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TAMARIND SHELL CARBON AS AN ADSORBENT A COMPARATIVE STUDY ON ADSORPTION OFMONOBASIC AND DIBASIC ACID

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Abstract

In this study, adsorption of different monobasic and dibasic acids was performed on Tamarind shell carbon, which was used as an adsorbent, as it is serves as eco-friendly adsorbents. It has proven to be significantly effective with the provision of satisfactory adsorption capacities for the removal of pollutants from waste water. We have studied adsorption on different monobasic and dibasic acid by taking Tamarind shell shell carbon as an adsorbent. The monobasic acids and dibasic acids under study were Acetic acid, Propionic acid, oxalic acid and Succinic acid. India is the largest producer of tamarind in the world According to Exportimportdata.in, India produces 162,000 metric tons annually, making it the top exporter of tamarind globally. Thailand is another major producer, known for its high-quality tamarind paste. Tamarind processing by – products include tamarind shell. Currently, these materials are disposed of in lands or used as soil amendments, which results in negative environmental impacts and phytotoxicity to plants, respectively. These materials need to be economically and environmentally managed.

Tamarind shells have increasingly been explored as sustainable, low-cost, and efficient adsorbents for removing various pollutants from water. These agricultural by-products offer high porosity and surface area, particularly when converted into biochar or chemically modified. Recent studies emphasize their potential in adsorbing heavy metals, dyes, emerging contaminants, and nutrients like phosphates. Modifications such as activation with $ZnCl_2$ or incorporation into biochar composites further enhance adsorption capabilities. The experimental isotherm data were analyzed using Freundlich and Langmuir models. The adsorption isotherm for Langmuir adsorption isotherm and Freundlich adsorption Isotherm was studied for different monobasic and dibasic acid by taking Walnut shell carbon as an adsorbent.

The results obtained when compared with different acids the conclusion obtained was compared with different monobasic acids (Acetic acid and Propionic acid) dibasic acids (oxalic acid, succinic acid).

From the readings obtained we observed that extent of adsorption of propanoic acid is greater than acetic acid. i.e propanoic acid (0.01224) > acetic acid (0.01172). The reason behind the above conclusion is the presence of CH_2 group in propanoic acid and absence of CH_2 group in acetic acid.

From the readings obtained we observe that the extent of adsorption of succinic acid is greater than oxalic acid. i.e, succinic acid (0.0126) > oxalic acid (0.01186) The reason behind the above conclusion is the presence of 2 CH_2 group in succinic acid or absence of 2 CH_2 group in oxalic acid.

Introduction

Owing to the use and discharge of synthetic dyes worldwide, water bodies are getting polluted rapidly, causing a severe threat to all forms of life. Apart from the increase of chemical oxygen demand and biochemical oxygen demand values of the contaminated waters, the presence of dyes in aquatic ecosystems can adversely affect the photosynthetic activity of aquatic plants and phytoplankton by reducing the transmission of sunlight [1–4]. The harmful effects of dyes and pigments on human health include itching, DNA mutation, dermatological diseases, liver and kidney damage, the disorderliness of the central nervous system, etc. It is estimated that about 90% of the water pollution is caused by organic chemicals, of which more than 50% is attributed to dyes. Other organic chemicals include cosmetics, pigments, pharmaceutical products, hazardous hydrocarbons, pesticides, etc. [5,6]. The highly coloured waters are generally discharged from industries such as pulp and paper, textile, and dye manufacturing [7].

Natural adsorbents are plentiful, inexpensive, require little processing, and are effective in removing pollutants. Natural adsorbents are divided into four groups based on their availability status: waste materials from agricultural, fruit waste, plant waste, and bio adsorbents. Solids agricultural wastes are a cheap and abundant source of resources. Sugarcane bagasse, rice husk, oil palm shell, cotton waste, cashew nut shell, garlic peel, Tamarind shell, and other agricultural waste adsorbents can be used to remove pollutants effectively.

The world literature provides information about the use of by – products of processing vegetables such as cabbage, carrots, tomatoes, eggplants, turnips, cucurbits, and other as adsorption materials. The largest producer of Tamarind shell shell is United states, Spain, Australia, and Turkey are among the four countries leading in Tamarind shell production.

Tamarind shell shell processing by – products include Tamarind shell. Currently, these materials are disposed of in lands or used as soil amendments, which results in negative environmental impacts and phytotoxicity to plants, respectively. These materials need to be economically and environmentally managed. Since commercial activated carbons are expensive, the development of adsorbents using biomass of insignificant economic value has attracted great attention in recent years. In this work, activated carbons were prepared from tamarind

It can be concluded that the Langmuir adsorption isotherm was more appropriate for explaining equilibrium than the Freundlich adsorption isotherm. Gibbs' free energy was spontaneous for all interactions, and the adsorption process had exothermic enthalpy values.

The effects of various experimental conditions on the removal of Cu ions from aqueous solution by Tamarind shell shell were investigated. The point of zero charges for Tamarind shell shell was between 4.55 to 4.75. The adsorption capacity of the Tamarind shell nut shell was found to be 66,7mg/g at pH 5.3 and T = 303K.)The pseudo-second-order kinetic model fitted the batch data adequately. The rate constant coconut scale in the absence of diffusional resistance was estimated to be 0.075 mg/g/min respectively at 303 K. The thermodynamic studies showed that the Cu ions adsorption on the coconut skin was spontaneous and endothermic.

