Enhanced removal of Methyl red dye from aqueous solutions using Zirconium oxide impregnated Royal palm fiber Activated carbon (ZrO_2-RPAC)

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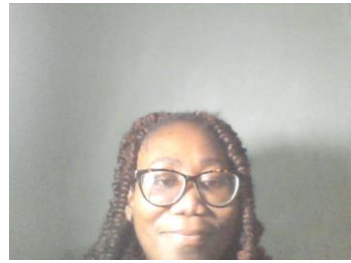
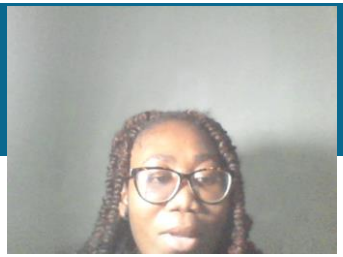


OUTLINE



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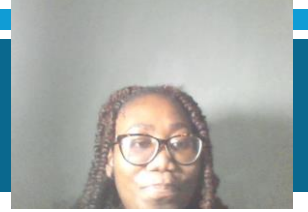
INTRODUCTION (BACKGROUND)



- The continuous use of synthetic dyes by textile manufacturing and hair dye industries and the subsequent discharge of these effluents into the environment poses a great danger to mankind and the environment at large (Uddin, 2021).
- The turbidity of the water is increased by the suspended particles associated with colored and greasy contaminants, which prevents sunlight from penetrating, which is important for the process of photosynthesis (Singha et al., 2021).
- The susceptibility of these dyes to bioaccumulate in the food chain, ultimately has an impact on human health (Al-Tohamy et al., 2022).

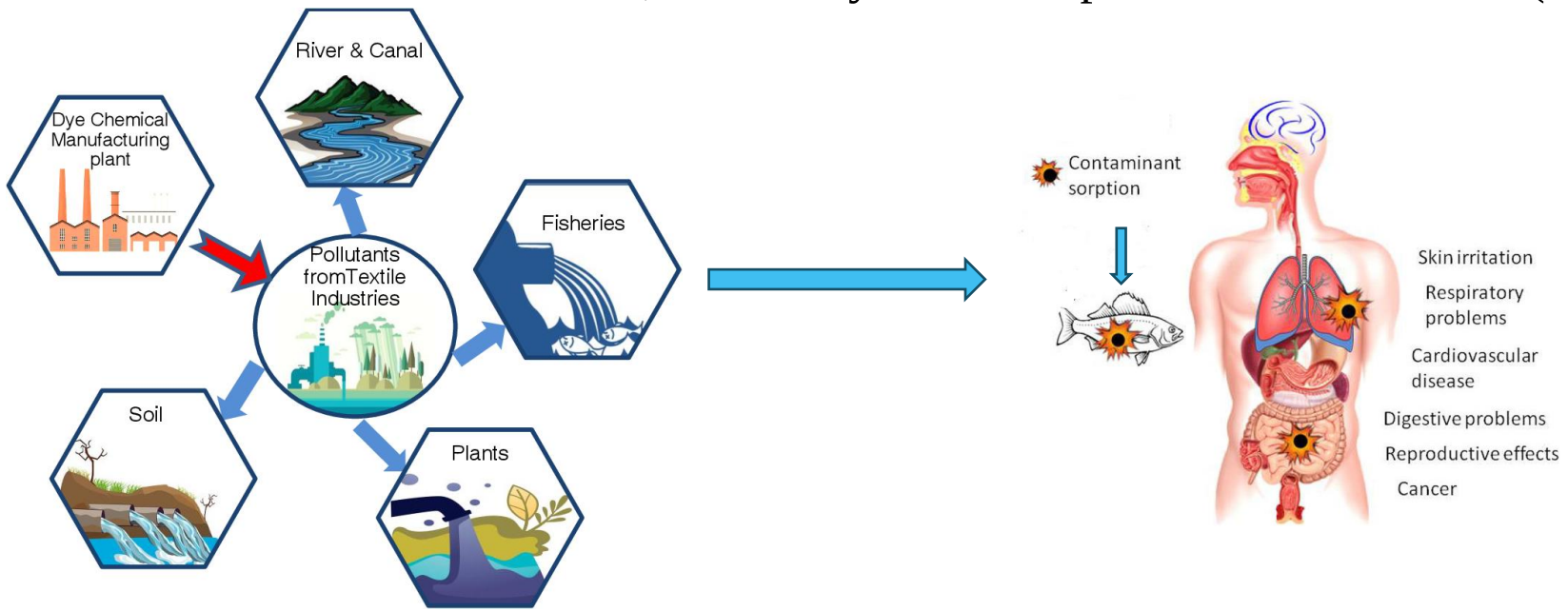
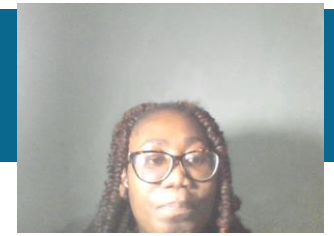


