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Evaluation of biosportion capacity of crystal violet dye by using Red algae *Gelidium pusillum*

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Abstract
Effluents of textile dyeing / finishing processes have often a complex composition, characterized by intense colour, high chemical oxygen demand, suspended solids and a variety of refractory matter such as heavy metals, nonionic surfactants, etc. There are various methods for dyes removal, such as membrane separation, flocculation, anaerobic biological treatments, oxidative destruction via UV/ozone treatment, photocatalytic degradation, which have certain efficiency but their initial and operational costs are too high. Adsorption is one of the several techniques that have been successfully used for dyes removal. A large number of materials have been used as suitable adsorbents for decolourization of industrial effluents: activated carbon (the most common but expensive adsorbent), polymeric resins, various low-cost adsorbents (agricultural and industrial byproducts, peat, chitin, silica, fly ash, etc.). In present study we have shown that preliminary results of the red algae *G. pusillum*which are tested for adsorptive properties in the recovery of crystal violet (CV) dye. Results have shown that *G. pusillum*exhibited time depended adsorption of tested CV dye in the range of 32-56% at time interval of 20- 40 min, the obtained biosorption sizes of *G. pusillum* in the range of 53-152µm, at the size of 53 µm and shown maximum adsorption of 56% and the adsorption of CV is gradu
ally have been decreasing up to 40% and at the pH -6 size of 53 µm *G. pusillum* shown 61% of CV dye adsorption. Based on our study we can conclude that *G. pusillum* is a best alternative biological source to remove the dye from textiles industries by the process of adsorption.

Keywords: Adsorption, Biosorption, *Gelidium pusillum*, Crystal Violet, Percentage of dye removal.

1. Introduction
Drinking or consumable water is being related with these sorts of colors from underground water and people devouring this polluted water are being familiar to new illnesses. This can be halted and destroyed utilizing various methods (El-MaghrabyA and El DeebH.A 2011; Karthik *et.al.*, 2014). After observation of various techniques which are costly and leaves destructive synthetic compounds, Biosorption has been exceptionally encouraging now a day to treat and take care of the above issue **(**Voudrias*et.al.,* 2002; Mustafa *et.al.*,2014) . With more affordable and normally

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accessible biosorbents the above strategy is extremely encouraging and hopeful to tackle the material profluent issues. Coloring industry effluents are one of the trickiest wastewaters to be dealt with for their high compound oxygen interest, yet additionally for high organic oxygen interest, suspended solids, turbidity, and poisonous constituents yet additionally for shading, which is the main toxin perceptible by the natural eye. Colors might influence the photosynthetic movement in sea-going life because of diminished light entrance and may likewise be poisonous to some amphibian life because of the presence of aromatics, metals, and so forth (Fu Y and Viraraghavan T 2001; Robinson *et.al*., 2001) in them.

Currently various conventional and advanced treatment methods having different disadvantages such as low efficiency, non recycle, economic burden, maintenance of high pressure and temperature, in effective disposal of dyes and formation hazardous by products, hence researchers are focused on alternative method to overcome these disadvantages, biosorption is a process in which a substantial metals and dyes are removed by natural materials such plants and aquatic animal products has acquired energy from 1990's.Phycoremediation is the process in which by using different algaespecies removal of chemical wastes, from wastewaters released from industries, (Rao, *et.al.,* 2019) it is the cost effective, no hazardous, and easy to handle, and waste residues can be used for bio fuel production.*G. pusillum* is a species of red algae belons to family of *Gelidiaceae*, having inherent capacity to remove chemicals, metals and dyes,therefore the present study has been undertaken to evaluate biosorbent capacity of naturally occurring *G. pusillum*.(Kyeong and Sung 2012).

2. Methodology:

2.1. Sample Collection: *G. pusillum* was collected from costal sea area of Teneti Park,Jodugullapalem , Visakhapatnam, Andra Pradesh, India.

