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Research Article

CHARACTERIZATION AND APPLICATION OF ACTIVATED CARBON PREPARED FROM WASTE WEED

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ABSTRACT

In the present study, use of waste weed as a raw material for producing activated carbon is investigated. *Achyranthes aspera* Linn. belongs to family amaranthaceae. This plant is widespread in the world as a weed, which is locally available on road sides and wastelands. In this study, Activated carbon has been prepared from stem of *Achyranthes aspera* Linn. by acid treatment and 63 micron size is selected. Adsorption capacities are studied by using methylene blue as dye at various temperature. Surface structure investigation is carried out by *scanning electron microscopy (SEM)*. The powdered raw material and activated carbon (63 micron) are used for the study. The results revealed that the removal of dye by activated carbon is more effective than raw material at higher temperature. It can be useful as efficient, potential, cost effective and ecofriendly adsorbent for the treatment of effluents.

Keywords: *Achyranthes aspera* Linn., Raw material, Activated carbon, SEM, Methylene blue.

INTRODUCTION

Industries manufacturing dye and dye intermediates are the largest sector of chemical industries in India. Dyes are used in a variety of industries producing textiles, paints, pulp, paper, plastics, leather, cosmetics and food industries [1]. Dyes usually have complex aromatic molecular structures which make them more stable and difficult to biodegrade. Dyes even in low concentrations affect the aquatic life and food web [2,3]. Activated carbon has many applications[4-6]. Activated carbon is porous in nature ,which has been widely used as an adsorbent for separation, purification, decolorization, deodorization of vegetable oils and fats. It is also applied for removal of pollutants from water, air and gas (cigarette filters, motor vehicles exhaust control). It is also exhausted by food and pharmaceutical industries [7-9]. In addition to serving as an adsorbent, high porosity carbon has recently been applied in the manufacture of high-performance layer capacitors [10]. More recently interests have been shown in the preparation of activated carbon using agricultural waste material as precursor materials [11-15].

This has lead many researchers to find out cheaper source to prepare activated carbon. Use of waste as raw material for producing activated carbon for removal of methylene blue from aqueous solution was investigated in this work.

MATERIALS AND METHODS

Preparation of adsorbent

The plant material was collected from the Purander district of Pune, Maharashtra, India. It was authenticated form Botanical survey of India, Pune, Maharashtra, India. The air shade dried and pulverized stem material of *A. aspera* was used. The raw material (100g) was charged with A. R. grade concentrated H_2 SO_4 (35 ml), which was charred and kept in an oven at 100-110^{0}C for six hours for complete carbonization. The carbonized material was washed with distilled water to get free from acid and dried at 110^{0}C for six hours. The dried material was grounded and sieved to get uniform particle size (63 mesh). It was characterized by SEM.

Scanning electron microscope analysis (SEM)

The surface morphology of the activated carbon was examined using scanning electron microscopy (S-2150, Hitachi High-Technologies), the corresponding SEM micrographs being obtained using an accelerating voltage of 20 kV at (x1,000, x5,000 and x10,000) magnification **(Fig. 1,2&3)**. At such magnification, SEM micrographs clearly revealed that wide variety of pores are present in activated carbon along with fibrous structure. It is also found that there are holes and caves type openings on the surface of the adsorbent, which would have more surface area available for adsorption.

