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Original Research Article

Removal of Acetic, Oxalic and Phosphoric Acids from Water Using Sawdust as Biosorbent

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A B S T R A C T

As the industries are growing day by day in need for the production of supplies to meet the demand of the growing population, a huge amount of waste is generated from the industries which cause the pollution of water. Acids which are the by-products of some various chemical reactions in the industry causes a negative impact on the health of the aquatic organisms which inturn causes a health hazard to human beings. These acids are water soluble [(1)] and hence need to be removed. In the present investigation we have used the Biosorption [(2)] technique for the removal of the acidic pollutants like Acetic, Oxalic and Phosphoric acid. As these acids are water soluble and colorless; the method of determination of concentration of these acids is through simple volumetric analysis [(3)]. From our studies a conclusion can be made that the saw dust which is a waste product of the timber industry is found to be an effective biosorbent for the removal of these acids from water. The Freundlich and Langmuir adsorption isotherms have been verified by the experimental data. The Biosorption studies were done at room temperature.

Introduction

The industries of the various fields like medical industry, chemical industry etc; are releasing acids as their waste products into the water bodies which is causing pollution of water. In this group of acids the talk is mostly about Acetic, Oxalic and Phosphoric acids as these acids are generated as waste in large quantities and they have very hazardous properties and these acids are very hard to remove as they are easily miscible in water.

The Acetic Acid is mainly the waste product generated from the Pharmaceutical industry as a waste product and reaches the water bodies and disturbs the aquatic life by causing some alterations in the aquatic organisms which in turn degrades the species[(4)]. Similarly the Oxalic Acid is a waste product of the Agricultural Industry where it is used in excess in the man-made fertilizers. This also causes various health problems in human beings such as blisters on the skin, deep redness of the eye etc [(4)]. Phosphoric Acid is generated as a waste product from various chemical industries, this acid when reaches the water bodies causes an adverse affect on the aquatic life and inturn causing a negative effect on human beings[(4)].

As there is a growing threat for human life by these acids, there is a need to remove this acid-waste from water. As these acids are water soluble and colorless in nature, the method of separation is through Biosorption techniques as the adsorbent used here is naturally available and not synthetic. Biosorbents [5] these days are making an attractive mark as these biosorbents are easily available and are of less cost when compared to the synthetic adsorbents. Biosorbents in nature are the waste products of materials which are abundant in nature. The saw dust in nature acts as an effective biosorbent because this saw dust contains the powder forms of various barks of trees. By the use of this Biosorption technique solid waste management is also done as this saw dust is a waste product of the timber industry.

In the present investigation the identification of saw dust as a biosorbent is made through the adsorption studies of Acetic, Oxalic and Phosphoric acid by the use of saw dust as the biosorbent.

The experimental data is verified by the Freundlich and Langmuir adsorption isotherms and the studies were carried out at room temperature.

Materials and Methods

The adsorbate taken here are the Acetic, Oxalic and Phosphoric acids. These acids are taken separately in 0.5M aqueous solutions. This is prepared as the stock solution. The stock solutions of the different acids are made into different dilutions and are taken up for the adsorption studies.

Saw dust was collected from a local saw mill and this was washed, dried, and stored. As the adsorption is carried out on acids which are water soluble and colorless; the determination of the concentration of the acid is done through simple volumetric analysis and the mechanism used here is simple acid-base titration [3]. The indicator used in these titrations is the Phenolphthalein indicator.

Experiment

The saw dust stored was taken in a china dish and was heated up in a muffle furnace at 200°C and the residue obtained from this process is the activated carbon from produced from the saw dust. This is used up in the adsorption studies of Acetic, Oxalic and Phosphoric acids. This saw dust was taken in different amounts for different adsorbate. For Acetic acid this saw dust was taken in 0.2g/100ml; 0.3g/100ml; 0.4g/100ml and 0.6g/100ml. For Oxalic and Phosphoric acid the amount of saw dust taken is 0.6g/100ml.After a time period of 24hrs these respective dilutions are taken up for the adsorption studies carried out through acid-base titration. In this 0.1M sodium hydroxide is taken in a burette and 10ml of the filtered dilutions are taken in a conical flask. 2-3 drops of Phenolphthalein indicator was added. Now the sodium hydroxide is allowed to enter the conical flask drop wise and the burette readings were noted for each dilution as the base neutralizes the acid present in the conical flask. This is noted by the appearance of pink color in the conical flask marking the completion of the neutralization reaction.

