BIOSORPTION OF TEXTILE EFFLUENT USING SARGASSAM LONGIFOLIUM

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ABSTRACT

Bisorption capacity of saragassam longifolium for textile effluent was studied in this paper. The impact of sorbent measurements, agitation, temperature, contact time and initial dye concentration, were contemplated in cluster examination. The measure of dye adsorbed at equilibrium was found to change from 67.32 mg/g to 581.61mg/g with expanding introductory dye amassing of 20-100 mg/L for a biomass of 0.1 g. It was found that the biomass demonstrated greatest adsorption limit at 100 mg/L colour answer for a sorbent dose of 0.1g at 20 ^{o}C with a agitation speed of 100 rpm. The exploratory information was dissected by Langmuir and Freundlich adsorption isotherm. The equilibrium information was found to fit well with Freundlich when compared with Langmuir adsorption isotherm. The chemical kinetics of the adsorption procedure was likewise concentrated on and the response was found to take after the pseudo second order kinetics. The surface morphology of the biomass was analyzed by utilizing SEM.

Keywords: Biosorption, Sargassam Longifolium, Dye Adsorption, Isotherm, Chemical Kinetics

I. INTRODUCTION

Textile industry is one of the biggest and most established commercial industry which exhibit all around, expending 80-200 m3 of water for every ton of product and discharges 1,650 m3 of wastewater every day [1,2,3]The kind of colours and chemicals utilized as a part of the textile industry are found to vary contingent upon the fabrics produced. A few sorts of material colours which are used vary with different sorts of fabrics.[4] More than 7x105 tons and around 10,000 unique sorts of colours are created on the planet. Shockingly, around 10 to 15% of the aggregate delivered colours is discharged into the sea-going biological communities without being expelled from the effluents and huge volumes of exceedingly contaminated wastewater are created.[5,6,7,8] The synthesis of the effluent are substantial metals (chromium, copper, lead, and arsenic), colours (azo, receptive), surfactants, and so forth. It also contains high values of COD,BOD, suspended and dissolved solids.[9,10] Improper textile dye effluent disposal in biological systems prompts the decrease in daylight entrance which thusly diminishes the photosynthetic movement, broke down oxygen fixation, water quality and delineates intense harmful impacts on sea-going widely varied vegetation, creating serious ecological issues around the world.[11] These effluents are rich in colours and chemicals, some of which are non-biodegradable and cancer-causing and represent a noteworthy risk to wellbeing and nature if not legitimately treated.[12] Also, colours in the water bodies experience synthetic and natural changes that expend disintegrated oxygen bringing about fish executes and the obliteration of other amphibian organic entities.[13] Textile effluents are additionally found to contain other natural and microbial polluting influences [14]

Current advancements to treat effluents incorporate reverse osmosis, organic oxidation, coagulation and actuated carbon. Tragically these techniques experience the ill effects of confinements like high-vitality request, high cost, moderate colour evacuation prepare, a lot of compound prerequisites, and dangerous results .[15,16,17] Reverse osmosis powers water under weight through a film that is impermeable to contaminants, yet the procedure is extremely extravagant and vitality escalated .[18].Biological oxidation procedure includes gushing water treatment utilizing oxygen consuming and anaerobic micro organisms, is costly, and produces by-product as a side effect .[18] It can't be recovered in a financially savvy way and is not feasible everywhere scales.[17]

II. MATERIALS AND METHODS

2.1 Effluent

The effluent is collected from NACSOLS industry which is located at Thirupur in Tamil Nadu. The effluent waste from this industry is combined with sagassam longifolium which was then subjected to many processes.

2.2 Preparation of Biomass

The brown algae Sargassum longifolium was collected from Pamban coast(Lat 9˚ 16′ N; Long 79˚ 13′ E) (Fig I) Gulf of Mannar region, southeast coast of Tamil Nadu during July 2014. The Fresh plant was completely washed with seawater to uproot the disciple sand and the epiphytes and got to the research facility in plastic sacks. The kelp sample was again washed altogether with refined water to evacuate the earth and other follower materials and dried in free air at room temperature took after by 40ºC in the hot air oven for two days. At that point it was processed in a mechanical grinder for 5 min, to acquire a fine homogeneous powder and kept in impermeable plastic sacks at room temperature for examination of their natural organization.

