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EQUILIBRIUM AND ISOTHERMAL STUDIES ON REMOVAL OF BISMARCK BROWN DYE USING MAGNESIUM NANOPARTICLES BY ADDING BACTERIAL CULTURE TO NANOPARTICLES

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Abstract

The research had been done on the removal of dyes from wastewater using low-cost and eco-friendly biosorbent options. A cheap and effective biosorbent for removing Bismarck Brown dye from aqueous solutions using magnesium nanoparticles by adding pseudomonas Aeruginosa culture to it, which is widely accessible. The equilibrium stirring time for BB dye sorption is 40 minutes. The optimum dosage for sorption is 2.6 g/L. Maximum extent of sorption is noted at pH = 7. The maximum uptake capacity of 6.6153 mg/g is obtained at 303 K. The experimental data are well represented by Langmuir (R2 = 0.994), Freundlich (R2 = 0.988) and Temkin (R2 = 0.994) isotherms.

Keywords: *Magnesium Nano Particles, pH, time, Dosage and Temperature.*

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1.0 Introduction

The main dangerous substances that endanger aquatic life are dyes.These are the main contaminants emitted by seve ral businesses, including food, paper, textiles, and more.Th ese water contaminants endanger aquatic life, and in order to reduce pollution and keep aquatic species alive, water e ffluents must be treated.Adsorption, photocatalytic destru ction, electrochemical decomposition, the Fenton reaction, and filtering are some of the techniques that have been de veloped thus far to remove the color[1-4].

Adsorption is the most appealing of these purification tech niques for elimination since it is simple to use inexpensive, very effective, produces no secondary polluti on, and is recyclable. Dye removal effectiveness depends on physicochemical effects.Features of comparable adsorb ent development.High specific surface area and internal po re structureArea, pore size distribution, pore volume, surf ace charge (both hydrophilic and hydrophobic), and functi onal surface group presence.Therefore, it is crucial to treat dyecontaminated wastewater using decontamination tech niques prior to their release.One of the most efficient and c osteffective methods for removing dyes from wastewater i s the adsorption of dyes on less costly and powerful materi als[5-7].

2.0 Experimental Procedure

2.1 Preparation of Nanoparticle Solution

To make the broth solution, Quisqualis indica leaves are co llected from surrounding areas, thoroughly washed to rem ove dust, and then cooked in distilled water.

The leafbased broth solution is combined with a 0.05M Mg $(NO3)2$ solution and heated to 60°C for 15 minutes. A shift in hue indicates the formation of nanoparticles.

2.2 Preparation of Dye Solution

To prepare the stock solution, 1g of dye powder is added t o 1000 ml of distilled water. This results in a dye solution with a concentration of 1000 ppm, from which 20 ppm is t aken for the procedure.

To determine the bioadsorption capability, batch equilibri um tests have been carried out for the removal of BB dye.

2.3 Studies on equilibrium and Isothermal biosorption:

A pre-weighed volume of magnesium nanoparticles was added to a predetermined volume of aqueous solution for a predetermined period of time in an orbital shaker in order to perform the biosorption in a batch procedure. Below is an explanation of the methods used to assess the different parameters: temperature, pH, initial lead concentration in aqueous solution, dose, and agitation time.

3.0 Results and Discussion

3.1 Effect of Agitation time

In Figure 3.1, Bismarck Brown's removal rate is plotted against stirring time. The plot shows that the removal rate increases continuously over the first 40 minutes of agitation. After a stirring time of 40 minutes, the change in the removal rate of the BB dye is fairly constant. Therefore, the equilibrium stirring time is 40 minutes. In the current study, the agitation time was extended from 5 minutes to 180 minutes, 50 ml of aqueous solution, 0.2 g of bacterial culture and 0.05 g of nanoparticles were added, and 11% to 52% of BB was removal. There was a dye achieved in stirring times 5-40 minutes [8-9].

