

ADSORPTION OF METHYLENE BLUE DYE USING MANGO LEAF POWDER

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INTRODUCTION & AIM

- The increasing pollution of water bodies due to industrial effluents has raised significant environmental concerns, particularly regarding the presence of synthetic dyes such as methylene blue.
- Methylene blue is a cationic dye widely used in various industries, including textiles, pharmaceuticals, and food processing.
- Water pollution is one of the most unpleasant environmental problems in the world.
- The direct discharge of water waste from textile industries which include contaminants from dying process makes it hard for treatment because the dye present are chemicals with complex structure which is why normal biological treatment is not enough for the removal of colors from water.
- Its persistence in aquatic environments poses serious risks to both human health and ecological systems.
- As a result, effective methods for removing methylene blue from wastewater have become a focal point of research.
- Adsorption has emerged as one of the most promising techniques for dye removal due to its simplicity, cost-effectiveness, and efficiency.
- So adsorption technique using various adsorbents were applied which in this case activated carbon was due to its high adsorption capacity, availability and non-toxicity and also agricultural adsorbents (Mange Leaf Powder) was used as they are available and do not affect the environment.
- The use of plant based materials not only provides an eco-friendly solution but also contributes to waste management by valorizing agricultural residues.
- Utilizing mango leaf powder for methylene blue dye removal presents a sustainable approach to addressing water pollution challenges while promoting resource recovery from agricultural waste.
- This work highlights the importance of exploring natural biosorbents like mango leaves in developing efficient wastewater treatment solutions

METHOD

Mango leaf powder preparationGrinding Process

- ❖ The sample of mango leaf powder were sorted, washed with tap water and then with distilled water.

- ❖ The samples were grounded into a fine powder in a grinding machine (a blender).
- ❖ The sample was grounded to produce a fine powder to pass through a 1mm sieve.

- ❖ The samples were stored in airtight bottles from which the required quantities were removed for chemical determination and analysis.

Material Characterization

- ❑ The surface morphology of the synthesised materials was examined using Scanning Electron Microscopy (SEM).

- ❑ Thermogravimetric Analysis (TGA), Fourier transform infrared spectroscopy (FT-IR) was used to analyse sample functional groups in the synthesised materials using an FTIR spectrophotometer (Carry 630, Agent technologies).

- ❑ The functional group composition of the synthesised adsorbent materials was presented in the wavenumber range from 4000 cm⁻¹ to 400 cm⁻¹ and determined under Happ Genzel Appotization mode.

- ❑ X-ray diffraction (XRD) was used to determine the crystalline phases present in the synthesised samples. The XRD patterns were scanned in the 2θ (theta) range of 10 – 80° using the Goniometer operating in continuous scan mode. The XRD analysis was performed under Cu radiation, 40 mA applied current, and 45 kV accelerating voltage.

Procedure

- ✓ A ultraviolet visible spectrophotometer device was used to determine the adsorption capacity of mango leaf powder.

Preparation of methylene blue dye stock solution

- A synthetic wastewater mother liquor was formed by dissolving 1 g of methylene blue dye in 100 ml distilled water.

- At first, a sample of this wastewater was scanned using UV to determine the maximum wavelength of dye, the maximum wavelength was found to be 560 nm.

Batch analysis of methylene blue dye from water using mango leaf powder

- ❖ The effect of pH, dose, concentration, time and temperature were examined, so batch adsorption was performed. As a first step, mango leaf powder was prepared by washing mango leaf using tap water then distillate water.

- ❖ After washing they were dried at 60oC in the oven to get rid of the moisture content, then grinding was performed to increase the adsorption surface area. Then powder was used as such without further treatment.

- ❖ Different dose of mango leaf powder was taken to be able to determine the most effective dose for a constant concentration which is 100 ppm at 100rpm and 25°C, so 0.1, 0.5, 1, 1.5 and 200 mg of adsorbents were applied and samples were taken every 10 minutes to check the performance of the adsorbent.

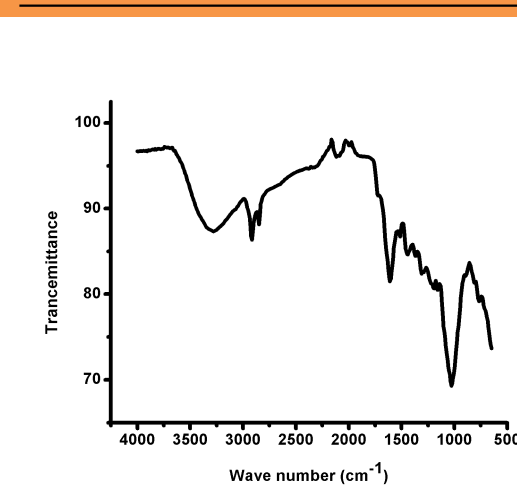
- ❖ Different parameters were studied, effect of pH (2,4,6,8,10), effect of adsorbent dose (0.1, 0.2, 0.3, 0.4, 0.5) g, effect of dye concentration (10,15,20,25) ppm, effect of temperature (10, 20, 30, 40 and 50) °C, and effect of contact time (10, 20, 30, 40, and 50) min.

