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Degradation Of Synthetic Dyes By Green Synthesis Of Silver Nanoparticles Using Leaf Extract

Dr. Jeldi Anitha[1], Lukas Gelibo[2], Dr. Srikanth Komarabathina[3], Dr. CH.AI.Raju[4]

[1]Lecturer, Department of Petroleum Technology, Aditya Education Institution, East Godavari – 533 437, AP, India
[2]Lecturer, Departments of Chemical Engineering, KloT, Wollo University, Kombolcha, Ethiopia
[3]Assistant Professor Departments of Chemical Engineering, KloT, Wollo University, Kombolcha, Ethiopia
[4]Associate Professor, Department of Chemical Engineering, Andhra University, Visakhapatnam – 530 003, AP, India

ABSTRACT
The Textile effluent toxicity is currently a worldwide concern. To address this issue, this study introduced a low-cost, environmentally friendly technique for toxic dye adsorption. Green synthesis has gotten a lot of attention in materials science as a reliable, sustainable, and environmentally friendly method for making a variety of materials/Nano-materials, such as metal/metal oxide nanomaterial's, hybrid materials, and bio inspired materials. As a result, green synthesis is seen as an important tool for reducing the harmful effects of traditional method. When the aqueous leaf extract was added to the silver nitrate solution, the reaction medium's color changed from pale yellow to brown, indicating that the silver ions were reduced to silver nanoparticles. The UV-Vis spectrophotometer was used to identify the synthesized silver nanoparticles. Scanning electron microscope (SEM) was used to examine dispersion and morphology. The effective functional molecules responsible for the reduction and stabilization of silver nanoparticles synthesized by leaf extract were identified using the FESEM and FTIR spectrum. The present experimentation carried out in a batch process using sorption method. The optimization studies are pH, concentration, temperature and the green synthesized silver nanoparticles effectively degraded the dye by nearly 95 percent.
Keywords—Silver nanoparticles, Dyes, Broth solution, SEM, FTIR, FESEM

1. Introduction

Nowadays the Nanotechnology has provided a new platform for wastewater treatment/purification. Nanotechnology is perhaps the most dynamic examination fields in current material science and innovation [1]. The synthesized Nanoparticles were effectively utilized as an eco-friendly Nano-sorbents in water remediation to remove modal dyes. In this research studied on the Green synthesis of silver Nanoparticles were used because Ag-NPs have excellent medical and non-medical properties and applications compared with other metallic nanoparticles [2]. The plant-based nanoparticle can have immense application in the field of food, drug, and corrective businesses.

2. Experimental Methods or Methodology

Stock solution containing 1.0 g of RB dye dissolved in 1.0 litre double distilled water. The gathered plants leaves were washed with water a few times until the soil particles are taken out. Later through washing with distilled water, sorbents was dried in sun light for thirty days, cut into little pieces, powdered and sieved. In the current experiment, 53, 75, 105, 125 and 152 µm size powders were utilized as sorbents with no other pretreatment. In this process 10 gms of fresh and cleaned

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leaves of Ceiba Pentandra through washing with distilled water after cutted into pieces and kept in the magnetic stirrer flask, to this 100 ml of distilled water is added and it is warmed at 60 °C for 30 min. After 30 min the solution is filtered and taken away from the flask for further process. The broth obtained is in pale yellow color. 50 ml of broth solution is taken and to that 50 ml of 1.0 mM silver nitrate AgNO3 (0.17g) is added in 250 ml conical flask and is kept in an oven for around 10 min at 60 °C to obtain Silver Nano particles. The Nano particles arrangement is seen when the pail (light)-yellow color is changed to dark brown color. Experimentation carried out in a batch wise process and characterisation studies like FTIR and SEM analysis.