Fig 1. Effect of discharge of textile effluents

INTRODUCTION



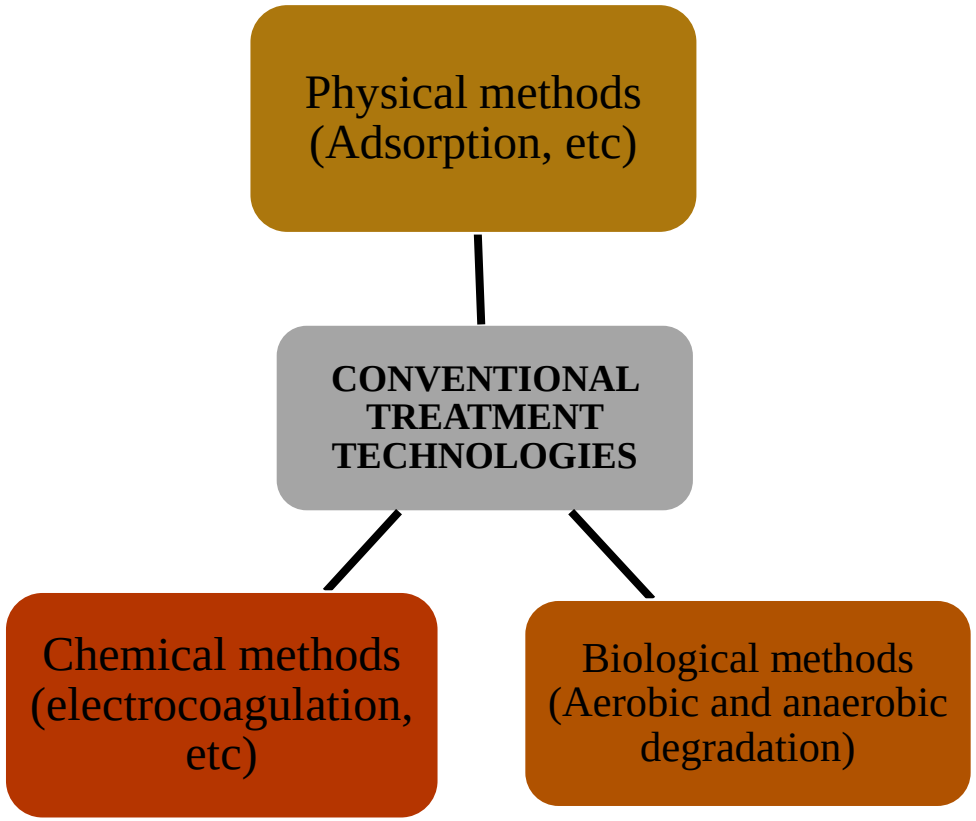


Fig 2. Conventional treatment techniques

SETBACKS

- Sludge generation, high maintenance cost, toxicity of dyes to microorganism, etc. (Pang & Abdullah, 2013; Dawood & Sen, 2014).

