



Adsorption of Methylene Blue from Water on *Ulva lactuca*

By

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Outlines

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- Material & Methods
- Results & Discussion
- Conclusion

INTRODUCTION

● Sorption

Is the common term used for both absorption and adsorption, where

- *Absorption*

is incorporation of substance in one state into another of a different state (e.g. liquids being absorbed by a solid or gases being absorbed by water).

- *Adsorption*

is the physical adherence or bonding of ion and molecules onto the of another molecule.

Followed

- Effluents from the dyeing and finishing process in the textile industry are known to contain colour, high amounts of surfactants, dissolved solids and possibly heavy metals such as Cr, Ni and Cu.
- The effluents from the dyestuff manufacturing and some similar industries are also generally highly coloured with a large amount of suspended organic solids and hence are the important sources of water pollution.
- From an environmental point of view, the removal of synthetic dyes is of great concern, since some dyes and their degradation products may be carcinogens and toxic, and its difficult or impossible to remove by conventional biological treatment processes.

Followed

- Biological treatment processes are reported to be efficient in the removal of suspended solids and reduction of chemical oxygen demand but are largely ineffective in removing colour from waste water
- aquatic plants are used as adsorbent for the removal of various dyes from waste waters.
- This makes the biosorption a practical and economically feasible treatment process

Aim of the work

The purpose of this work was to study the kinetics and mechanisms of adsorption of Methylene Blue on various weight of algae.

Material and Methods

Ulva Lactuca were collected from Alexandria coastal area. The Algae were washed with tap water three times to remove other algae Species, and insect larvae. The algae were cut into small pieces and dried at 80°C.

Followed

● Adsorption Studies

- Batch adsorption experiments were carried out using diluted stock (1000 ppm) solutions to the required initial concentrations. Adsorption experiments were carried out at room temperature.
- The initial concentration of MB were obtained by measuring O.D. at 663 nm(λ max) using UV visible spectrophotometer Model.
- The percentage removal of dye and amount adsorbed (in mg/g) were calculated using the following relationships:

$$\text{Percentage removal} = 100(c_i - c_f) / c_i$$

$$\text{Amount adsorbed } (q_e) = (c_i - c_f) / m$$

Experimental condition for the various of adsorption of the removal of Methylene Blue dye on algae

Variation	Dye	Algae
1- Concentration	5 – 25 ppm	0.125 – 1 g
2- Contact time	5 – 120 minutes	0.125 – 1 g
3- Volume of dye	100 ml	0.125 – 1 g
4- pH	2 – 10	0.125 – 1 g
5- Particle size		0.135 – 0.8 mm