Results and Discussion

The study of the adsorption by the saw dust against Acetic, Oxalic and Phosphoric acids has been studied by using the Freundlich and Langmuir adsorption isotherms. The Freundlich and Langmuir plot for Acetic acid is shown in fig1, fig2, fig3, fig4 respectively. For oxalic and Phosphoric acids, the Freundlich and Langmuir plots are shown in fig5, fig6 respectively.

The Freundlich adsorption isotherm equation is

$$\log\frac{x}{M} = \log k + \frac{1}{n} \times \log C_e \quad (6)$$

Fig.1 Freundlich and Langmuir Plot for Acetic Acid with 0.2g saw dust

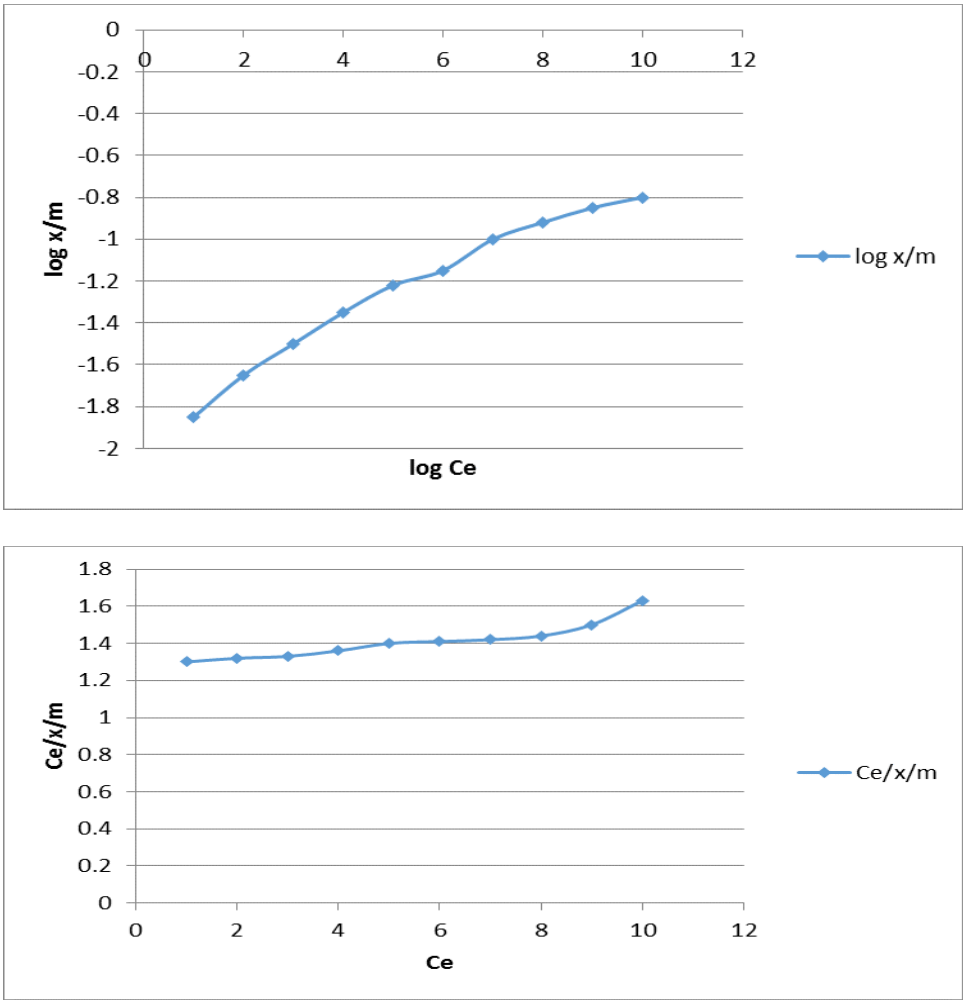
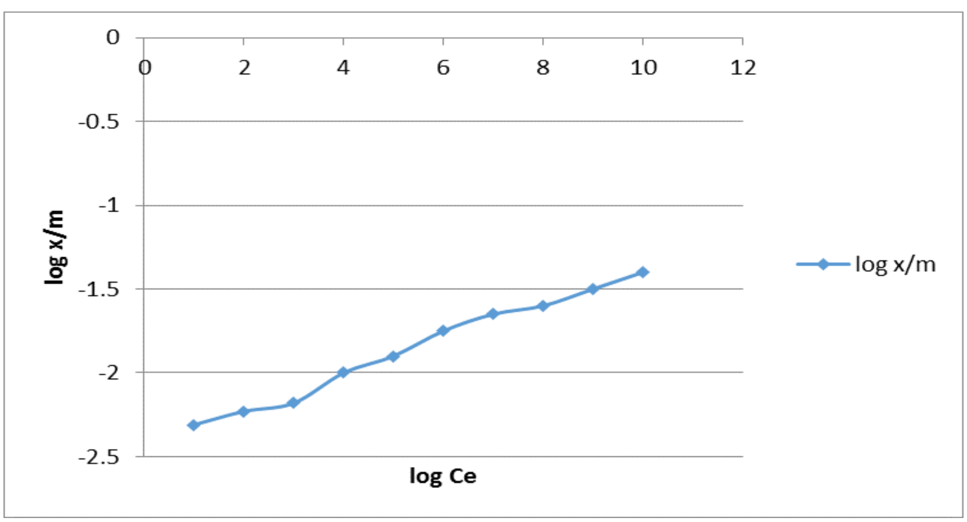