2.2. Materials: U.V spectroscopy; Crystal violet, pH meter, incubation shaker.

2.3. Preparation of the bisorbents:

Collected *Gelidium pusillum*was washed with refined water a few times until the soil particles are taken out. After through washing with refined water, *G.pusillum* was sun dried, powdered and sieved byusing 53, 75, 105, 125 and 152 µm sizes (Bindra Shrestha 2016)

2.4. **Preparation of CVstock solutions:**

1.0 gram of CV is dissolved in 1.0 L of distilled water to get concentration of 1000 mg/L of CV stock solution. Also Tests of various centralizations of CV is ready from this stock solution by suitable weakening. 20 ml of 1000 mg/L CV stock arrangement is taken in a 1000 ml volumetric flask andmake up with distilled water. Additionally, arrangements with various colors fixations like 20 mg/L, 50 mg/L, 100 mg/L, 150 mg/L and 200 mg/L were ready. The pH of the arrangement is changed by adding required measures of 0.1 N HCl and 0.1N NaOH (Ilyasse*et al.*,2020).

2.5.Effect of agitation time

15 new Erlenmeyer funnel shaped jars were washed with refined water and dried in a hot air broiler at 60oC for 15 minutes. Some known measure of biosorbent was added to 50 mL of CV color arrangement in each of over 250 mL Erlenmeyer jars. The flagons were brooded in an

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orbital shaker at a speed of 180 rpm at room temperature for various unsettling times (5, 10, 15, 20, 25, 30, 40, 50, 60, 90, 120, 150, 180 min). The examples were sifted independently by Whatman channel papers and investigated in UV-Spectrophotometer to acquire last convergences of colors (Slimani*et al.*, 2012)

$$\textbf{\% Biosorption is calculated from the equation} = \frac{C_o - C_i}{C_o} \times 100$$

WhereC_o= initial dye concentration in the aqueous solution (mg/L)

C_i = final dye concentration in the aqueous solution (mg/L)

Dye uptake = [V (C_o-C_i)] / [Wx1000]

Where V = volume of the dye solution taken and W = amount of biosorbent addedor taken

2.6. Effect of biosorption size

Keeping disturbance time as ideal worth got in the above interaction, 50 ml of watery arrangement is taken in a 250 ml cone shaped jar with various sizes of biosorbents. The example is stayed in touch for ideal tumult time by shaking at room temperature. The example was permitted to settle, separated and broke down in UV-Spectrophotometer to get last color focus (Aseel M. Aljeboree*et .al.*,2016).

2.7. Effect of biosorption dosage

Keeping pH, biosorbent size and starting color focus at ideal qualities, 50 ml of fluid arrangement is taken in a 250 ml cup with various measures of biosorbents. The examples are stayed in touch for ideal tumult time by shaking at room temperature. The examples were permitted to settle, sifted and investigated in UV-Spectrophotometer to get last color fixation.

2.8. Effect of initial dye concentration

Keeping pH at ideal worth alongside ideal biosorbent size, known measure of biosorbent was added to 50 ml of watery arrangement containing diverse color fixations and are shaken in an orbital shaker at room temperature for ideal unsettling time. The example was permitted to settle, separated and examined in UV-Spectrophotometer to acquire last centralization of color.

2.9. Effect of pH

The impact of pH on the harmony take-up was examined over an alternate pH range. The pH of the arrangements is changed by adding required measures of 0.1 N HCL or 0.1N NaOH. To 50 ml of fluid arrangement, known measure of biosorbent (ideal size acquired from above test) is added. The jars were shaken in an orbital shaker at a speed of 180 rpm at room temperature for ideal tumult time. The example was permitted to settle, sifted and examined in UV-Spectrophotometer to get last convergence of metal (Ngaha *et.al.* 2018).

2.10. Effect of temperature

Keeping pH, introductory color fixation and biosorbent size at ideal qualities, 50 ml of watery arrangement is taken in a 250 ml carafe at five unique temperatures and kept in orbital shaker for suitable ideal time. The examples were separated by Whatman channel paper and broke down in UV-Spectrophotometer to get last color focus.