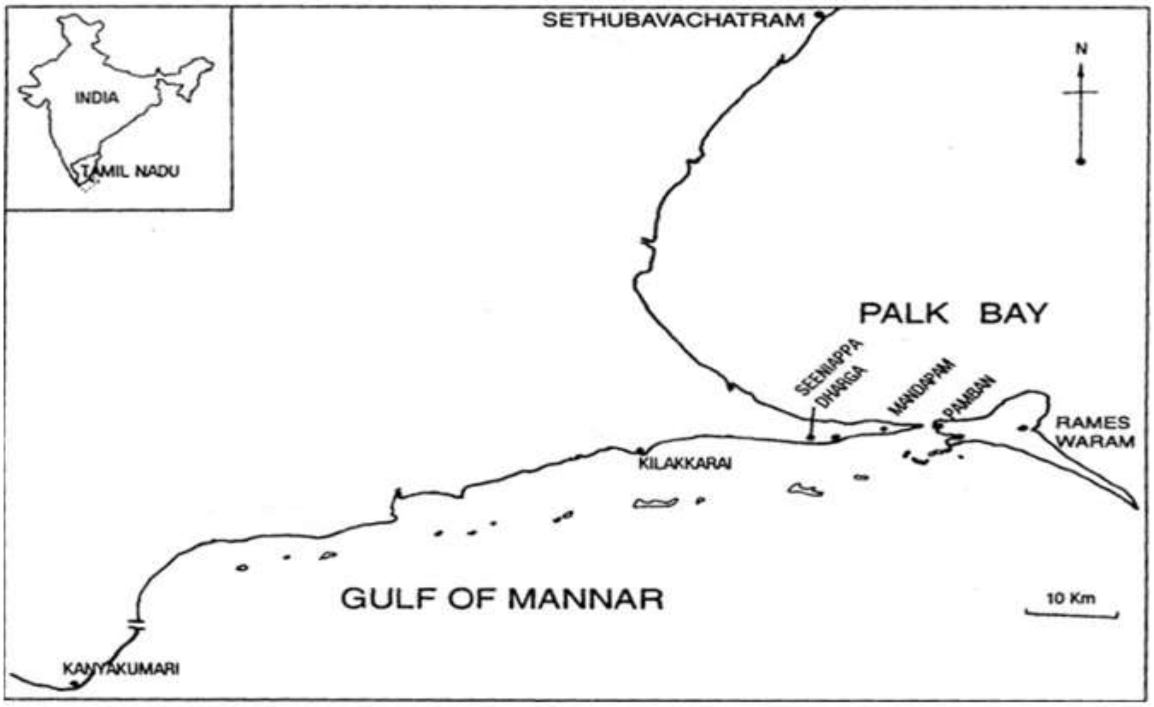

Fig 1, Geographical Location of Biomass

III. METHODS

3.1 Dye Analysis

The change in dye concentration because of adsorption was controlled by UV-vis spectrometer. Absorbance was measured at wavelength 450 nm. The rate of dye removal because of bio sorption was ascertained as % dye as removal = [Co- Ci/Co] x 100 %, where Ci and Co are the beginning and last convergence of colour arrangement (mg/L) individually.

3.2 Study of Sorbent Dosage

20ppm of the colour arrangement was arranged and the impact of starting sorbent measurement on the evacuation of colour arrangement was concentrated on by fluctuating the sorbent dose from 0.1 to 0.5g every 100mL of colour arrangement. The set up was kept up in a thermostatic shaker at a temperature of 20˚C and a tumult of 100rpm. The adjustment in amassing of the colour was watched for the given arrangement at 24hours time interim for 5days utilizing colorimeter at the wavelength 450nm.

$$q_e = \frac{C_O - C_e}{w} x\ V$$

Where Co is initial dye concentration (mg/L), Ce is the final dye concentration (mg/L), V the volume of the sample (L), and W is the weight of the biomass (g).

