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ADSORPTION OF METHYLENE BLUE DYE FROM SYNTHETIC WASTEWATER BY LOW-COST NATURAL ADSORBENTS (Activated Teak Leaves and Banana Trunk)

Lalitha TR[1], KM Sham Sundar[2], DP Nagarajappa[3]

[1]PG Student, Department of Civil Engineering, UBDT Collage of Engineering, Davanagere, Visvesvaraya Technological University, Belagavi-590018, Karnataka, India
[2]professor, Department of Civil Engineering, UBDT Collage of Engineering, Davanagere, Visvesvaraya Technological University, Belagavi-590018, Karnataka, India
[3]professor, Department of Civil Engineering, UBDT Collage of Engineering, Davanagere, Visvesvaraya Technological University, Belagavi-590018, Karnataka, India

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Abstract - *We all know that only small quantity of water is available as a fresh water, but polluting of fresh water is not stopped till now. The textile industry taken big role in polluting the streams due to usage of bulk number of dyes in textile industry for processing of clothes. In this investigation, naturally and freely available materials like Teak leaves and Banana trunks are available in large amount. For treating textile effluent with chemicals cost high so by utilizing these materials as a low-cost natural adsorbent to treat the MB synthetic waste water of concentration 10mg/l, was described in detail. Teak leaves and banana trunk was collected and washed to eliminate unwanted impurities and scorched bellow daylight for 1 week. And made in to powder by grinding them in a mixer. Activated by using 0.1 HNO_3 and 80% orthophosphoric acid respectively. Artificial solution was created by diluting 1g of MB powder in 1L of de-mineralized water and kept on magnetic stirrer for 30min to achieve uniform mixing. And solution was diluted to required amount for experimental purpose. Removal capacity is affected by many characteristics like adsorbent dosage, pH of solution and contact time between adsorbate and adsorbent, in order get optimum amount of dosage, pH. jar test was conducted by adjusting the variations in the adsorbent dosage, pH and contact time*

Key Words: Adsorption, Methylene Blue Dye, Teak Leaves, Banana Trunk, Artificial Waste Water, Spectrophotometer.

1.INTRODUCTION

The word "Jalam" is referred as water in Sanskrit language. Water is created by two components, one is 2 hydrogen atom another one is 1 oxygen atom, or we can simply say water as H_2O. Hydrogen is positively charged and oxygen is negatively charged so by electro static force of attraction this two particles are attracted each other. Usefulness of jalam is not only limited to need of human, it is as well important source to many productive activities such as agriculture, industrial activity, cattle rising etc [21]. Development of economic of any nation is mainly, most importantly depends on industrialization of the country, but the serious issue is that the pollution caused by rapid industrialization throughout the world [4]. As the population of the India increased, the requirement of the human also increased. The basis need of human now a days is food cloth and shelter [3]. The fabrication of textile taken big role in polluting the streams due to usage of bulk amount of dyes.in textile industry for many processes, and silk methylene blue is most widely using dye. The chemical formula of MB is C16H18N3SC1. Textile industry contributes 17-20% of the industries water pollution a estimation from world bank [19]

1.1 Scope of Study

1. The destination of present job will assistance in the growth of low-cost wastewater treatment systems for removal of artificial dyes (colour) by variety of industries.
2. investigation can be made on effluent of waste (use of adsorbents waste formed in future).
3. These adsorbents can also be used to eliminate various types of dyes other than that of MB.

1.2 Objectives of Study

1. To made the activated adsorbents by using Teak leaves and banana trunk.
2. To made the synthetic Wastewater by utilizing MB artificial dye.
3. To test the initial characteristics of synthetic Wastewater.
4. To inspect and gauge the capacity of activated adsorbents in the removal of synthetic dyes from synthetic solution through the batch experiments.
5. To analyze the Adsorption Isotherms and to recognize the acceptable isotherm.

2. METHEDOLOGY

2.1 Adsorbent Preparation

TEAK LEAVES

A finely gowned Teak leaves were gathered from SIT Collage in Tumkur. Collected leaves are washed in tap water to make it free from unwanted impurities and dust particles. Washed leaves are dried under sunlight till it converted in to brown color and turns into crispy. By using mechanical grinder, the dried leaves are crushed to make fine powder. Then the powder was sieved by using 75microns sieve and collected powder was stored in closed container. By 1:1 ratio of 0.1N HNO_3 (Nitric Acid) Teek leaves powder are activated. Then the powder was dried in muffle furnace at 410c for 40minutes. To remove acid, again the powder was rinsed in distilled water, and over dried to eliminate moisture content. Then the adsorbent is filters in watts man filter paper and dried in oven and stored in airtight box.

