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REMOVAL OF NICKEL (II) FROM AQUEOUS SOLUTION USING *POMEGRANATE* PEEL POWDER

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ABSTRACT

Removal of Nickel (II) from aqueous solution using *Pomegranate* peel powder as a new biosorbent was studied. Investigations have been made to study various sorption parameters such as biomass amount, contact time, pH, temperature and initial ion concentration. The selected adsorbent was effective for the removal of Nickel (II) ions in acidic medium and attained the equilibrium in 30 minutes. The adsorption process is endothermic in nature. This adopted method is quite feasible, economic, time saving and low cost.

KEYWARDS: Adsorption**,** *Pomegranate* peel powder, Heavy metal, Aqueous solution.

1. INTRODUCTION

Industrialization to a larger degree is responsible for the contamination of environment especially water where lakes and rivers are overwhelmed with a large number of toxic substances. Heavy metals are reaching hazardous levels when compared with the other toxic substances [1]. Heavy metals are a unique group of naturally occurring compounds. Their continuous release leads to overconsumption and accumulation. Many industries such as fertilizers, metallurgy, leather, mining, electroplating, energy and fuel production, discharge waste containing heavy metals either directly or indirectly into the water resources.[2] There are several conventional methods can be adopted for the removal of heavy metal from wastewater like chemical precipitation, electroplating, ion-exchange, reverse osmosis, chemical coagulation and adsorption. These methods are highly costly, not effective, require high energy input and non-ecofriendly in nature.[3-4] Among these, adsorption technique has gained importance due to its cost economy, high efficiency, harmless nature and ease handling.[5]

Pomegranate is a widely available fruit, belongs to *Lythraceae* family. *Pomegrante* has various properties as anti-oxidant, anti-viral, anti-tumor and many more. *Pomegranate* fruit is a good source of vitamins as well as folic acid. *Pomegranate* fruit peel is full of flavonoids and tannins.[6] The main objectives of this research is to investigate the effects of various parameters as biomass amount, contact time, pH, temperature and initial ion concentration on the adsorption efficiency of Nickel (II) ion on the *Pomegranate* fruit peel powder.

2. MATERIALS AND METHOD

2.1. Preparation of Biomass

The fruit peels of *Pomegranate* were collected and washed severally followed by distilled water to remove dirt and dust. After washing, peels were dried in shade for 6-7 days, till becomes crispy. Dried peels were grinded on grinder to obtain a desired size powder. Dried powder were further used throughout the experiment.

2.2. Preparation of Stock solution

The stock solution of Nickel (II) 1000 mg/L was prepared by dissolving 1.1343 g of $NiSO_4.6H_2O$ in distilled water. All chemicals used were of analytical grade. For working solutions, it was further diluted to desired concentration by diluting the Nickel stock solutions. The concentrations of Nickel (II) ion in the solution was determined complexometrically.

2.3. Adsorption study

In this study, adsorption experiments were conducted for the adsorption of Nickel (II) on natural *Pomegranate* fruit peel powder as a function of biomass amount, contact time, pH, temperature, and initial ion concentration. Aqueous 25 ml Nickel (II) solution of different concentrations were taken in 100 ml Erlenmeyer flask. The experiment was carried with 0.2 to 0.6 g of *Pomegranate* fruit peel powder varying with contact time. We varied the experiment for different

parameters. After the completion of the experiment, the solution was filtered through Whatman no.41 for 5 minute. The filtered supernatant was titrated with 0.01 M EDTA complexometrically. The percentage removal of Nickel (II) was calculated using equation as,

$$R\% = [C_i - C_f / C_i] \times 100$$

Where R is the percentage removal of nickel, C_i and C_f are the initial and final Nickel (II) ion concentrations.