In addition, the fruit shell activated carbon particles are porous and have a large surface area, which means they can provide more adsorption sites and improve adsorption efficiency. This highly effective adsorption characteristic makes it an important part of oral

Textile industries generate highly colored waste waters that bearing organic and inorganic pollutants, so removal of dyes from these industries is an important practice due to its pollution of environment. Azo dyes are one of the synthetic dyes that used in many textile industries. Azo dye have an azo group band (AN@NA) and because of their low cost, solubility and stability,are widely used in many textile industries.

Water contamination by fluoride is a major concern in many places of the world. When its concentration in drinking water is more than 1.5 mg/L, which is the maximum allowable concentration of fluoride by the World Health Organization (WHO), it can become harmful to people's health, for example, causing dental or skeletal fluorosis.

So, it is quite urgent to develop more advanced and cost-effective techniques to decrease and remove fluoride from the water. Several defluorination technologies of drinking water, such as ion exchange, precipitation-coagulation, reverse osmosis, electrodialysis and nano filtration, have been developed for fluoride removal from water.

The cheapest and effective way to overcome form these problem is adsorption by biowaste, for example Tamarind shell nut shell carbon. Tamarind shell nut shell carbon as an adsorbent, as we know that adsorbents play a very vital role in the adsorption processes. Tamarind shell nut shell is low-cost adsorbents, we have simply used the criteria of low cost as well as eco-friendly adsorbents. It has proven to be significantly effective with the provision of studied adsorption on different monobasic and dibasic acid by taking Tamarind shell nut shell carbon as an adsorbent.

ISOTHERMS

The adsorption isotherms describe the pathway of the interaction of a substrate from the bulk solution to the surface of adsorbate. It represents a relation between the amount of substrate adsorbed per unit mass of adsorbent and the substrate concentration or pressure in the bulk solution at a fixed temperature.

The role of temperature is to determine a modal that describe how adsorption process between sorbent and adsorbate and describe the effect of temperature on adsorption process if favorable or not. Adsorption isotherms were classified into four main groups: L (Langmuir type), H (high affinity), S (cooperative) and C (constant partition). The classification depends on the lower part of the curve when the adsorbate solution is very dilute.

FREUNDLICH ADSORPTION ISOTHERM

Freundlich isotherm is a special case of Langmuir, used for modeling the multi-layer adsorbed on heterogeneous surfaces.

He gave an empirical relation between extent of adsorption with pressure, at a constant temperature:

$x/m = KP$ 1/n……………….. (1)

where, x is the mass of the gas adsorbed on mass, m, of the solid adsorbent at a pressure P. K and n are constants for a given adsorbate-adsorbent pair at a particular temperature. Taking logarithm of equation (1), we get

log (x/m) = $logK$ + 1 $nlog$ P/Po …………(2)

where P o is the unit pressure required to make the pressure term unitless whose logarithm can then be taken. The validity of Freundlich isotherm can be verified by plotting a graph between log (x/m) and log (P/Po). A straight line with slope equal 1/n and, intercept log K, validates Freundlich adsorption isotherm.

LANGMUIR ADSORPTION ISOTHERM

Irving Langmuir was the first to device a scientifically based adsorption isotherm in 1918. The model applies to gases adsorbed on solid surfaces. It is a semi-empirical isotherm with a kind basis and was derived based on statistical thermodynamics. It is the most common isotherm equation to use due to its simplicity and its ability to fit a variety of adsorption data.

The Langmuir isotherm nonetheless the first choice for most models of adsorption and has many applications in surface Kinetic (usually called Langmuir-Hinshelwood Kinetic) and thermodynamics.

Langmuir suggested that, adsorption takes place through this mechanism

$A_g+S \leftrightarrow AS$,

Where A is a gas molecule, and S is an adsorption site. The direct and inverse rate constants are k and k_{-1}.

If we define surface coverage, 0 as the fraction of the adsorption sites occupied, in the equilibrium we have:

$K=k/k_{-1}=\theta/(1-\theta)P$,

Or

$\theta=KP/1+KP$,

Where P is the partial pressure of the gas or the molar concentration of the solution. For every low pressure $\theta \approx KP$, and for high pressure $\theta \approx 1$.

The value of 0 is difficult to measure experimentally, usually the adsorbate is a gas and and the quantity adsorbed is given in moles, grams or gas volumes at standard temperature and pressure (STP) per gram of adsorbent. If we call $\boldsymbol{\nu}_{mon}$ the STP volume of adsorbate required to form a monolayer on the adsorbent (per gram of adsorbent), then $\theta=\boldsymbol{\nu}/\boldsymbol{\nu}_{mon}$, and we obtain and expression for a straight line,

$1/v=1/K\ \boldsymbol{\nu}_{mon}\ 1/P+1/\boldsymbol{\nu}_{mon}$.