Figure 1:- Teak Leaves and Activated Teak Leaves Powder

BANANA TRUNK

The banana stem was collected from garden. The banana trunk was peeled layer by layer and made into small pieces about 5 to 6cm in length by cutting. Then the pieces are rinsed in tap water to remove impurities and again rinsed in hot water. Then the washed stem pieces are dried under sunlight up to it attained dry state it made in to fine powder by using mechanical grinder. Then the powder was sieved by using 75µm particle size sieve. By using 98% orthophosphoric acid Banana stem powder was activated in a 1:1 ratio. Then the adsorbent was dried in oven for 110c, then the adsorbent was kept in muffle furnace are 770C. It was then washed and filtered with distil water to take away the acid, then it was dried in oven to eliminate the moisture content.

Figure 2:- Banana Trunk and Activated Banana Trunk Powder

2.2 Preparation of Adsorbate

The known solution of 1000 ppm concentration of synthetic waste water was made by diluting 1000mg of dye to 1L of zero mineral water and to attain homogenous mixture solution was kept on magnetic stirrer for 30minutes. further for experimental purpose the solution is adulterer to 10mg/l.

Figure 3:- Artificial Waste Water Made by Magnetic Stirrer

Table -1:- Primary Examined Values of Variant Characteristics of Artificial Waste Water.

Characteristics	Initial concentration at of Artificial Waste Water
concentration	10 mg/L
pH	6
Turbidity (NTU)	5.29
TDS (ppm)	59
colour	266ptco

2.3 Jar Test Experiment

Figure 4: - Jar Test Experiment Apparatus

The investigation is done by jar test experiments by keeping some parameters constant and changing wanted parameters to get optimum dosage and pH and time of contact. The experiment is done in a 1000ml beakers at 30C, with the speed of 150rpm for 15 minutes. By varying the adsorbents dosage, the poignant of adsorbents dose was checked for adsorbents. The optimum time of contact was checked for both the adsorbents by varying time of contact from 30, 60, 90, 120,150 and 180 minutes. The best pH for all adsorbents was investigate by varying the pH of solution, the poignant of pH was done by using 0.1N H_2SO_4 as well 0.1N NaOH. After the assessment by the help of filter paper the absorbent separated. Dye concentration was determined by using UV visible spectrophotometer of 665 nm for MB. The dye removal percentages of Adsorbent were determined.

Dye removal Percentage (%) $= \frac{(C_i - C_f)}{C_i} \times 100$

Where, C_i is the primary fixation of artificial waste water.

C_f is the resultant fixation of artificial waste water.

3.RESULT AND DISCUSSION

3.1 Effect of Adsorbent Dosage

For the synthetic water water of initial concentration 10 mg/L, the dosage of teak leaves, banana trunk was varied to see the impact by adsorbent dosage. And to know the optimum dosage of adsorbents.

FOR TEAK LEAVES

Table 2: - Showing Effect on Adsorption By Altering Teak Leaves Dosage at Initial Concentration of Synthetic Waste Water Is 10 Mg/L.

Sl no	Dosage of Adsorbent (g/L)	Initial Concentration (mg/L)	Final Concentration (mg/L)	Efficiency (%)
01	1	10	1.42	85.8
02	1.5	10	1.116	88.84
03	2	10	1.08	89.2
04	3	10	0.896	91.01
05	4	10	0.898	91.02
06	6	10	0.898	91.02

According to Table 2, MB eradication ability also got higher with increases the quantity of adsorbent, up to 4g/l after it become constant.