3. RESULTS AND DISCUSSION

3.1. Effect of Biomass amount

In this study, effect of biomass amount from 0.2 to 0.6 g is studied on the removal of Nickel (II) ion. It is evident from the study that, the percentage removal of Nickel increases from 0.2 to 0.5 g i.e. maximum adsorption 96.84 % is seen at 0.5 g of biomass (Fig.1), afterwards there is seen a decreasing trend. This is owing to the increase of bio adsorbent mass that would result in greater availability of reactive groups.[7]

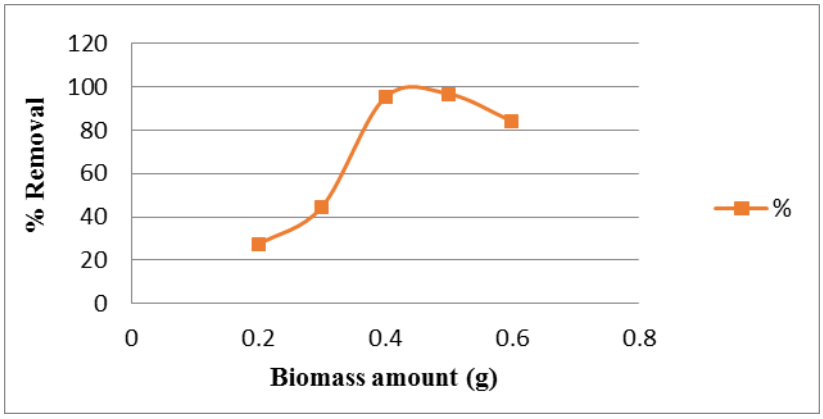

Figure 1: Effect of biomass on percentage removal of Nickel (II).

3.2. Effect of Contact time

The contact time plays crucial role in the adsorption of metal species onto the surface of adsorption of Nickel (II) on *Pomgranate* fruit peel powder as a function of time 0 to 60 minutes in this investigation. Results depicted that, as the processing time increases, the uptake of metal also increased from 32.50 % to 97.51%. Maximum percentage removal of Nickel (II) was found to be 97.51% at 30 minutes thereafter, found negligible decrease in the adsorption rate as shown in Fig. 2. This increase may be attributed to the presence of large number of vacant surface sites on the biomass.[8]

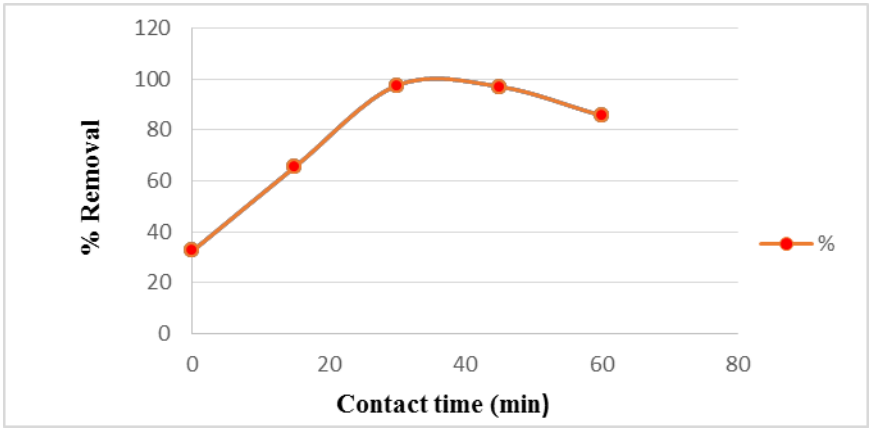

Figure 2: Effect of contact time on percentage removal of Nickel (II).

3.3. Effect of pH

In this study, pH ranging from 2.0 to 8.0 was studied with biomass amount of 0.5 g, for contact of 30 minutes at 130 rpm keeping all the parameters constant. It can be seen (Fig. 3) with the increase of pH from 2.0 to 7.0, increases the maximum adsorption of Nickel (II). At higher pH beyond 7.0, there seen a precipitate formation, decreasing the rate of adsorption. This is due to increase in OH^- ion causes a decreases in adsorption of metal ions at adsorbent interface.[9] Maximum percentage removal of Nickel (II) was found to be 97.45% for pH 7.0.