Through its slope and 'y' intercept we can obtain $\boldsymbol{\nu}_{mon}$ and k, which are constant for each adsorbent-adsorbate pair at a given temperature. $\boldsymbol{\nu}_{mon}$ is related to the number of adsorption sites through the ideal gas law. If we assume that the number of sides is just the whole area of the solid divided into the cross section of the adsorbate molecules, we can easily calculate the surface area of the adsorbent. The surface area of an adsorbent depends on its structure, the more Pores it has, the greater the area, which has a big influence on reactions on surfaces.

If more than one gas adsorbs on the surface, we define theta E as the fraction of empty sites, and we have

$\theta_E = 1/1+\sum_{i=1}^{n} K_i P_i$

Also, we can define theta j as the fraction of the sites occupied the jth gas

$\Theta_j = K_j P_j/1+\sum_{i=1}^{n} K_i P_i$

Where, I is each one of the gas adsorb.

ADSORBENT USED

Fig.1 Tamarind shell nut shell Fig.2 crushed Tamarind shell Nut shell Fig.3 Tamarind shell nut shell

carbon

The use of Tamarind shell nut shell carbon as an absorbent of the industrial pollutant is a new trend. The Tamarind shell nut shell carbon has a capability as an absorbent since it has high carbon content and density low ash content and uniform pore distribution. As an agriculture waste material, the use of Tamarind shell nut shell carbon also becomes a solution for environment. Problems with a low- cost production. Moreover, Iran is a tropical country provide a large number of Tamarind shell nut shell as a raw material for carbon.

The characteristics of carbon depends on the parameters such as temperature, pressure and time period. The need of Tamarind shell nut shell carbon is increasing due to its applications such as for industries & various human aids.

Tamarind shell nut shell is the best material that can be made into carbon as they have a lot of micropores, low ash content high water Solubility and high reactivity. Tamarind shell nut shell carbon has become one of the best forms of carbon for water filtration and water Purification in recent years. Additionally, it can effectively absorb Certain impurities.

Tamarind shell nut shell carbon referred to a wide range of carbonaceous materials with a high degree of porosity and an extended inter particulate surface area and widely used adsorbent in waste water treatment throughout the world.

They are obtained by combustion, partial condition or thermal decomposition of a variety of carbonaceous substance such as wood, peat, coal, coconut shell, waste of origin (example nutshell, fruits). The process consists of dehydration of the raw material and carbonization followed by activation. The Tamarind shell nut shell carbon have been obtained powdered carbon as shown in figure above has a large internal surface area and small pore size while the finally divided powdered form from figure is associated with layer pore diameter and a small internal surface area. In the recent, although Tamarind shell nut shell carbon have been used as an adsorbent, catalyst and catalyst support and in environment application, their adsorption ability and catalytic activity are largely controlled by their surface characteristics.

STRUCTURE OF TAMARIND SHELL NUT SHELL CARBON

Tamarind shell shell-derived carbon is increasingly utilized in environmental remediation, energy storage, and catalysis due to its *high fixed carbon content, low ash, and hierarchical porous structure*. The conversion of Tamarind shell shells into carbonaceous material involves carbonization and activation (physical or chemical), which tailors the structure, surface area, and functional groups of the resultant carbon. Key structural features include **Amorphous carbon** matrix with disordered graphitic layers. **Porous structure**, especially when chemically or physically activated. Presence of **micropores (<2 nm)**, **mesopores (2–50 nm)**, and sometimes **macropores (>50 nm)**, depending on the activation method. **High surface area** (often >500 m^2/g when activated) beneficial for adsorption applications.

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PREPARATION OF TAMARIND SHELL NUT SHELL CARBON

The tamarind fruit shell was initially washed with deionized water and dried in a hot air oven at 100 °C for 6 h The dried shells are ground into a fine powder.

2. Materials and Methods

Adsorption process of different mono basic acid (Acetic acid, Propionic acid) dibasic acid (Oxalic acid and Succinic acid)

Materials Used: Tamarind shell shell carbon, Mono basic acid (Acetic acid and Propionic acid) Dibasic acids (Oxalic acid and Succinic acid), NaOH, Phenolphthalein, Stoppered bottle, Burette, Pipette, Funnel, Conical flask.

PROCEDURE:

Prepared aqueous solution of acids into numbered flask as labelled, the total volume of each solution is 50ml taken in Stoppard bottles. Transfer 10ml of the solution from each bottle into the conical flask. Add 2-3 drops of Phenolphthalein indicator and titrate against NaOH. Once the end point is reached, read the burette reading. The volume of baseV_1..

