COMPARATIVE STUDY OF VARIOUS ADSORPTION ISOTHERMS, BY THE ADSORPTION OF SUCCINIC ACID ONTO ACTIVATED CARBON OF BHAGAR RICE HUSK

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A B S T R A C T

The aim of this investigation was to determine the adsorption behaviour of succinic acid solution on activated carbons prepared from Bhagar Rice husk. The activated carbons were prepared by chemical activation method. The adsorption data were well described by the Langmuir and Freundlich adsorption methods. . A variety of adsorbents are available naturally- orange pills, rice husk, neem bark, clays etc. that can be used to remove acids from the discharged waste. In this review, we look at the various adsorbents available particularly Bhagar rice husk and see how effectively they can be utilized to meet our requirements. The acid removal process followed Freundlich isotherm in most of the cases and in few investigations, it followed Langmuir. The adsorption equilibrium of succinic acid on prepared activated carbon was then examined. The adsorption isotherms of succinic acid on activated adsorbent was determined and correlated with common Langmuir and Freundlich isotherm models. The Freundlich isotherm showing a better fit for the adsorption data than the Langmuir isotherm. The maximum monolayer adsorption capacity obtained from Langmuir isotherm of succinic acid on activated carbon of Bhagar rice husk.

Keywords:Adsorptions, succinic acid, Activated carbon of Bhagar rice husk, bio-adsorbent, Freundlich, and Langmuir isotherm, Adsorption constant

Introduction:-

Water pollution is the contamination of water bodies such as lakes, rivers, oceans, and groundwater caused by human activities, which can be harmful to organisms and plants .So the water reservoirs be treated carefully and wastewater treatment be done.[1] Adsorption appears to be good for the treatment of effluents.[2] The first thing for an efficient adsorption process is the search for a low cost adsorbent with high adsorption capacity and second it should bebiodegradable.[3] The activated carbon has been till now the most used adsorbent but inexpensive to use on a large scale[5] and the idea of using natural adsorbents gives very good results[4].

Many researchers have done the research on using agricultural waste in adsorption of heavy metals. They had reported that the modified rice husks are a potentially useful material for the removal of lead from aqueous solutions[5]. The rapid uptake and high adsorption capacity make it very attractive alternative adsorption material. Rice husks contain a high proportion of cellulose (28-36%), thus it appears to be a good candidate for modification with carboxylic acids. The addition of carboxyl functional groups may enhance the sorption capacities of the rice husks. It showed that tartaric acid modified rice husks had the highest binding capacities for lead.

In previous studies the adsorption of succinic acids on orange pills adsorbents has been done by the phenomenon of accumulation of one species on the surface of other is called as adsorption. It verifies the Freindlich and Langmuir isotherms of acetic[6].

The efficiency of technique depends on the nature of adsorbent. The adsorbent such as activated carbon were used for heavy metal removal.

Exchanging ions and creating chemical bonds. There are a wide variety of adsorbent materials such as silica gel, zeolites, synthetic adsorbents

(resins), clays, activated alumina, industrial wastes, bio adsorbents and activated carbonyl[7]. Activated carbon (AC) adsorbents are frequently used in the extraction of chemical species in both gas and aqueous phases[8]. This is because of their high adsorption capacity, their porous structure and accessibility of their surface.[9] they are used in water treatment and in industrial applications such as in the extraction of metal ions, air handling, and purification, the discolouration of food in the food industry and in the pharmaceutical industry.[10]

Milind R. Gidde, Julie Datta, Snehal Jadhav et al: Activated Rice Husk (ARH) and Rice Husk Ash (RHA) were used as adsorbents for decolourisation. ARH was prepared from rice husk treated with nitric acid and RHA was collected directly from mill.[11]There adsorption capacity was evaluated for the decolourisation of wastewater containing methylene blue. The effect of system variables such as pH, contact time, initial concentration and adsorbent dose were investigated.[12]The result shows that efficiency varies with the variation in adsorbate concentrations and adsorbent.[13] Colour removal efficiency was found to be 88 % to 94 % at the dose of 20 g/l for ARH and 80 % to 95 % at the adsorbent .dose of 2.5 g/l for RHA. The studies were carried out at methylene blue concentration of 50 mg/l, 30 mg/l and 10 mg/l. On the basis of adsorption isotherm graphs, R-square values were determined and found to fit the adsorption data. The Linear, Langmuir and Freindlich adsorption isotherms are good fitted for the experimental data.[14]