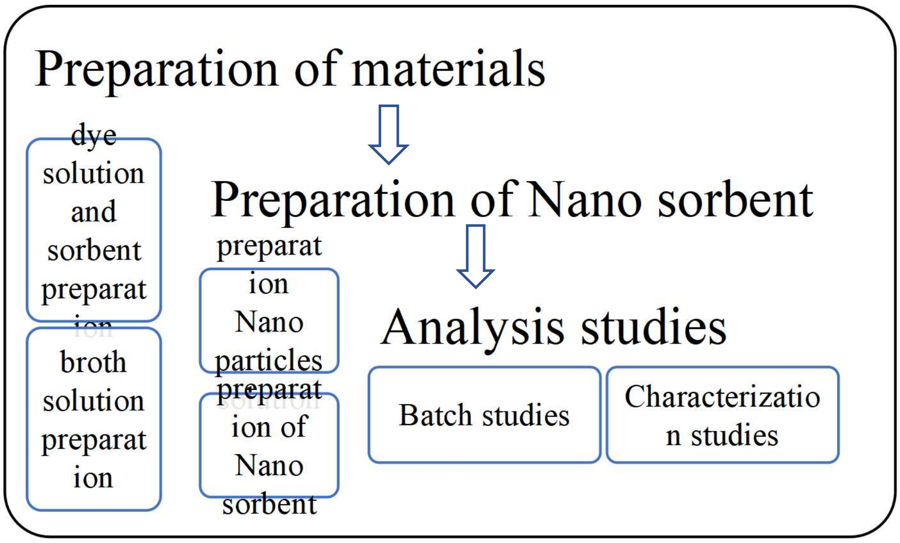

Fig. 1. Experimental procedure

3. Results and Discussion

3.1 Impact of Shaking Time

Fig.2 demonstrates the corruption of green combined silver nanoparticles as for shaking time. Notwithstanding, there was an abatement after 25 min (49%), dye uptake (12.25mg/g). The rate of % of removal is higher in the initial stages because adequate surface area of the sorbent is available for the removal. Similar views were formed by Ovais et al [3].

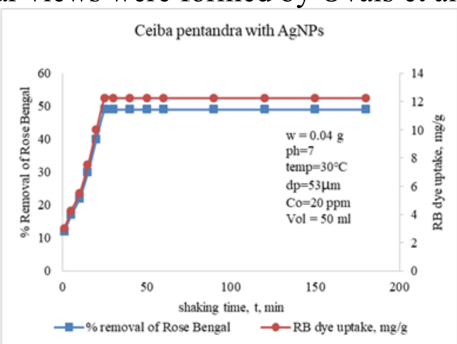

Fig. 2. Impact of shaking time on % removal of Rose Bengal dye

3.2 Impact of pH

pH was differed from 2 to 8. It very well may be seen that the level of debasement expanded with an expansion in pH with an ideal rate removal of 65 % (16.25 mg/g) at pH 5 (Fig.3), Inspected and comparative reports of outcomes discovered by Anna Klepacz-Smólka et al [4].

3.3 Impact of initial concentration

At higher focuses, 20 and 200 ppm at different boundaries were steady for example shaking time 25min, pH 5.0, portion 0.04 g and temperature 30°C, showed a low-rate corruption of 65 % (16.25 mg/g) and 47.5 % (118.75 mg/g), in fig. 4 at high concentration, large number of the dye molecules

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occupied the adsorbent surface, resulting into removal of high number of the dye molecules, similar exploratory work was completed and comparable results were obtained by Ramalingam et al [5].

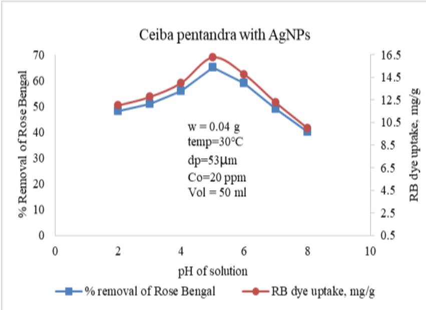

Fig. 3. Impact of pH on % removal of Rose Bengal dye

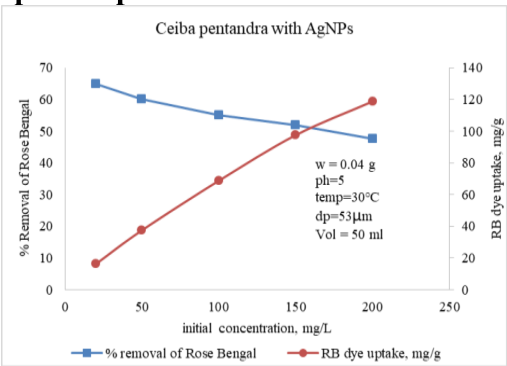

Fig. 4. Impact of concentration on % removal of Rose Bengal dye

3.4 Impact of dosage

The impact of silver nanoparticles dosage was concentrated from 20 ppm, shaking time 25min at pH 5. Fig.5. shows that the rate corruption expanded from 0.04g (65 %) to 0.24g (88 %) and diminished at 0.16g (85 %). This could be because of the agglomeration of silver nanoparticles at higher dosage. Besides, it would suggest that at 0.16 g, the dissipating and screening of light by nanostructures happened. Similar discernments were made by Isa et al [6].

