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EVALUATION OF PISTACHIONUT SHELLDERIVED ACTIVATED CARBONASANADSORBENTFOR UPTAKE OF DIFFERENTDIBASICACIDS

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Abstract

In this study, adsorption of different dibasic acids was performed on pistachio shell carbon,which was used as an adsorbent, asit 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 dibasic acid by taking pistachio shell carbon as an adsorbent.

The dibasic acids under study were oxalic acid, malonic acid, succinic acid and Glutaric acid.Pistachionutshellisthebestmaterialthatcanbemadeintocarbonasthey have a lot of micropores, low ash content high water Solubility and high reactivity.Pistachio nut shell carbon has become one of the best forms of carbon for waterfiltration and water Purification in recent years. Additionally, it can effectively absorbCertainimpurities.

Inthevery firststepwecollectpistachionutshellandremoveddirtandunwanted substances from it. Then the shell is smashed and crushed and put it in acontainer or furnace and get it for heating. The heating is done until the pistachio nutshell by product it is the pistachio nut shell processed into carbonation of the latter toproduce pistachio nut shell carbon in the form of burned carbon. In the run of burningof pistachio nut shell, the heating temperature should be programmed to increase fromthe room temperature to the desired carbonization temperature. The overall preparationis bychemical method.

The adsorption isotherm for Langmuir adsorption isotherm and Freundlich adsorption isotherm was studied for different dibasic acids by taking pistachio shell carbon as an adsorbent.

The results obtained when compared with different acids the conclusion obtained was compared with differentdibasic acids (oxalic acid, malonic acid, succinic acid and glutaric acid).Fromthereadingsobtainedit wasobservedthatextentofadsorptionof oxalic acid (0.01182), malonic acid(0.01166), succinic acid (0.01263) and glutaric acid (0.01221)reasonbehindtheaboveconclusionmay bethepresenceofCH_2group. theextentofadsorptionof,succinicacid(0.01263)>oxalicacid(0.01182)thereasonbehindtheabove conclusionisthepresenceof2CH_2groupinsuccinicacid or absenceof2 CH_2groupin oxalicacid.

Introduction:

Adsorption is the adhesion of atoms, ions or molecules from a gas liquid or dissolved solid to a surface. This process creates a film of the adsorbate on the surface of the adsorbent. Adsorption is present in many natural, physical, biological and chemical system and is widely used in industrial applications such as heterogeneous catalysts, Coconut shell Carbon, capturing and using waste heat to provide cold water for air conditioning and other process requirements.Garlic processing by-products include skins, outer leaves, tops, and bottoms. Currently, these materials are disposed of in landfills or used as soil amendments, which result in negative environmental impacts and phytotoxicity to plants, respectively. These materials need to be economically and environmentally managed.

Natural adsorbents are plentiful, inexpensive, require little processing, and areeffective inremoving pollutants.Naturaladsorbentsare dividedintofour groupsbased on their availability status: waste materials from agricultural, fruit waste, plantwaste, and bio adsorbents. Solids agricultural wastes are a cheap and abundant sourceof resources. Sugarcane bagasse, rice husk, oil palm shell, cotton waste, cashew nutshell, garlic peel, almond shell, and other agricultural waste adsorbents can be used toremovepollutants effectively.

Pistachio processing by – products include pistachio shell. Currently, thesematerialsaredisposedof inlandsor usedassoilamendments,whichresultsinnegativeenvironmentalimpactsandphytotoxicitytoplants ,respectively.Thesematerialsneed to beeconomicallyandenvironmentallymanaged.