- ❖ At all parameters the concentration was measured with constant time intervals (10 min) up to reaching equilibrium concentration

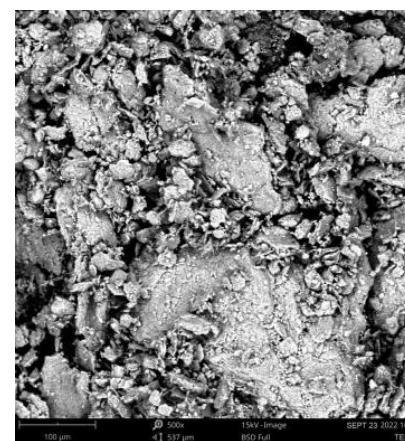
RESULTS & DISCUSSION

RESULTCharacterization

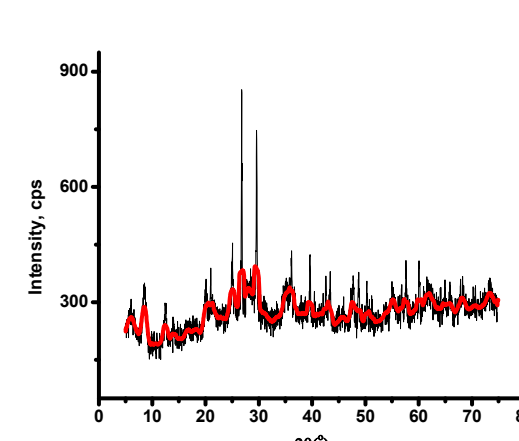
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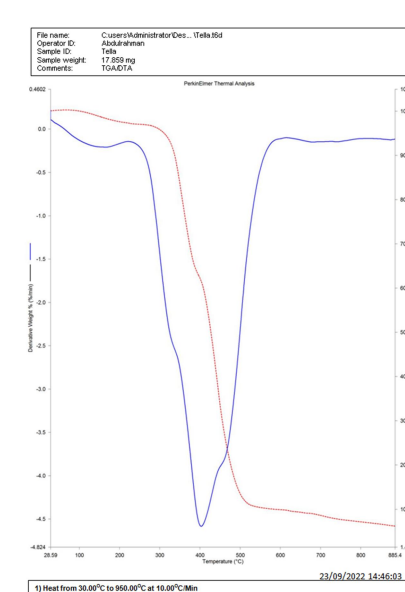
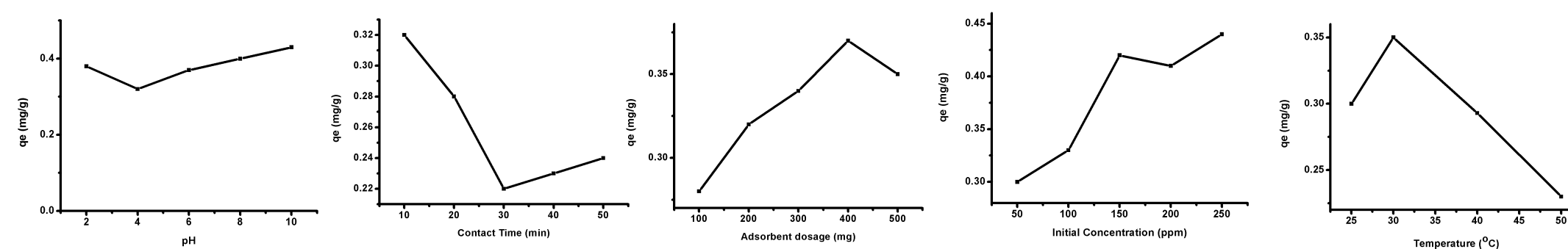
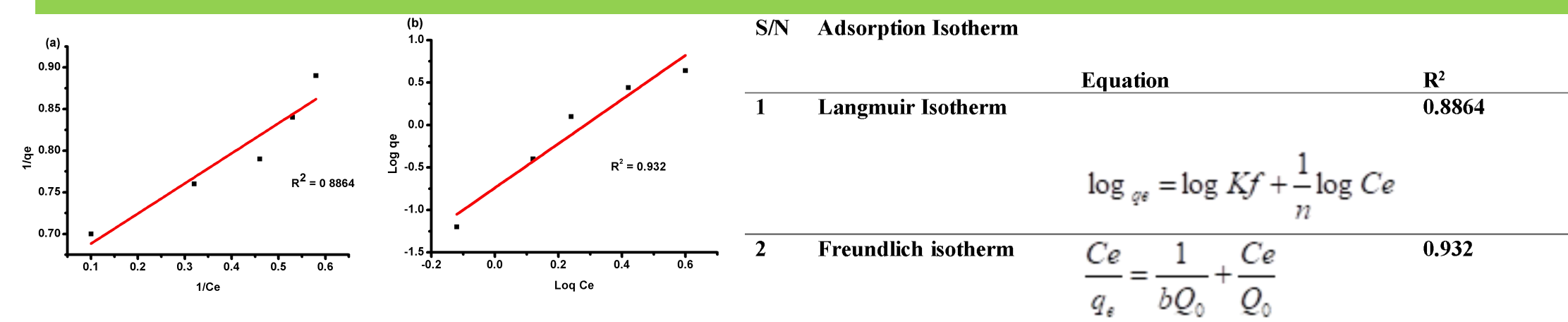
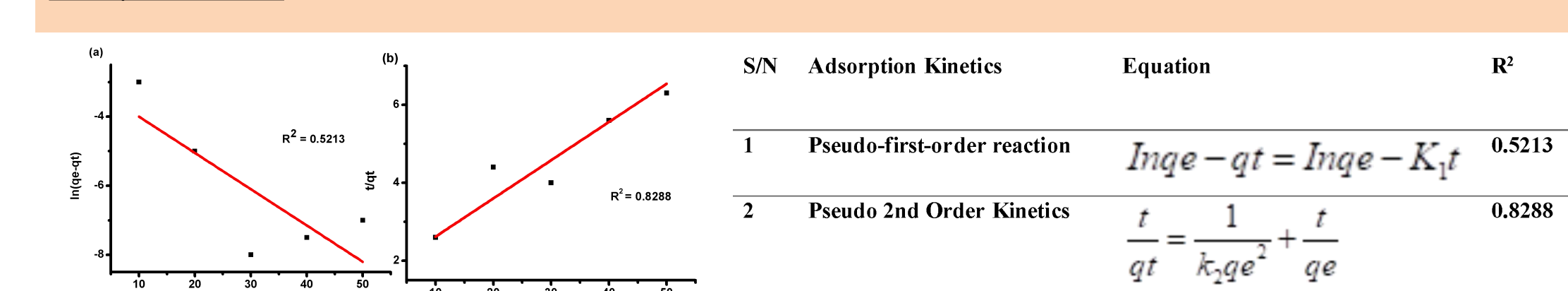
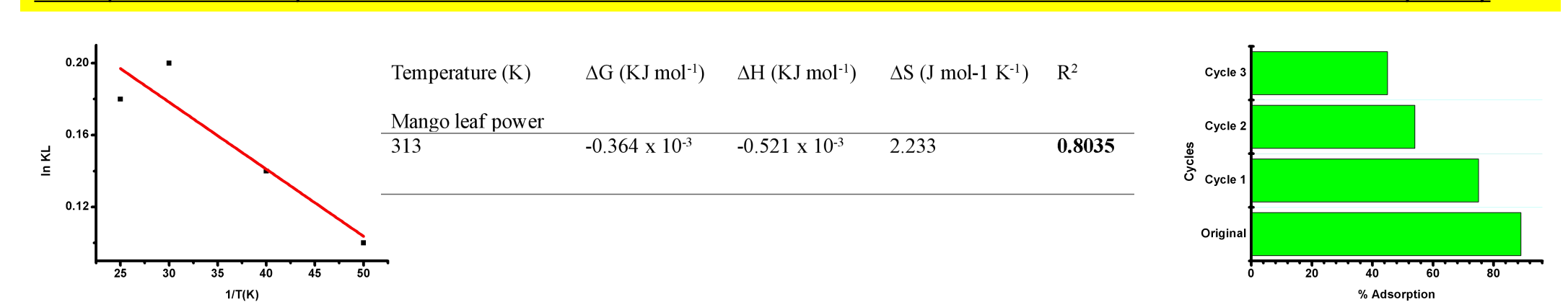
SEM