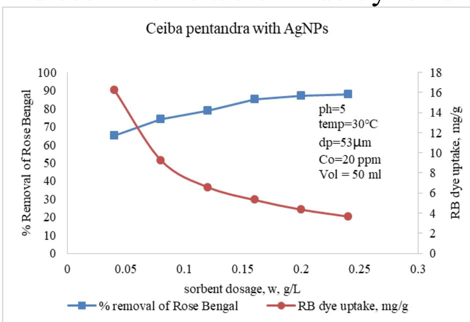

Fig. 5. Impact of dosage on % removal of Rose Bengal dye

3.5 Impact of Temperature

The Impact of temperature on the sorption speed of Rose Bengal on Ceiba Pentandra was explored some place in the scope of 283 and 323 K using 0.04 g, shaking time 25min, pH 5 and Co 20 ppm, CP (Fig.6). Results show that the degree of shading clearing extended moderately to the temperature, Furthermore, changing the temperature will change the equilibrium furthest reaches of the sorbent for a specific sorbate, Inspected and comparative reports of outcomes discovered by Albukhari et al [7].

3.6 Characterization of Ceiba pentandra with Ag-NPs powder

FTIR spectrum of untreated and treated Ag-NPs powder with RB dye

FTIR spectrum of untreated and treated Ceiba pentandra with Ag-NPs powder is presented in fig.7. The sharp peaks of 1027.056 cm-1 arose suddenly after loading of RB dye due to the involvement of denoting stretching of C–O stretching respectively. Further, three additional peaks at 1233.170

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cm-1 for -SO3 stretching 1335.558 cm-1 for –CH2 bending vibrations have suddenly appeared in RB dye treated. The peak appearing at 1608.151 cm-1 in RB dye treated powder is denoting C = C and Carbonyl C = O stretching and is not seen in native biomass. The characteristic of stretching modes of O–H (indicated by the band at 3336.936 cm-1) is also not seen in untreated biomass [8].

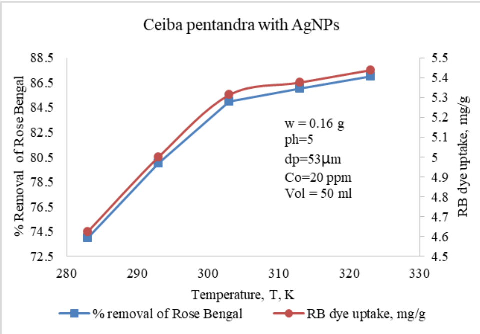

Fig. 6. Impact of temperature on % removal of Rose Bengal dye

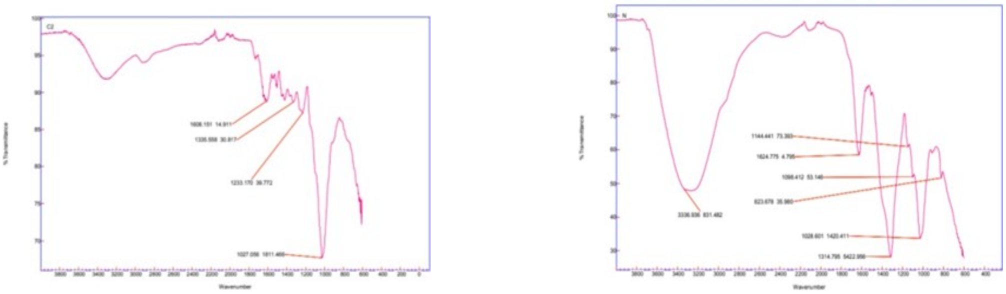

Fig. 7. FTIR spectrum of RB dye untreated and treated Ceiba pentandra with Ag-NPs powder

Table. 1. FTIR peaks for untreated and treated Ceiba pentandra with Ag-NPs, RB dye