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3. Results and Discussion

3.1. Effect of agitation time

As shown in the fig 3.1 the % biosorption of CV dye by *G. pusillum*in initial 20 min of disturbance the 32 % biosorption is slowly increased and their plots are found be muchhigher and shifted to steady at fomentation time is 40 min 56 % biosorption. In the tumult timeframe of 5 to 180 min, explore which is commonly made with 50 mol of fluid arrangement including 10g/L of 53 µm size biosorption, the % biosorption is expanded from 10% to 56% time span of 5 to 40 min and dye take-up is 0.2 to 1.12 mg/g. The % of biosorption is higher in the underlying stages. It is kept up high as a result of the biosorbent promotion equivalent surface zone is accessible for the biosorption of CV dye by *G.pusillum.*

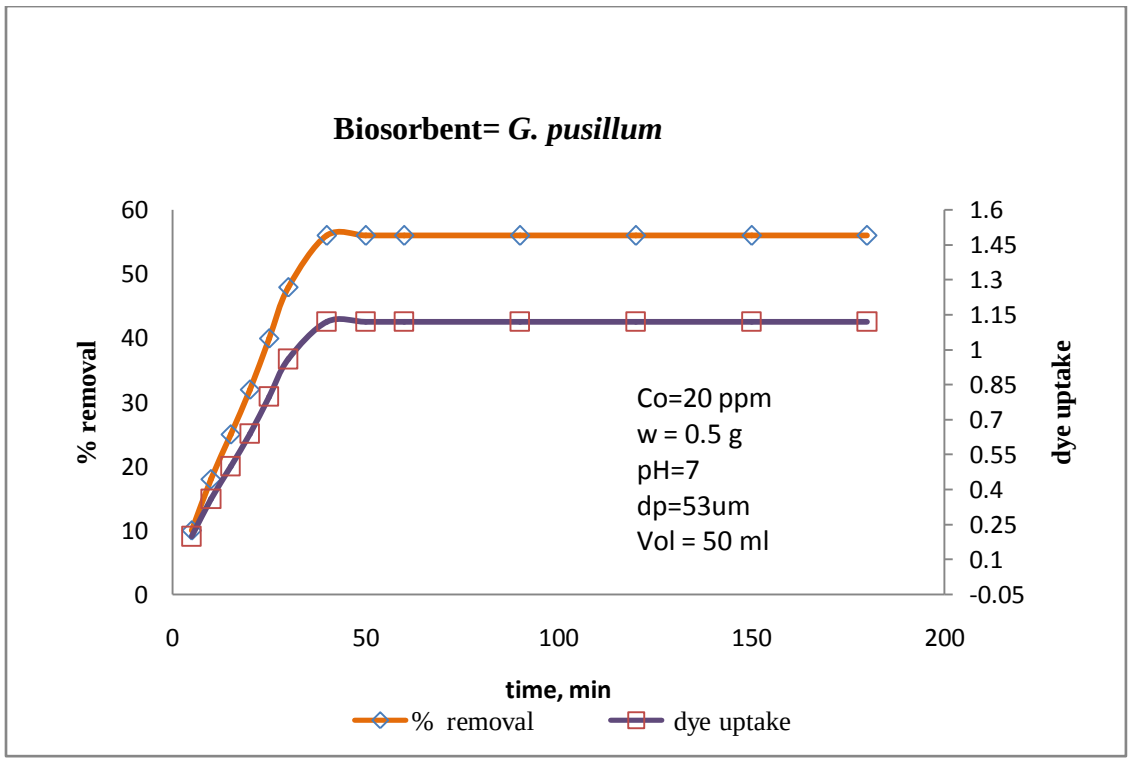

Fig-3.1. Effect of agitation time on % biosorption of CV dye

3.2 Effect of biosorbent size

The shown in the fig-3.2 the varieties in % biosorption of CV dye by *G.pusillum* with biosorbent size. As the biosorbent size expanded from 53 to 152µm, the % biosorption is diminished from 56 to 40% and dye take-up is 1.12 to 0.8 mg/g, the biosorbent surface region increments as the size of the molecule diminishes.