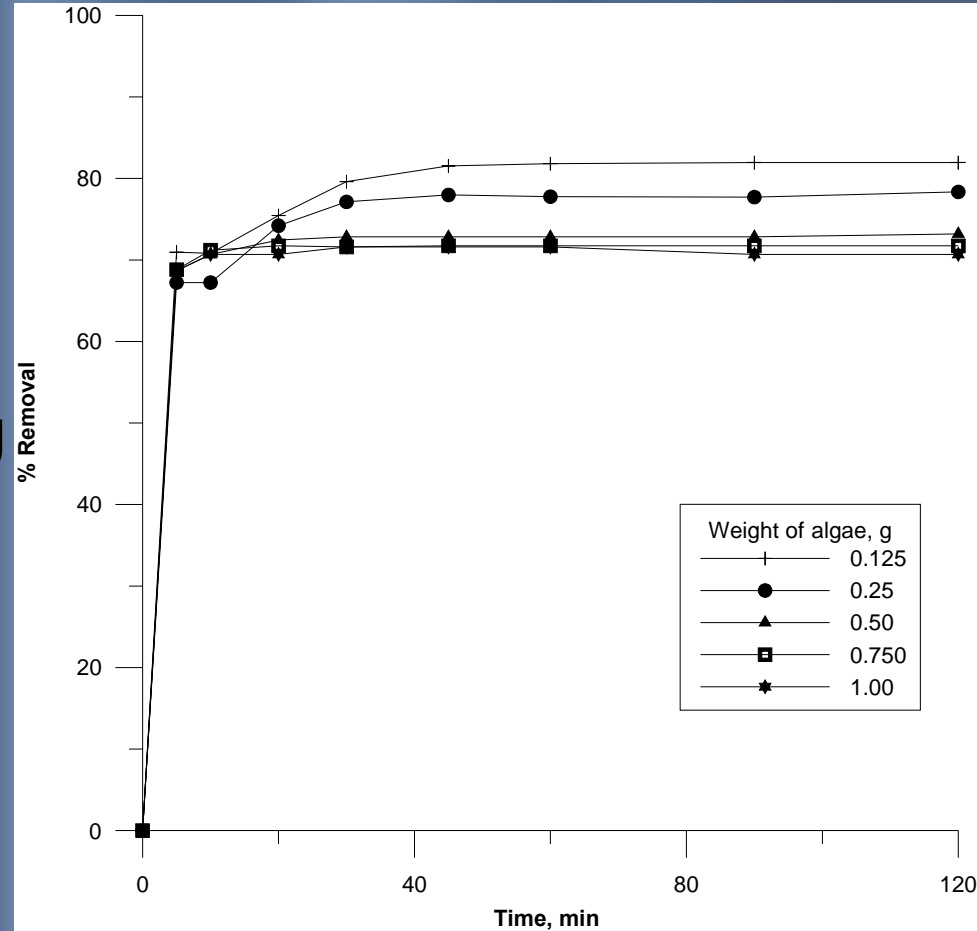
Results and Discussion



Effect of Contact Time:

From these figures we can find three phases of adsorption

- **Phase 1:** Take the long time (30 min) to reach to acclimatization
- **Phase 2 and 3:** reach rapidly to saturation at around (45 min) for all dye concentrations and biomass



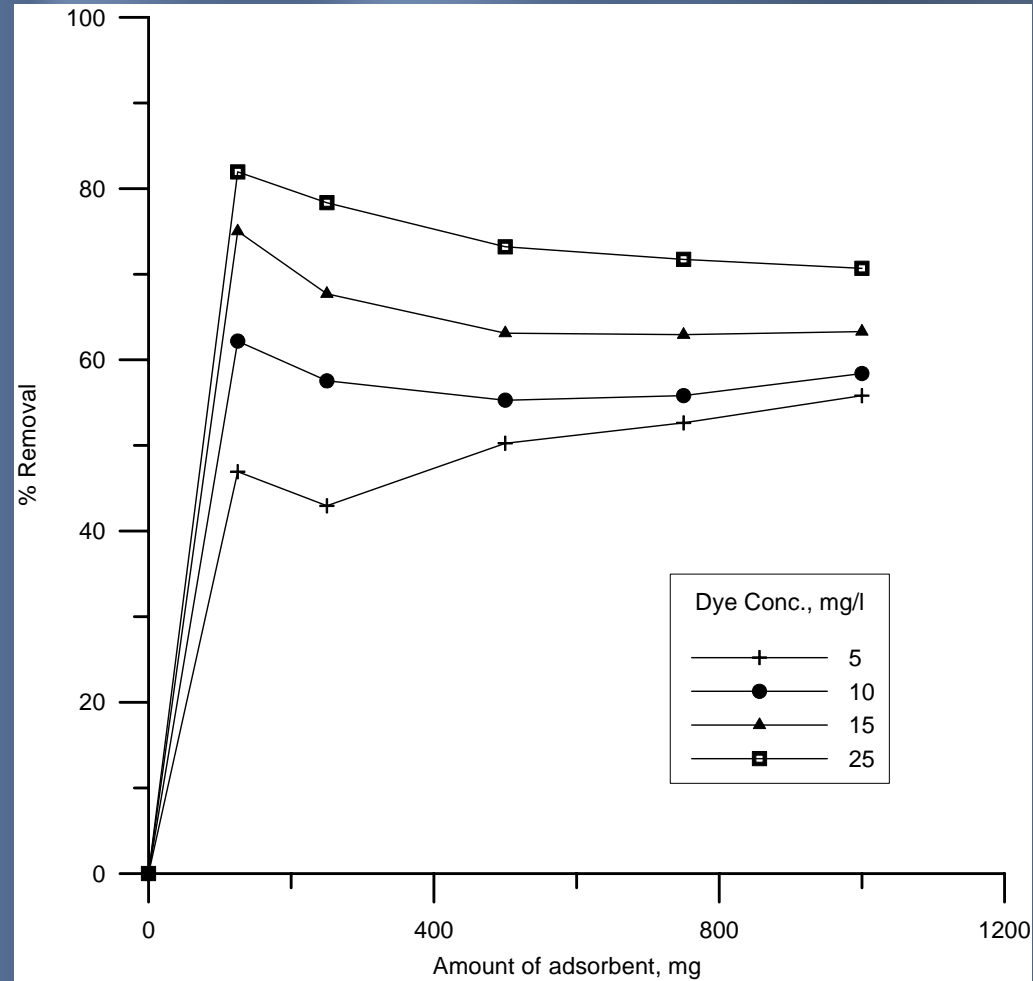
Effect of time on removal efficiency of dye (25 mg/L) at different weights of dye