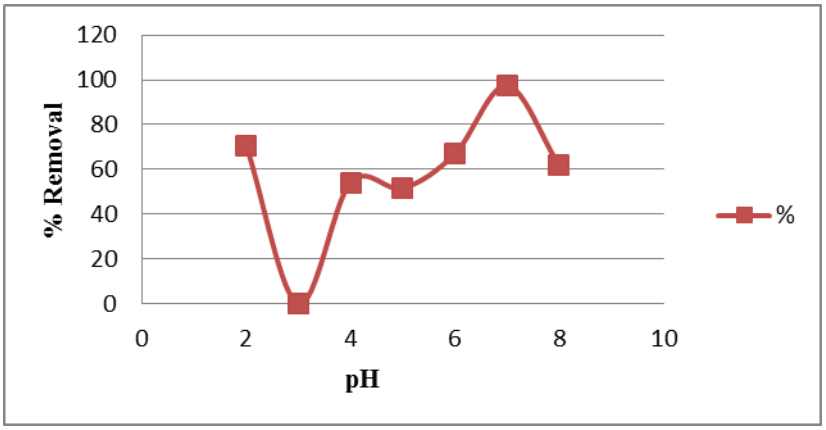

Figure 3. Effect of pH on percentage removal of Nickel (II)

3.4. Effect of Temperature

In this investigation, the adsorption of Nickel (II) by *pomegranate* fruit peel powder with the increasing temperature from 10°C to 60°C is studied keeping all the parameters constant. It is evident from Fig. 4, that the maximum percentage removal of Nickel (II) is 91.09% at an optimum temperature 50°C. Decrease in percentage removal beyond 50°C, showing the endothermic nature of reaction. The decrease of adsorption capacity at higher temperature may be due to the damage of active binding sites in the biomass.[10]

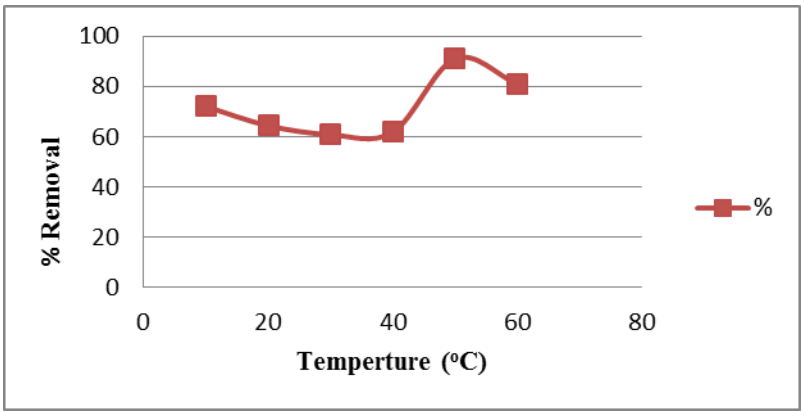

Figure 4. Effect of Temperature on percentage removal of Nickel (II).

3.5. Effect of Initial ion concentration

The initial ion concentration provides an important driving force to overcome all mass transfer resistance of metal between the aqueous and solid phases. Here in, initial ion concentration ranging from 1 mg/ml to 5 mg/ml was studied by keeping other parameters constant. Decreasing trend can be seen as initial ion concentration increases from 1 mg/ml to 5 mg/ml. As illustrated (Fig. 5), the higher percentage removal of Nickel (II) was obtained 98.20 % at 1 mg/ml. At higher initial ion concentration, percentage removal of Nickel (II) was lower.[11]