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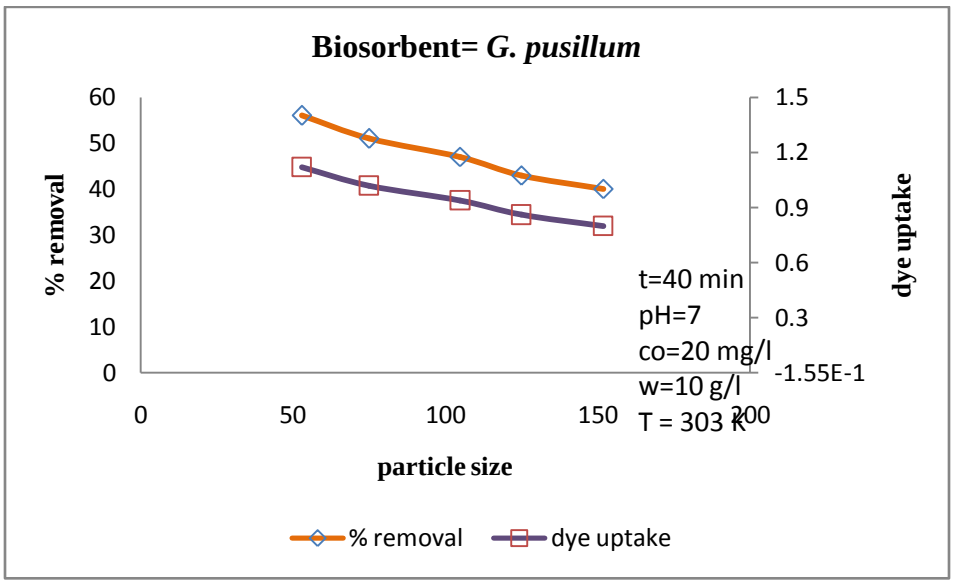

Fig. 3.2. Effect of biosorbent size on % biosorption of CV dye

3.3. Effect of biosorbent dosage

The fig. 3.3 speaks to biosorbent measurement from fluid arrangement and its variety in % biosorption of CV dye by *G. pusillum*. The dose is expanded from 10 to 25 g/L and the % biosorption is expanded from 61 to 78 % just as it increments in the biosorbent along with an expansion in the watery face. This is so because the measure of biosorbent is expanded, and it would be more for the quantity of dynamic locales accessible for dye take-up. The measurements are expanded from 30 to 70 g/L alongside the expansion in % biosorption isn't acknowledge (80 to 89%).

