BATCH AND COLUMN STUDY FOR TREATMENT OF SUGAR INDUSTRY EFFLUENT BY USING LOWCOST ADSORBENT

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ABSTRACT

The sustainment of life is not possible without water, the total available water for usage is about 1 percent only. All processing industry need water for various purpose like utility, solvent etc. the water used and discharge is subjected to pre-treatment method like ion-exchange, precipitation etc. out of the various methods available removal of pollutants on a solid body ie Adsorption is much effective. based on literature survey it has been found that the removal of pollutant from effluent waste stream has been carried out by various researcher in batch mode and various kinetic data has been generated. this leaves behind an unexplored area of pollutant removal by adsorption in a continues mode, which has been selected as a focus of present study

Keyword: - *Low cost adsorbent, fixed bed, contaminant, batch experiment.*

1. Introduction:-

Water is one of the essential need of industry as well as life on earth. But pure water is not available to a large fraction of the population of the planet. While availability of fresh water is major issue, so it is necessary to be treat, recycle or reuse of water for fulfill the demand of water. For the treatment of waste water various methods are available like ion-exchange, membrane separation but this method need more financial input due to that it restrict the use of this method. Among them adsorption by using low cost adsorbent is an effective method for waste water treatment.

The sugar Industry in India is one of the oldest and largest industries in the country. These Industries require large volume of water of high purity and generate equally large volume of waste water which is highly complex and polluted. In the present study, it was aimed to carry out batch and continuous experiments using Powdered and granular Activated Carbon, Lignite, bituminous is used for the removal of organic contaminants especially COD contributing components from the waste water form sugar Industry. A number of conventional treatment technologies have been considered for treatment of wastewater contaminated with organic substances. Among them, adsorption process is found to be the most effective and economical method.

Batch experiments are usually done to measure the effectiveness of adsorption for removing specific adsorbates as well as to determine the maximum adsorption capacity. The continuous adsorption in fixed-bed column is often desired from industrial point of view. It is simple to operate and can be scaled-up from a laboratory process

Adsorption is known to be a promising technique, which produces good quality effluents with low levels of dissolved organic compounds such as dyes, acid dye, basic dye, methylene blue, reactive azo dye. Although activated carbons have been most widely used as adsorbents in waste water treatment processes (kunnan *et al*[1], davies *et al*[2], kulkarni *et al*[3], walker *et al*[4], there is growing interest in using low cost, commercially available materials for the adsorption of dyes. A wide variety of materials such as peat [5], palm-fruit [6], silica fumes [7], natural zeolite [8], montmorillonite, and kaolinite [9] are employed as low cost alternatives to activated carbons. Recently, clay materials have been increasingly paid attention because they are cheaper than activated carbons and their sheet-like structures also provide high specific surface area.

The adsorption of dye such as (acid dye, basic dye, methylene blue, reactive azo dye), surfactant, metals(Al, Fe, Pb), organic compound like(para-chlorophenol, furfural, naphthalene 2-sulfonic acid) using activated carbon(tan et al [10], walker *et al* [1],lin *et*[11],sze *et al*[12],jauta *et al*[13],jung *et al* [14],ahmad *et al* [15],sing *et al*[16],sotelo *et al*[17],goel *et al*[18],song *et al*[19])was investigated in fixedbed column. The effect of selected operating parameters such as bed capacity, initial concentration, bed height was evaluated. The breakthrough data fitted well to Langmuir, Freundlich, Temkin and Dubinin-Radushkevich isotherm models, pseudo-second-order model. The highest bed capacity was obtained at 40.86 mg/g . The results showed that activated carbon prepared from oil palm shell can be an effective adsorbent for dye such as (acid dye, basic dye, methylene blue, reactive azo dye), surfactant, metals(Al, Fe, Pb), organic compound like(para-chlorophenol, furfural, naphthalene 2-sulfonic acid) removal.