Fortheaimofwastewatertreatment,thebiosorptionofCr(VI)bythepistachio nut shellin a batch-type reactor was researched in depth. To maximizeCr(VI)removalfromaqueoussolutionsandequilibriumisothermsandkineticdata,theeffectsofinitialCr(VI)concentration,time,andpHwereexplored.Fromasolution containing 3000 ppm of Cr, the pistachio nut shell adsorption capacity wasreported to be 103.09 mg/g of adsorbent (VI). It can be concluded that the LangmuiradsorptionisothermwasmoreappropriateforexplainingequilibriumthantheFreundlichadsorptionisotherm.Gibbs'freeenergywasspontaneousforallinteractions,and theadsorptionprocess hadexothermicenthalpyvalues.

Water contamination by fluoride is a major concern in many places of theworld. When its concentration in drinking water is more than 1.5 mg/L, which is themaximumallowableconcentrationoffluorideby theWorldHealthOrganization(WHO), it can become harmful to people's health, for example, causing dental orskeletalfluorosis.

Pistachio nut shell carbon as anadsorbent, as we know that adsorbents playsa very vital role in the adsorptionprocesses.wehavesimplyusedthecriteriaof eco-friendly adsorbents. It has proven to be significantlyeffective with the provision of studied adsorption on different monobasic and dibasicacidbytakingpistachionut shell carbonas anadsorbent.

ISOTHERMS

The adsorption of gases and solutes is usually described through isotherms, i.e the amount of adsorbate on the adsorbent as a function of its pressure (if gas) or concentration (for liquid phase solutes) at constant temperature. The quantity adsorbed is nearly always normalized by the mass of the adsorbent to allow comparison of different materials. To date, 15 different isotherms models have been developed.

FREUNDLICH ADSORPTION ISOTHERM

The first mathematical fit to an isotherm was published by Freundlich and Kuster (1906) and is purely empirical formula for gaseous adsorbates:

$x/m = Kp^{1/n}$

Where X is the mass of adorbate adsorbed, m is the mass of the adsorbent, p is the pressure of adsorbate (this can be changed to concentration if investigation solution rather than gas), and k and n are the empirical constant for each adsorbent- adsorbate pair at a given temperature.

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.

If we define surface coverage, θ 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 $\theta \approx 1$.

ADSORBENT USED

Fig.1 pistachio nut shell

Fig.2 crushed pistachio Nut shell

Fig.3 pistachio nut shell carbon

The use of pistachio nut shell carbon as an adsorbent of the industrial pollutantis a new trend. The pistachio nut shell carbon has a capability as an absorbent since ithas high carbon content and density low ash content and uniform pore distribution. Asan agriculture waste material, the use of pistachio nut shell carbon also becomes asolution for environment. Problems with a low- cost production. Moreover, Iran is atropical country provide a large number of pistachio nut shell as a raw material forcarbon.

Pistachio nut shell carbon are unique and versatile adsorbent and they are usedfor the removal of undesirable odour, colour, taste, and other organic and inorganicimpurities (generally referred to as adsorbates) from domestic and industrial wastes,for air purification inhabited places restaurants, food processing, removal of colorfromvarioussyrupsandpharmaceuticalproducts,inairpollutioncontrolfromindustrial and automobile exhaust and in a variety of gas phase applications. They arealso well known for their applications in medicine for the removal of toxins andbacterialinfections in certain alignments.

Adsorption by pistachio nut shell carbon is one of the most frequently usedmethod to remove organic compounds from water, because pistachio nut shell carbonpossess perfect adsorption ability for chloro phenols. In this project, the objective is toinvestigate how the adsorption capacity of pistachio nut shell carbon is influenced byelevatedtemperatureusingdifferentconcentrationsofparachlorophenolastheadsorbate.

STRUCTUREOFPISTACHIONUTSHELLCARBON

Adsorptiontakesplaceatthesurfaceofpistachionutshellcarbon. Thesurfacecharacteristics of pistachio nut shell carbon play a crucial role in adsorption fromaqueous solutions and catalytic properties of carbon. The structure of pistachio nutshell carbon is classified based on the activities that occur at the surface of the carbon.The structure of pistachio nut shell carbon surface can therefore be viewed in twodimensionsnamely,physicalstructure andchemicalstructure.

