Column Separation and Recovery of Hg^{2+} and Ni^{2+} from Admixture by Nitrated Biomass of *Cicer arientinum*.

Anandrao A. Kale1*

1*. P.G.Dept. of Chemistry, S.M.Joshi College, Hadapsar. Dist-Pune, (Maharashtra)

Corresponding author: 1*. Anandrao A. Kale E Mail- anandraoakale@gmail.com

Telephone number: 91-9922753472

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Abstract

The sieved biomass of *Cicer arientinum* has been converted in to cheap carbonaceous adsorbent by AR. Nitric acid treatment. This adsorbent exhibits a good sorption potential for heavy metals like Hg^{+2} and Ni^{+2} from their mixture. Present work deals with removal and recovery of heavy metals like Hg^{+2} and Ni^{+2} from their mixture and chemical regeneration of the adsorbent material. Particle size affects separation and recovery but only to certain extent 63 micron mesh particle when used for column packing there is maximum recovery of the metals. Hg^{2+} 90 to 96% and for the % recovery of Ni^{2+} ranges from 82 to 88%. Thus nitrated biomass of Cicer areintinum is cheap and abundant biomass, effectively applied for removal of Hg^{2+} and Ni^{2+} by column separation to minimize the water pollution.

1.0 Introduction

The separation and recovery of heavy metals is also a matter of great concern for environment. This type of separation could be achieved by subjecting the effluents to column separation. For using an adsorbent as a stationary phase in the column the particles should have a specific size. The use of various adsorbents such as activated carbon [1], rice husk carbon [2], saw dust [3] and fly –wollastonite [4] have been documented for the removal of Cr (VI) from aqueous solutions. The toxicity of hexavalent chromium from the discharge of various industrial wastes is well reported [5-7]. Srivastava have studied adsorption of heavy metal ions on carbonaceous material developed from waste slurry of fertilizer plants [8]. Balsubramanium have reported utilization of fly ash and waste tea leaves ash as decoloursing agents for dye effluents [9]. The presents study reports work on removal and recovery of heavy metals like Hg^{2+} and Ni^{2+} from their mixture.

Mohamed Chaker Ncibi and et al. reported sorption of Cd^{2+}, $Pb^{2+,}$ NI^{2+}, and $Zn2^{+}$ by mangifera indica. Mohammad Ajmal and et al (1998), reported the Minamata [10] tragedy in Japan 1953-1960 due to metallic mercury released from industries passed to human being largely by natural food chain by fish. While diseases like "Itai-Itai" occurred in the farmer who drank water containing cadmium reported by Benefield, Jadleins and Weand et al. (1982) [11]. Mercury is widely used in industry excessive mercury dangerous to humans, it will cause stomach upset and ulcer, mental disorder, liver, and brain damage [12] reported by Ramos, L, et al.(1999) .Hence, removal of Hg^{2+} from effluents is needed. The sorbent that is cheap, abundant obtained from other industries [13] was presently preferred for sorption process was reported by Bailey, S.E et al. (1999). Our results on Sorbent indicated that they were good adsorbents for Hg^{2+} and Ni^{2+} therefore trials were also taken to test their uptake capacity for nickel. These experiments gave promising results. As a further extension of this work we have tried to select particles of nitrated biomass having appropriate size and carried out column chromatographic studies. Preliminary experiments on column chromatographic studies using simply nitrated biomass (sorbent) as stationary phase materials have been carried out for the separation and recovery of Hg^{2+} and Ni^{2+} from their mixture. A large number of heavy metals have been recovered from effluents as well as from waste water by using synthetic organic, inorganic ion- exchangers, column methods. The details of these methods are described in many standard text books and in reviews. The distribution of metals on the ion exchanger can be modified by complex formation since the process of separation is not selective. However a number of separations could be achieved by complex formation due to enhanced selectivity. The most common example of selectivity is found with anionic chlorocomplexes of metal which are separated from hydrochloric acid solution by quaternary amine exchanger. Every metal has its own characteristic dependence of sorption on hydrochloric acid solution by quaternary amine exchanger. Every metal has its own characteristics dependence of sorption which makes an almost infinite variety of column chromatographic separations. Mishra have studied Fe (OH)3 loaded marble as an adsorbent for the removal of phenolic compounds from aqueous solution. The adsorbed compounds have been quantitatively eluted with 1M NaOH solution.

2.1 Materials and Method

Sieved Agro-waste of *Cicer arientinum*, AR.grade Nitric acid, HCl, E.D.T.A., Indicator solution etc. Column Chromatographic, technique, complex metric titration. The dried powdered, subjected to simple chemical treatment with AR. Nitric acid (Loba Chem.) and then washed repeatedly till free from acid and dried at 105^0C. The dried material was passed through sieves of 63 micron mesh, 25micron mesh, 18 micron mesh size to get Sorbent of different particle size.

