

Methylene blue removal using orange peel

Aswathy R Krishnan and Duithy George

Abstract— In the textile industry, up to 200,000 tons of these dyes are lost to effluents every year during the dyeing and finishing operations. The effluent from textile is an important source of dye pollution. Many dyes and their breakdown products may be toxic for living organism. Methylene blue is a basic aniline dye with the molecular formula $C_{16}H_{18}N_3SCl$. At room temperature, it appears as a solid, odourless, dark green powder that yields a blue solution when dissolved in water. The dyeing industry effluents contain high BOD and COD value. Therefore, decolourisation of dyes is an important aspect of wastewater treatment before discharge. Activated carbon is the most widely used physicochemical treatment for the removal of dissolved organics from wastewater & is effective even in dilute solution, but commercially available activated carbon is very expensive. In this study the colour removal was extensively studied with physicochemical method such as adsorption. The removal of dyes from effluent by adsorption process provide an alternative treatment especially orange peel is inexpensive and readily available. Study is to explore the feasibility of Orange peel as a low cost natural adsorbent with respect to adsorbent dosage

Index Terms—Adsorption, physicochemical method, orange peel adsorbent

1. INTRODUCTION

The presence or introduction of unwanted materials in the environment which have harmful or poisonous effects is called Pollution. With the advancement in technology the luxury of human life has enhanced considerably and so has the degradation of ecological systems. Instance of such advancement is the use of dyes in various fields of textiles, food, cosmetics, paper, paints, pharmaceuticals and several other industries. Most synthetic dyes are aromatic in nature making them physical, chemical, thermal, biological and optical stable. Upon degradation, the dye products are toxic, carcinogenic and mutagenic to life forms. The effluents containing dyes are difficult to be treated because of high chemical oxygen demand, color of the water which is easily recognizable and high structural stability of these molecular dyes. Numerous studies have been conducted to assess the harm impacts of colorants on the ecosystem. The removal of this colour is one of the intimidating tasks for the fisheries industries, textile finishing, dye producing,

Kraft bleaching and tannery industries and pulp and paper among others. Chemical oxidation, membrane separation etc. are the various ways used to remove dyes from waste water(3). A variety of physical, chemical and biological treatment methods have been reported. The choice of method is limited by cost, efficiency, release of secondary effluents and simplicity in design for operation. Among the treatment methods, adsorption is the most preferred method because it is simple & efficient. The commercially available granulated activated carbon provides an excellent adsorption surface but is expensive. Natural materials that are available in large quantities may have potential as inexpensive sorbents. The present study is to explore the feasibility of orange peel as a low cost natural adsorbent.

2. OBJECTIVES

The objectives of this study were

1. To investigate the feasibility of orange peel for the removal of methylene blue dye from aqueous solutions
2. To carry out batch adsorption studies, to assess the removal efficiency of orange peel under various adsorbent dosage

3. MATERIALS AND METHODS

Adsorption is defined as the change in concentration at the interfacial layer between the

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two phases of a system due to surface forces. Adsorption is mass transfer operation in that a constituent in the liquid phase is transferred to solid phase. The adsorbate is substance that is being removed from the liquid phase and transferred to the solid phase. The adsorbent is the solid, liquid, or gas phase onto which the adsorbate accumulates. Factors affecting adsorption methods are i) Surface Area ii) Nature of the adsorbate iii) pH iv) Temperature v) Presence of mixed solutes and vi) Nature of adsorbent. Orange peel is largely composed of cellulose pectin; hemi-cellulose, lignin and other low molecular weight compounds. These compounds contain various functional groups, carboxyl groups make adsorbent as a potential material for the removal of dye. This study was performed to utilize the orange peel as a low cost natural adsorbent with respect to the adsorbent dosage

3.1 Preparation of orange peel Powder

Orange is used mainly in orange-juice and soft drinks industries all over the world. They discard a huge amount of orange peels. At first, the peels were cleaned with distilled water to remove dust particles and water-soluble impurities; dried in sunlight for 2 days. And kept in oven for 8 hours then grind it to a fine powder and Finally packed in air tight container and labelled (1)