Calculate the actual concentration of oxalic acid C_1 in the flask number 1 to 5 respectively, and write it down in the table. Using practical balance weigh 5 portions of walnut shell carbon, each portion1 gram. Placed Tamarind shell carbon into numbered flask into stoppered bottle and shake them, wait for 20 minutes, the process of adsorption is in progress. Mix the mixtures for several times by shaking the flask. (The process of adsorption is a function of times it is important to put on ion feel into flask at the same time to provide adsorption for the same period in each flask). Filter the mixtures into clean and dry flask to avoid disturbing effect of adsorption of acid into filtering paper, remove away the first portion of filtration approximate of 5ml. Determine the final concentration of acid C, in each of the flask after adsorption from each solution, pipette out 10ml of oxalic acid solution and transfer it to clean and dry conical flask. To this conical flask containing oxalic acid solution at 2 to 3drops of Phenolphthalein indicator. Now, titrate this solution against NaOH in the burette, note down the burette reading. The volume of base V_2

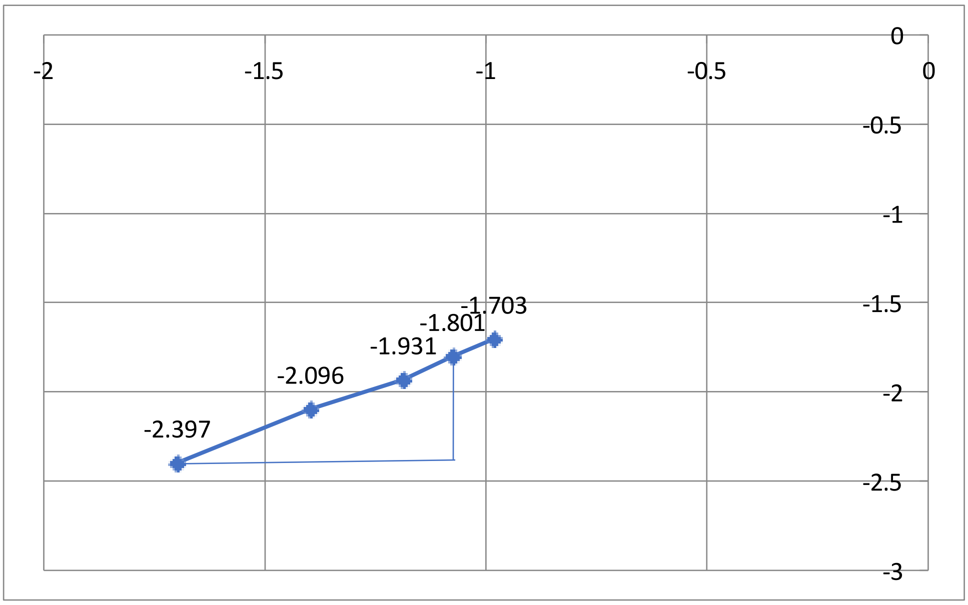
PROCEDURE TABULAR COLUMN: -Dilution of acids

Bottle No.	Vol. of acid added (0.5N)	Volume of water added in ml	Amount of Tamarind shell nut shell carbon added in gm
1	50	00	1
2	40	10	1
3	30	20	1
4	20	30	1
5	10	40	1

TABULAR COLUMN :

SI NO.	**Initial concentration of Oxalic Acid acid(C_0)**	**Vol. of titrant taken in ml**	**Amt. of tamarind shell carbon added in gm**	**Burette reading**	**C_e=B.Rx0.1/10 Eq. conc. of acid in mol/dm^3**	**X=C_0-C_e/20 amount adsorbed in moles**	**x/m**	**Log(x/m)**	**Log C_e**	**C_e(x/m)**
1	0.5	10	1	10.4	0.104	0.0198	0.0198	-1.703	-0.982	0.00205
2	0.4	10	1	8.4	0.084	0.0158	0.0158	-1.801	-1.075	0.00132
3	0.3	10	1	6.5	0.065	0.0117	0.0117	-1.931	-1.187	0.00076
4	0.2	10	1	4.0	0.04	0.008	0.008	-2.096	-1.397	0.00032
5	0.1	10	1	2.0	0.02	0.004	0.004	-2.397	-1.698	0.00008

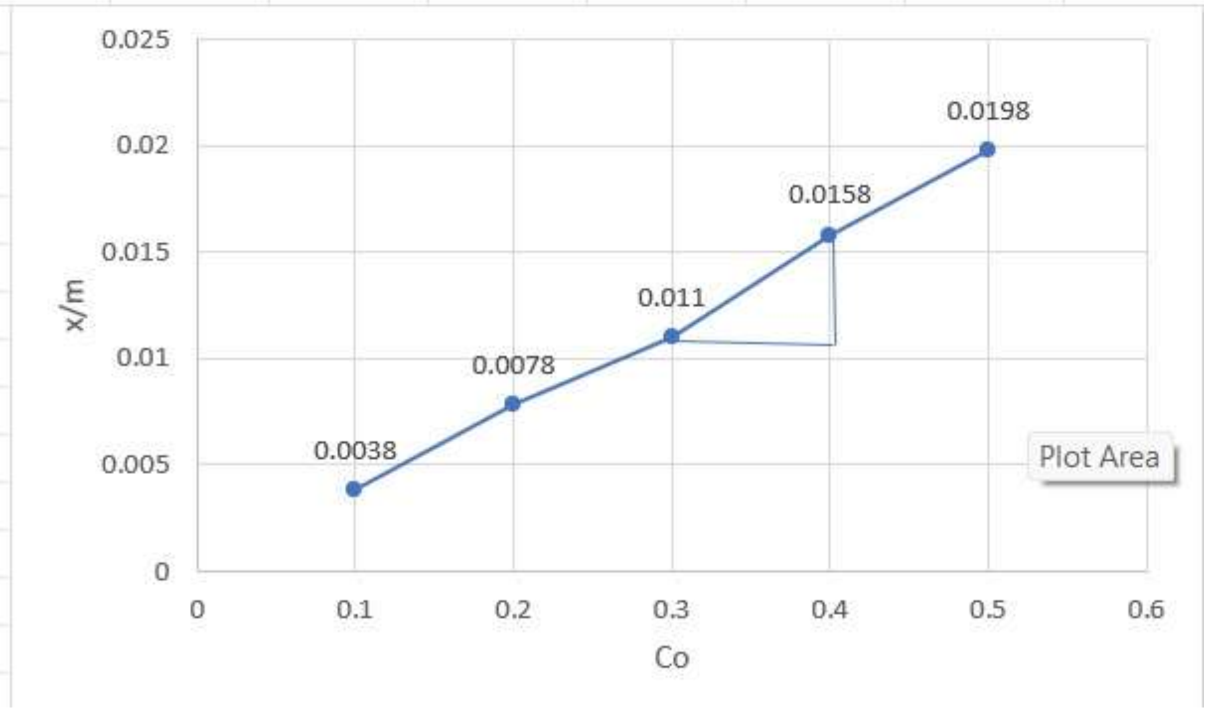
GRAPH: FREUNDLICH ADSORPTION ISOTHERM (OXALIC ACID)



