

Removal of dyes from textile wastewater using Orange peel as adsorbent

Jeyajothi.K*

Department of chemical engineering, Periyar Maniammai University, Thanjavur, Tamil Nadu, India. - 613 403

*Corresponding author: E.Mail address: jayaset@yahoo.com

ABSTRACT

The main objective of the work is the study of adsorption of dye solution acid yellow using low cost adsorbent like orange peel. It is the batch adsorption studies are carried out for observing the effect of initial concentration, effect of adsorbent dosage and adsorption isotherm. Optimum conditions for dye removal are studied like contact time required, amount of adsorbent and dye concentration. Spectrometry technique was used for the adsorption equation. The equilibrium time was found to be 140 hours for different concentration of dye solution. A maximum removal of 94% was adsorbed in the 50mg/l of dye solution for an adsorbent dosage of 6g. The maximum adsorption capacity obtained from Langmuir equation was 10.69. The result generated by this can be used for determination of optimum condition for adsorption of dye in aqueous solution.

Keywords: Adsorption, Langmuir, Acid yellow, Dye removal.

INTRODUCTION

Dyeing is one of the fundamental operations in the textile industry irrespective of the fiber material or processes adopted. Dyeing is generally carried out in aqueous phase. The dyes are retained on the substrate by physical adsorption, mechanical retention or by formation of covalent chemical bond. About 56% of the total dye production is consumed in the textile sector. Textile dye effluents are complex in chemical nature, highly coloured and are most often bio-degradable, inhibitory and exhibit toxicity to both aquatic and non-aquatic biota. Colour acquired by a water body through the discharge of coloured effluent inhibits growth of the desirable aquatic biota necessary for self-purification by reducing penetration of sunlight and consequent reduction in photosynthetic activity and primary production. Due to high absorption capacity of solar energy in the visible range of the spectrum, coloured water limit the active aquatic biota to a narrow depth which consequently reduced the self-purification capacity of the stream. Recent survey indicates that approximately 12% of synthetic dyes used each year are lost during manufacturing and processing operations and that 20% of these dyes enter the environment by means of processing effluents. Dyes are almost invariably hazard, their removal from effluent stream is ecologically necessary. The dye effluents also spoil; the quality and quantity of the yield in the agriculture. The discharge of highly colored effluents into natural water bodies is not only aesthetically displeasing but also retards light penetration thus reducing the dissolved oxygen content of the dyes can cause skin irritation, allergic dermatitis, cancer and mutation in human beings, Of all the dyes available basic dyes were found to be brightest class of soluble dyes used by textile industry.

Materials and methods

Preparation of adsorbent: Orange peel was collected from the local fruit stall. The peel was first washed to remove the adhering dirt and then were dried, crushed, and sieved. They were dried in sunlight for 42 hour. After drying they were crushed and sieved through 100 mesh size. Acid yellow dye was used in this study and the chemical structure of the dye was shown. The orange peels were collected and dried in the sunlight for 48 hrs. The dried orange peels were cut in to small pieces and then crushed using mortar and pestle. The crushed orange peels were sieved through 100 mesh size. Some dried orange peels burnt in the atmospheric air to make carbonized adsorbent. This experiment was conducted in the batch process. The batch adsorption experiments were conducted to study optimum removal of color from textile wastewater. The adsorption study was conducted with different concentration of dye solution. The dye solution was taken in the 250 ml conical flask and the conical flask was kept in the orbital shaker in room temperature at 120 rpm. The adsorption study conducted to determine the effect of time and effect of adsorbent dosage.

Effect of initial Concentration and adsorbent dosage: To study the effect of time with the different concentration of wastewater like 25, 50, 75, 100 mg/l. The effect of initial concentration was investigated for 1, 2, 3, 4, 5, 6 days at optimum pH 6.5. Here it is found out the best ratio of colour removal with respect to time. The different dosage of adsorbent namely orange peel taken such as 2g, 4g, 6g, 8g, and 10g with 50mg/l waste water in the 250 ml conical flask in orbital shaker in room temperature at 120rpm. To know the effective adsorbent dosage the readings were investigated for 1, 2, 3, 4, 5, 6 days.