Fig.2 Freundlich and Langmuir Plot for Acetic Acid with 0.3g saw dust



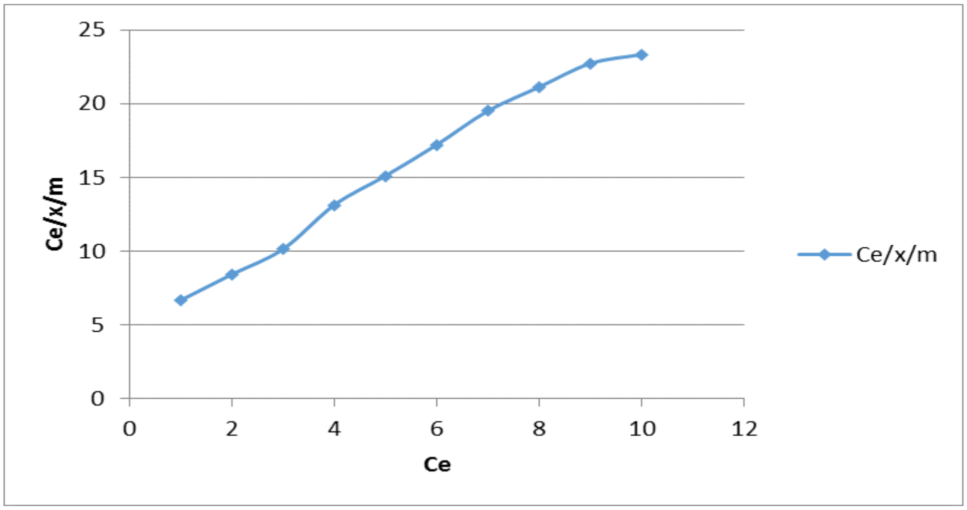
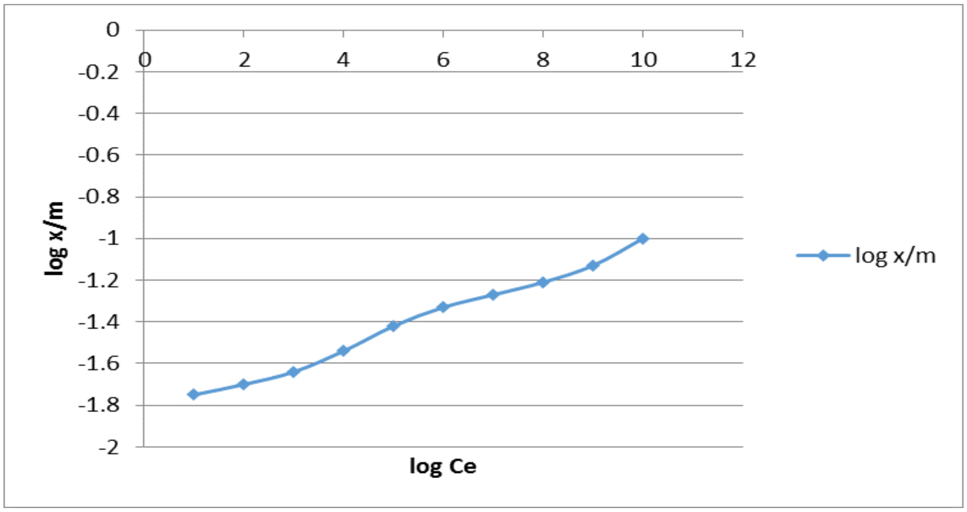