PHYSICALSTRUCTURE OFPISTACHIO NUTSHELLCARBON

This refers to how the atoms of pistachio nut shell carbon is linked together and howthis arrangement actually give rise to the adsorption ability of pistachio nut shellcarbon it also describes the various for sizes available on the surface of pistachio nutshell carbon which is responsible for its wide range of applicability in the sense thatthe four size of any particular pistachio nut shell carbon determine to a large extentwhat it is used for. The physical structure of pistachio nut shell carbon is furtherdivided into:

POROUSSTRUCTURE

Non-graphitizingcarbon(i.e.pistachionutshellcarbonwitharandomarrangementof microcrystalline, strong cross- linking between neighbouring crystallites and well-developedporousstructure)wasfoundtohaverelativelylowdensity(lessthan2gm/cm^3).Theporo usstructureformedduringcarbonizationprocessisfurtherdevelopedduringactivation process.

Activation process is a process through which small, low volume pores whichincrease the surface area of carbon are created within its structure by either heatingcarbon at temperature changes between 600 to 1200 degree celsius in the absence ofoxygen or by impregnating carbon with certain chemicals such as acids, strong basesor salt followed by heating at low temperatures of about 400 to 700 degree Celsius.This process enlarges the diameter od the pores and improve their volume. The natureof the raw material used for the carbonization determines the structure of the poresgeneratedandtheporesizedistribution. Activationcarbonporesarecategorizedbasedon theirsizeand their function. Based on their function, wehave,

particles consisting of gaps between carbon plates of about 1-5 molecular diameter insize.

PORES FOR TRANSPORT: these are the largest pores within the particle.They vary fromporesgreaterthan5moleculardiameterstovisiblecracks. Theyconsistof avarietyof different sizes andshapes.

Basedontheirsizes,3groupsofporescanbedistinguishedandtheyare:

- Micro-pores(<2nmdiameter)
- Meso-pores(2-50nmdiameter)
- Macro-pores(>50nmdiameter)

Micro-pores generally contribute to the bulk part of the internal surface area whilemeso-pores aregenerally regardedas highwaysinto the carbon particles and arecrucial kinetics. According to Duninin and Zaverina, a micro-porous active carbon isproduced when the degree of burn-off is less than 50%, micro-porous active carbon isproduced when the extent of burn-off is between 50% and 75%, the product willcontainamixtureof all types of pores.

TheclassificationofporesbytheDuninin isbasedontheirwidthwhichrepresents the distance between the walls of a slit shaped pore. This classification hasnowbeenadoptedbythe internationalunionforpureandappliedchemistry.

Adsorptioninmicroporeswhoseeffectiveradiiislessthan2nmoccursthrough volume filling with no capillary condensation taking place. The adsorptionenergy in micro-pores is much larger comparedto other pore types, their volumerangebetween 0.15-0.70cm3/gm.

PREPARATION OFPISTACHIO NUTSHELLCARBON

Inthevery firststepwecollectpistachionutshellandremoveddirtandunwanted substances from it. Then the shell is smashed and crushed and put it in acontainer or furnace and get it for heating. The heating is done until the pistachio nutshell by product it is the pistachio nut shell processed into carbonation of the latter toproduce pistachio nut shell carbon in the form of burned carbon. In the run of burningof pistachio nut shell, the heating temperature should be programmed to increase fromthe room temperature to the desired carbonization temperature. The overall preparationis bychemical method.