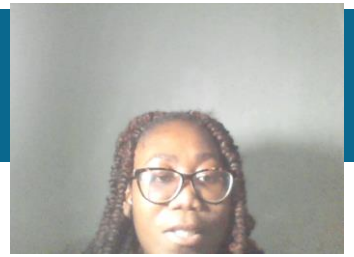
ADSORPTION

- flexible and simple in design, low cost and ease of operation, does not result in the formation of harmful substances. (Rafatullah et al., 2010)

JUSTIFICATION

- Advent of nanotechnology can provide a solution in water remediation.
- Lack of total recovery: Surface modification by incorporating into polymers
- Determine efficacy of material: Adsorption removal experiments and adsorption isotherms

AIM AND OBJECTIVES



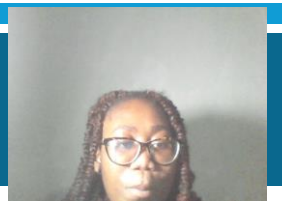
AIM

To synthesize zirconium oxide impregnated royal palm fiber activated carbon nanocomposite (ZrO_2-RPAC) for the removal of methyl red dye from aqueous solutions.

OBJECTIVES

- To synthesize ZrO_2-RPAC nanocomposites by in-situ polymerization technique.
- Characterize the materials using analytical techniques such as XRD and UV/Visible spectroscopy.
- Perform adsorption removal studies on the adsorbents using methyl red dye.

METHODOLOGY



Synthesis of ZrO_2 nanoparticles:

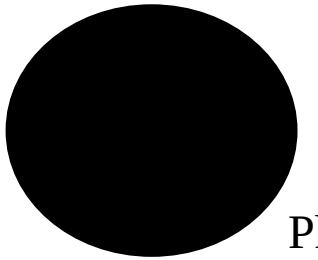
$ZrCl_4$ + Ethylene glycol → (25 % NH_4OH, Constant stirring) → Washing → (110 ° C, Calcination)

ZrO_2 NP

Preparation of RPAC/ZrO_2 nanocomposite

Royal palm fiber (RP)