Fig.3 Freundlich and Langmuir Plot for Acetic Acid with 0.4g saw dust



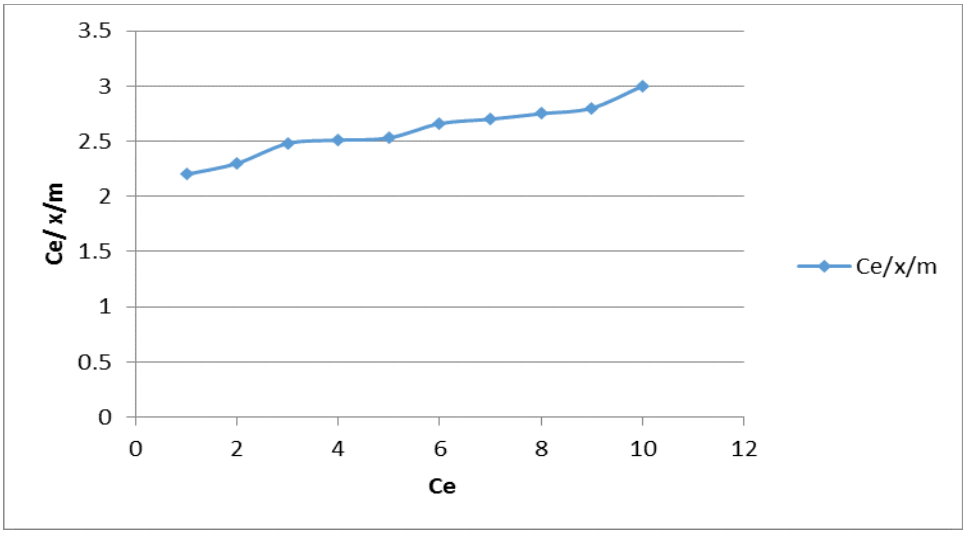
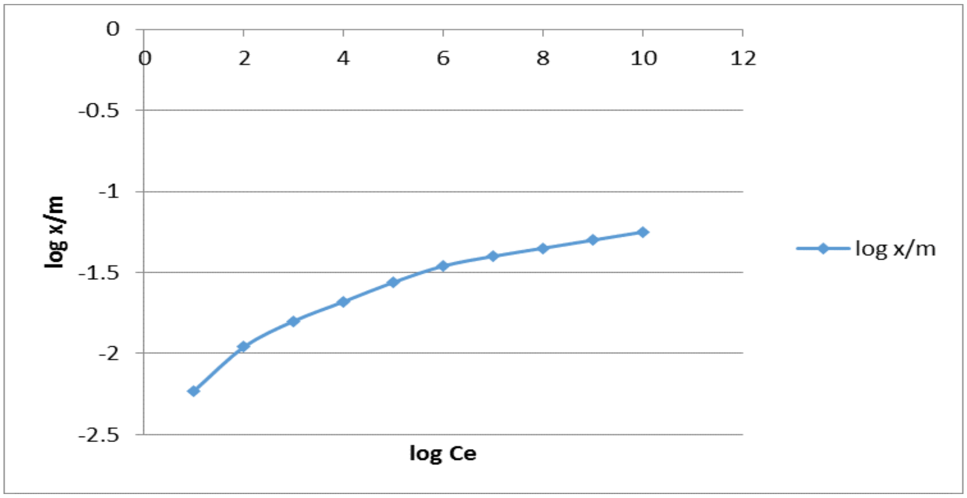