SLOPE=(-1.8)-(-2.3) /(-1.1) –(-1.6)

=0.5/0.5 1.00

GRAPH : LANGMUIR ADSORPTION ISOTHERM (OXALIC ACID)



Slope (-0.0117) –(-0.008) /(0.3) –(0.2)

=0.003/0.1

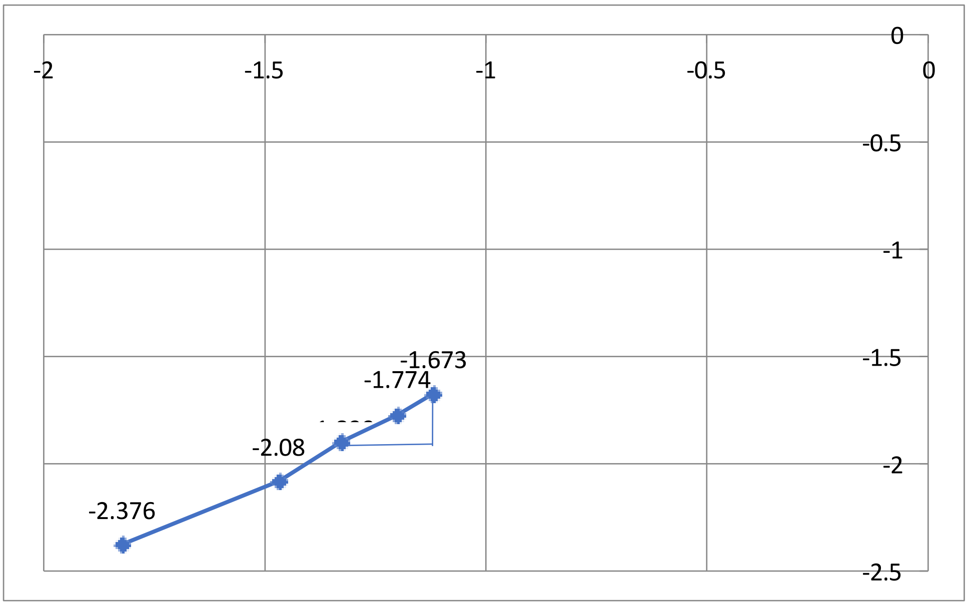
=0.03

TABULAR COLUMN :

SI NO.	Initial concentration of succinic acid(C_0)	Vol. of titrant taken in ml	Amt. of tamarind shell carbon added in gm	Burette reading	C_e=B.Rx0.1/10 Eq. conc. of acid in mol/dm^3	X=C_0-C_e/20 amount adsorbed in moles	x/m	Log(x/m)	Log C_e	C_e(x/m)

1	0.5	10	1	7.6	0.076	0.0212	0.0212	-1.673	-1.119	0.00161
2	0.4	10	1	6.3	0.063	0.0168	0.0168	-1.774	-1.200	0.00105
3	0.3	10	1	4.7	0.047	0.0126	0.0126	-1.899	-1.327	0.00059
4	0.2	10	1	3.4	0.034	0.0083	0.0083	-2.080	-1.468	0.00028
5	0.1	10	1	1.5	0.015	0.0042	0.0042	-2.376	-1.823	0.000063

GRAPH: FREUNDLICH ADSORPTION ISOTHERM (SUCCINIC ACID)