Followed

Effect of Algal Biomass

The variation of dye removal (saturation) values was depicted in this Figure.

The increase in dye adsorption was due to increase in availability of dye binding sites resulting from an increase in adsorbent dosage.



Effect of weight of algae on the removal efficiency of different dye concentrations

Followed

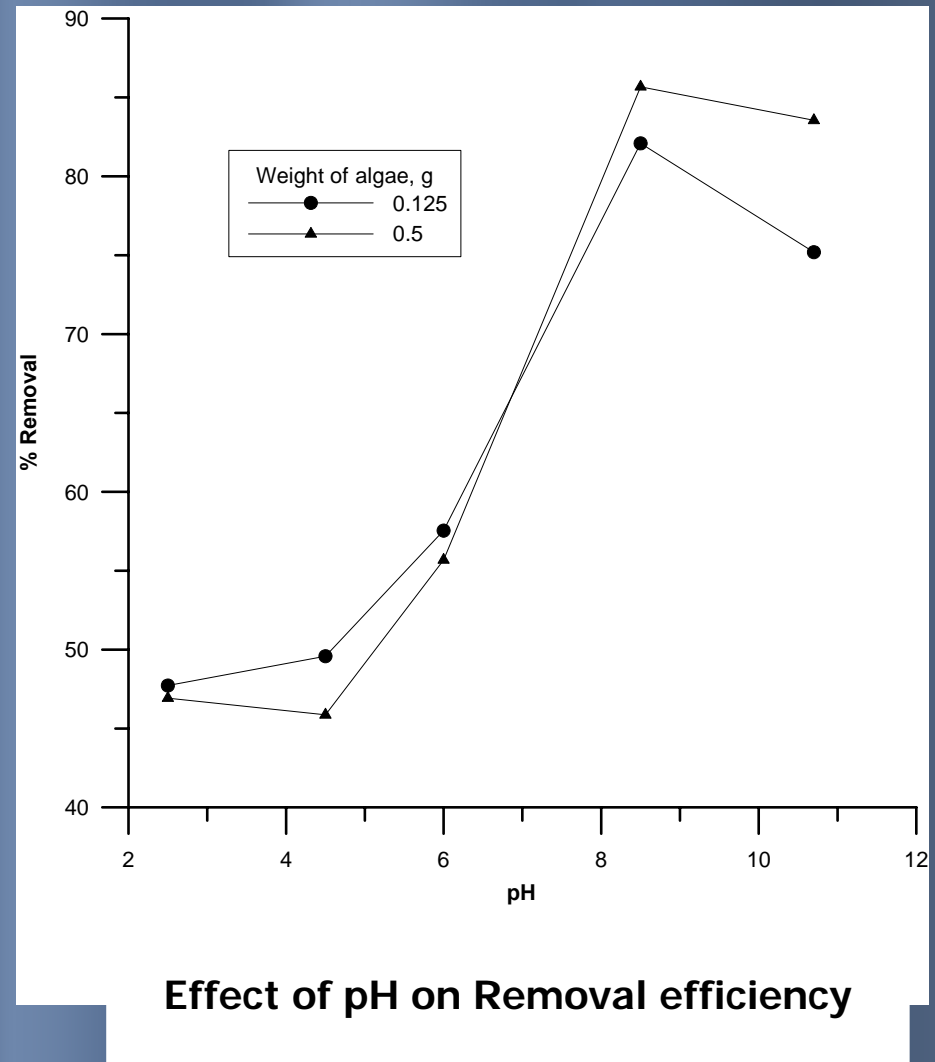
● Effect of pH

- At high pH

The algae recorded the maximum adsorption of this dye cations

- At low pH

The adsorption was unfavorable probably because of excess H^+ competing for sorption sites on the *Ulva lactuca*