Fig.4 Freundlich and Langmuir Plot for Acetic Acid with 0.6g saw dust



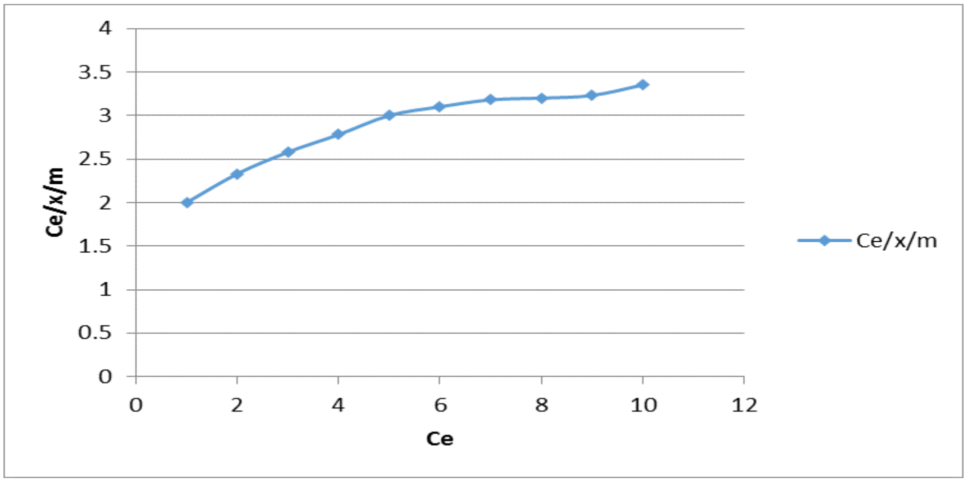
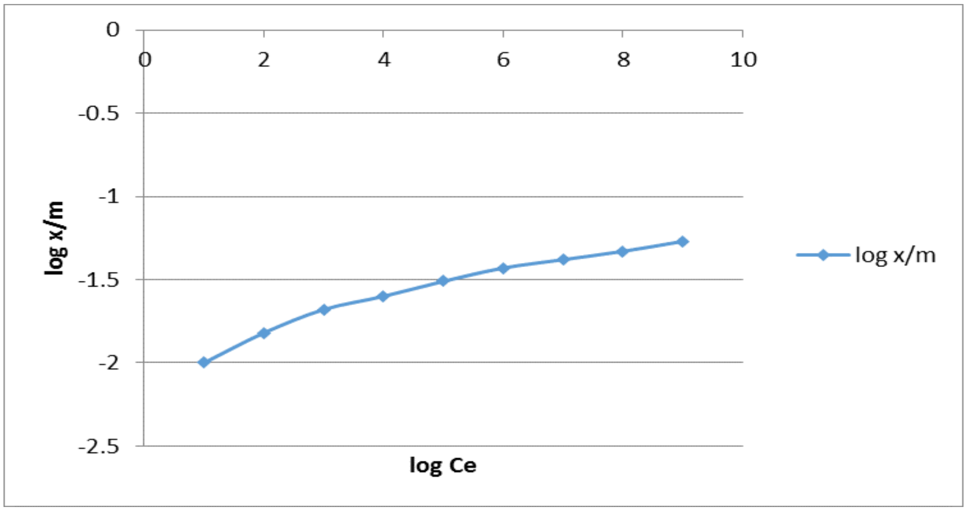