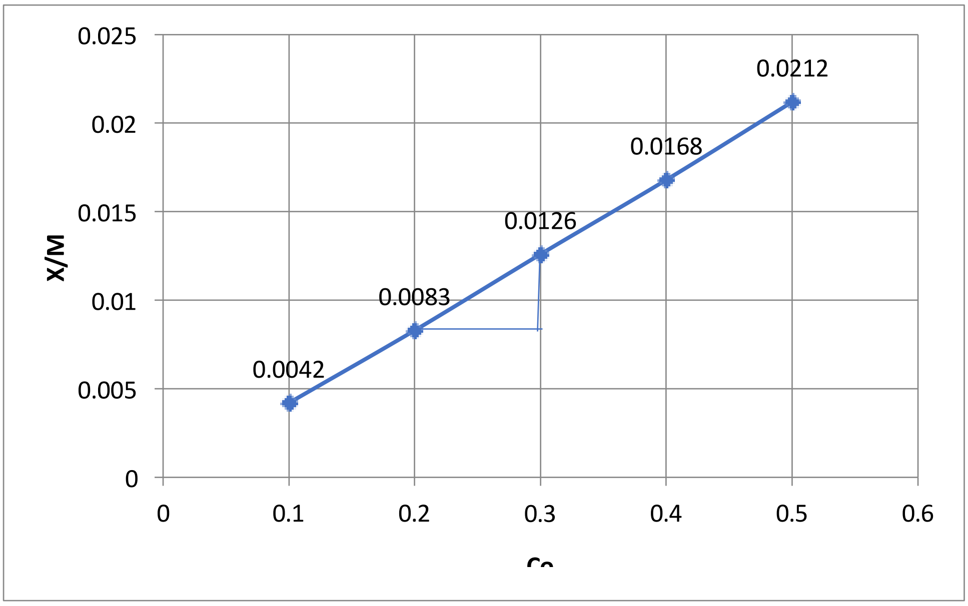


SLOPE=(-1.673) –(-1.899) /(-1.11) –(-1.32)

= 0.226/0.21

= 1.076

GRAPH : LANGMUIR ADSORPTION ISOTHERM (SUCCINIC ACID)



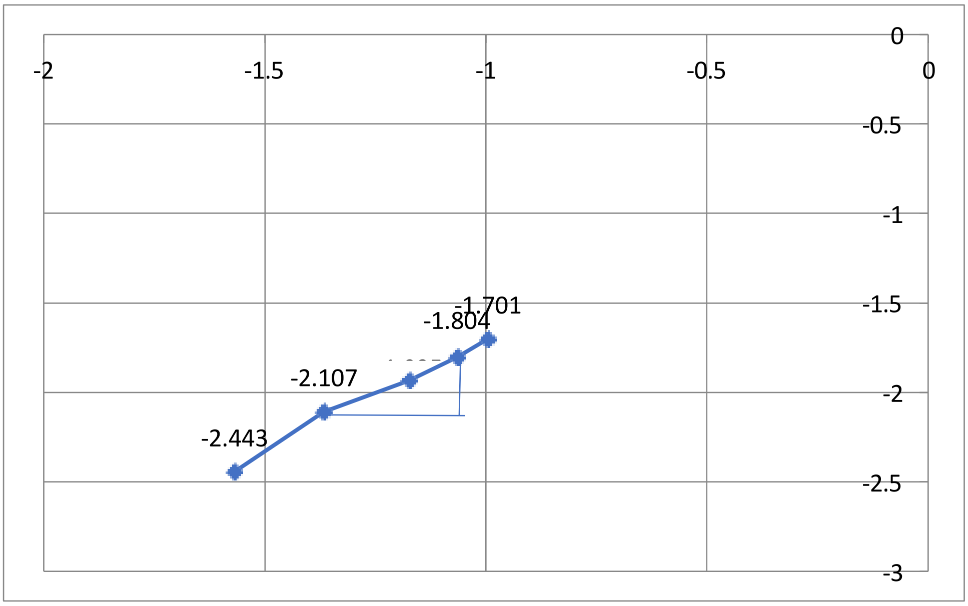
SLOPE=((0.0216) –(0.0083) /(0.3) –(0.2)

= 0.0043/0.1 0.043

TABULAR COLUMN :

SI NO.	**Initial concentration of Acetic acid(C_0)**	**Vol. of titrant taken in ml**	**Amt. of tamarind shell carbon added in gm**	**Burette reading**	**C_e=B.Rx0.1/10 Eq. conc. of acid in mol/dm^3**	**X=C_0-C_e/20 amount adsorbed in moles**	**x/m**	**Log(x/m)**	**Log C_e**	**C_e(x/m)**
1	0.5	10	1	10.1	0.101	0.0199	0.0199	-1.701	-0.9956	0.00200
2	0.4	10	1	8.6	0.086	0.0157	0.0157	-1.804	-1.0655	0.00135
3	0.3	10	1	6.7	0.067	0.0116	0.0116	-1.935	-1.1739	0.00077
4	0.2	10	1	4.3	0.043	0.0078	0.0078	-2.107	-1.3665	0.00033
5	0.1	10	1	2.7	0.027	0.0036	0.0036	-2.443	-1.5686	0.000097

GRAPH: FREUNDLICH ADSORPTION ISOTHERM (ACETIC ACID)