Followed

• Adsorption Dynamics

- Adsorption Rate Constant

First order kinetic model calculated according to Lagergren equation :-

$$\text{Log } (q_e - q) = \log q_e - (k_1 t / 2.303)$$

The experimental q_e values do not agree with the calculated ones obtained from the linear plots. This shows that the adsorption of MB on *Ulva lactuca* is not a first-order reaction.

Followed

Second order kinetic model expressed by:

$$t/q = (1/k_2q_e^2) + (t/q_e)$$

The experimental q_e values were agree with the calculated ones obtained from the linear plot, this indicate that the adsorption system belongs the second order kinetic model.

Followed

Adsorption Capacity of Algae

The adsorption capacity of algae was determined by

Freundlich isotherm

$$\text{Log } q_e = (\text{log } k_f) + (1/n) \text{ log } c_e$$

And Langmuir isotherm

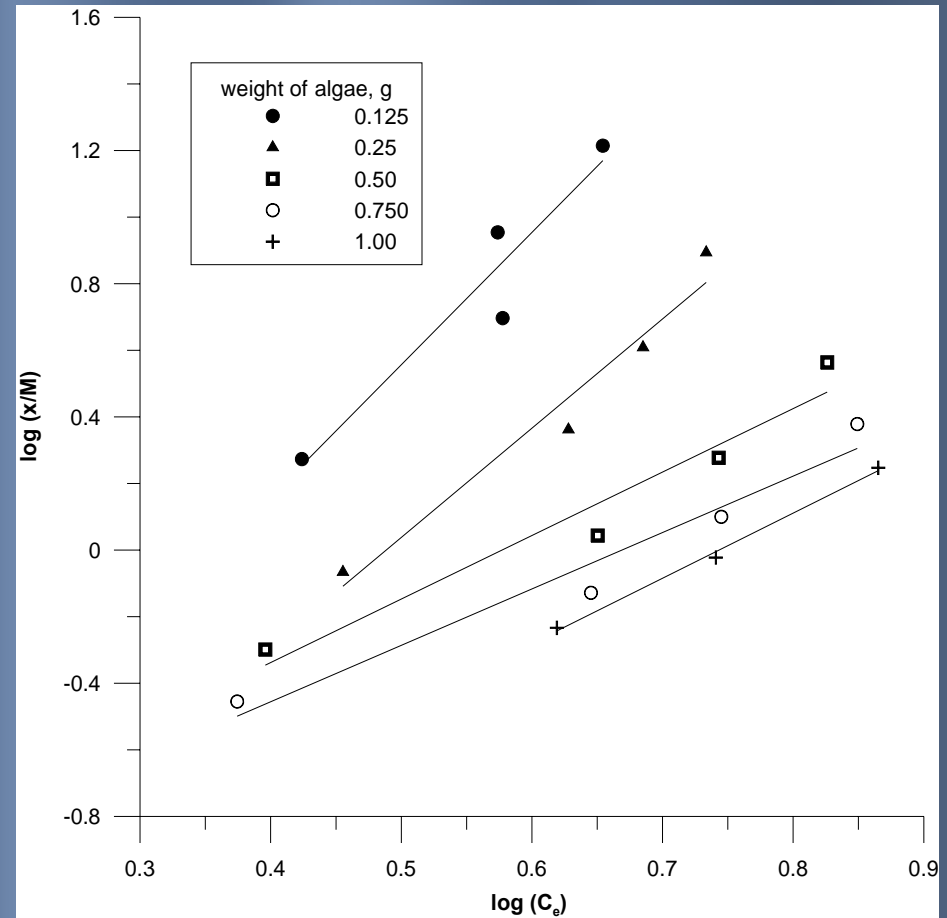
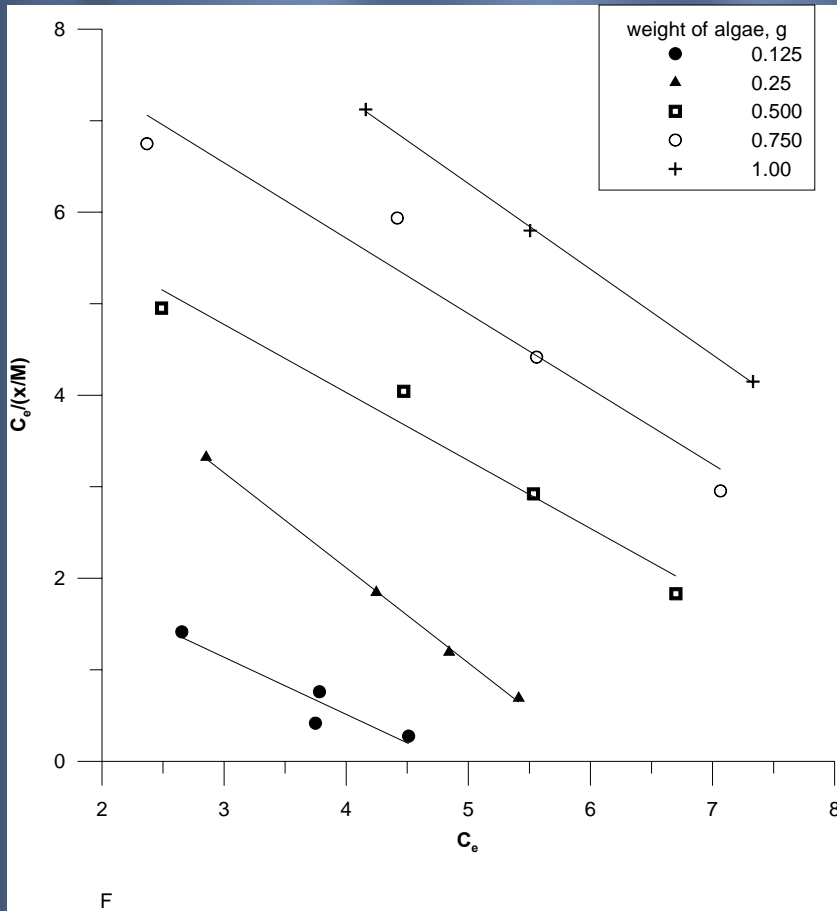
$$c_e/q_e = (1/q_0b) + (c_e/q_0)$$