Fig.5 Freundlich and Langmuir Plot for Oxalic Acid with 0.6g saw dust



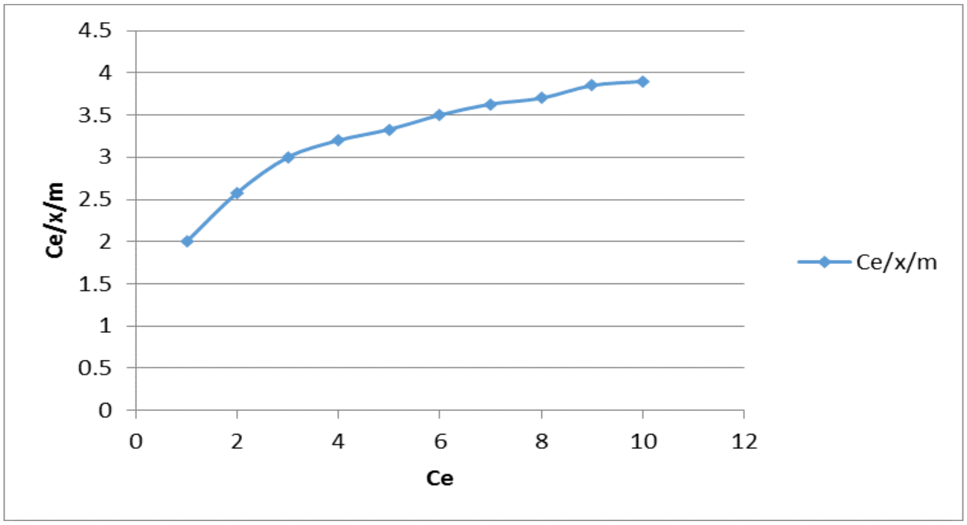
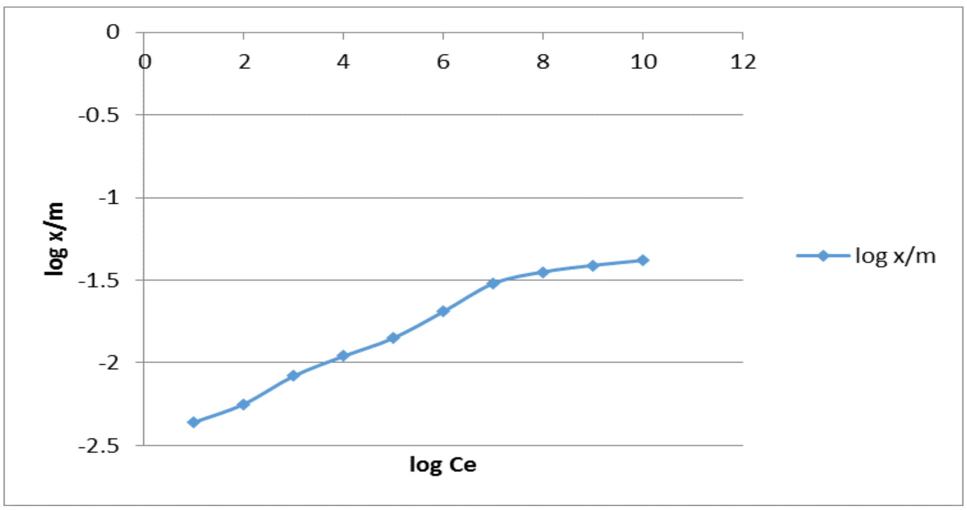