2.2 Column Preparation:

Stock solutions of Hg^{2+} and Ni^{2+} of strength of 1mg/ml were prepared using the nitrates of the two metals. The column studies were carried out by using down flow method. For these experiments 20 gm of Sorbent of different particle size was suspended in distilled water, stirred for about 15 minutes and finally transferred into a glass column of length 30 cm and inner diameter 30 mm. A glass wool plug was kept at the bottom of the column to avoid the loss of adsorbent with the liquid flow. 50 ml of solution containing Hg^{+2} and Ni^{+2} was fed in to the column at the flow rate 1 ml/min.

2.3 Column Separation: The exhaustive capacity was determined by collecting 50 ml fraction of the eluent after break through. Similar experiments were carried out with different particle size of Sorbent. The amount of metal ions retained by the sorbent was found out. The sorbed metal ion Hg^{2+} and Ni^{2+} loaded on the column were collected until the entire metal ion was completely removed using HNO3 and HCl as eluents. The amount of metal ion extracted from the sorbent after elution was determined complexmetric titration with standard E.D.T.A. method. All chemicals used for were Loba Chem. The amount of metal ion retained by sorbent and recovered after elution, from columns of Sorbent of the different particle sizes (0.18, 0.25 and 0.63 micron) was calculated.

3.0 Results and Discussion

The results in Table-1 indicate the effect of particle size on the recovery of the metals. As the particle size increases the % recovery of Hg^{2+} also increases from 90 to 96%. Similar trends were also observed for the % recovery of Ni2+ ranges from 82 to 88% (Fig-1). Nitrated biomass have very good recovery for (0.63mm) smallest sized particles of sorbent. The % recovery Hg^{2+} and Ni^{2+} was decreases with decrease in particle size of sorbent (Fig.2). A slight but distinct amount of Hg^{2+} and Ni^{2+} appears to be retained on the column containing sorbent. These results indicate that Hg^{2+} and Ni^{2+} can be separated and recovered 4 quantitatively using sorbent. The present study clearly indicates that sorbent are good materials for column separation of heavy metals viz Hg^{2+} and Ni^{2+} in quantitative yields. Comparatively it was found that sorbent have Hg^{2+} good removal and recovery than Ni^{2+} for sorbent probably this may be due to strong oxidizing property of nitric acid. However further study is needed which would throw light upon the utility of these materials for recovery of heavy metals and also precious metals.

3.1 The % Recovery (Sorption) by Sorbent for Hg^{2+} and Ni^{2+}

Table-1

Metal ion	Amount sorbed (mg)	Amount recovered by sorbent (mg)	% recovery by Sorbent	Mesh size in mm
Hg^{2+}	25	23	90	0.18
Hg^{2+}	25	24	96	0.25
Hg^{2+}	25	24	96	0.63
Ni^{2+}	25	21	82	0.18
Ni^{2+}	25	21	84	0.25
Ni^{2+}	25	22	88	0.63