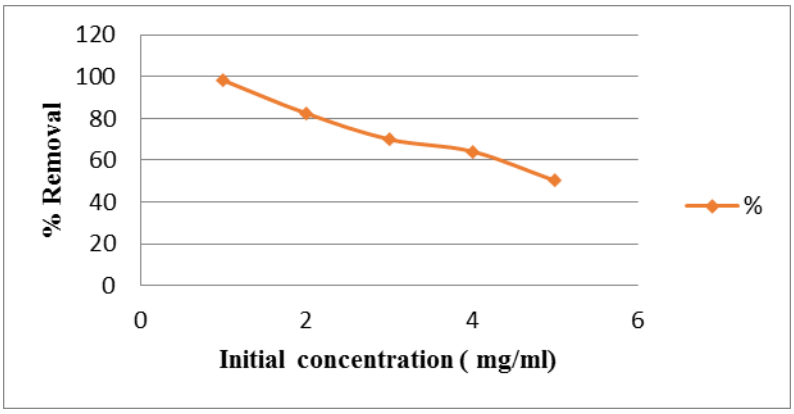

Figure 5: Effect of concentration on percentage removal of Nickel (II).

4. CONCLUSION

In this research work, *Pomegranate* fruit peel is selected as a natural, low cost adsorbent for the removal of Nickel (II) ions from aqueous water. *Pomegranate* fruit peel has shown the adsorptive potential for removal of Nickel (II) ion. This study has revealed the acidic pH is the optimum pH as maximum percentage removal was obtained 97.45% at pH 7.0. Increase in temperature increases the higher percentage removal of Nickel (II) ion showing the endothermic nature of reaction. The proposed method offers a very convenient, effective, eco-friendly alternative methodology over the traditional methodologies for the adsorption of Nickel (II) ion from the aqueous water. This study can be helpful in developing a wastewater treatment plant for the removal of metals from wastewater by using natural adsorbent. *Pomegranate* peel powder, as green, low cost, naturally occurring is an effective alternative over the traditional methods for the removal of Nickel(II) from industrial wastewater and contaminated water.

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REFERENCES

1. Vieira RH, Volesky B. Biosorption: A solution to pollution, International Microbiology, 2000; 3: 17-24.
2. Das N, Vimala R, Karthika P. Biosorption of heavy metals an overview, Indian Journal of Biotechnology, 2008; 7: 159-169.
3. Baiely SE, Olin TJ, Bricka RM, Adrian DD. A Review of potentially low cost sorbents for heavy metals, Water Research, 2009; 33(11): 2469-2479.
4. Demirbas A. Heavy metal adsorption onto agro-based waste material: a review, Journal of Hazardous Material, 2008; 157(2): 220-229.
5. Cooney DO. Adsorption design for waste water treatment: *CRC press*, ISBN; 9781566703338-CAT, L1333, 1998.
6. Abdel MAE. Antioxidant activities of punica granatum (*Pomegranate)* peel extract on brain of rats. JMPR, In press, 2011.
7. Kucheakr SR, Patil MP, Aher HR, Zaware B, Gaikwad VB. Removal of Hg(II) from contaminated water on the bark powder of Syzygium cumini, International Journal of Scientific & Engineering Research, 2019; 10(10): 976-988.
8. Kucheakr SR, Patil MP, Aher HR, Gaikwad VB, Sung Han. Removal of Bismuth (III) with adsorption using Syzygium cumini, Bulletin of Environment, Pharmacology and Life Sciences, 2021; 10(4): 224-228.
9. Periasamy K, Namasivayam C. Bicarbonate treated peanut hull carbon for Hg (II) removal from aqueous solution, Water Res., 1993; 27: 1663–1668.
10. Ghorbani M, Eisazadeh H, Ghoreyshi AA. Removal of Zinc Ions from Aqueous Solution Using Polyaniline Nanocomposite Coated on Rice Husk, Iranica Journal of Energy and Environment, 2012; 3(1): 66-71.
11. Chakravarty P, Sarma NS, Sarma HP. Removal of lead (II) from aqueous solution using heartwood of Areca Catechu powder, Desalination, 2010; 256: 16-21.