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Research Paper

SYNTHESIS OF LOW COST ADSORBENT FROM *AZADIRACHTA INDICA* (NEEM) LEAF POWDER

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ABSTRACT

The adsorption technique is effective and economical to application level. The regular commercial activated carbon is expensive, so there is a need of alternatives for such application. In present study Neem leaves powder activated carbon has developed as an adsorbent.

In the textile industry, the activities involving dyeing generate pollutants due to the discharge of toxic effluents, originating from the byproducts generated. If not treated properly before being discharged into natural water bodies, the effluent from this industry may reach potable water resources, causing serious ecological concern. Therefore the development of new technologies for the removal of color from waste water is necessary.

The aim of this work is to study the color removal by Neem Leaves Powder from methyl red & $K_2Cr_2O_7$ solution and to offer this biosorbent as local replacement for existing commercial adsorbent materials.

KEYWORDS: Adsorption; Neem leaves; Methyl Red; $K_2Cr_2O_7$

1. INTRODUCTION

Adsorption has been used successfully in the removal of color from effluents. Activated carbon is the most used adsorbent. Due to its high cost and considering the enormous quantity of effluent produced by textile industries, researches are turning toward the use of alternative adsorbents, also called non-conventional low-cost adsorbents. Industries like plastic, paper, textile and cosmetics use dyes to color their products. These dyes are common water pollutants and they may be frequently found in trace quantities in industrial waste water. Their presence in water, even at very low concentrations, is highly visible and undesirable.

Adsorption has been used extensively in industrial processes for separation and purification. In wastewater treatment, commercially activated carbon has long been used as a standard adsorbent for color removal. In spite of its widespread use in various cleaning procedures, activated carbon remains expensive; therefore, the development of low-cost alternative adsorbents has been the focus of recent research. Contributions in this regard have been made by many researchers who have utilized a number of substances such as agricultural wastes: coir pith, banana pith, sugar cane dust, sawdust, activated carbon fibers and rice hulls, industrial solid wastes: fly ash, red mud and shale oil ash, and so on.

The Neem tree is noted for its drought resistance. Normally it thrives in areas with sub-arid to sub-humid conditions, with an annual rainfall between 400 and 1200 mm. It can grow in regions with an annual rainfall below 400 mm, but in such cases it depends largely on ground water levels. Neem can grow in many different types of soil, but it thrives best on well drained deep and sandy soils. It is a typical tropical to subtropical tree and exists at annual mean temperatures between 21-32°C.

2. LITERATURE SURVEY

Adsorption is not necessarily a physical phenomenon always. It may as well be a chemical process involving chemical interaction between the surface atoms of the adsorbent & the atoms of the adsorbate. This type of adsorption is known as chemisorption. For example, oxygen is chemisorbed by carbon & hydrogen is chemisorbed by nickel under suitable conditions.

In conventional waste water treatment methods, it is not possible to remove all the soluble compounds from the raw wastewater. Use of granular activated carbon for the adsorption of organic materials from water & wastewater has been introduced as a reliable & economical non-biological or physio-chemical process.

Adsorbents are available as irregular granules, extruded pellets and formed pellets. The size reflect the need to pack as much surface area as possible into a given volume of bed and at the same time minimize pressure drop for flow through the bed. Size up to 6 mm is common.

The adsorbent must have following features;

- It should have large surface area.
- The area should be accessible through pore enough to admit the molecule to be adsorbed. It is a bonus if the pores are also small enough to exclude molecules which it is not desired to adsorb.
- It should be easily regenerated
- The adsorbent should not age rapidly, that it loses its adsorptive capacity through continuous recycling.

3. MATERIALS AND METHODS

3.1 Preparation of Adsorbent

Initially Neem leaves were washed repeatedly by using distilled water to remove moisture and soluble impurities. Then Neem leaves kept in dryer at 90^0C, for2-3 hrs till leaves turn pale yellow. Then crushed and screen by 10-15um mesh size.

Neem leaves powder washed to remove moisture and free acid and kept in dryer 20-25 minute. After drying powder was mixed with H_3PO_4 in silica crucible and kept in furnace at 260^0c for 15-20 minute .The heating period depend on atmospheric temperature then solution was cooled & repeatedly washed using hot water to remove free acid and moisture, total 7 washing taken and kept it in dryer for 20-25 minute the prepared black coloured adsorbent kept in bottle for further use

About 20 gm of sample and 10ml of Ortho-H_3PO_4 acid taken in silica crucible and kept in furnace. The furnace is initially at normal room temperature then furnace set at 260^0C. Heating was carried out for 20 minute. Then sample was removed and cool. After cooling the sample was repeatedly washed for 7 times using hot water to remove free acid and moisture .Then sample kept in dryer for 20-25 minute and the activated black colored adsorbent stored in bottle.

3.2 Preparation of methyl red solution

In a clean beaker 400 ml water is heated, in this boiling water 0.8 gm Methyl Red powder added with constant stirring .The solution is allowed to boil for 5 minute and cooled, then filter the cooled solution to remove suspended matter and undissolved matter .The clear solution is collected and store in beaker for further use.

3.3 Preparation of $K_2Cr_2O_7$ solution

In a clean beaker 250 ml water is heated, in this boiling water 9.056 gm $K_2Cr_2O_7$ powder added with constant stirring .The solution is allowed to boil for 5 minute and cooled, then filter the cooled solution to remove suspended matter and undissolved matter. The clear solution is collected and store in beaker for further use.

3.4 Experimental setup

The samples are taken and put in dryer for about 30 minutes. After the sample is dried, the sample is weighed as 1gm, 2gm, 3gm, 4gm, and 5gm. The weighed samples are put in the conical flask of 250 ml. The prepared solution of methyl red is poured in the flask. Exactly 50 ml of the solution is poured in each conical flask. After the addition of the solution, the flask is well shaken for 10 minutes and allowed to stand still for 48 hours.