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

Materials Used: pistachio nut shell carbon, Dibasic acids (Oxalic acid, Malonic acid, Succinic acid and glutaric 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 pistachio nut shell carbon, each portion1 gram. Put pistachio nut shell carbon into number flask into stoppers and shake them, wait for 20 minutes, the process of adsorption is in progress. Mix the mixtures for several times by

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shaking the flask. (The process of adsorption is a function of times it is important to put onion 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 ofPhenolphthalein indicator. Now, titrate this solution against NaOH in the burette, note down the burettereading. The volume of base V_2

PROCEDURE TABULAR COLUMN:

Dilution of acid

Bottle No.	**Vol. of acid added (0.5N)**	**Volume of water added in ml**	**Amount of pistachio 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:Oxalic acid

SINO.	**Initialconcentration ofoxalicacid(C_0)**	**Vol.oftitranttakeninml**	**Amt.ofpistachioshellcarbonaddedin**	**Burettereading**	**C_e=B.Rx0.1/10 Eq. conc. of acid in**	**X=C_0-C_e/20amountadsor**	**x/m**	**Log(x/m)**	**LogC_e**	**C_e(x/m)**
1	**0.5**	**10**	**1**	**10.4**	**0.104**	**0.0198**	**0.0198**	**-1.7033**	**-0.9829**	**0.0020592**
2	**0.4**	**10**	**1**	**8.6**	**0.086**	**0.0157**	**0.0157**	**-1.8041**	**-1.0655**	**0.0013502**
3	**0.3**	**10**	**1**	**6.2**	**0.062**	**0.0119**	**0.0119**	**-1.9244**	**-1.2076**	**0.0007378**
4	**0.2**	**10**	**1**	**4.4**	**0.044**	**0.0078**	**0.0078**	**-2.1079**	**-1.3565**	**0.0003432**
5	**0.1**	**10**	**1**	**2.2**	**0.022**	**0.0039**	**0.0039**	**-2.4089**	**-1.6575**	**0.0000858**

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TABULAR COLUMN: Malonic acid

SINO.	Initialconcentratio n ofoxalicacid(C_0)	Vol.oftitranttakeni nml	Amt.ofpistachioshe llcarbonaddedin gm	Burettereading	C_e=B.Rx0.1/10 Eq. conc. of acid in mol/dm^3	X=C_0-C_e/20amountadsor bedin moles	x/m	Log(x/m)	LogCe	C_e(x/m)
1	0.5	10	1	10.8	0.108	0.0196	0.0196	-1.70274	-0.9665	0.0021168
2	0.4	10	1	8.9	0.089	0.01555	0.01555	-1.80826	-1.0506	0.0013839
3	0.3	10	1	6.7	0.067	0.1165	0.1165	-1.93367	-1.1739	0.0007805
4	0.2	10	1	4.7	0.047	0.00765	0.00765	-2.11633	-1.3279	0.0003595
5	0.1	10	1	2.3	0.023	0.00385	0.00385	-2.41453	-1.6382	0.00008855

TABULAR COLUMN: Succinic acid

SINO.	Initialconcentration ofsuccinicacid(C_0)	Vol.oftitranttakeninml	Amt.ofpistachioshellcarbo naddedin gm	Burettereading	C_e=B.Rx0.1/10Eq.conc.ofac id in mol/dm^3	X=C_0-C_e/20amountadsorbedin moles	x/m	Log(x/m)	LogCe	C_e(x/m)
1	0.5	10	1	7.8	0.078	0.0211	0.0211	-1.67571	-1.10790	0.0016458
2	0.4	10	1	6.4	0.064	0.0168	0.0168	-1.77469	-1.19382	0.0010752
3	0.3	10	1	4.4	0.044	0.0128	0.0128	-1.89279	-1.35654	0.0005632
4	0.2	10	1	3.4	0.034	0.0083	0.0083	-2.08092	-1.46852	0.0002822
5	0.1	10	1	1.7	0.017	0.00415	0.00415	-2.38195	-1.76955	0.00007055