3.3 Adsorption isotherms

The adsorption isotherm investigates when the adsorption process reaches an equilibrium state, how the adsorption molecules distribute between the liquid phase and the solid phase. The analysis of equilibrium adsorption data by fitting them to different isotherm models is an important step in finding a suitable model that can be used for design purposes. Adsorption isotherm study was carried out well-known isotherms, Langmuir, Freundlich[15] and temkin. The Langmuir isotherm is based on assumption that the monolayer adsorption onto a surface containing a finite number of adsorption sites with uniform forces of adsorption with no migration of adsorbate in the plane of surface. The Freundlich isotherm model assumes heterogeneous adsorption, in which the energy term in Langmuir equation varies as a function of the surface coverage.

Langmuir isotherm The Langmuir isotherm model is given by the following linear form by the equation.

$C_e / q_{e\ = 1/q}{}^{m} + C^e / q^m$

Where Ce is the equilibrium concentration of Succinic Acid (mg/L), qe, the amount of adsorbate adsorbed per unit mass of adsorbent (mg g-1), qm and KL are Langmuir constants related to monolayer adsorption capacity and affinity of adsorbent towards adsorbate, respectively. When Ce/qe was plotted against *C*e, straight line with slope 1/ qm was obtained (Fig. 2), indicating that the adsorption of succinic acid on activated carbon produced from Bhagar rice husk follow the Langmuir isotherm. The Langmuir constants qm and K, L were calculated from this isotherm and their values are given in Table.

Freundlich isotherm The well-known linear logarithmic form of Freundlich model is given by the following equation,

$\text{Log}q_e = \log K_F + 1/n \log C_e$

Where qe is the amount adsorbed at equilibrium (mg g-1), Ce the equilibrium concentration of the adsorbate (Succinic acid) and KF and n are Freundlich constants, n giving an indication of how favourable the adsorption

Experimental:-

Materials: Chemicals: Succinic acid, NaOH, oxalic acid, phenolphthalein indicator, distilled water, Bhagar rice husk adsorbent etc.

Instruments: microwave oven, containers mechanical shaker etc.

Preparation of adsorbent:

A weighed amount of Bhagar rice husk charged into the furnace at a temperature of 300, 400, 500 and 600^0C for 0.5, 1.0, 1.5 and 2 hours. The resulting charred material was collected and cooled at room temperature. The domain of variation of these factors is defined according to Borne Mann et *al*[16]. A known amount of Bhagar rice husk charcoal (10 g) was transferred in a beaker (250mL) and added 100 mL distilled water to it and continued adding water to it up to 200mL to completely soak the charring rice straw in beaker. When the charring rice husk completely settled down then decanted the distilled water and repeated this process for several times until the decanted water become cleared. Bhagar husk charcoal was then filtered

through ordinary filter paper and washed again with distilled water. Cleaned Bhagar rice husk charcoal was dried in an oven to get a constant weight and stored[16].

Method:

Prepare 0.1 N oxalic acid solutions by dissolving 0.63g oxalic acid in 100 ml distilled water.

Standardize the given NaOH solution using phenolphthalein indicator.

Take 6 clean reagent bottles and number them from 1-5.

Weigh out accurately about 1 g finely ground activated charcoal in each of them.

Prepare various systems in these bottles as follows:

Shake these bottles vigorously and keep for one hour.

Filter each solution through filter paper and titrate 10 ml of each of them with 0.1N NaOH solution.

Results & Discussion:-

Similarly, adsorption of succinic acid on activated Bhagar rice husk as a bio adsorbent. Different concentration of succinic acid solution we are prepared and determine the adsorption for 1 hr contact time. From the table 1 we have determined the values of log x/m and log Ce. The graph 1 of Freundlich adsorption isotherm of succinic acid on Bhagar rice husk the straight line is obtained. From the graph R^2 ,n ,k values were determine. From the values it was observed that Freundlich adsorption is verified.