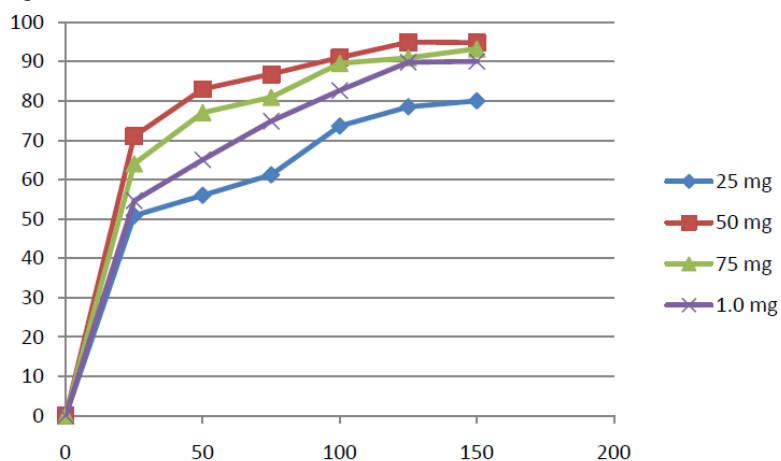
RESULT AND DISCUSSION

To study the effect of initial concentration on efficient removal of textile wastewater the study was carried out. The wastewater sample was taken in a 250 ml conical flask with different concentration such as 25, 50, 75, 100 mg/l and its kept in an orbital shaker in room temperature at 120 rpm. The sample was withdrawn from the beaker at the predetermined time interval. The effect of initial concentration was investigated for 1, 2, 3, 4, 5, 6 days at optimum pH 6.5 and the results are compared with original colour concentration of wastewater to know the colour efficiency of adsorbents. It is clear from the result that times play an important role in dye removal from wastewater. The optimum time required for the colour removal is 144 hours for orange peel. The representation of graph was shown below.

Table.1 % Removal vs Initial concentration

Time	25 mg/l	50 mg /l	75 mg/l	1.0 mg/l
	%R	%R	%R	%R
0	0	0	0	0
25 mg/l	61.2	86.8	80.9	74.8
50 mg/l	73.6	91	89.5	82.6
75 mg/l	78.5	94.9	90.9	89.8
100 mg/l	80	94.8	93.2	90

Effect of contact time on adsorption was studied and the graph was shown. From the figure it is indicated that efficiency increases with increase in contact time between adsorbent and the adsorbate. It can be attributed to the fact that more time becomes available for the dye to attraction complex with the orange peel. Therefore it is concluded that dye and orange peel should be in contact for 140 hour in order to get maximum removal.

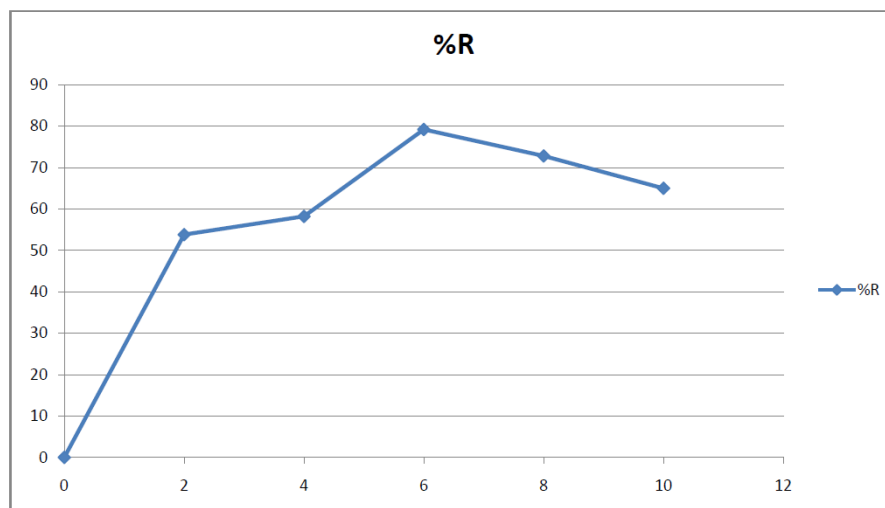
**Graph.1.Effect of initial concentration on removal of dye by adsorption on to the orange peel.(Amount of Adsorbent: 5g, and pH Value: 6.9):**

From the effect of initial concentration it is found out that best concentration i.e. maximum amount of dye removed from the wastewater was noted down and effect of adsorbent dosage experiment was carried out for that investigated sample. Different adsorbent doses like 2g, 4g, 6g, 8g and 10g were taken in 250 ml conical flask and kept in an orbital shaker in room temperature at 120 rpm. Using the value the graph was plotted. It was found that adsorption found decreases further with increase in dosage.

Table.2.% Removal vs Adsorbent dosage(effect of adsorbent dosage)

Dosage	2g	4g	6g	8g
0	0	0	0	0
2	47.9	42.6	53.8	45.1
4	54	51.1	58.2	49
6	61.2	57	65	54.7
8	68.3	64	72.4	61.6
10	75	69.8	79.2	65.5

The adsorbent capacity was increased with increment of adsorbent dosage. The dye removed percentage is raised from 50% to 80% while the adsorbent percentage is increased from 2g to 6 g for 50mg/l solution. At low amount of dosage higher uptake was obtained. The graph shows that the, above 6g of dosage the removal percentage is decreased. So 6 g of adsorbent indicates the optimum amount.



Graph.2.Effect of Adsorbent Dosage on removal of dye by adsorption on to the orange peel.(Amount of Adsorbent:2g, 4g, 6g, 8g and pH Value: 6.9)

CONCLUSION

The effect of dye concentration was studied by keeping the adsorbent dosage constant at 5g and the concentration of the dye was in the different range such as 25, 50, 75, 100 mg/l. maximum dye adsorption was obtained 94.8% at 50mg/l dye concentration. To investigate the effect of adsorbent dosage, the adsorption of acid yellow on to the orange peel was measured at the 50mg/l dye solution with different adsorbent dosage like 2g, 4g, 6g, 8g and 10g. In this study 6g of adsorbent adsorbed the dye more than the others adsorbent dose.

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