3.3 Study of Initial Dye Concentration

Textile effluent of different concentration changing from 20ppm to 100ppm was dissolved in distilled water to study initial dye concentration. To these changing amounts of colours arrangement a balance amassing of sorbent dose was included. The tapered carafes were then put in a thermostatic shaker and disturbed at 20˚C at100rpm. The specimens were occasionally tried at 24 hours time interim for 5ays utilizing UV-Spectrophotometer at greatest absorbance of 450nm.

$$\text{Percentage color removal} = \frac{C_O - C_e}{C_O} x\ V$$

Where Co and Ce are equilibrium concentrations of dye in the solution (mg/L), V the volume of the sample (L).

3.4 Study of Temperature Change

The impact of temperature on the uptake limit of dye by the biomass was contemplated. The conical flasks were then set in a thermostatic shaker kept up at 100rpm and different temperature goes (20, 24, 28, and 32˚C). The arrangement in changing temperature was analyzed for each 24hrs at once interims for 5days utilizing UV spectrophotometer at greatest absorbance of 450nm.

3.5 Study of Adsorption Isotherms and Kinetics

Adsorption isotherm and kinetic experiments were conveyed utilizing the batch method. In five conical flasks 100ml of arrangement containing 20ppm, 40ppm, 60ppm, 80ppm and 100ppm of textile effluent were prepared with a sorbent dose of 0.1 grams in each. The conical flasks were then put in a thermostatic shaker which agitated the arrangement at 100rpm at 20c.The measure of colour adsorbed at balance was computed from mathematical statement,

$$q_e = \frac{C_O - C_e}{w} x\ V$$

Where c and c are the amassing of the colour in the arrangement in the first place and at balance separately (mg/l), V is the volume of solution (L), w is the mass of dry algae powder(g). With a specific end goal to comprehend the impact of temperature, introductory colour fixation and sorbent measurement on the absorbance of colour preparatory analyses were done utilizing shifted fomentation paces and the best disturbance rate was found to happen at 100rpm.

3.6 Langmuir Isotherm

The Langmuir isotherm is derived from the assumption that the adsorbed layer is monolayer and is given by equation,

$$\frac{C_e}{q_e} = \frac{1}{Q_O\, b} + \frac{1}{Q_o} C_e$$

Where c the equilibrium concentration of dye (mg/l) is, q s the amount of dye sorbent per unit mass of sorbent at equilibrium (mg/g),Q (mg/g) and b (l/mg) are the Langmuir constants related to the sorption capacity and energy of separation respectively.

3.7 Freundlich Isotherm

The Freundlich isotherm describing heterogeneous reversible multilayer adsorption on catalytic surface is give empirically be the formula,

$$q_e = \mathrm{K} C_e^{\frac{1}{n}}$$

This is most generally utilized as a part of portraying colour adsorption onto a strong surface. in the above recipe is the sorbate focus at equilibrium(mg/L),is the measure of colour adsorbed every unit mass of sorbent(mg/g),K and n speaks to the Freundlich adsorption isotherm constants which shifts as indicated by the heterogeneity of the material. The values of the adsorption constants can be estimated by plotting a graph between log vs log. The slope of the linear graph and intercept gives logK .

IV. RESULTS AND DISCUSSIONS

4.1 Effect of Sorbent Dosage

The impact of sorbent dose of SARGASSAM LONGIFOLIUM concerning the dye uptake limit is assessed and the greatest balance uptake limit is found to happen for sorbent measurements of 0.1grams of dry weight. The equilibrium uptake limit was found to decrease with expanding sorbent measurement. This could be clarified by the way that the measure of dye to be adsorbed is part among the expanded dye adsorption sites with increasing sorbent dosage prompting lower particular dye uptake limit. The accompanying analyses were consequently directed with adsorbent measurements of 0.1 grams.