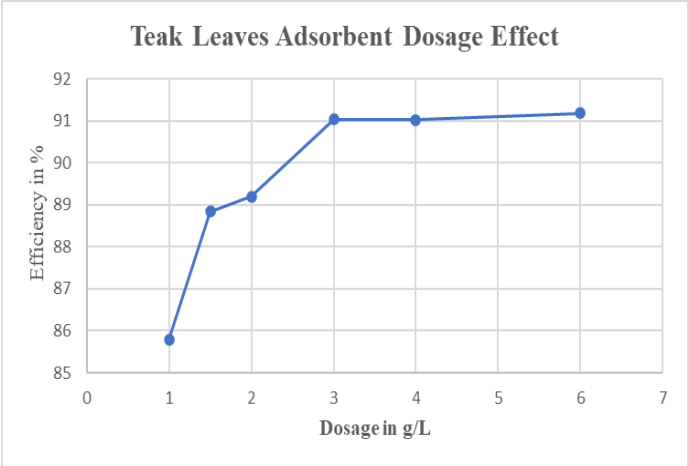

Figure -5: Showing Efficiency of Teak leaves Adsorbent v/s Dosage of Adsorbent.

According to figure 5, the removal efficiency of MB become higher with an increase in the adsorbent dose at synthetic waste water of 10 mg/L initial concentration. after 4g/l after it become constant.

FOR BANANA TRUNK

Table 3: - Showing effect on Adsorption by Altering Banana Trunk Dosage at initial Concentration of Synthetic Waste Water is 10 mg/L.

Sl no	Dosage of Adsorbent (g/L)	Initial Concentration (mg/L)	Final Concentration (mg/L)	Efficiency (%)
01	0.1	10	7.09	29.1
02	0.2	10	4.89	51.1
03	0.4	10	3.79	62.1
04	0.5	10	1.09	89.1
05	1	10	0.249	97.51
06	1.5	10	0.249	97.51

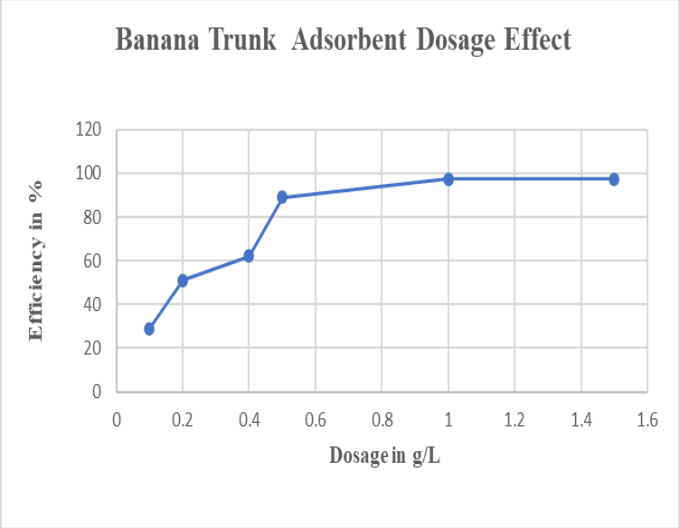

Figure -6: Showing Efficiency of Banana Trunk Adsorbent v/s Dosage of Adsorbent

According to table-3 and figure 6, at a 10 mg/L initial concentration of synthetic waste water, The MB removal efficiency enhanced with increasing the adsorbent dosage, MB removal efficiency also enhanced with increases the dosage of banana trunk up to 0.4g/l after it become constant.

3.2 Effect of Time of Contact

For synthetic waste water of initial concentration 10 mg/l. The time of contact between adsorbents and the synthetic waste water is changed from 30 to 180 minutes, to know the optimum contact time to remove higher removal ability of MB.

FOR TEAK LEAVES

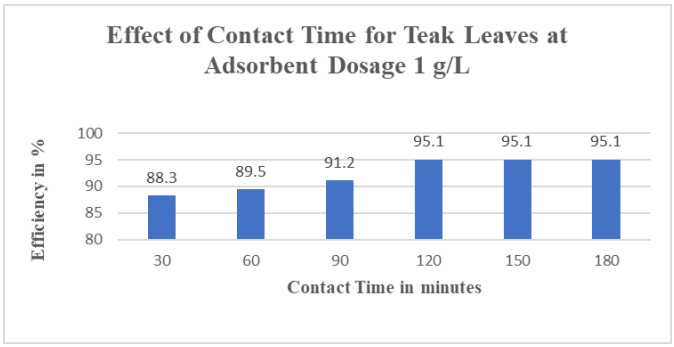

Figure 7- Showing Contact Time v/s Efficiency of Teak Leaves Adsorbent at 1 g/L Adsorbent Dosage.