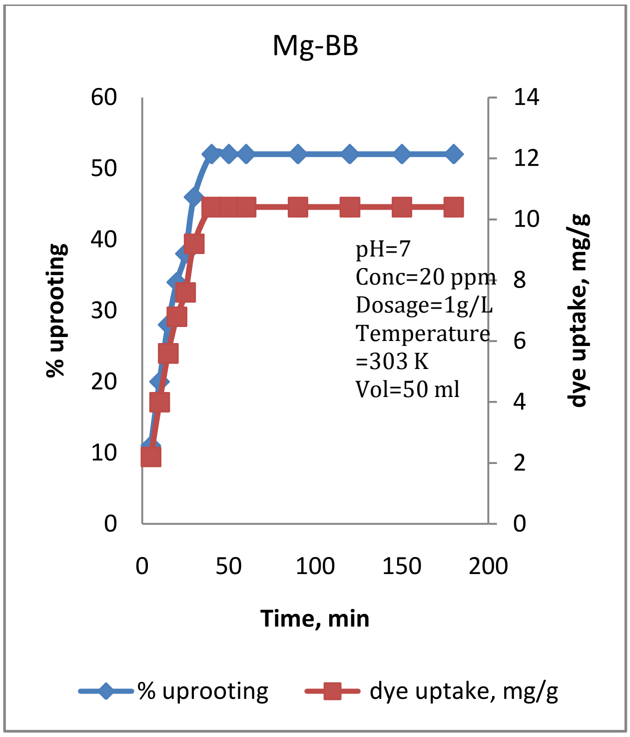

Figure 01: Effect of Stirring time of BB dye on % removal and Dye uptake

3.2 Effect of pH

Fig.3.2 is plotted among the removal of bismarck brown and the pH of the aqueous solution. When the pH will increase from 2 to 7, a pointy growth withinside the removal charge of BB is observed, and while the pH in addition will increase above 7, a lower with inside the removal charge is observed. In the modern examine of pH with the addition of fifty ml aqueous solution, nanoparticles and organisms, the removal elevated from 36% to 52% and the dye uptake changed into 7.2-10.4 mg / g withinside the pH variety of 2-7. The removal decreased over the pH value of 7 [10-11].

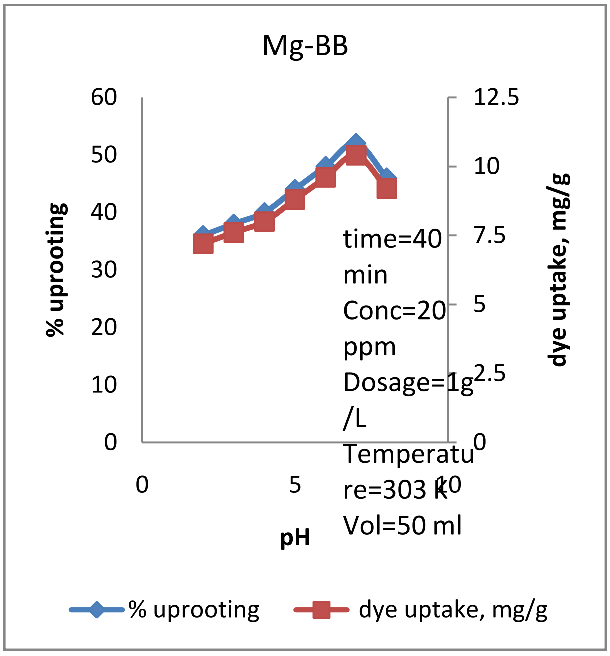

Figure 02: Effect of pH of BB dye on % removal and Dye uptake

3.3 Effect of concentration

In fig. 4.17 shows the Effect of the Bismarck Brown's initial concentration of the aqueous solution on the removal rate at an optimal stirring time of 40 min. As the concentration of dye BB increases from 20 to 100 mg/l, the removal rate gradually decreases from 52% to 32.3% and the bioadsorption of the dye increases from 10.4 mg/g to 32.3 mg/g. The initial concentration of Bismarck Brown also Effects the removal process. In general, increasing the initial dye concentration generally increases removal rate as it provides the driving force for the dye to migrate towards the surface of the bioadsorbent particles. Increasing the initial concentration of BB increases the ability of the dye to adhere to the bioadsorbent surface. [12-13].