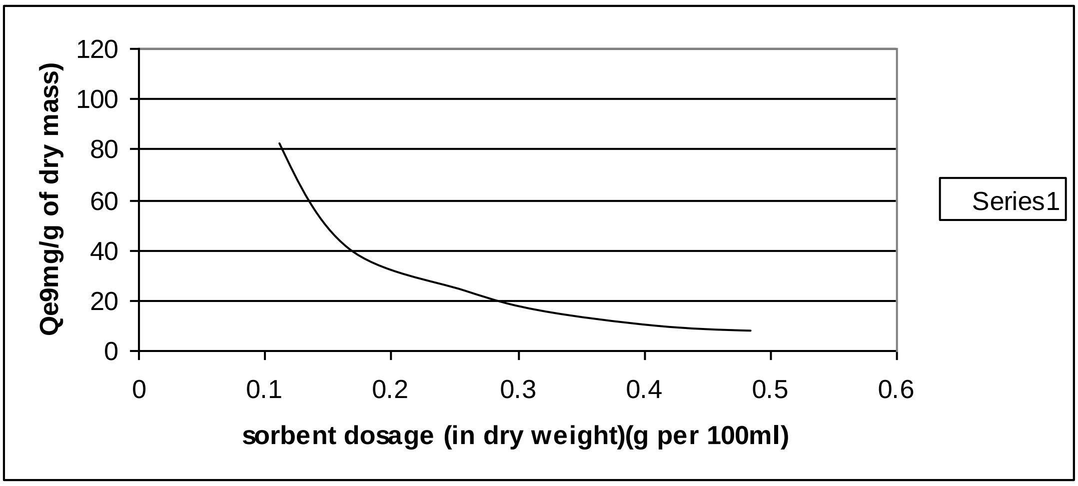

Fig 2, Effect of Sorbent Dosage

4.2 Effects of Temperature

The impact of temperature on the balance uptake limit of textile effluent on Sargassam longifolium was mulled over with starting dye concentration of 20 mg/L .The temperatures of study taken were 20°C, 24°C, 28°C and 32°C. The best equilibrium uptake limit was found to happen for 20°C. There was a discernible pattern of lessening in adsorption limit of Sargassam longifolium with increment in temperature. These outcomes demonstrate that the adsorption of Sargassam longifolium is an exothermic procedure and the quality of the physical securities between the colour particles and the dynamic locales of the Sargassam longifolium diminishes with expanding temperature. Comparable results were seen by (Hu et al. 2010) who explored the impact of temperature on the evacuation of the colour Congo red from watery arrangement by cattail root and demonstrated adsorption diminishing with increasing temperature.