Similarly, from graph 2, Ce/x/m vs. Ce of Succinic acid on activated Bhagar rice husk, straight line is obtained. From the graph a, b, R^2 were determining. This value shows the Langmuir adsorption is verified.

Also, from table 3 the values of % adsorption vs. concentration graph 3 were plotted. From the graph it was observed that as the concentration of acid solution decreases % adsorption decreases

From graph 1 the Freundlich adsorption isotherm can be said to be good. And Fit for the given experimental adsorption data, since the linear regression of log x/m vs log Ce gave R^2values in the range of 0.99 for the different concentration of Succinic acid with rice husk adsorbents. To understand the actual application of this adsorption method on the results obtained the experiments were conducted on different waste water samples collected from different industries. The activated rice husk and rice husk ash can be used as good adsorbent for selected effluent having specific concentration of adsorbate (colour/organic matter).

Similarly, From graph 2 the Langmuir adsorption isotherm can be said to be good fit for the given experimental adsorption data, since the linear regression of Ce/ x/m vs Ce gave R^2values in the range 0.79 for the different concentration of Succinic acid with rice husk adsorbents. Application of adsorbents for different effluent samples. To understand the actual application of this adsorption method on the results obtained the experiments were conducted on different waste water samples collected from different industries. The activated Bhagar rice husk and rice husk ash can be used as good adsorbent for selected effluent having specific concentration of adsorbate (colour/organic matter).

Similarly, for Succinic acid Freundlich constant , 'n' having value 1.039 and 'k' having value 17.82 and Langmuir constant 'a' having value 2.188 and 'b' having value 14.28 indicate that both Freundlich and Langmuir adsorption isotherm is verified.

From graph 3 it is concluded that the adsorption of acids decreases with decrease in concentration of acid. As the concentration of acid decreases from system 1 to 5 the adsorption of acid on rice husk adsorbent also get decreases.

From the above all graphs we can conclude that having R^2 value greater than

0.70 indicate the adsorbent gives better adsorption of acids.

Conclusion:-

The result of present study clearly shows that acid treated rice husk is effective in adsorption of acids. It is evident that experimental adsorption data for the

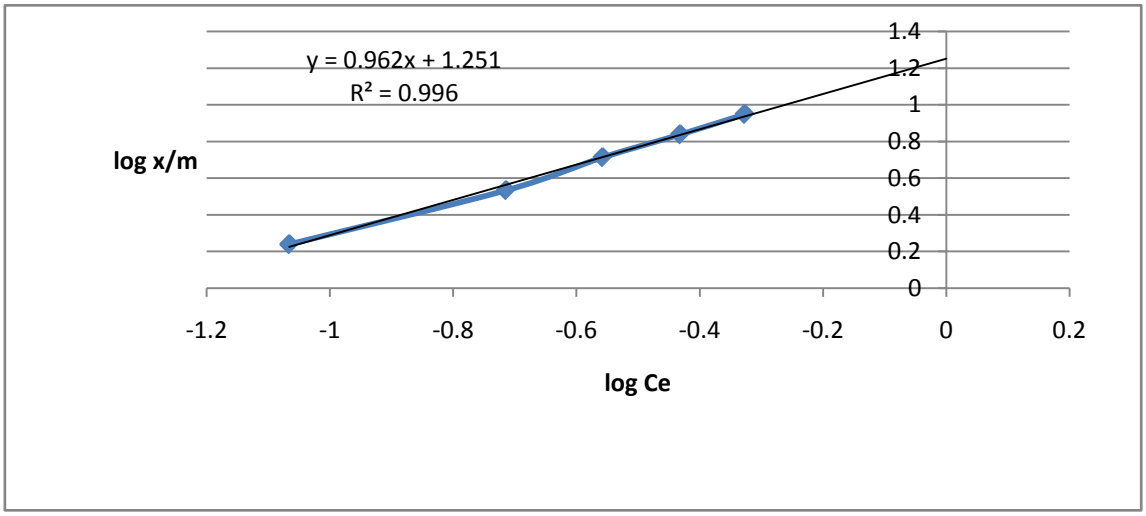
Adsorption of colour in this research can be explained by more than one adsorption isotherms. The result shows that the R^2 values are closer to 1 for all adsorption isotherm plots. Thus, Linear, Langmuir and Freundlich isotherm models are good fitted to the experimental data. Thus full utilization of agro-

waste and treatment of wastewater is one of the good prospective for good environment. The Bhagar rice husk can be proved as good, effective and eco friendly adsorbent.