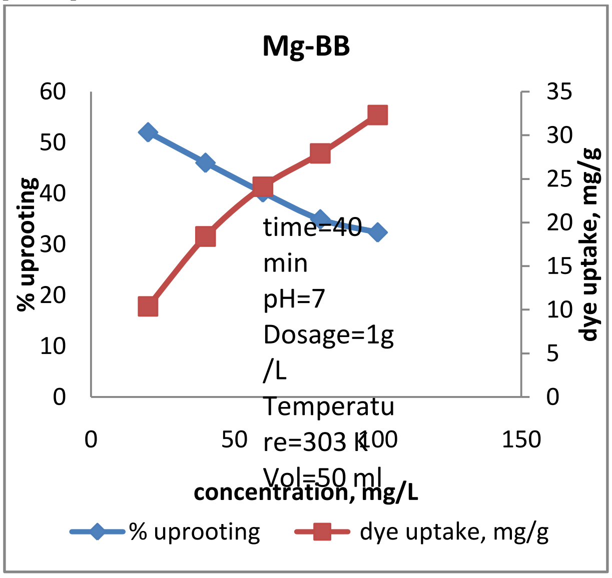

Figure 03: Figure Effect of concentration of BB dye on % removal and Dye uptake

3.4 Effect of Dosage

Figure 3.4 shows the change in bismarck brown removal rate from aqueous solution with biosolvent dose. Increasing the dose from 0.04 g of organisms + 0.01 g nanoparticles to 0.16 g organisms + 0.05 g nanoparticles increases the removal rate from 52% to 86%. Removal rate from solution increases by with increasing dose of bioadsorbent. This is because increasing the dose of bioadsorbent increases the number of active centers available for dye uptake. The increase in removal rate is not noticeable (84 to 86%) as the dose increases from 0.08 g org + 0.05 g Np to 0.16 g org + 0.05 g Np. Therefore, in all other remaining studies, the dose is assumed to be 0.08 g org + 0.05 g Np [14-15].

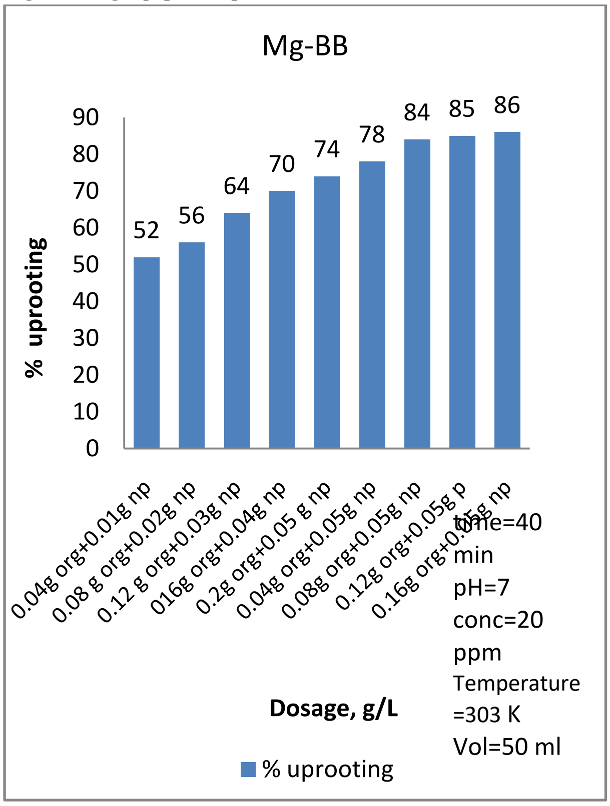

Figure 04: Effect of Dosage of BB dye on % removal

Increasing the concentration of bioadsorbent at a fixed BB concentration improves the availability of more removal sites for BB dyes and thus increases the degree of BB removal

3.5 Effect of Temperature

The temperature Effect on optimal dye absorption was important. Figure 3.5 shows the Effect of temperature changes on the uptake of BB dye. The results show that the Mg Nps bioadsorption limit on the BB dyes increases with temperature. As the temperature rose from 283K to 323K, the removal rate increased from 77% to 86%. Therefore, temperature affects the removal process [16-17].