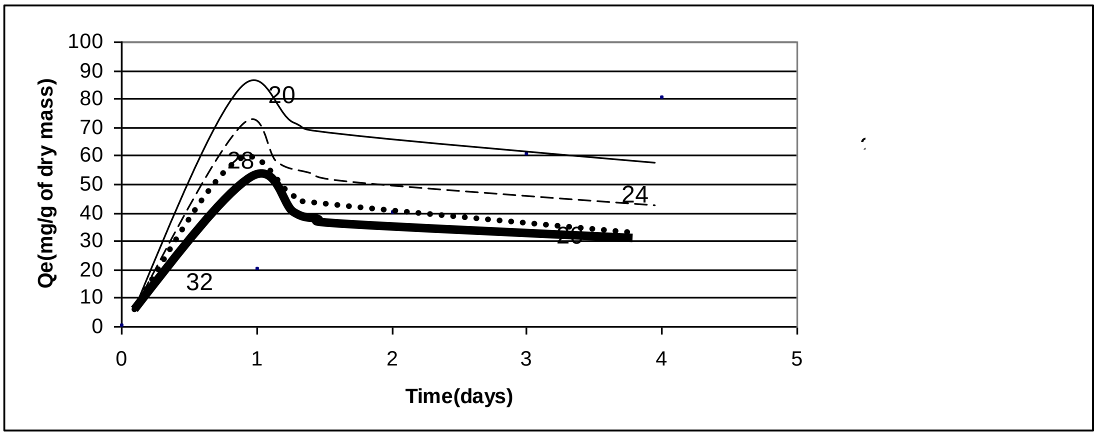

Fig 3. Effect of Temperature

4.3 Effect of Initial Dye Concentration

Dye concentration ranging from 24ppm to 100pm were contemplated and the balance uptake limit for 100ppm colour focus was discovered to be the biggest. The ascertained estimation of equilibrium uptake limit for 100ppm was 458.367 (mg/g dry biomass). The equilibrium uptake can be clarified by the vicinity of an expanding focus slope which gives an expanding main impetus to conquer all mass exchange resistances of the colour atoms between the watery and strong stage prompting an expanding balance adsorption until saturation is reached. A comparative pattern was accounted for with methyl violet onto sunflower seed frames (Hameed 2008) certainty a lot of colour particles are accessible for adsorption on the sorbent surface are thus expanding the uptake limit of the material alongside the arrangement of multilayer adsorption framework.

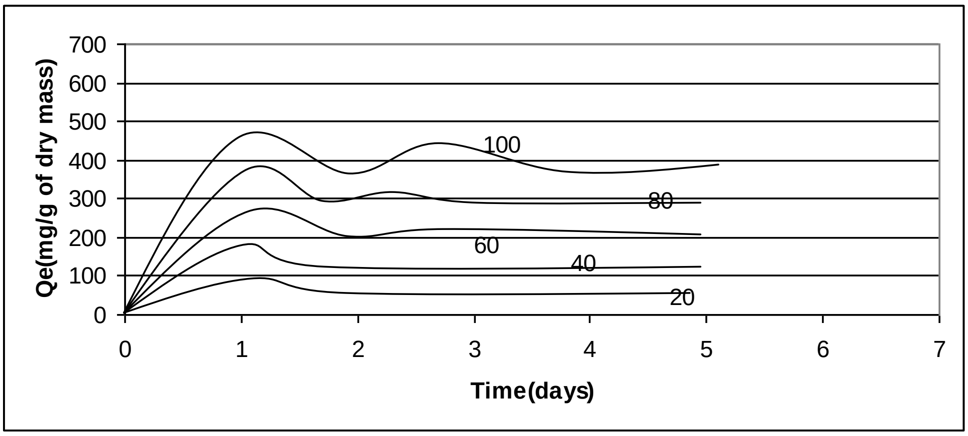

Fig 4, Effect of Initial Dye Concentration

4.4 Equilibrium Modelling

Equilibrium modelling was done for the adsorption of Sargassam longifolium onto the surface of the sorbent by the preparation of 20ppm colour arrangement and after that dissolving the sorbent into the arrangement. The arrangement containing the sorbent is kept up at a steady temperature of 20 °c and shaker is kept at 100rpm.The dye concentration is tried at 24 hours interims. It is seen from the watched qualities that the greatest adsorbance up to 90% happens inside of the initial 24 hours after which equilibrium is reached because of the absence of accessibility of adsorption locales.

4.5 Equilibrium Isotherms

Figure 5 and Figure 6 Shows the fitting of Langmuir and Freundlich isotherms individually for material colour on Sargassam longifolium. Analysis of qualities demonstrates that the Freundlich isotherms are a more proper fit for the given information. .This is additionally an evidence of surface heterogeneity of Sargassam longifolium in charge of multilayer adsorption because of the vicinity of enthusiastically heterogeneous adsorption locales.

