



Accessing the Effectiveness and Applicability of Raw Danielle-oliveri Sawdust as a Sustainable Adsorbent for the Removal of Dyes

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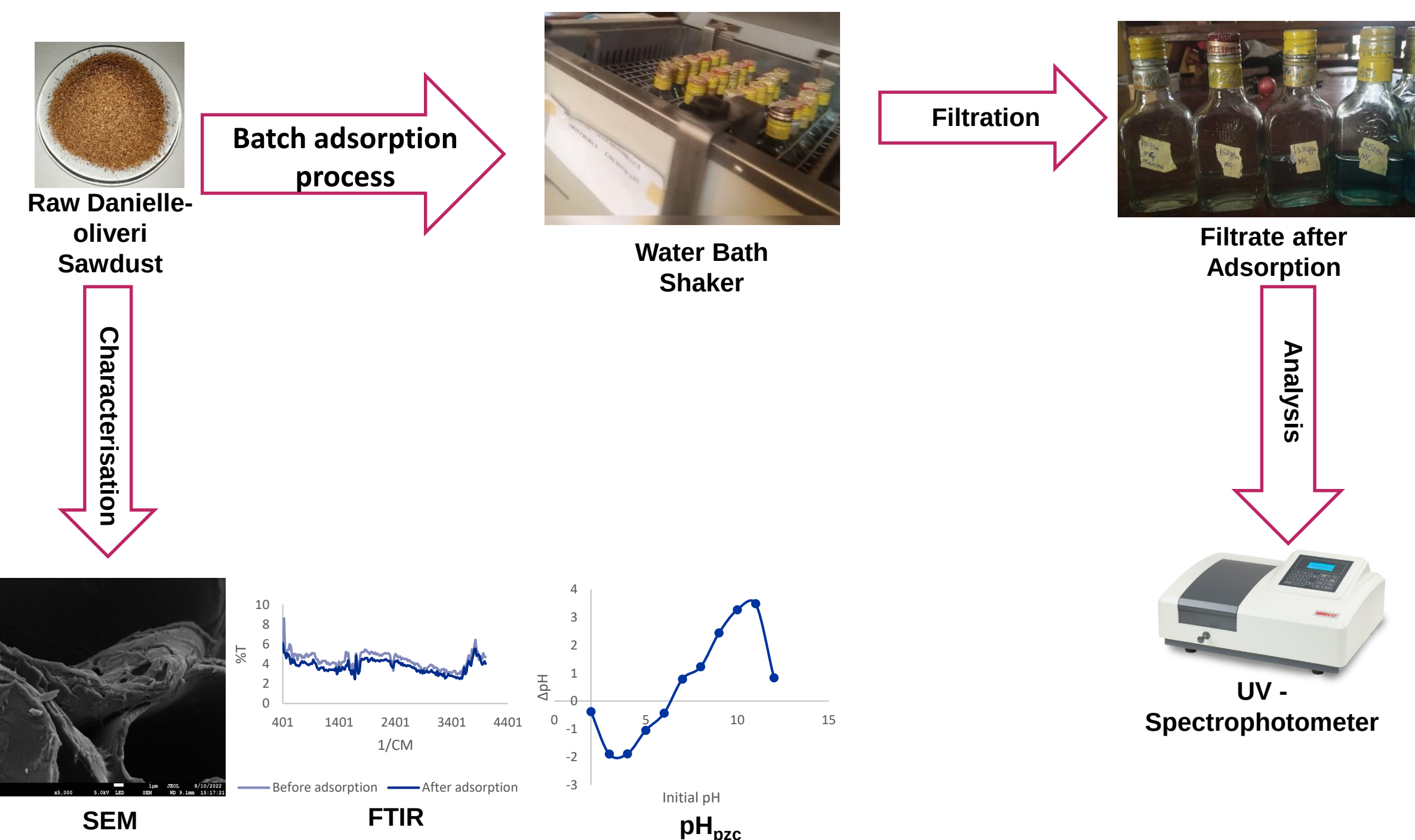
Introduction

The rapid demand for water due to industrial growth and urbanization, and the swift climate crisis has left one-fourth of the world's population facing "extremely high water stress." In addition to the fact that water is a scarce resource, the textile industry has been reported to consume a whopping 79 trillion litres of available water annually, thereby posing severe challenges to water sustainability. (Obaideen *et al.*, 2022, Bailey *et al.*, 2022)

Apart from consuming one-fourth of available water, the textile is also responsible for about 20 percent of global clean water water pollution from dyeing and finishing products. And dyes, once present in the environment, they are deemed persistent and could have debilitating effects. (Niinimäki *et al.*, 2020).