Freundlich and Langmuir parameters of adsorption isotherms

Parameter	Weight of Algae (gram)				
	0.125	0.25	0.50	0.75	1.00
Freundilch isotherm					
Intercept	1.432	1.603	1.101	1.134	1.453
Slop (1/n)	3.978	3.283	1.908	1.695	1.955
Correlation Coefficient (r)	0.914	0.959	0.948	0.957	0.996
Langmuir isotherm					
q _o	0.625	1.038	0.742	0.824	0.936
b	3.012	6.268	7.001	9.013	10.994
Correlation Coefficient (r)	0.888	0.999	0.962	0.944	0.999
RL	0.660	0.660	0.540	0.460	0.420

Data used : pH=7.4, Speed 200 rpm, Contact time 5-120 min, Temp. RT, Conc of dye 5-25 mg/L

Followed



The observed linear relationship are evidence by r values indicate the applicability of these two adsorption isotherms and the monolayer coverage on adsorbent surface. The monolayer adsorption capacities of the adsorbents is possess high adsorption capacity and hence it could be employed as low-cost adsorbent for the removal of MB.

Conclusion

- Adsorption has been found to be an efficient and economic process to remove dyes, pigments and other colourants and also to control the biochemical oxygen demand
- Since this aquatic plant (*Ulva-Lactuca*) is readily available in the environment, it is more economical and can yield sorbents of higher sorption capacity than others. Furthermore, regeneration is not necessary because it is available biological material.

وإن من شجرة
إلا يسبح بحمده