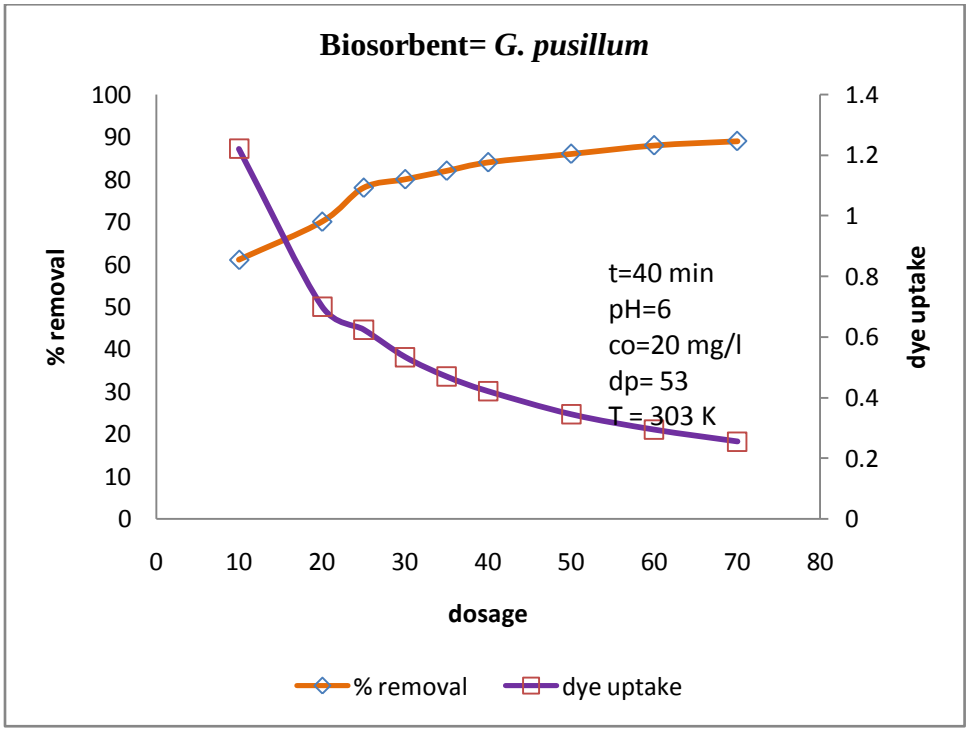

Fig. 3.3. Effect of biosorbent dosage on % biosorption of CV dye

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3.4 Effect of initial concentration of CV dye by *G.pusillum*

The fig.3.4 shows the impact of starting centralization of CV dye by *G.pusillum* in the fluid arrangement on the % biosorption at balance fomentation time. The % biosorption is steadily diminished from 61 to 45% (1.22 to 9.0 mg/g) while expanding CV dye by *G.pusillum* fixation from 20 to 200 mg/L. In fluid arrangement lesser % of CV dye by *G. pusillum*is taken out from higher convergence of CV dye by *G. pusillum* .