H_2SO_4

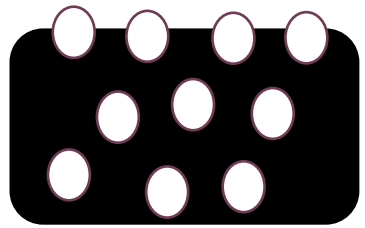


Chemical activated RP

110 ^oC, 3 hr, Physical activation

RPAC

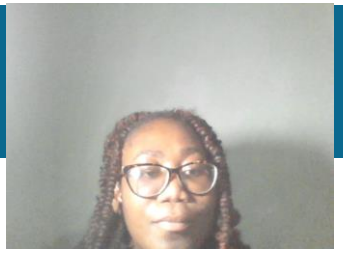
ZrO_2 NP, impregnation



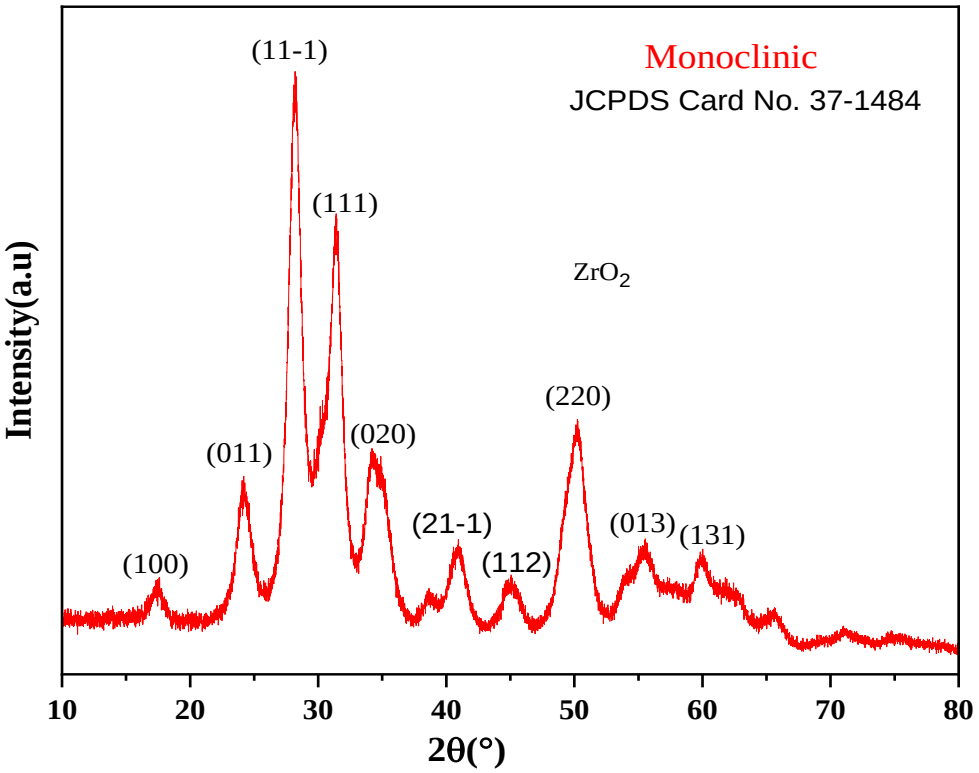
ZrO_2 –RPAC nanocomposite

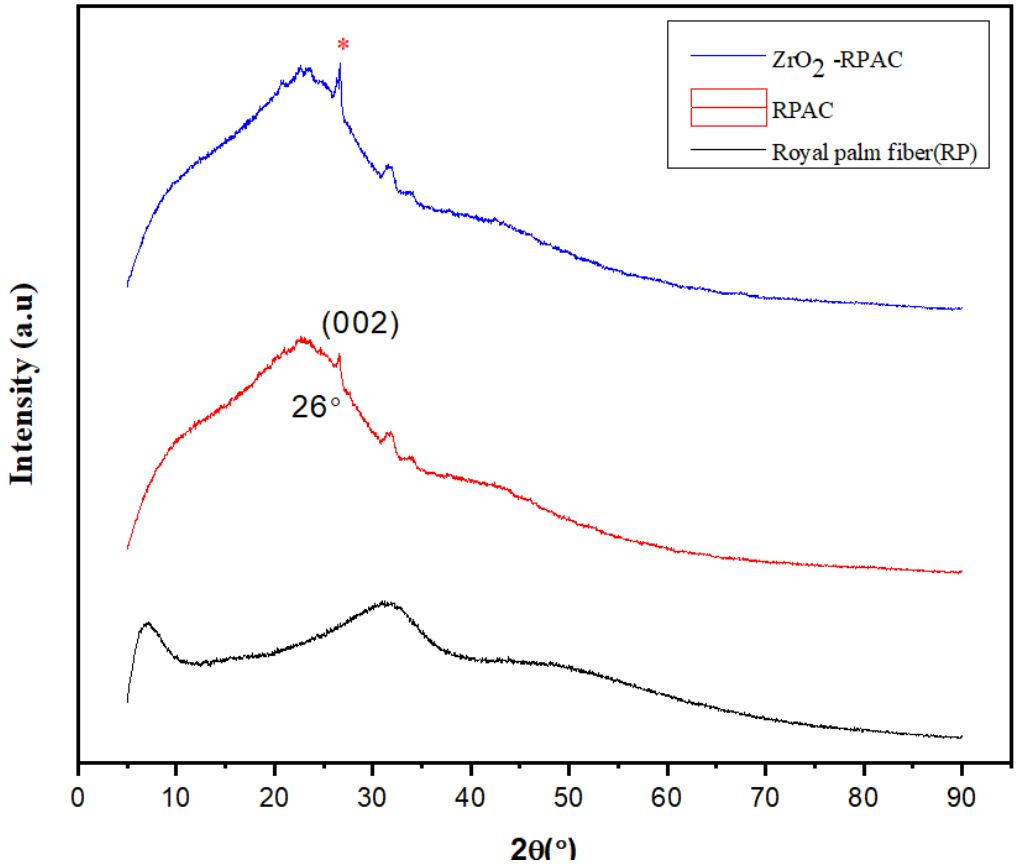
Fig 3. Flow chart for the synthesis of ZrO_2 NP and ZrO_2-RPAC composite