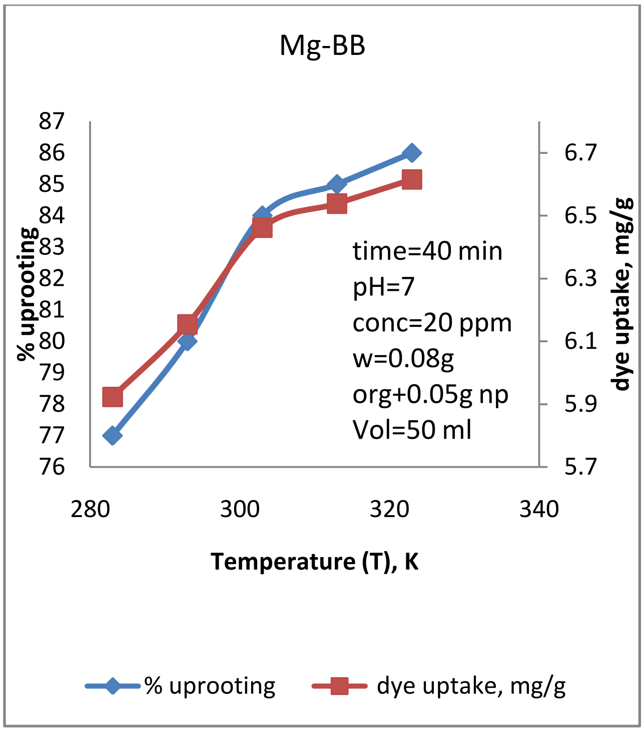

Figure 04: Effect of Temperature of BB dye on % removal and Dye uptake

3.6 Isotherms

3.6.1 Langmuir Isotherm

Langmuir isotherm is drawn between Ce / qe and Ce in Figure 3.6 for current data.

The resulting formula is equation 3.1

Ce / qe = 0.020 Ce + 0.736 ..... (3.1)

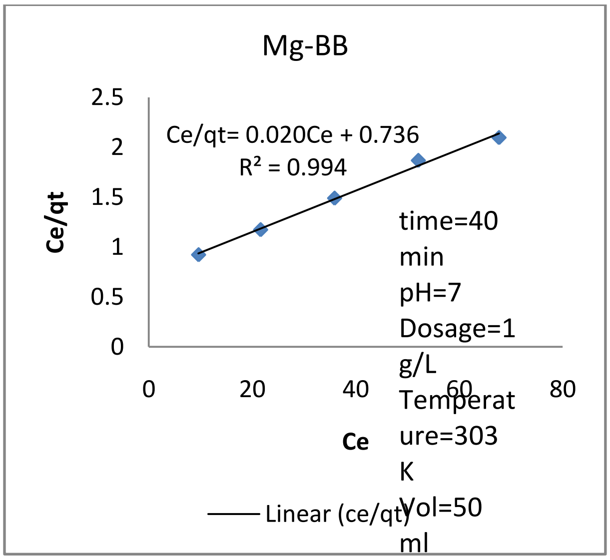

Figure 05: Langmuir Isotherm for BB dye

The (correlation coefficient 0.994) confirms the strong binding of bismarck brown ions to the surface of the QI **[18].**