XRD



TGA

Parametric Investigation of methylene blue onto Mango leafAdsorption MechanismAdsorption IsothermAdsorption KineticsAdsorption ThermodynamicsReusability study

CONCLUSION

- ❖ This wor successfully produced an eco friendly adsorbent with high removal efficiency for methylene dye in water.
- ❖ The study revealing a higher correlation coefficient for the Freundlich model (R² = 0.932)
- ❖ Kinetic studies indicated that the pseudo-second-order model provided a better fit for the adsorption process (R² = 0.8288)
- ❖ Thermodynamic parameters were calculated, showing a Gibbs free energy change (ΔG) of -0.364 × 10⁻³ kJ/mol, an enthalpy change (ΔH) of -0.521 × 10⁻³ kJ/mol, and an entropy change (ΔS) of 2.233 J/mol·K, indicating that the adsorption process is spontaneous and exothermic in nature.
- ❖ Furthermore, a reusability study demonstrated that mango leaf powder can be effectively reused across three cycles without significant loss in adsorption capacity, affirming its potential as a sustainable biosorbent for wastewater treatment applications.

FUTURE WORK / REFERENCES

Future work

- ✓ There is room for future wor where mango leaf power can bemoified with nano materials like nanoparticles and metal Organic Framworks for improved adsorption

References

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