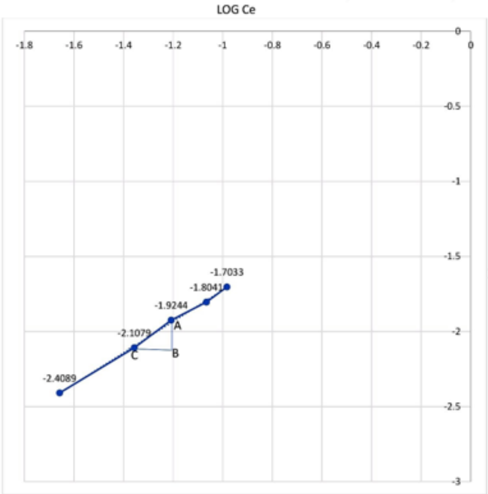
TABULAR COLUMN:

Glutaric acid

SINO.	Initialconcentration ofoxalicacid(C_0)	Vol.oftitranttakeninml	Amt.ofpistachioshellcarbonaddedin	Burettereading	C_e=B.Rx0.1/10 Eq. conc. of acid in mol/dm^3	X=C_0-C_e/20amountadsorbedin moles	x/m	Log(x/m)	LogC_e	C_e(x/m)
1	0.5	10	1	9.5	0.095	0.02025	0.02025	-1.69357	-1.0227	0.00192375
2	0.4	10	1	7.7	0.077	0.01615	0.01615	-1.79182	-1.11350	0.00124355
3	0.3	10	1	5.5	0.055	0.01225	0.01225	-1.91186	-1.252963	0.00067375
4	0.2	10	1	3.3	0.033	0.00835	0.00835	-2.07831	-1.48148	0.00027555
5	0.1	10	1	1.9	0.019	0.00405	0.00405	-2.39254	-1.72124	0.0000765

EVALUATION OF PISTACHIO NUT SHELL DERIVED ACTIVATED CARBON AS AN ADSORBENT FOR UPTAKE OF DIFFERENT DIBASIC ACIDS

GRAPH: FREUNDLICH ADSORPTION ISOTHERM (OXALIC ACID)



Scale= X-aixs – 1 unit =0.5cm

Y- axis - 1 unit=0.5cm

SLOPE= $\frac{AB}{BC}$

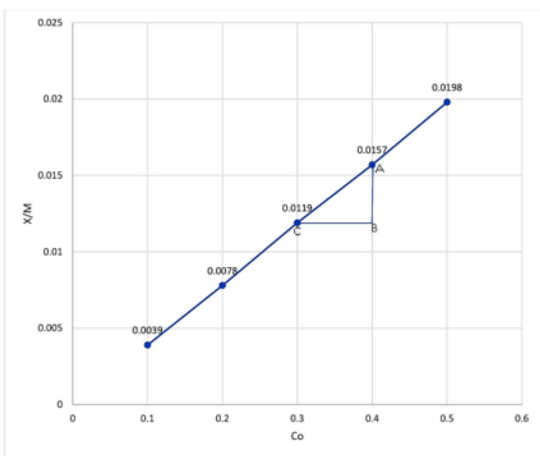
$= \frac{(-1.9244)-(-2.1079)}{(-1.20)-(-1.35)}$

$= \frac{0.1835}{0.15}$

= 1.22

EVALUATION OF PISTACHIO NUT SHELL DERIVED ACTIVATED CARBON AS AN ADSORBENT FOR UPTAKE OF DIFFERENT DIBASIC ACIDS

GRAPH : LANGMUIR ADSORPTION ISOTHERM (OXALIC ACID)



