	0.042
pH	4.1	4.4	4.7	5.0

Table 3 - Determination of optical density of solutions before and after adsorption at different wavelengths for activated charcoal of tur peel powder

Initial conc.	0.5 M		0.25M		0.125 M		0.06M	
Wavelength	Before	After	Before	After	Before	After	Before	After
400	1.304	0.820	0.607	0.262	0.321	0.201	0.120	0.049
420	1.619	1.099	0.774	0.334	0.390	0.212	0.159	0.068
440	1.563	0.956	0.749	0.419	0.371	0.198	0.152	0.054
460	1.203	0.685	0.856	0.423	0.283	0.101	0.111	0.041
480	0.807	0.431	0.375	0.127	0.190	0.059	0.068	0.020
500	0.577	0.291	0.260	0.091	0.139	0.041	0.043	0.012
520	0.636	0.342	0.292	0.098	0.155	0.050	0.052	0.013
540	0.907	0.499	0.430	0.261	0.219	0.123	0.087	0.034
560	1.260	0.701	0.612	0.377	0.299	0.147	0.133	0.071
580	1.509	0.932	0.742	0.528	0.397	0.281	0.160	0.101
600	1.525	0.921	0.752	0.517	0.353	0.251	0.159	0.102
620	1.325	0.632	0.650	0.397	0.307	0.217	0.139	0.081
640	1.041	0.512	0.509	0.312	0.240	0.145	0.106	0.043
pH	2.7	4.5	2.9	4.9	3.3	5.1	3.6	5.5

Graph-2: Optical density of Cr+3 solutions before and after adsorption at different wavelengths for activated charcoal of tur legumes peel powder.

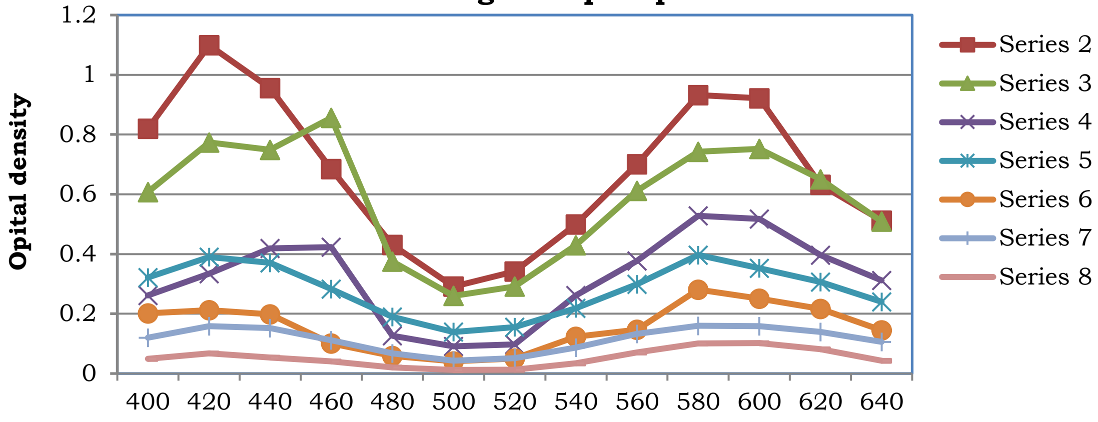

Table 4- Determination of concentration of solutions after adsorption

Initial conc.	0.5 M	0.25 M	0.125 M	0.06 M
Wavelength				
400	0.314	0.107	0.078	0.025
420	0.306	0.107	0.067	0.026
440	0.305	0.139	0.066	0.022
460	0.284	0.123	0.044	0.023
480	0.267	0.084	0.038	0.018
500	0.252	0.087	0.036	0.017
520	0.268	0.083	0.040	0.015
540	0.275	0.151	0.070	0.024
560	0.278	0.154	0.061	0.033
580	0.308	0.177	0.088	0.039
600	0.301	0.171	0.088	0.040
620	0.238	0.152	0.088	0.036
640	0.245	0.153	0.075	0.025
pH	4.5	4.9	5.1	5.5