After 48 hours the sample is shaken and filtered. The filtered sample is collected in small plastic bottles and the activated carbon is collected. The collected sample kept in dryer. After drying the samples are packed and colorimeter reading taken of all filtered solution. Same procedure was repeated for $K_2Cr_2O_7$ solution.

4. RESULTS AND DISCUSSION

4.1 Colorimeter reading and % Adsorption

The collected solution after the experiment is used for calculating percentage adsorption. At first the reading for water is taken this is blank reading. Then colorimeter reading taken for all sample solution. This is reference reading. Reduce concentration of solution calculate from the standisation graph of Methyl Red solution colorimeter reading. The % Adsorption of all sample calculated by following formula,

$$\% \text{ Adsorption} = \frac{Initial\ conc. - Final\ conc.}{Initial\ conc.} * 100$$

Following table shows the colorimeter reading and % Adsorption for Methyl Red solution using various weight of adsorbent.

Table1: Sample 1- Methyl Red Solution

Sr. no.	Wt. of Adsorbent/Vol. of solution	Colorimeter Reading	% Adsorption
1	1gm/50ml	0.21	44.10%
2	2gm/50ml	0.18	53.12%
3	3gm/50ml	0.15	62.16%
4	4gm/50ml	0.11	75.43%
5	5gm/50ml	0.08	79.45%

The fig. 1 shows the behavior of amount of adsorbent and the concentration of solution. It can be concluded that the amount of adsorbent increases the concentration of solution decreases as the surface for adsorption increases.

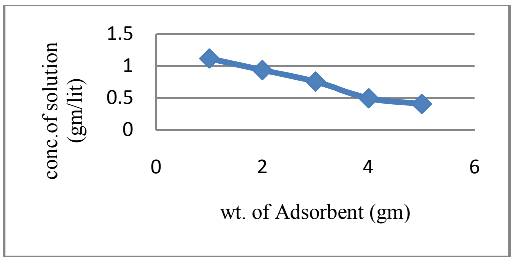

Fig.1 wt. of Adsorbent Vs Colorimeter reading

The fig. 2 shows the behavior of amount of adsorbent and the % Adsorption. It can be concluded that the amount of adsorbent increases the % Adsorption increases as the surface for adsorption increases.

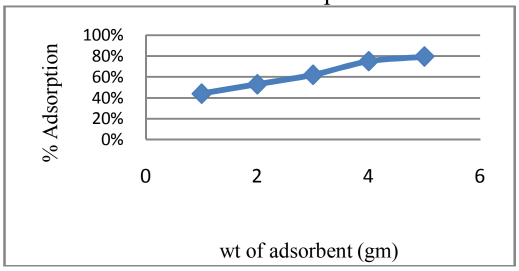

Fig.2 Wt. of Adsorbent Vs Colorimeter reading

Following table shows the colorimeter reading and % Adsorption for $K_2Cr_2O_7$solution using various weight of adsorbent.

Table [2] Sample 2: $K_2Cr_2o_7$ Solution

Sr. no.	Wt. of Adsorbent/Vol. of solution	Colorimeter Reading	% Adsorption
1	1gm/40ml	0.45	45.35%
2	2gm/40ml	0.43	49.61%
3	3gm/40ml	0.39	63.85%
4	4gm/40ml	0.34	71.01%
5	5gm/40ml	0.31	73.25%

The fig. 3 shows the behavior of amount of adsorbent and the concentration of solution. It can be concluded that the amount of adsorbent increases the concentration of solution decreases as the surface for adsorption increases.

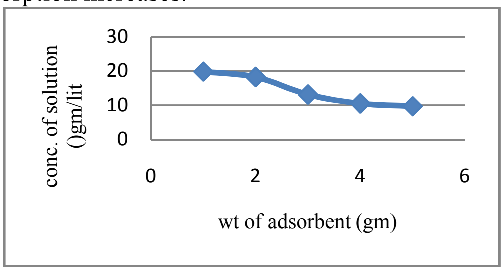

Fig.3 Wt. of Adsorbent Vs Colorimeter reading

The fig. 4 shows the behavior of amount of adsorbent and the % Adsorption. It can be concluded that the amount of adsorbent increases the % Adsorption increases as the surface for adsorption increases.

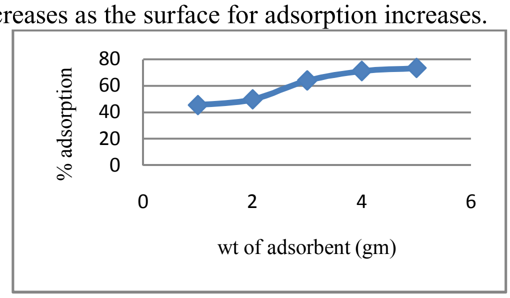

Fig 4: Wt. of Adsorbent Vs Colorimeter reading

4. CONCLUSION

In present work attempt have been made for systematic studies of removal of color using low cost adsorbent prepared from Neem leaves. From the experimental finding it has been observed that the adsorbent material can be used successfully for removal of color. The maximum removal efficiency was observed up to 80% for prepared Neem leaves at optimum value of parameter.

The project is aimed to utilize the commonly available waste material Neem leaves. In the present work the materials have been converted to the activated carbon by chemical activation. This activated carbon was utilized for the adsorption of color from the prepared solution. Various amount of the sample was taken and the adsorption study was carried out. It was seen that the amount of sample is increased the percentage adsorption also increases.

Thus from the studies carried out it can be concluded that the prepared activated carbon can be used effectively to adsorb color.

There is a tremendous potential in these materials to be explored as industrial low cost effective adsorbents.

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