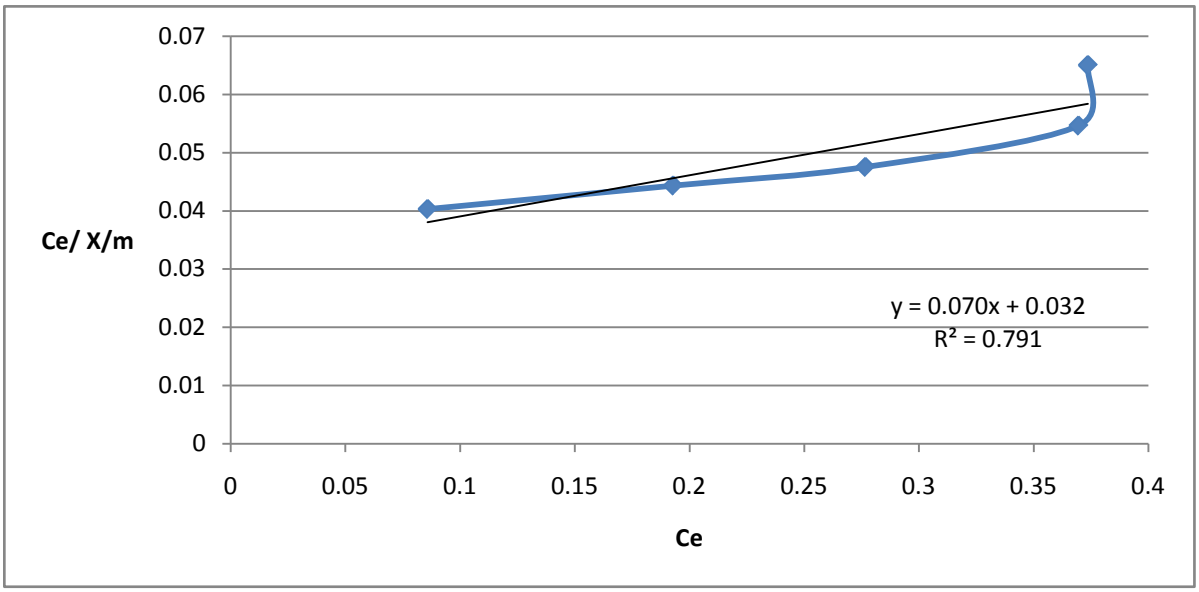
Bhagar Rice husk is cheap, less expensive and easily available in market. As it is a waste material of Rice after threshing of rice, generally it is available in free of cost. It gives better adsorption of acids so instead of activated carbon it is more beneficial for adsorption as an adsorbent.