SEM micrographs

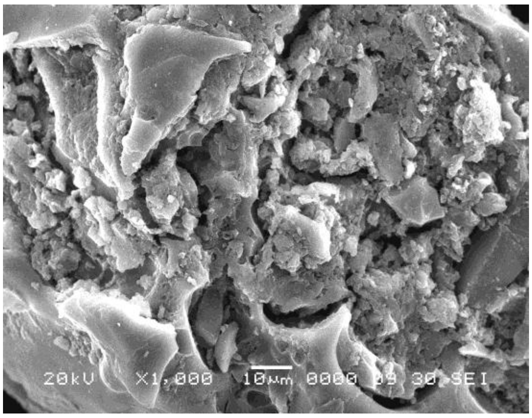


Fig. 1: (20 kV x1,000) magnification

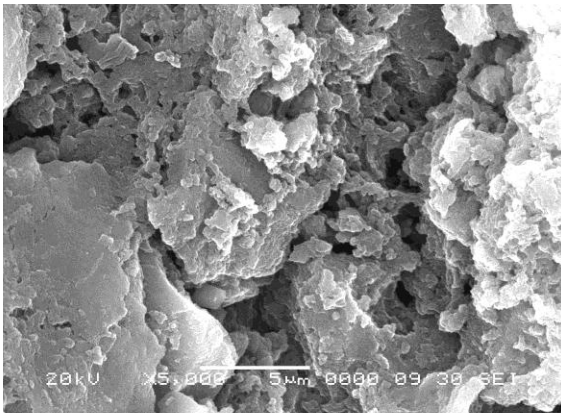


Fig. 2: (20 kV x5,000) magnification

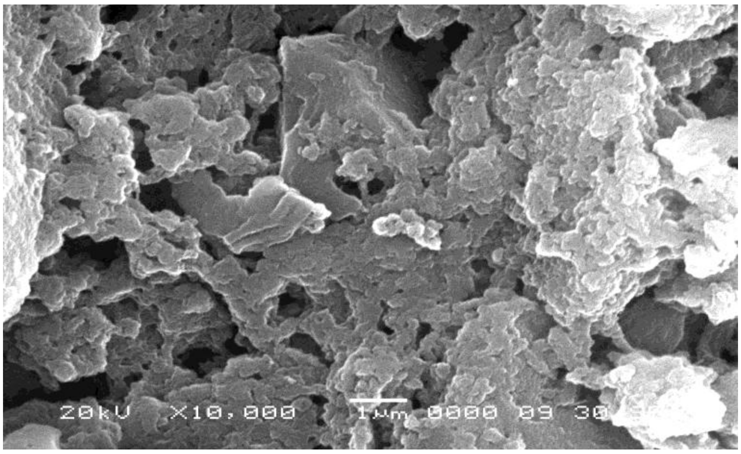
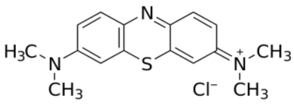


Fig. 3: (20 kV x10,000) magnification

Preparation of dye solution

Methylene blue [3, 9-bis dimethyl-aminophenazo thionium chloride], a cationic dye was purchased from Merck .The stock solution of methylene blue 1x10^{-5} M was prepared in distilled water.



Adsorption study

Batch adsorption studies

The adsorption capacity of a dye depends on the temperature employed. Thus, the adsorption equilibrium uptake of dye solutions were investigated by employing different temperatures for powdered raw material (PRM) and activated carbon (AC).

Effect of temperature

In each adsorption experiment, 0.050gm of adsorbent was added into50 ml of dye solution of known concentration at initial pH of solution in a 100 ml flask and the mixture was stirred at 500 rpm on a mechanical stirrer for different intervals of times. After predetermined time intervals, adsorbent was separated from solution by filtration method. The absorbance of the supernant solution was estimated to determine the residual dye concentration at 660 *nm* with Digital colorimeter (EQ-651- A EQUIP- TRONICS).

RESULTS AND DISCUSSION

The percent removal of methylene blue from aqueous solution of activated carbon is maximum as compared to powdered raw material. Increase in percent removal for activated carbon is due to porous nature which is detected by SEM. In powder raw material results reveals that, as temperature increases, percent removal of methylene blue from aqueous solution decreases.

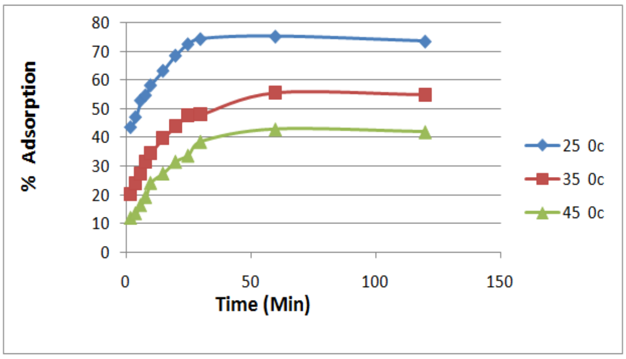


Fig. 4: Effect of Temperature on % Adsorption of RM

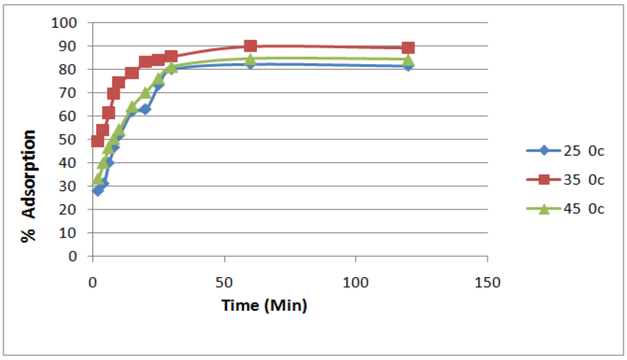


Fig. 5: Effect of Temperature on % Adsorption of AC

This indicates physisorption process. The activated carbon show that percent removal first increases and then decrease with increases in temperature. This indicates chemisorption process.

The results are summarized of powdered raw material (RM) and activated carbon (AC) at 25^{0}C, 35^{0}C, 45^{0}C by the graphs **(Fig. 4,5)**.

CONCLUSION

The *Achyranthes aspera* Linn stem can be useful as low cost, efficient, potential and ecofriendly adsorbent for the for decolorizing of industrial effluents.

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