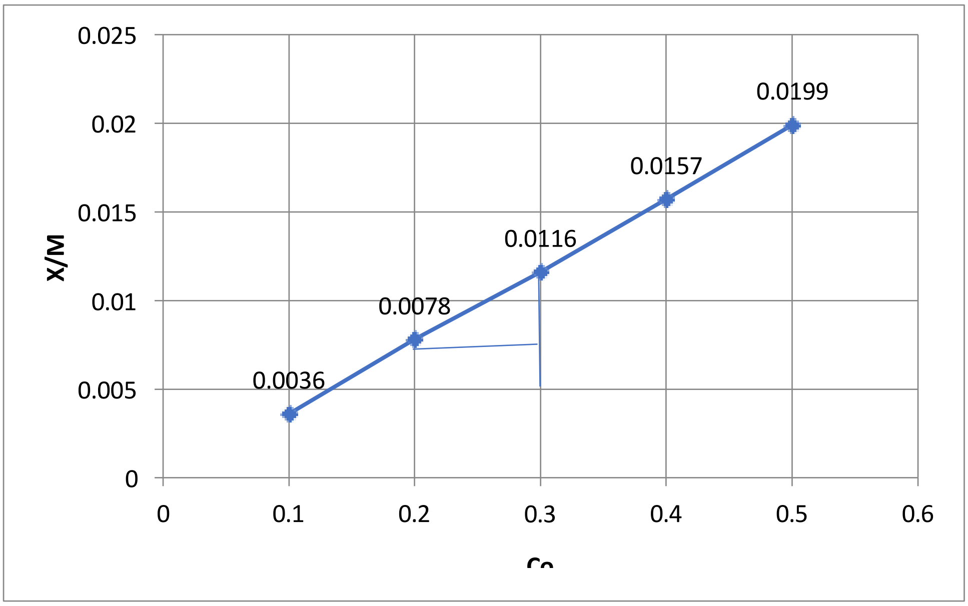


SLOPE=(-1.804) –(-2.107) /(-1.06) –(-1.36)

=0.303/0.3

=1.01

GRAPH : LANGMUIR ADSORPTION ISOTHERM (ACETIC ACID)



SLOPE=(0.0116) –(0.0078) /(0.3) –(0.2)

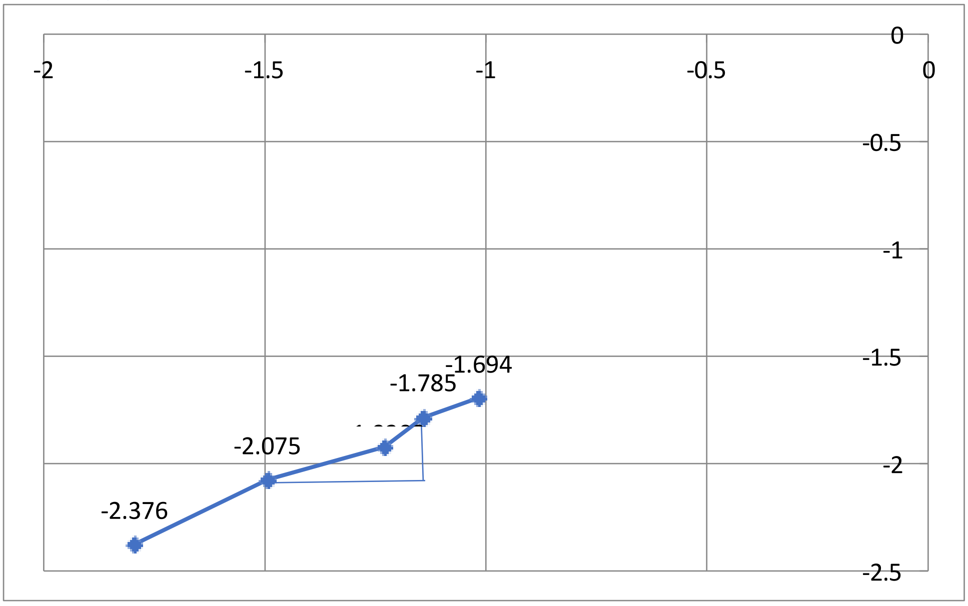
=0.0038/0.1

= 0.038

SI NO.	**Initial concentration of Acetic acid(C_0)**	**Vol. of titrant taken in ml**	**Amt. of tamarind shell carbon added in gm**	**Burette reading**	**C_e=B.Rx0.1/10 Eq. conc. of acid in mol/dm^3**	**X=C_0-C_e/20 amount adsorbed in moles**	**x/m**	**Log(x/m)**	**Log C_e**	**C_e(x/m)**
1	**0.5**	**10**	**1**	**9.6**	**0.096**	**0.0202**	**0.0202**	**-1.694**	**-1.014**	**0.00193**

2	**0.4**	**10**	**1**	**7.2**	**0.072**	**0.0164**	**0.0164**	**-1.785**	**-1.142**	**0.00180**
3	**0.3**	**10**	**1**	**5.9**	**0.059**	**0.01220**	**0.01220**	**-1.9208**	**-1.229**	**0.00070**
4	**0.2**	**10**	**1**	**3.2**	**0.032**	**0.0084**	**0.0084**	**-2.075**	**-1.494**	**0.000268**
5	**0.1**	**10**	**1**	**1.6**	**0.016**	**0.0042**	**0.0042**	**-2.376**	**-1.795**	**0.00006**

GRAPH: FREUNDLICH ADSORPTION ISOTHERM (PROPANOIC ACID)