2 Methodology:-

2.1 Batch experiment:-

Batch test were perform to finding out the maximum capacity of adsorbent. For conducting batch experiment 100ml of sample is to be taken from the respective carboy in a beaker. In which 1% & 2%(1gm, 2gm) Activated carbon (A/C), lignite, bituminous is to be added in to the beaker and putting on to the magnetic stirrer and staring is started at fixed 160 to 170 revolutions per minutes. 2-3 ml of sample is to be drawn in time interval of 30, 60, 90, 120 min from this beaker. Then Filtered on filter paper and the filtrate analyzed for COD. At the end of 2hr the stirring is stopped and the experiment is terminated.

2.2 Column experiment:-

After batch experiment were completed, maximum removal capacity of adsorbent to deduced COD level was observed. Column tests were then to be performed to provide a real-life treatment process but on a smaller scale. Continuous experiment were carried out in glass column having 1.8 meter length and 2.75 diameter. in which adsorbent was filled in the column and at the top and bottom glass beds are filled for the supporting purpose. Effluent sample was feed from bottom against gravity by using pump and the effluent sample was collected from the top and was recirculated and at a regular time interval of 10,20,30,60 minutes sample was collected and analyses for COD analysis. And the experiment were carried out by changing the bed height of adsorbent as 5 cm, 10 cm, 15 cm and different flow rate 300 ml/minutes and 600 ml/minutes for two adsorbent lignite and bituminous.

3. Result & Discussion:-

The effluent sample was collected ETP inlet waste water of sugar industry located in Gujarat and preserved in a sealed carbow. The effluent collected was acidic in nature and contain high COD.