Peaks in untreated powder, cm-1	**Peaks in treated powder,cm-1**	**Description**
---	823.678	S = O and C–S–O bands fromester sulphonate
1027.056	---	C–H bending vibrations
---	1028.601	C–H bending vibrations
---	1098.412	C–H bending vibrations
---	1144.441	C-O stretching
1233.170	---	-SO3 stretching
---	1314.795	–CH2 bending vibrations
1335.558	---	–CH2 bending vibrations
1608.151	---	C = C and Carbonyl C = O stretching
---	1624.775	C = C and Carbonyl C = O stretching
---	3336.936	OH stretching or –NH2 stretching

Scanning Electron Microscope (SEM)

SEM analysis for untreated and treated Ceiba pentandra with Ag-NPs powder

The SEM pictures of untreated Ceiba pentandra with Ag-NPs powder displayed in fig.8. Due to running intended to control impacts of substances ordinarily removed Rose Bengal dye structures,

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the typical width of the Ceiba pentandra sorbent could vary marginally. After sorption with Rose Bengal dye, SEM pictures of Ceiba pentandra basically delineate that there is a facade, and the photo uncovers the lobed order.

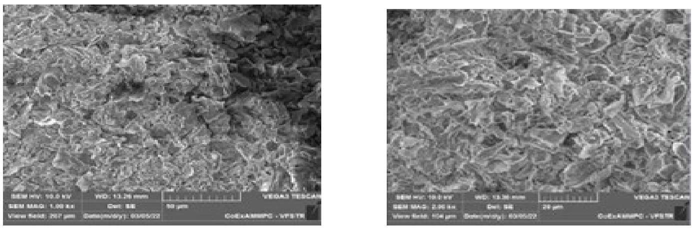

Fig. 8. SEM pattern of RB dye treated with Ceiba pentandra

SEM analysis after removal in Fig.9 shows that the surface has irregular texture with globular, elongated grains and shiny particles over the surface of sorbent which are absent in the fresh sorbent. The clustered grains like morphology, on treated sorbent denote increased active surface area [9]. SEM micrographs of Ceiba pentandra upon sorbent with Rose Bengal dye after addition of Ag Nanoparticles merely shows that there is indeed a facade, and the image exposes the shaped hierarchical system.

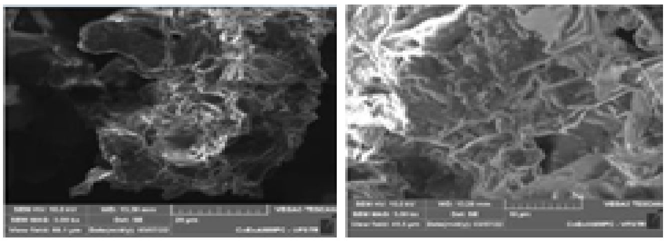

Fig. 9. SEM pattern of RB dye untreated with Ceiba pentandra

3.7 FESEM Analysis

From the FE-SEM (Field Emission of Scanning Electron Microscope) to know the formation of Ag-NPs and its size [10]. From the fig.10 the Ag-NPs with a particles size between 100 nm to 150nm (depending on the concentration of broth solution).

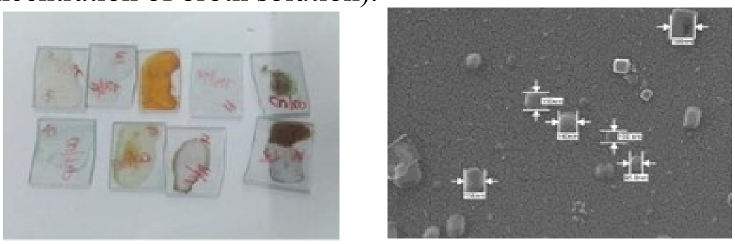

Fig. 10. FESEM Analysis for silver Nano particles

CONCLUSION

The conclusion should include the following: The silver Nanoparticles has been successfully prepared by using medicated plant leaf extract i.e., Ceiba pentandra. This bio synthesized silver Nanoparticles were implemented for removal of synthetic dyes from its aqueous solutions. The synthetic dyes were removed from the water solution using these biosynthesized silver Nano particles. Ceiba pentandra plant leaves sorbent is more effective than reducing water pollutants from colored dyes, according to the study. Overall, the study suggests achievement of an ecofriendly and highly efficient sorbent which may be considered useful for the removal of dyes.

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