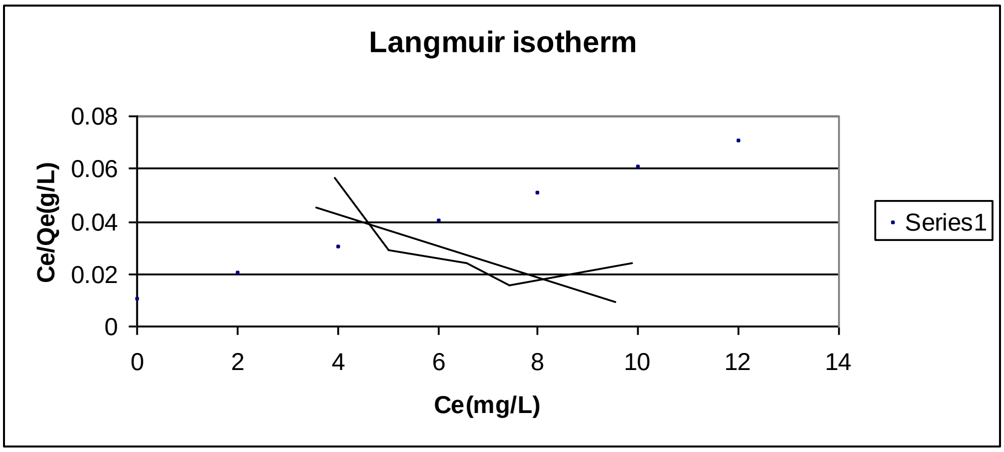

Fig 5, Langmuir Isotherm

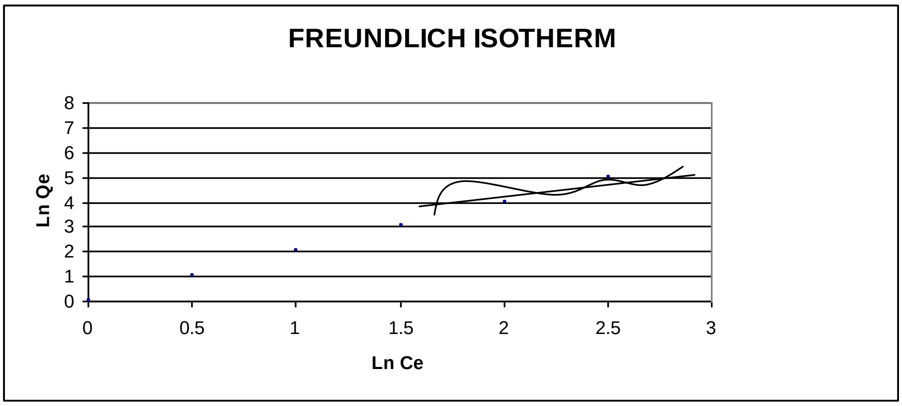

Fig .6 Freundlich Isotherm

4.6 Kinetic studies

The active studies give valuable data to demonstrating and planning adsorption forms. The energy of material colour sorption on Sargassam longifolium was considered under pseudo first order and second order energy models.