3.1 Batch Experiment result of 1% Adsorbent:-

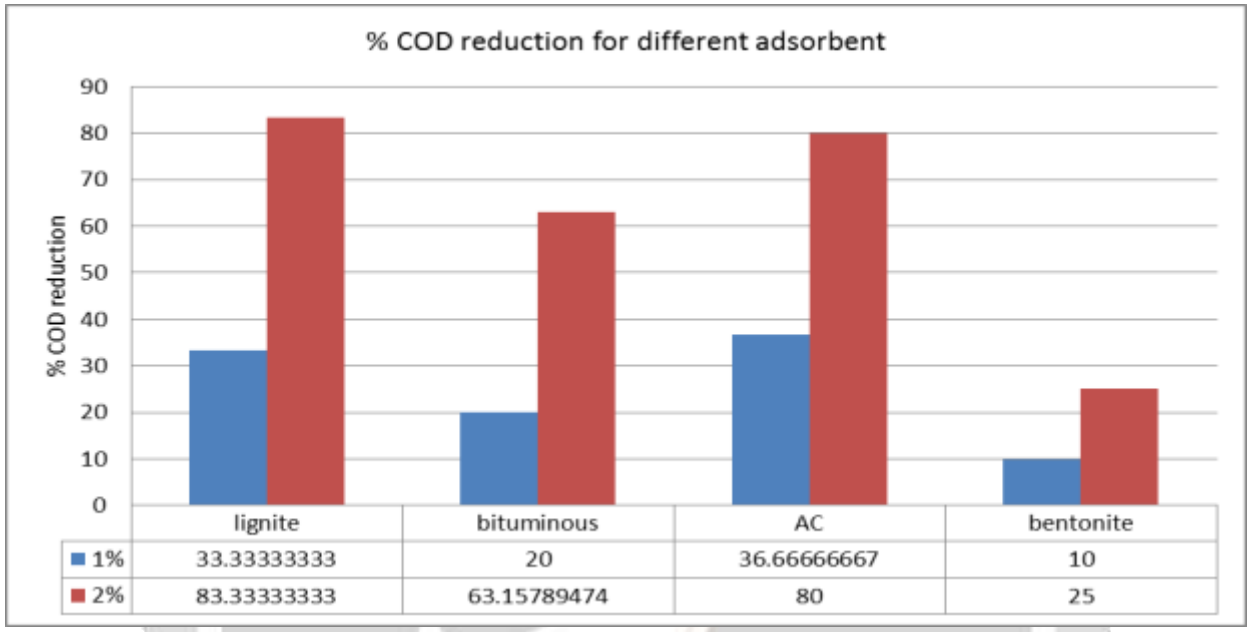

Fig -1: % COD vs. 1% Adsorbent used for treatment of sugar industry effluent

3.2 Batch Experiment result of 2% Adsorbent:-

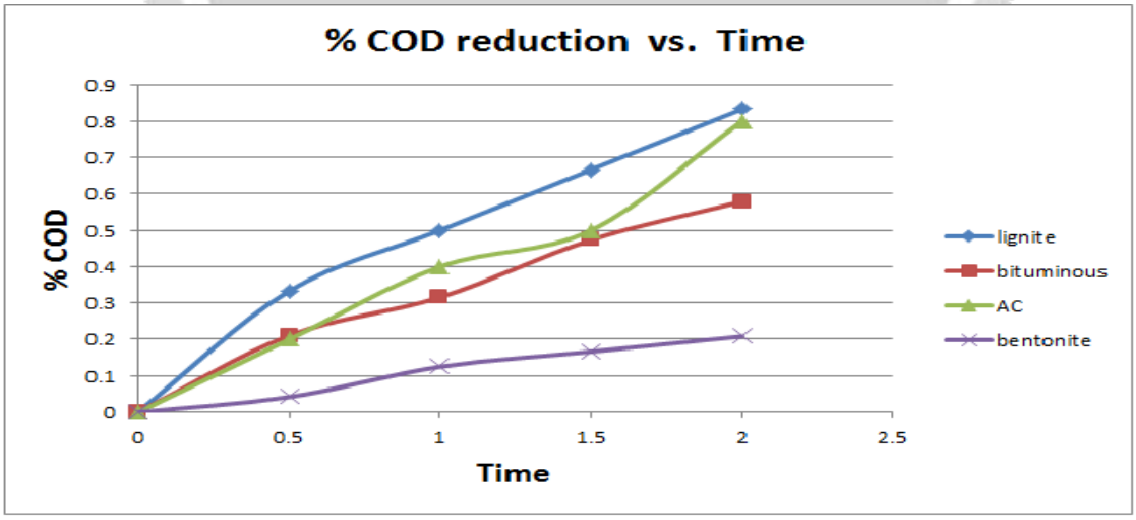

Fig -2: % COD vs. 2% Adsorbent used for treatment of sugar industry effluent

From figure 1 and 2 it can be clearly seen that % COD reduction by using lignite is around 81% where as the % COD reduction by using activated carbon is 83% which is very close, so we can easily replace lignite in place of activated then the cost of treatment will decrease. Seen the cost of activated carbon is approximately 200 times the cost of lignite.

3.3 Column Experiment result:-

3.1 Column Experiment result table:-

Various experimental result obtained are as shown below.

			% COD reduction					% COD reduction	
Height	**Flow rate**	**Time**	**Lignite**	**Bituminous**	**Height**	**Flow rate**	**Time**	**Lignite**	**Bituminous**
5	300	10	7.7	7.7	5	600	10	8	3.8
		20	15.2	15.4			20	15	7.7
		30	30.8	23.1			30	19	15.4
		60	30.8	26.9			60	19	15.4
10	300	10	15	11.5	10	600	10	8	7.7
		20	35	23.1			20	23	15.4
		30	54	38.5			30	46	26.9
		60	62	46.2			60	54	38.5
15	300	10	30.8	19.2	15	600	10	23.1	15.4
		20	50	38.5			20	46.2	38.5
		30	69.2	53.8			30	61.5	46.2
		60	73.1	57.7			60	69.2	50