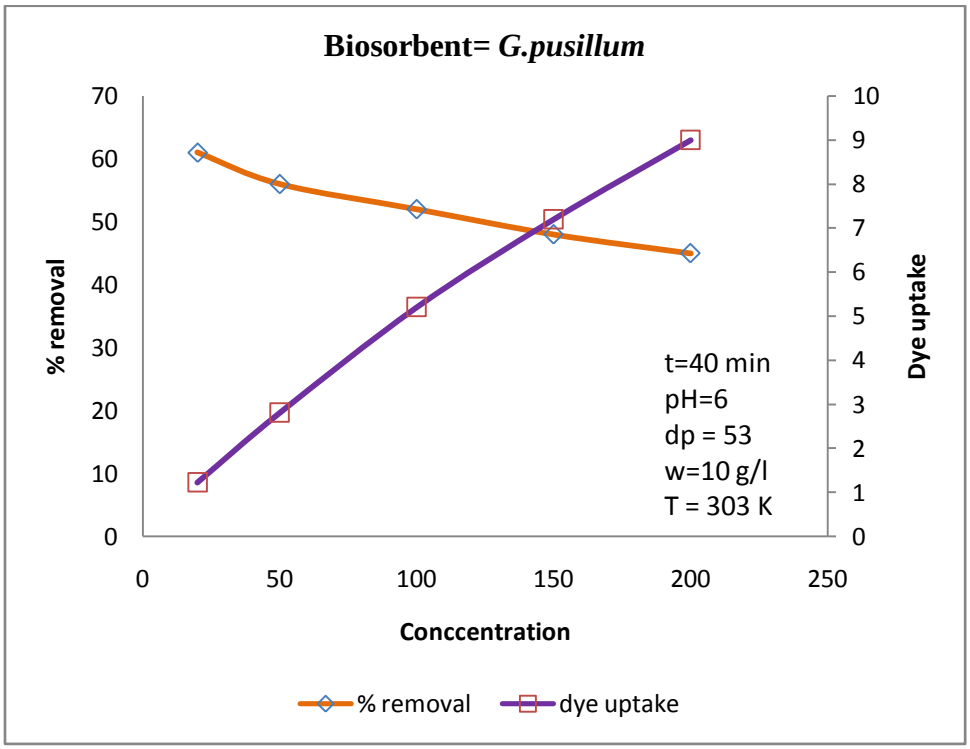

Fig. 3.4. Effect of initial concentration for the biosorption of CV dye

3.5. Effect of pH in aqueous solution

The underneath plot is attracted between pH of watery arrangement and biosorption CV dye by *G. pusillum* . The perception from the fig.3.5 is critical increment in % biosorption and pH is expanded from 2 to 8. Over 6 the pH is expanded (43 to 61%) and descending pattern of the % biosorption is noted. The degree of biosorption is expanded from 43 to half in the pH extend from 2 to 6 by including biosorbent measurements of 10g/L of 53 µm size alongside 50 ml of fluid arrangement is an average analysis done. The acquired outcome shows that the concoction cooperations may have been traded between the particles. Because of particle trade association in biosorption, the nearness of SO3 extending, S=O and C-S-O groups, from ester sulfonate bunches are very rich**.**

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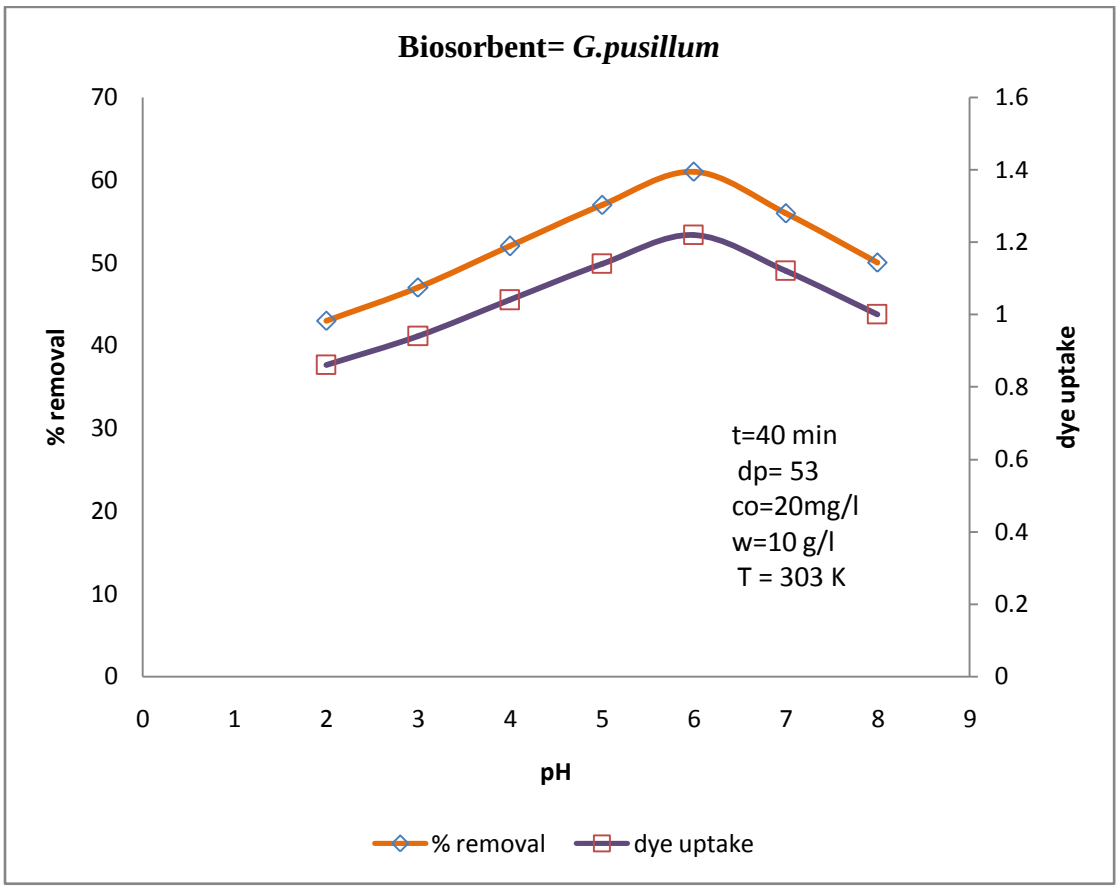