Fig 1 orange peel

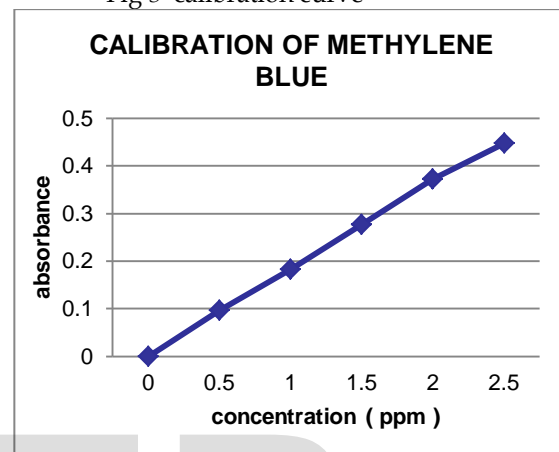


Fig 2. Orange peel powder

3.2 Stock solution of methylene blue

A stock solution of methylene blue dye was prepared by dissolving 0.1 g of dye powder in 100 ml of distilled water (1000 ppm). Experimental solutions of desired concentrations were obtained by successive dilutions. The concentrations of residual MB dye were measured using UV visible spectrophotometer at 664 nm (4). Here prepare a set of concentrations .5ppm, 1ppm, 1.5ppm, 2ppm, 2.5ppm was taken for calibration

Fig 3 calibration curve



4. ADSORPTION TEST USING SPECTROPHOTOMETER

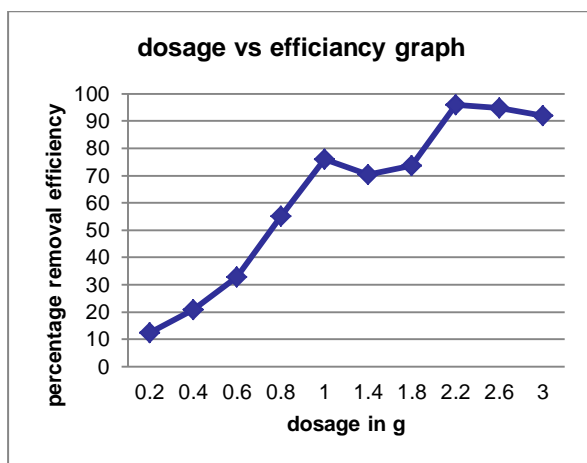
The methylene blue standard sample in the range 2.5 ppm was prepared by taking appropriate quantities of standard methylene blue solution with distilled water. In order to determine the effect of adsorbent dosage on the sorption of MB, The experiments were conducted in 250 mL Erlenmeyer flasks containing different amount of bio adsorbents 0.2 g , 0.4g ,0.6 g. 0.8g, 1g,1.4g,1.8g,2.2g,2.6g,3g and 100ml of MB solution at desired concentrations(2.5ppm) .The flasks were agitated using a shaker @250rpm for 60 minutes. After agitation allow the sample to settle and filter it using filter paper & determine the residual MB concentration using uv visible spectrometer at 664nm. Absorbance readings were compared with standard curve and the removal efficiency was found.

5. RESULTS AND DISCUSSION

It was seen that the removal of methylene blue increases with an increase in the amount of adsorbent. For all the experiments, initial MB concentration was fixed at 2.5mg/lit, and contact time was 60 minutes. The amount of adsorbent dose was varied from 0.2g to 3g aqueous solutions. Results shows that removal efficiency increases with increase in adsorbent dosage

Table 1: Efficiency after Adsorption using orange peel

Adsorbent dose in (g)	Initial MB Conc. mg/l	Final MB Conc. mg/l	% Removal Efficiency
0.2	2.5	2.19	12.4
0.4	2.5	1.98	20.8
0.6	2.5	1.68	32.8
0.8	2.5	1.12	55.2
1	2.5	0.60	76
1.4	2.5	0.74	70.4
1.8	2.5	0.66	73.6
2.2	2.5	0.10	96
2.6	2.5	0.13	94.8
3	2.5	0.19	92.02



6. CONCLUSION

Based on the present study following conclusions were made.

1. Use of the orange peel powder as bio adsorbent for removal of methylene blue is feasible.
2. The removal by adsorption increases with increase in adsorbent dose. After 22g of orange peel per liter the efficiency starts decreasing with the efficiency of 96% removal.

8. REFERENCES

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