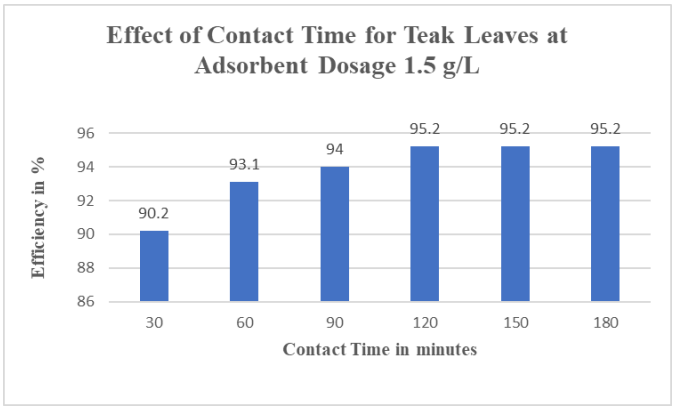

Figure 8:- Showing Contact Time v/s Efficiency of Teak Leaves Adsorbent at 1.5 g/L Adsorbent Dosage.

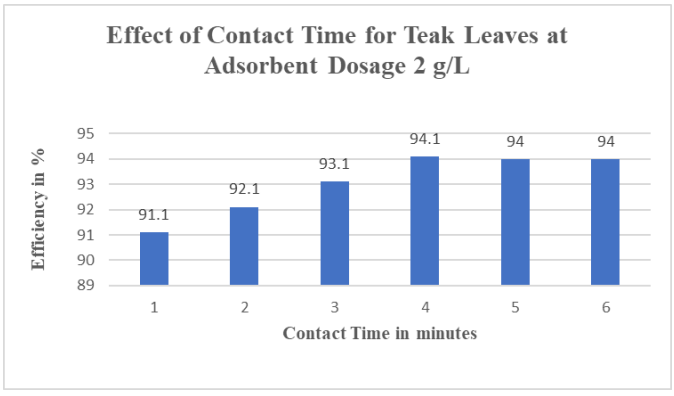

Figure-9: Showing Contact Time v/s Efficiency of Teak Leaves Adsorbent at 1 g/L Adsorbent Dosage.

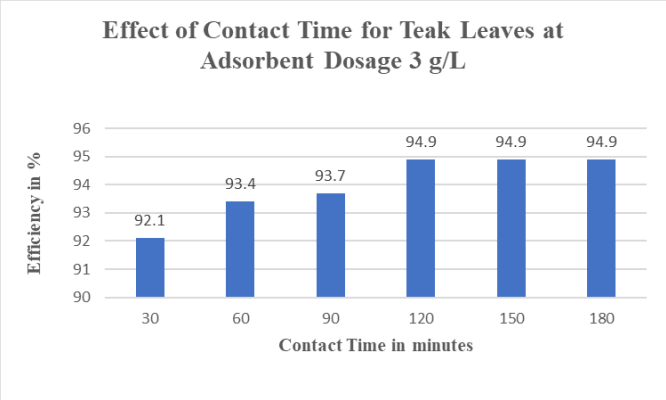

Figure-10:- Showing Contact Time v/s Efficiency of Teak Leaves Adsorbent at 3 g/L Adsorbent Dosage.

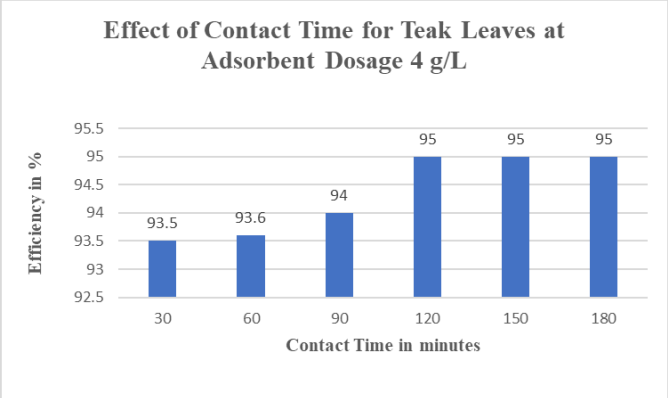

Figure-11: Showing Contact Time v/s Efficiency of Teak Leaves Adsorbent at 4g/L Adsorbent Dosage.