3.6.2 Frendlich Isotherm

Freundlich isotherm is drawn between lnCe and lnqe in the figure. As a result of Fig 3.7, the following equation 3.2 was obtained:

$$\ln qe = 0.572 \ln Ce + 1.092 \;..... (3.2)$$

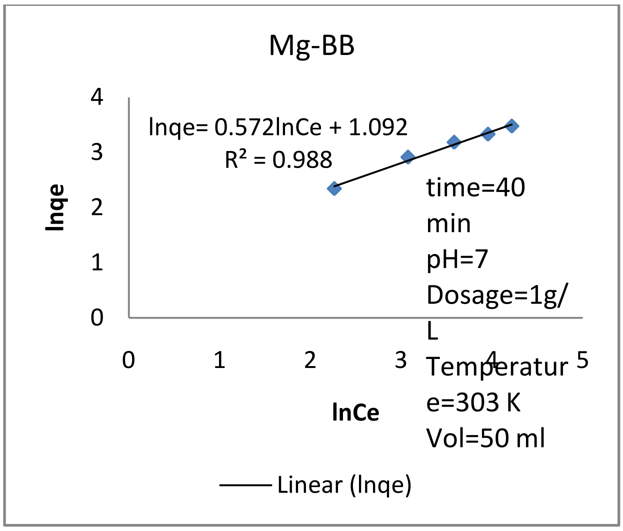

Figure 06: Frendlich Isotherm for BB dye

The correlation coefficient for this equation is 0.9999. A value of 0.572 for "n" indicates a convenient distance that satisfies the condition 0< n <1 [19].

3.6.3 Temkin Isotherm

Fig 3.8 shows the diagram between qe and lnCe. The formula for the distance from Bismarck Brown is obtained as equation 3.3: [20]

qe= 10.96lnCe – 14.85 ..... (3.3)

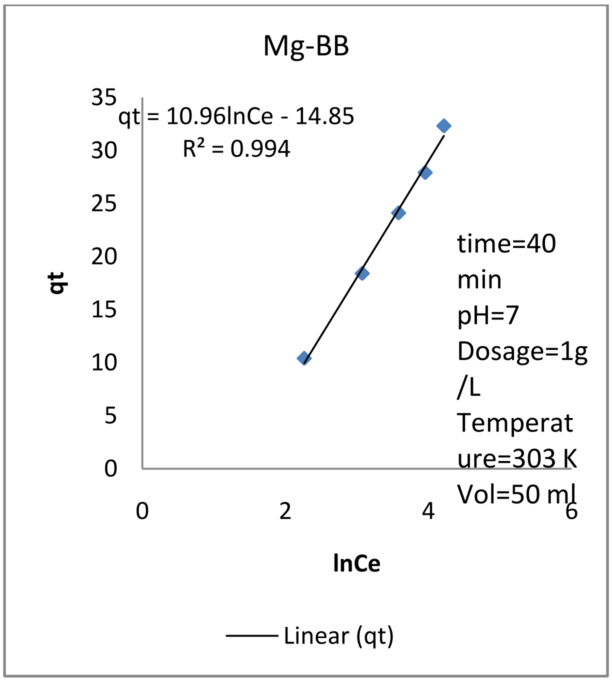

Figure 07: Temkin Isotherm for BB dye

Table 01: Equations and Isotherm constants for BB dye

Equations and Isotherm constants for BB dye Langmuir isotherm Ce / qe = 0.020 Ce + 0.736	Freundlich isotherm ln qe = 0.572 ln Ce + 1.092	Temkin isotherm qe= 10.96lnCe – 14.85
qm = 50 mg/g	Kf = 2.980 mg/g	AT = 0.257 L/mg
KL = 0.027	n = 0.572	bT =
		229.848
RL = 0.793		
R2 = 0.994	R2 = 0.988	R2 = 0.994

4.0 Conclusion

This investigation aims to determine the suitability of Magnesium Nanoparticles as a biosorbent for the removal of Bismarck Brown dye from aqueous solutions for biosorption of BB dye experimentally and theoretically, resulting in the following conclusions:

- The equilibrium stirring time for BB dye sorption is 40 minutes.
- The optimum dosage for sorption is 2.6 g/L.
- Maximum extent of sorption is noted at pH = 7.
- The maximum uptake capacity of 6.6153 mg/g is obtained at 303 K.
- The experimental data are well represented by Langmuir (R2 = 0.994), Freundlich (R2 = 0.988) and Temkin (R2 = 0.994) isotherms.

5.0 Acknowledgement

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