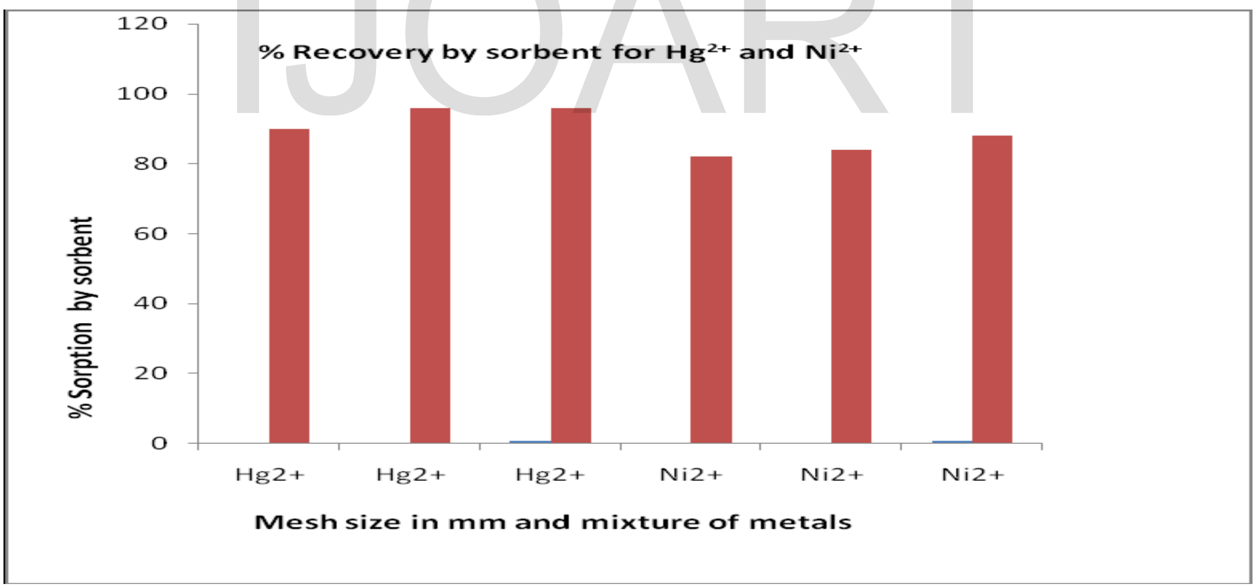

Fig-1 % Recovery (Sorption) by Sorbent for Hg^{2+} and Ni^{2+}

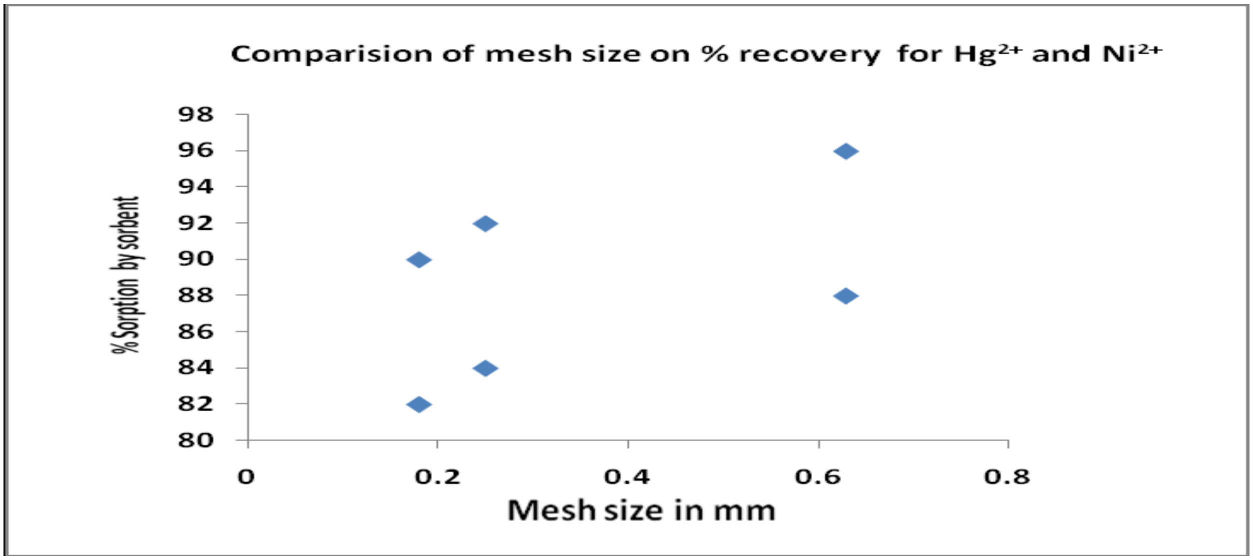

Fig-2 Effect sorbent size on % recovery of Hg^{2+} and Ni^{2+}

3.0 Conclusions

Nitrated biomass have very good recovery for (0.63mm) smallest sized particles of sorbent. Out of 25 mg of Hg^{2+} and Ni^{2+} taken in an admixture the amount of metal ions recovered depends on nature of sorbent, particle size, flow time and biosorbent dose, Hg^{2+} and Ni^{2+} can be separated quantitatively using Sorbent. The surfaces of Nitrated biomass of Cicer arientum (Sorbent) may not be very much different as there is only a slight difference in amounts of metal ions recovered**.** Particle size affects separation and recovery but only to certain extent.63 micron mesh particle when used for column packing there is maximum recovery of the metals. Hg^{2+} 90 to 96% and for the % recovery of Ni^{2+} ranges from 82 to 88%. Hg2+ and Ni2+ can be separated quantitatively ,Particles of Sorbent Obtained by sieving through 63mm mesh when used for packing a Column give nearly 100% recovery on both metals Hg^{2+} and Ni^{2+} .Comparatively it was found that sorbent have Hg^{2+} good removal and recovery than Ni^{2+} for sorbent probably this may be due to strong oxidizing property of nitric acid. Sorbent are good stationary phase materials for quantitative Separation and recovery of heavy metals such as nickel and lead from an admixture.

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