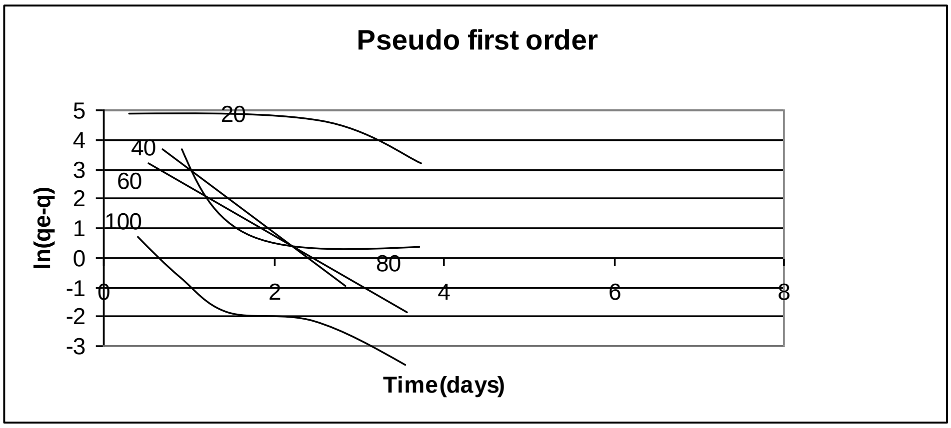

Fig 7 Pseudo First Order

From the slope and intercept of the diagram plotted between in versus lnq vs t, for the starting dye convergences of 20ppm ,40ppm, 60ppm, and 100ppm for a sorbent dose of 0.1 at temperature of 20 ^{0}C, the first order rate constant and equilibrium adsorption capacity were resolved. Contrasting computed estimation of and watched estimation of it turns out to be clear that the framework does not take after pseudo first order kinetics.

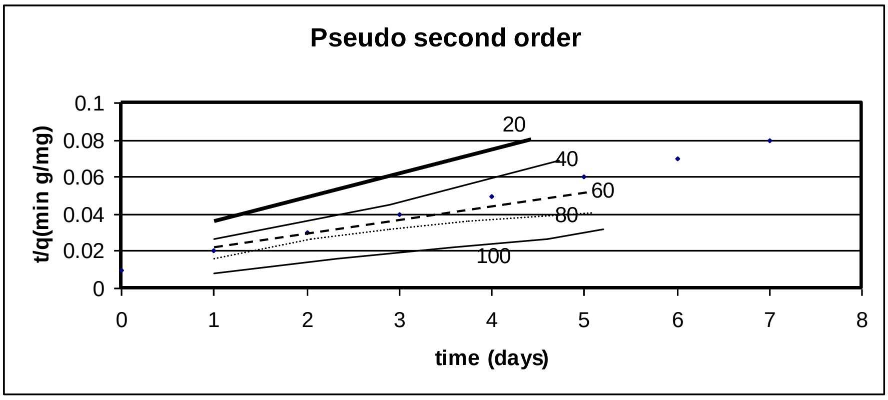

Fig 8, Pseudo Second Order

The slope and intercept of the graph plotted between t/q vs. t gave the pseudo second order coefficients and. Comparing calculated values of with observed values of shows the adsorption of textile dye on Sargassam longifolium is relatively well explained by pseudo second order kinetics.

V. SCANNING ELECTRON MICROSCOPY

SEM has been utilized to study the physical auxiliary of the plant species Sargassam longifolium. The biomass was investigated before the amassing of material colour utilizing SEM. SEM is extremely normal strategy used to study the surface morphology and physical properties of the adsorbent. It is observed that Sargassam longifolium is exceptionally sporadic and uneven consequently prompting higher adsorption range. This expanded surface zone gives bigger region to adsorbance and thus expands the uptake limit of the dye.

VI. CONCLUSION

In this examination of the harmony uptake limit of the dye by Sargassam longifolium were considered. The pulverized Sargassam longifolium particles were subjected to five introductory color focuses (20ppm, 40ppm, 60ppm, 80ppm and 100ppm). The equilibrium uptake limit of dye was discovered to be most elevated at a centralization of 100ppm and demonstrated expanding uptake limit pattern with starting dye concentration. The uptake limit was additionally tried against the impact of distinctive temperature (20°, 24°, 28°C and 32ºC)and sorbent doses (0.1g,0.2g,0.3,0.4 and 0.5g) and the uptake limit of the dye by Sargassam longifolium was found to increment with diminishing temperatures and sorbent measurement. The most noteworthy uptake limit was found to happen for sorbent measurements of 0.1g and at a temperature. The harmony information fitted well with Freundlich adsorption isotherm, affirming multilayer adsorption of textile effluent on Sargassam longifolium . The response energy was found to take after pseudo second order kinetic with great relationships. .SEM investigation of the biomass was led indicating sporadic surface having high surface territory every volume. Contemplating these data it can be outlined that Sargassam longifolium can be utilized as a viable and savvy system for the expulsion of dye from material wastewater.

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