1.1. Structures

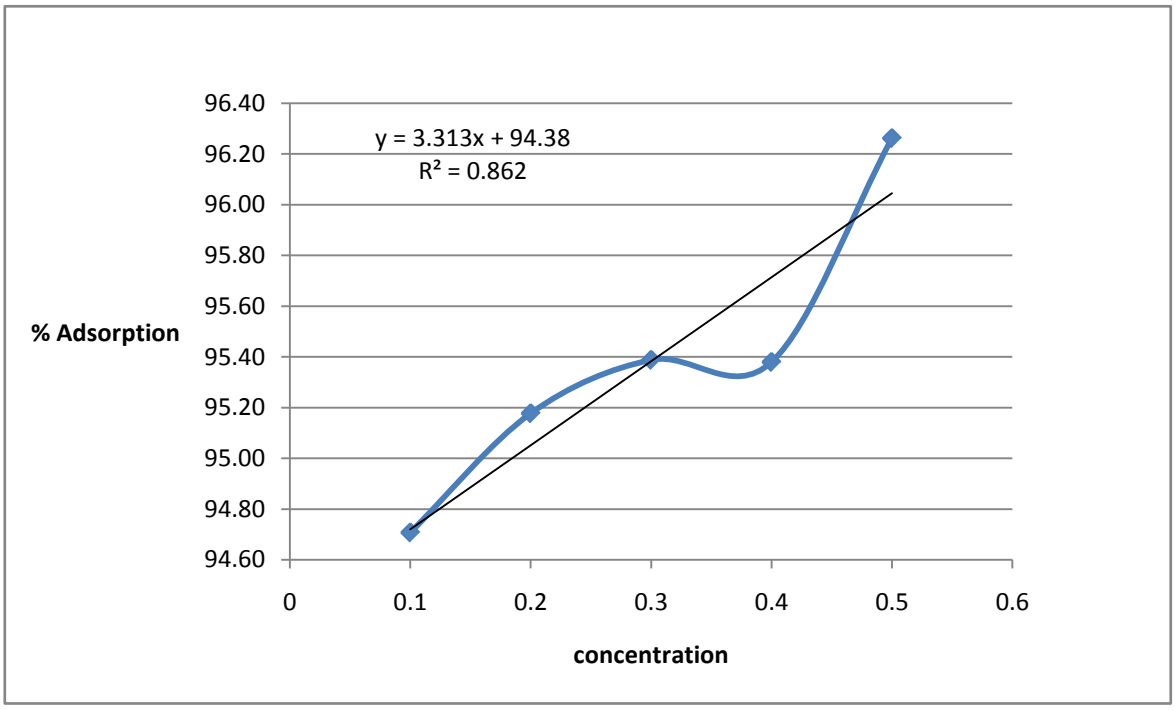
Graph 1: Verification of Freundlich adsorption isotherm of Succinic acid on Bhagar Rice husk adsorbent.



Graph 2: Verification of Langmuir adsorption isotherm of Succinic acid on Bhagar Rice husk adsorbent.



Graph 3: % Adsorption vs Concentration of Succinic acid on Bhagar Rice husk adsorbent.



1.2. Tables

Table no. 1: Observation table for Succinic acid (0.01 N) on Bhagar rice husk.

Bottle No.	Vol. Of succinic acid solution V (ml)	Vol. Of water (ml)	Amount of charcoal m (g)	Initial conc. Of succinic acid Co	Vol. Of filtrate taken V1 (ml)	Vol. Of NaOH solution required V2 (ml)	Eqn conc. Of succinic acid Ce	Succinic acid adsorbed X (g)	X/M	Log (x/m)	Log Ce	Ce/ x/m
1	50	0	1	10	10	37	0.3737	8.8789	8.8789	0.9483	0.4274	0.065
2	40	10	1	8	10	36.6	0.3696	6.8916	6.8916	0.8383	0.3321	0.0546
3	30	20	1	6	10	24.4	0.2767	5.1699	5.1699	0.7135	0.5579	0.0475
4	20	30	1	4	10	19.1	0.1929	3.4212	3.4212	0.5341	0.7146	0.0443
5	10	40	1	2	10	8.5	0.08585	1.7424	1.7424	0.2401	1.0662	0.04027

Table no.2: Percentage adsorption for Succinic acid on Bhagar rice husk.

Concentration	co	Ce	Co-Ce	Co-Ce/Co	% adsorption
0.5	10	0.3737	9.6263	0.96263	96.26
0.4	8	0.3696	7.6304	0.9538	95.38
0.3	6	0.2767	5.7233	0.953883	95.39
0.2	4	0.1929	3.8071	0.951775	95.18
0.1	2	0.1185	1.8815	0.94075	94.08

Table 3: calculation of Freundlich and Langmuir constant.

Freundlich constant	Values	Langmuir constant	Values
n	1.039	a	2.188
k	17.82	b	14.28
R^2	0.99	R^2	0.79

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