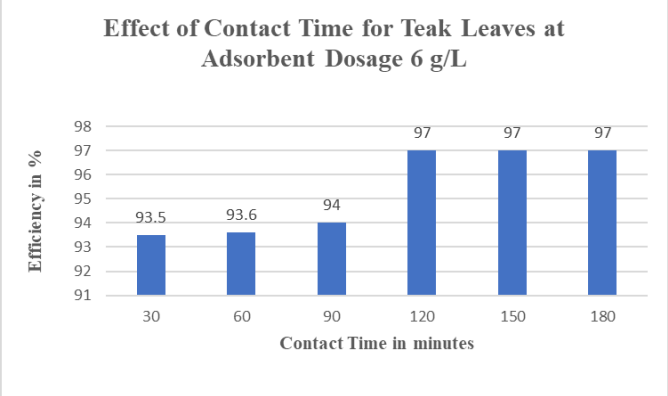

Figure-12: Showing Contact Time v/s Efficiency of Teak Leaves Adsorbent at 6 g/L Adsorbent Dosage.

As shown from figure 7-12, at a 10 mg/L initial concentration of synthetic waste water, for teak leaves adsorbent. as the amount of contact time increases the removal efficiency of MB also improves up 120minutes after it becomes constant.

FOR BANANA TRUNK

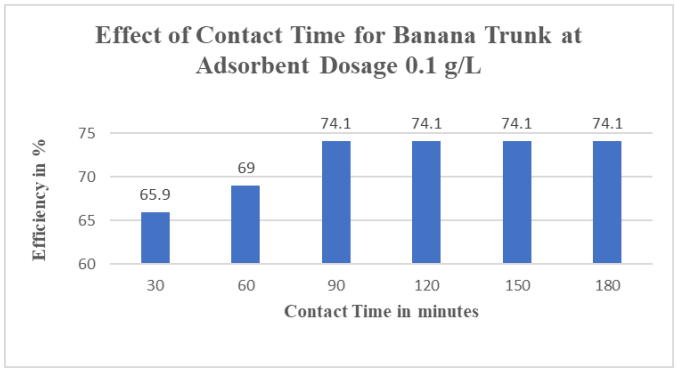

Figure-13: Showing Contact Time v/s Efficiency of Banana Trunk Adsorbent at 0.1g/L Adsorbent Dosage.

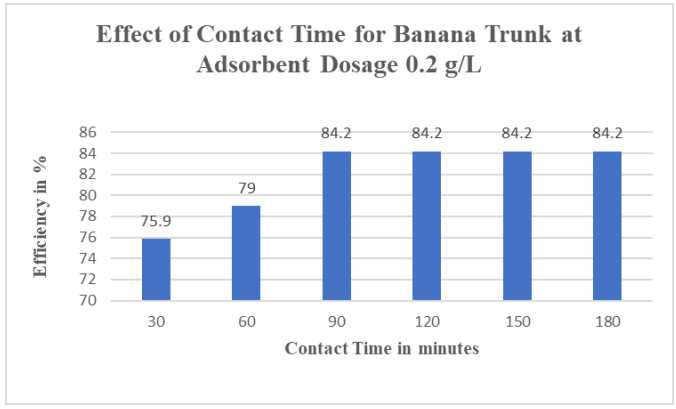

Figure-14: Showing Contact Time v/s Efficiency of Banana Trunk Adsorbent at 0.2g/L Adsorbent Dosage.

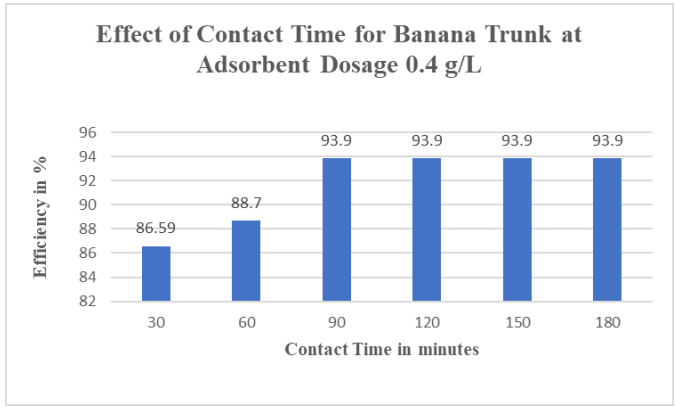

Figure-15: Showing Contact Time v/s Efficiency of Banana Trunk Adsorbent at 0.4g/L Adsorbent Dosage.