Fig.6 Freundlich and Langmuir Plot for Phosphoric Acid with 0.6g saw dust



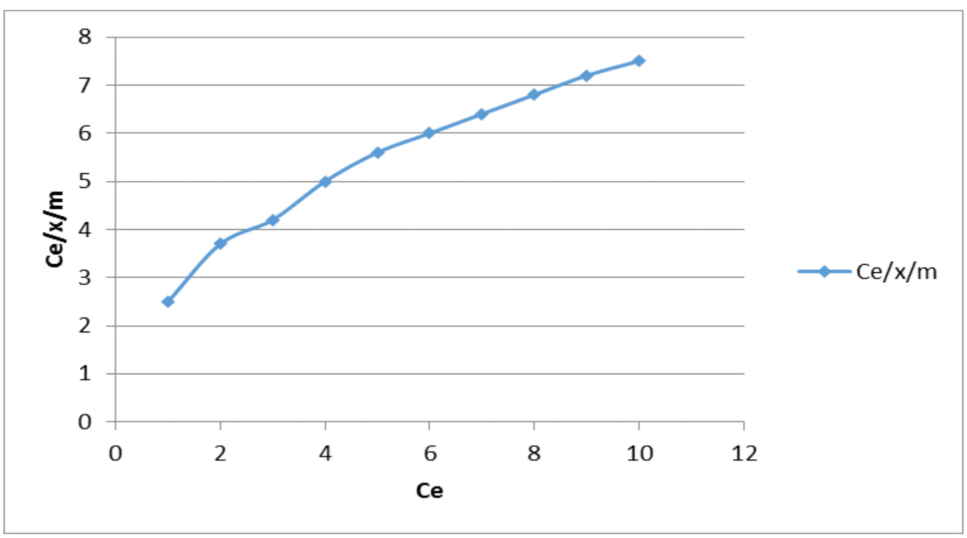


Table.1 log k and n values obtained from the Freundlich plot of different acids

Acid	Amount of Adsorbent Added	Log k	n
Acetic Acid	0.2	-2	22.2
	0.3	-2.5	3.33
	0.4	-1.8	8
	0.6	-2.5	10
Oxalic Acid	0.6	-2.3	5
Phosphoric Acid	0.6	-2.5	6.66

Table.2 k_1 and k_2 values obtained from the Langmuir plot of different acids

Acid	Amount of Adsorbent Added	k_1	k_2
Acetic Acid	0.2	0.84	0.95
	0.3	2	0.4
	0.4	4.34	0.1
	0.6	1.11	1.5
Oxalic Acid	0.6	2.38	0.3
Phosphoric Acid	0.6	1.38	0.9

The Langmuir adsorption isotherm is valid for the adsorption of monolayered nature onto a surface with a finite number of identical sites. The Langmuir adsorption isotherm equation is

$$\frac{C_e}{x/M} = \frac{1}{k_1 \times k_2} + \frac{C_e}{k_2} \quad (6)$$

Where k_1 and k_2 are Langmuir constants. The Freundlich adsorption isotherm using saw dust for the removal of Acetic, Oxalic and Phosphoric acids yielded a straight line with an intercept. The graphs are represented in the respected figures as discussed earlier. The 'log k' and 'n' values are noted in table 1. The Langmuir adsorption isotherm which is the graph between Ce/x/m which is on the y-axis and Ce which is on x-axis yielded a straight line with an intercept which is in accordance to the Langmuir adsorption isotherm. The Langmuir constants k_1 and k_2 of Acetic, Oxalic and Phosphoric acids were calculated and are listed in table 2.

The results obtained from the studies of the adsorption characteristics of the saw dust are in agreement with the Freundlich and Langmuir adsorption isotherms. The values obtained from the Freundlich and Langmuir plots suggest that the saw dust has a great adsorption potential for Acetic, Oxalic and Phosphoric Acid and the maximum adsorption potential is shown by Acetic acids. So we found that the saw dust is an easily available and cost-effective biosorbent for the removal of Acids.

References

1. The free dictionary by Farlax
2. Biosorption- An eco-friendly technique for removal of heavy metals Sasmita sabat *et al.*, Indian Journal of

Applied Research Vol-2 Issue: 3 Dec-2012
3. www.fpham.uniba.sk/Excersise5
4. National pollutant Inventory (NPI), Australia
5. *Marcelo L. Garcia et al., Int. Journal of Engineering Research and Application ISSN : 2248-9622, Vol. 7, Issue 3,* (*Part -3) March 2017, pp.60-68*
6. Advanced Physical Chemistry by Gurtu, Snehi; Reprint of 7th Edition (2005) pg no, 492-496.