3.1 Effect of bed height at fixed flow rate:-

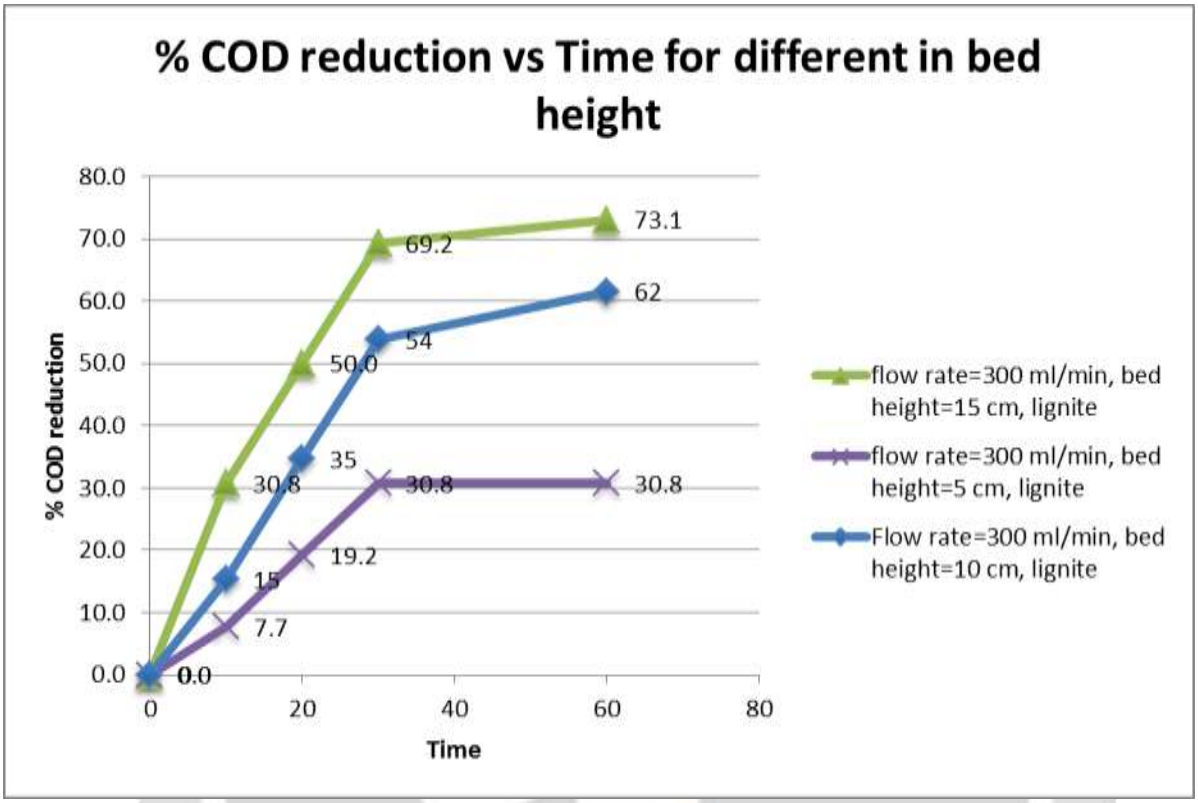

Fig -3: % COD vs. time for different in bed height of Adsorbent used for treatment of sugar industry effluent

From figure 3 we have fixing the flow rate 300 ml/minutes for both adsorbent (lignite and bituminous) and then the bed height changing from 5cm, 10cm,15cm and the results of COD reduction shows an increase of 30% to 73%. Increase in bed height result increase in COD is attributed since if bed height increase means active site available for the adsorption also increases so that more of the pollutant get adsorbed on a surface of adsorbent.

3.2 Effect of different flow rate at constant:-

From figure 4 we have fixing the bed height of 5 cm for both adsorbent (lignite and bituminous) and then the flow rate was reduced from 600 ml/minutes to the 300 ml/minutes and the results of COD reduction shows an increase of 1.6 times. The above increase in reduces of COD is attributed since if flow rate is reduce then the contact time between adsorbent and effluent increases so that more of the pollutant from the effluent gets adsorbed.