Scale= X-aixs – 1 unit =0.1cm

Y - axis- 1 unit=0.005cm

SLOPE= $\frac{AB}{BC}$

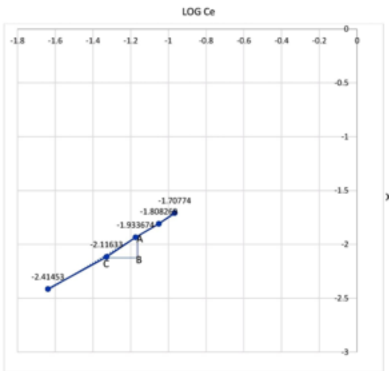
$= \frac{0.0157-0.0119}{0.4-0.3}$

$= \frac{0.0038}{0.1}$

= 0.038

EVALUATION OF PISTACHIO NUT SHELL DERIVED ACTIVATED CARBON AS AN ADSORBENT FOR UPTAKE OF DIFFERENT DIBASIC ACIDS

GRAPH: FREUNDLICH ADSORPTION ISOTHERM ((MALONIC ACID)



Scale= X-aixs – 1 unit =0.5cm

Y-axis- 1 unit=0.5cm

SLOPE= $\frac{AB}{BC}$

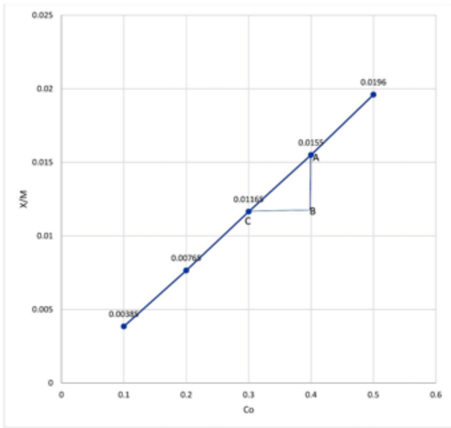
$= \frac{(-1.93367)-(-2.1163)}{(-1.17)-(-1.32)}$

$= \frac{0.182656}{0.15}$

$= 1.217$

EVALUATION OF PISTACHIO NUT SHELL DERIVED ACTIVATED CARBON AS AN ADSORBENT FOR UPTAKE OF DIFFERENT DIBASIC ACIDS

GRAPH : LANGMUIR ADSORPTION ISOTHERM (MALONIC ACID)



Scale= X-aixs – 1 unit =0.1cm

Y-axis- 1 unit=0.005cm

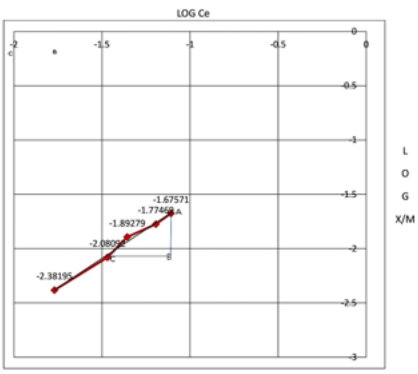
SLOPE= $\frac{AB}{BC}$

$= \frac{0.0155-0.01165}{0.4-0.3}$

$= \frac{0.00385}{0.1}$

$= 0.0385$

GRAPH: FREUNDLICH ADSORPTION ISOTHERM (SUCCINIC ACID)



Scale= X-aixs – 1 unit =0.5cm

Y- axis- 1 unit=0.5cm

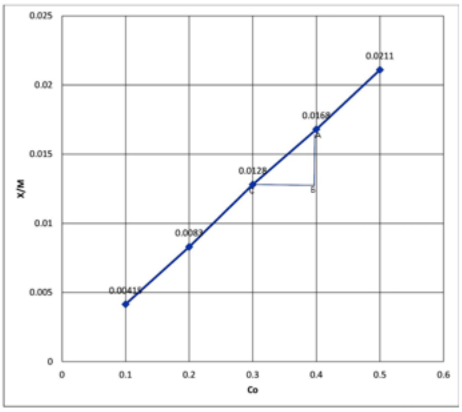
SLOPE= $\frac{AB}{BC}$

$= \frac{(-1.77469)-(-2.08092)}{(-1.19)-(-1.46)}$

$= \frac{0.30623}{0.27}$

$= 1.1341$

GRAPH : LANGMUIR ADSORPTION ISOTHERM (SUCCINIC ACID)