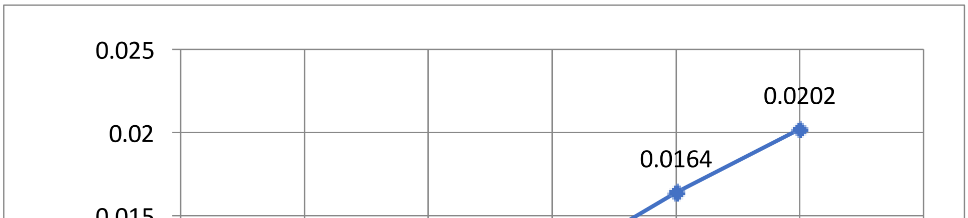


SLOPE=(-1785) –(-2.027) /(-1.2) –(-1.5)

=0.242/0.3

=0.806

GRAPH : LANGMUIR ADSORPTION ISOTHERM (PROPANOIC ACID)



X/M

SLOPE=(0.012) –(0.0084) /(0.3) –(0.2)

=0.0036/0.1

=0.036

Application of adsorption:

- **Production of high vacuum:** The last traces of air can be absorbed by charcoal from a vessel evacuated by a vacuum pump to achieve a very high vacuum.
- **Gas masks:** A gas mask (a device made of activated charcoal or a combination of adsorbents) is commonly used in coal mines to adsorb poisonous gases.
- **Control of humidity:** Adsorbents such as silica and aluminium gels are used to remove moisture and control humidity.
- **Colour removal from solutions:** Animal charcoal removes colours from solutions by adsorbing coloured impurities.
- **Heterogeneous catalysis:** Adsorption of reactants on the solid surfaces of catalysts accelerates the reaction. There are numerous industrially important gaseous reactions that use solid catalysts. The production of ammonia with iron as a catalyst, the production of H_2SO_4 through a contact process, and the use of finely divided nickel in the hydrogenation of oils are all excellent examples of heterogeneous catalysis.

- **Separation of inert gases:** Adsorption on coconut charcoal at different temperatures can separate a mixture of noble gases due to the difference in the degree of adsorption of gases by charcoal.
- **In curing diseases:** Several drugs are used to kill germs by becoming adsorbent on them.
- **Froth floatation process:** Using pine oil and a frothing agent, a low-grade sulphide ore is concentrated by separating it from silica and other earthy matter.
- **Adsorption indicators**: Surfaces of certain precipitates, such as silver halides, have the property of adsorbing dyes such as eosin, fluorescein, and others, resulting in a distinct colour at the endpoint.
- **Chromatographic analysis:** Chromatographic analysis based on the adsorption phenomenon has a variety of applications in analytical and industrial fields.
- **Purification of water:** Impurities are adsorbed on the alum stone when alum stone is added to water, and the water is purified.
- **Separation of noble gases by Dewar's flask process:** In the presence of heated coconut charcoal, a mixture of noble gases (Neon, Argon, and Krypton) is passed through a Dewar's flask. Argon and Krypton gels have been absorbed, leaving Neon.
- **In dying of cloth**: Mordants such as alums are used in dying of cloth. The adsorbed dye particles which otherwise do not stick to the cloth.
- **In ion exchange resins:** The organic polymer containing groups like -COOH, -SO, H-NH2 etc possess the property of selective adsorption of ion from solution. These are quite useful in the softening of water and also in the separation of the elements of the lanthanide series (alsocalled as rare earths) from the mixture.
- **In quantitative analysis**: Certain qualitative test such as the lake test for the confirmation of AI ions are based upon adsorption, ie AL(OH), has a capacity to adsorb the colour of blue litmus from the solution.
- **In pharmaceutical industry:** Some drugs can absorb the germs on them and hence kill them and save us from the diseases. Activated charcoal, magnesium oxide, tannic acid etc are used for the absorption of poisonous and toxic substances. Adsorption is also used in vitamin B1 preparation, bacterial filtration, pharmaceutical adsorption, etc.

- **In clarification of sugar**: Sugar is decolourised by treating sugar solution with charcoal powder. The latter adsorbs the undesirable colors present.
- **In the paint industry**: The dissolved gases in paints are removed using suitable adsorbents during the manufacture of paints. Dissolved gases do not adhere well to the surface to be painted and thus show poor covering power. Wetting agents are used to remove the gaseous, liquid, or solid films on the paints surface.
- **In water conservation:** In countries like Australia where there is acute scarcity of water during summer, a layer of stearic acid is sprayed over the lakes and other water reservoirs. It is adsorbed on the surface of the water, thereby minimizing the loss of water by evaporation.

CONCLUSION

Comparision of difference between monobasic acids (acetic acid and propanoic acid).

From the readings obtained we observed that extent of adsorption of propanoic acid is greater than acetic acid.i.e propanoic acid (0.01224) > acetic acid (0.01172) the reason behind the above conclusion is the presence of CH_2 group in propanoic acid and absence of CH_2 group in acetic acid.

Comparision of difference between dibasic acid (oxalic acid and succinic acid)

From the readings obtained we observe that the extent of adsorption of succinic acid is greater than oxalic acid. i.e, succinic acid (0.0126) > oxalic acid (0.01186) the reason behind the above conclusion is the presence of 2 CH_2 group in succinic acid or absence of 2 CH_2 group in oxalic acid.

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