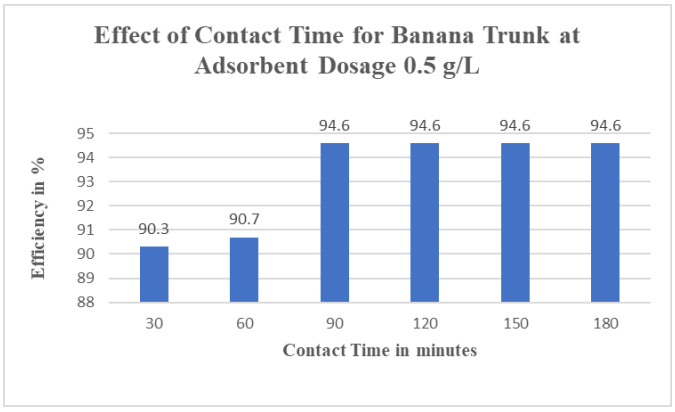

Figure-16: Showing Contact Time v/s Efficiency of Banana Trunk Adsorbent at 0.2g/L Adsorbent Dosage.

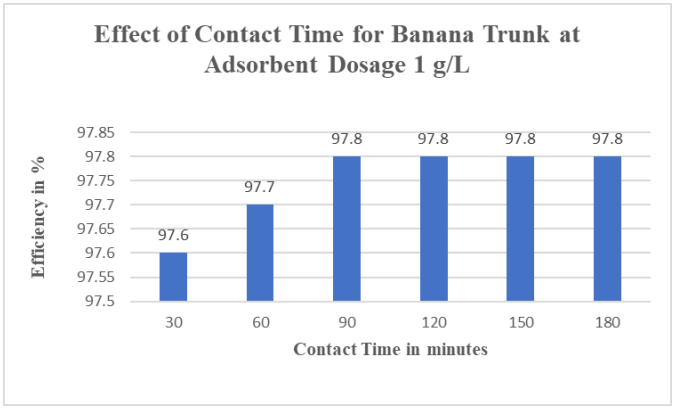

Figure-17: Showing Contact Time v/s Efficiency of Banana Trunk Adsorbent at 0.2g/L Adsorbent Dosage.

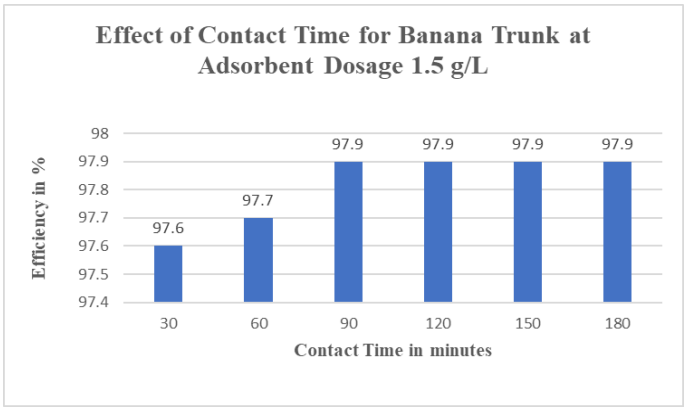

Figure-18: Showing Contact Time v/s Efficiency of Banana Trunk Adsorbent at 0.2g/L Adsorbent Dosage.

As shown from figure 13-18, at a 10 mg/L initial concentration of synthetic waste water, for banana trunk adsorbent at adsorbent, as the amount of contact time increases the removal efficiency of MB also improves up 60minutes after it becomes constant.

3.3 EFFECT OF pH

for initial concentration of synthetic waste water is 10 mg/l. The pH of adsorbents in the Synthetic waste water is varied to know the optimum pH to remove maximum removal efficiency of MB.

FOR TEEK LEAVES

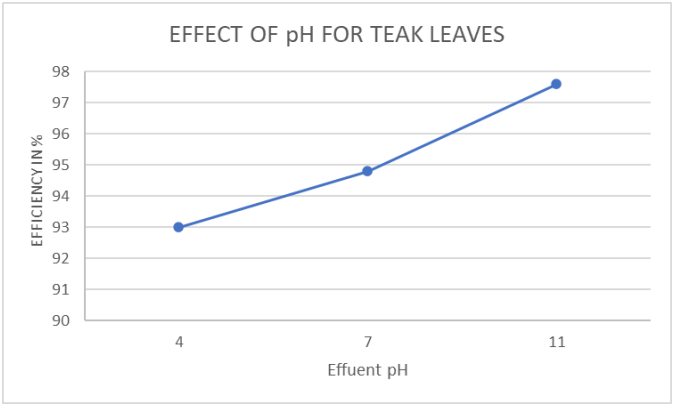

Figure-19:- Showing Effluent pH v/s Efficiency of Teek leaves Adsorbent

As shown in figure 19, for teak leaves adsorbent as pH value of synthetic waste water increases the MB removal efficiency also increases.