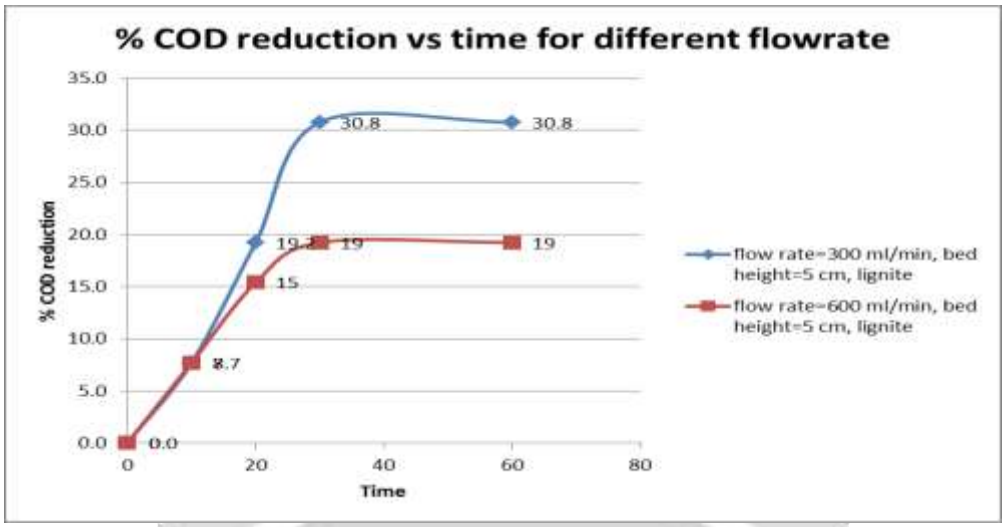

Fig -4: % COD vs. time for different flow rate used for treatment of sugar industry effluent

3.3 Effect of different adsorbent:-

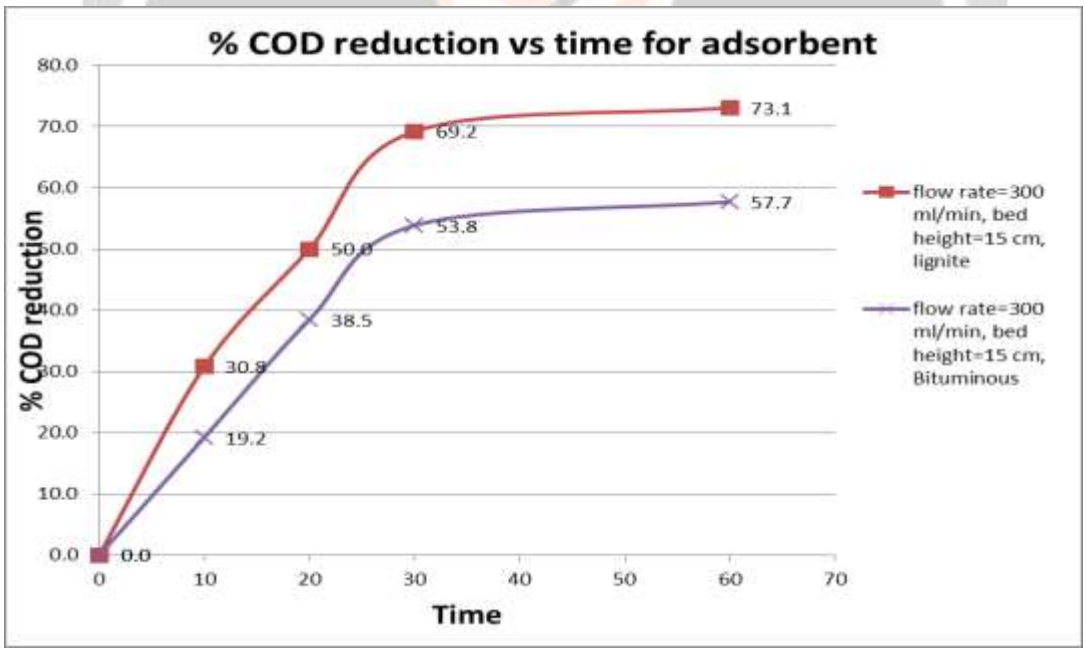

Fig -5: % COD vs. time for different Adsorbent used for treatment of sugar industry effluent

From the figure 5 we suggests that for different adsorbent (lignite and bituminous) fixing the bed height 15 cm and the flow is also fixed 300 ml/minutes for both the case and the result of % COD shows that if we replace lignite in place of bituminous then % COD reduction increase 1.2 times. because active site available for the adsorption is higher for lignite then bituminous due to that reason lignite give more % COD reduction then bituminous.

4. CONCLUSIONS:-

In sugar industries, adsorption treatment is done as tertiary treatment by using conventional activated carbon. From the above study, we can say that if the effluent is treated with lignite powder then COD reduction is very close to that of the treatment with activated carbon under identical conditions. Thus by modifying industrial effluent treatment flow sheet by carrying of adsorption operation initially than at the end, rates of COD can be decreased substantially to acceptable level and the capacity of effluent treatment plant can be increased. Hence if we use low cost adsorbent then the operational cost of the treatment will reduce.

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