RESULTS AND DISCUSSION



XRD RESULTS

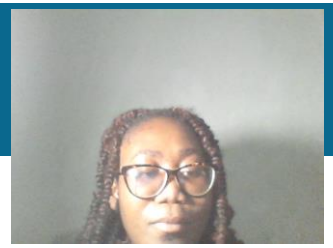




XRD pattern shows a peak at 2Θ = 26° indicative of a graphitic structure

Fig 4. XRD spectra of ZrO_2 nanoparticle and the Royal Palm Activated carbon composites

RESULTS AND DISCUSSION



ADSORPTION REMOVAL STUDIES

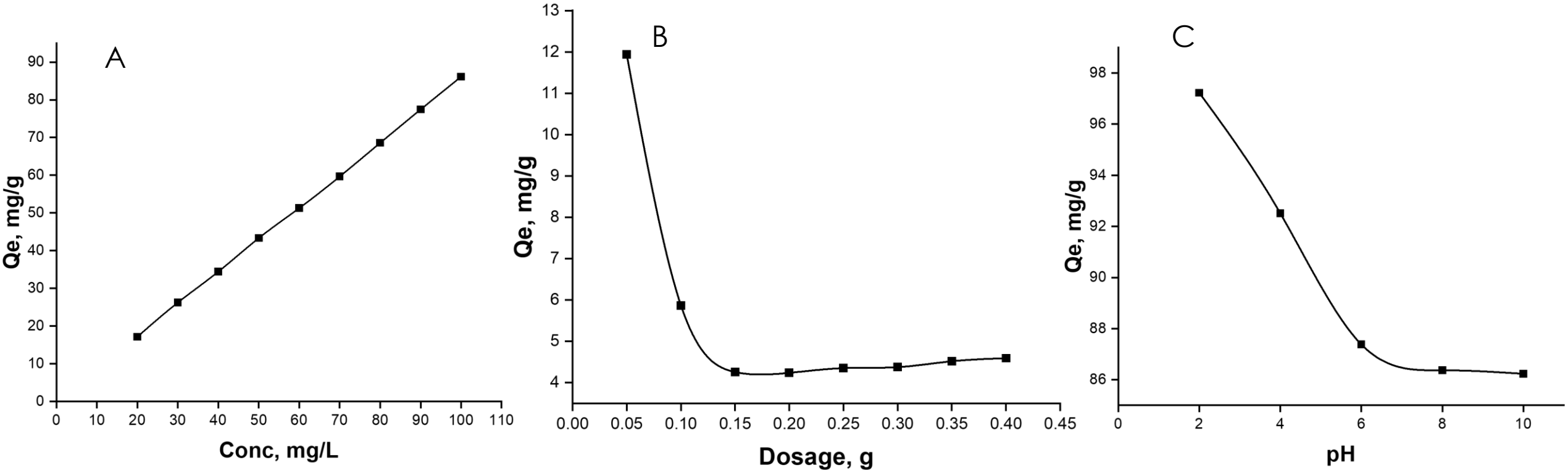
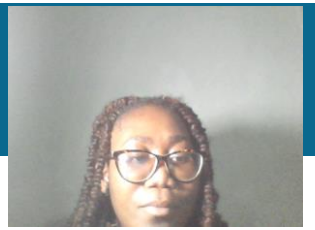


Fig 5. Effect of varying concentration (A), dosage (B) and pH (C) on MR dye adsorption onto ZrO_2-RPAC adsorbent