Scale= X-aixs – 1 unit =0.1cm

Y-axis- 1 unit=0.005cm

SLOPE= $\frac{AB}{BC}$

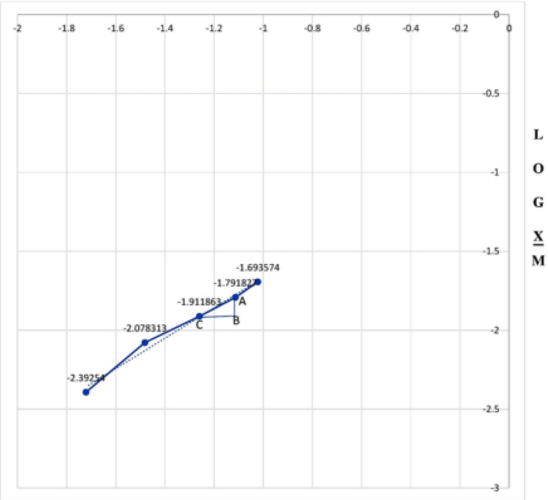
$= \frac{0.0168-0.0128}{0.4-0.3}$

$= \frac{0.004}{0.1}$

$= 0.04$

GRAPH: FREUNDLICH ADSORPTION ISOTHERM (GLUTARIC ACID)

LOG Ce



Scale= X-aixs – 1 unit =0.5cm

Y-axis- 1 unit=0.5cm

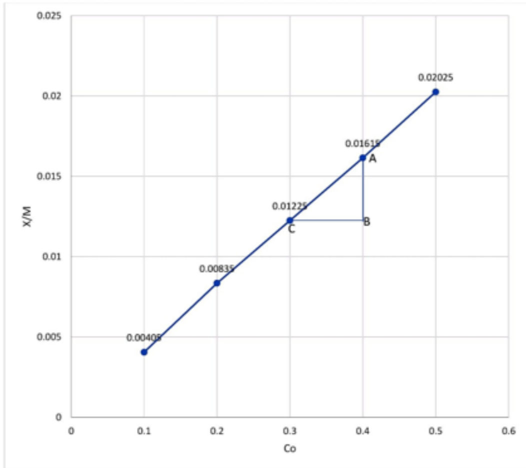
SLOPE= $\frac{AB}{BC}$

$= \frac{(-1.79182)-(-1.91186)}{(-1.11)-(-1.25)}$

$= \frac{0.12004}{0.14}$

$= 0.8574$

GRAPH : LANGMUIR ADSORPTION ISOTHERM (GLUTARIC ACID)



Scale= X-aixs – 1 unit =0.1cm

Y-axis- 1 unit=0.005cm

SLOPE= $\frac{AB}{BC}$

$= \frac{0.01615-0.01225}{0.4-0.3}$

$= \frac{0.0039}{0.1}$

$=0.039$

APPLICATIONS OF ADSORPTION

The phenomenon of adsorption finds extensive applications in industry, in laboratory an also in various chemical process. A few important applications are listed below:

1. Removal of coloring matter:

2. In gas masks:

3. In separating noble gases:

4. In dying of cloth:

5. In dehumidizers:

6. Heterogeneous catalysts:

7. In chromatography:

8. In ion exchange resins:

9. In quantitative analysis:

10. In adsorption indicators:

11. In creating high vacuum:

12. In froth floatation process:

CONCLUSION

Fromthereadingsobtainedit wasobservedthatextentofadsorptionof oxalic acid (0.01182), malonic acid(0.01166), succinic acid (0.01263) and glutaric acid (0.01221)reasonbehindtheaboveconclusionmay bethepresenceofCH_2group. theextentofadsorptionof,succinicacid(0.01263)>oxalicacid(0.01182)thereasonbehindtheabove conclusionisthepresenceof2CH_2groupinsuccinicacid or absenceof2 CH_2groupin oxalicacid.

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