Fig. 3.5. Effect of P^Hon % biosorption of CV dye

3.6 Effect of temperature

The impact of temperature was critical on the balance dye take-up. The fig. 3.6 shows the impact of changes in the temperature on the CV dye take-up. The adsorption limit of *G. pusillum* for the CV dye expanded with the temperature is the outcome found in the chart. Alongside the temperature, 283 (67 %) to 323K (81 %) it might be aftereffect of increment in the portability of the enormous dye particle. Dynamic locales at the surface go through a connection by expanding number of atoms may likewise required vitality. Further the interior structure *G.pusillum* empowering enormous dyes to enter with the temperature expanding which may create a growing effect.

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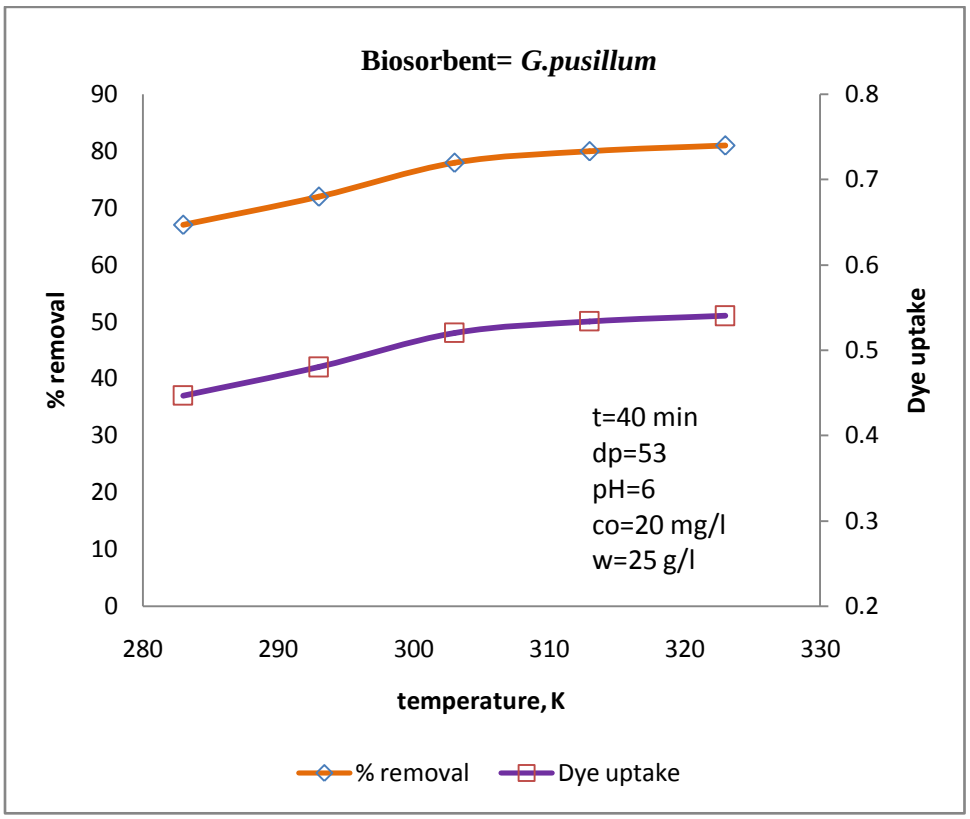

Fig. 3.6. Effect of temperature on % biosorption of CV dye.

Conclusion:

The aim of this investigation is to determine the suitability of *G. Pusillum* as sorbents for the removal of CV dyes from aqueous solutions. The equilibrium agitation time for CV dye sorption is 40 minutes, percentage adsorption of CV dye from the aqueous solution increases significantly with increase in pH from 2 (43%) to 6 (61 %), the optimum dosage for sorption is 53 g/L (1.12 mg/g), The maximum uptake capacity of 18.181 mg/g is obtained at 303 K.

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