FOR BANANA TRUNK

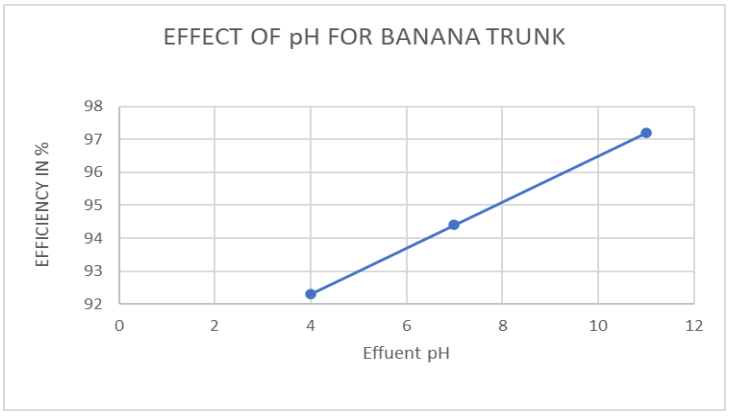

Figure-20:- Showing Effluent pH v/s Efficiency of Banana trunk Adsorbent

As shown in figure 20, for banana trunk adsorbent as pH value of synthetic waste water increases the MB removal efficiency also increases.

3.4 Adsorption Isotherm

Langmuir Isotherm for Teak Leaves Adsorbent

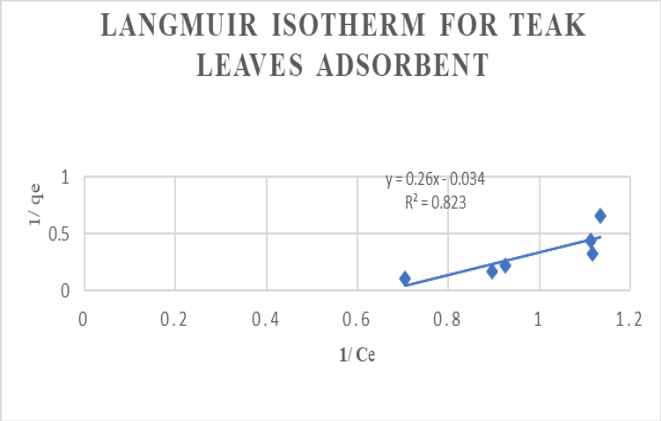

Figure 21:- Showing Langmuir Isotherm Graph for Teak Leaves Adsorbent.

Langmuir Isotherm for Banana Trunk Adsorbent

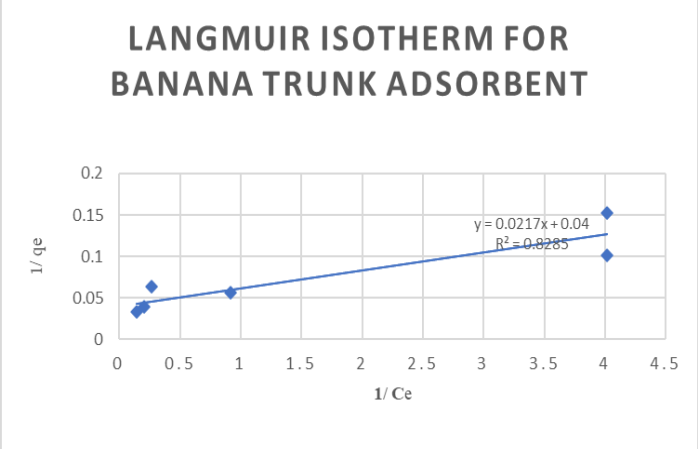

Figure -22:- Showing Langmuir Isotherm Graph for Banana Trunk Adsorbent.