RESULTS AND DISCUSSION



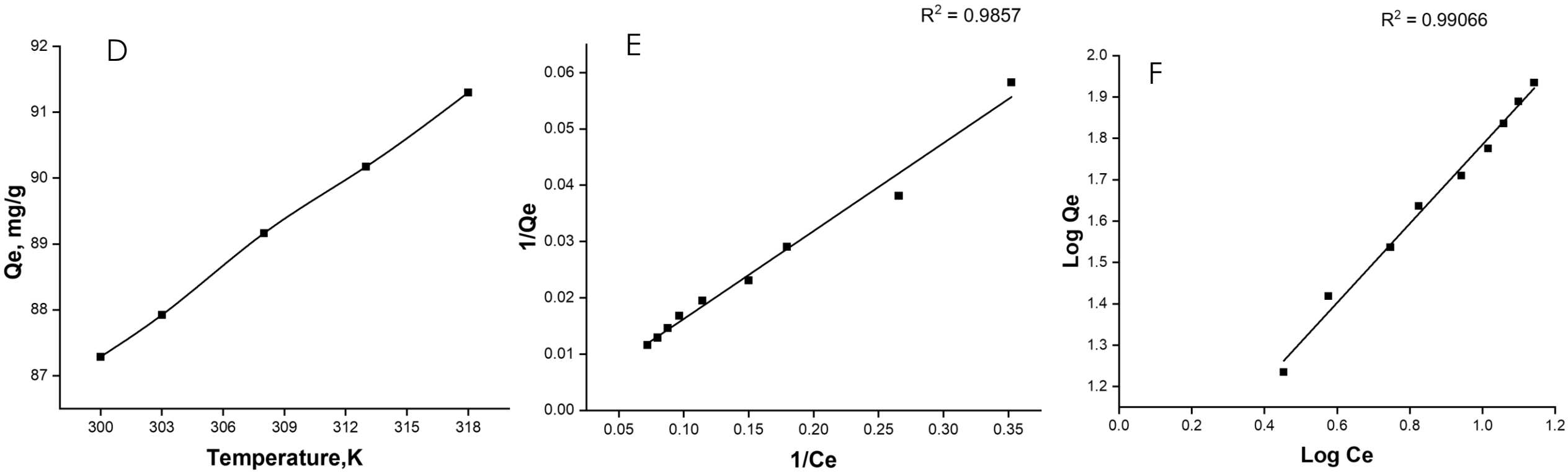
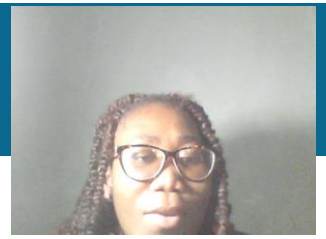


Fig 6. Effect of temperature (D) on MR dye adsorption onto ZrO_2-RPAC adsorbent, Langmuir (E) and Freundlich (F) isotherms plots of MR dye adsorption onto ZrO_2-RPAC adsorbent

CONCLUSION AND RECOMMENDATION



- ZrO_2 nanoparticles were successfully synthesized and impregnated into RPAC.
- XRD spectra confirmed the formation of the monoclinic phase ZrO_2 nanoparticle and RPAC composite.
- The nanocomposites produced, showed enhanced adsorption activity towards organic dye (methyl red) in aqueous solutions during the batch adsorption experiments
- The maximum dosage for methyl red removal for ZrO_2-RPAC was found to be 0.15 g, and acidic pH(ZrO_2-RPAC) was favourable for adsorption of methyl red dye.

RECOMMENDATION

- Further investigation may be conducted to determine the extent of reusability of the nanomaterials to help determine the number of cycles that the adsorbents can be used for in water treatment.

- ZrO_2-RPAC can be employed for the treatment of effluents from the textile industries and hair dye industries.

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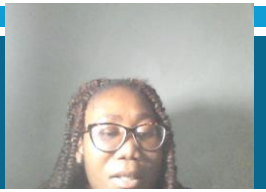

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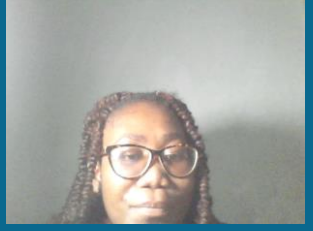

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