Table 4. Langmuir Isotherm Parameters

Adsorbent	Intercept	Slope	qmax (mg/L)	K_L	R_L	R^2
Teak leaves	0.034	0.26	29.411	0.130	0.434	0.823
Banana Trunk	0.04	0.0217	25	1.843	0.0514	0.8285

Freundlich Isotherm for Teak Leaves Adsorbent

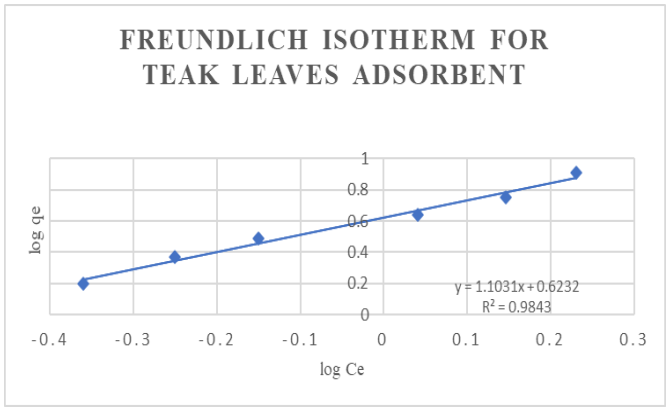

Figure -23:- Showing Freundlich Isotherm Graph for Teak Leaves Adsorbent.

Freundlich Isotherm for Banana Trunk Adsorbent

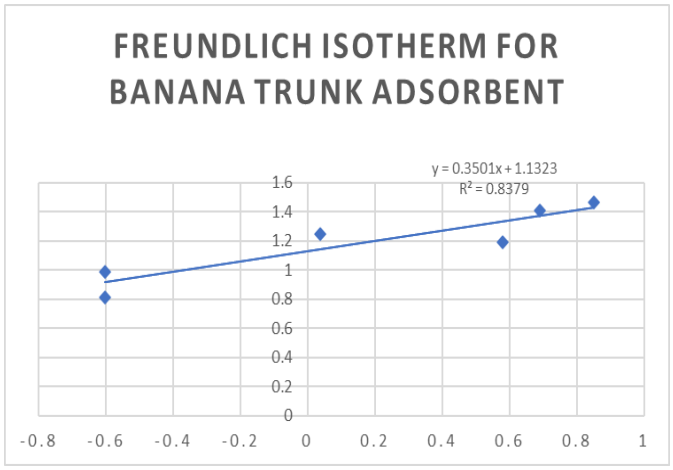

Figure 24:- Showing Freundlich Isotherm Graph for Banana Trunk Adsorbent.

Table 5: Freundlich Isotherm Parameters

Adsorbent	Intercept	Slope	1/n	K_f	R^2
Teak leaves	0.6232	1.1031	1.1031	4.199	0.9843
Banana Trunk	1.1323	0.350	0.350	2.2392	0.8379

5: CONCLUSIONS.

- In this investigation the adsorption of MB dye was analysed with natural adsorbents like teak leaf powder, banana trunk powder. The experiment carried out by batch adsorption; Conclusions are obtained as follows.
- The process of adsorption is strongly influenced by parameters such as adsorbent dosage, pH of the solution and contact time.

- It is observed that for teak leaf's adsorbent the MB removal efficiency improved with an increase in adsorbent dosage. up to 4g/l after it become constant. It removed 91.02% MB at a dosage of 4g/l. and with increasing in the contact time the removal efficiency was improved it removes 97% of MB at the dosage 6g/l with contact time 120minutes. At the optimum pH range of 11 it removes 97.6% of MB.

- For Banana trunk adsorbent the MB removal efficiency improved with an increase in adsorbent dosage. up to 1g/l after it become constant. It removed 97.51% MB at a dosage of 1g/l. and with increasing in the contact time the removal efficiency was improved it removes 97.9% of MB at the dosage 1.5g/l with contact time 90minutes. At the optimum pH range of 11 it removes 97.2% of MB

- Equilibrium data analysed using Langmuir and Freundlich isotherm for all the adsorbents. Langmuir and Freundlich isotherm is suited for teak leaves having R^2 value 0.823 and 0.9843 respectively. Langmuir and Freundlich isotherm is suited for banana trunk as well having R^2 value 0.8285 and 0.837 respectively.

- Comparing between teak leaves and banana trunk natural adsorbents, Banana Trunk removed 97.51% MB at a dosage of 1g/l and 97.9% of MB at the dosage 1.5g/l with contact time 90minutes. At the optimum pH range of 11 it removes 97.2% of MB. So that we can conclude that the efficiency of adsorption is more in banana stem compared to teak leaves , it can use as a low-cost natural adsorbent.

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