Consequently, removal of these substances before discharge into the environment is of paramount importance. To date, numerous methods have been employed in treating wastewater from textile industries but their drawbacks such as time wastage and high cost have made adsorption the best choice due to its high efficiency. Raw Danielle-oliveri Sawdust (RDS) was used in this study as a sustainable and eco-friendly adsorbent for the removal of congo red (CR) from aqueous medium.

Methodology



Results

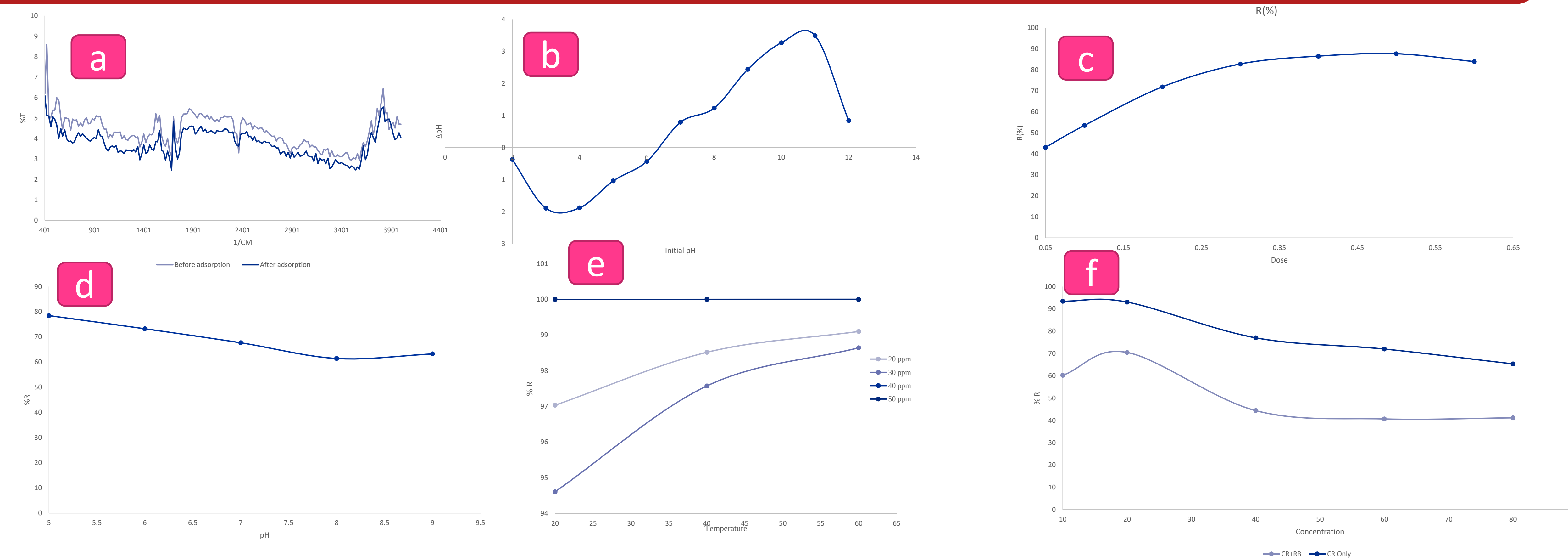


Figure 1. (a,b) FTIR and pH_{pzc} plots for Raw Danielle-oliveri Sawdust; (c,d,e,f) batch adsorption studies: effect of dose, pH, temperature, and concentration respectively.

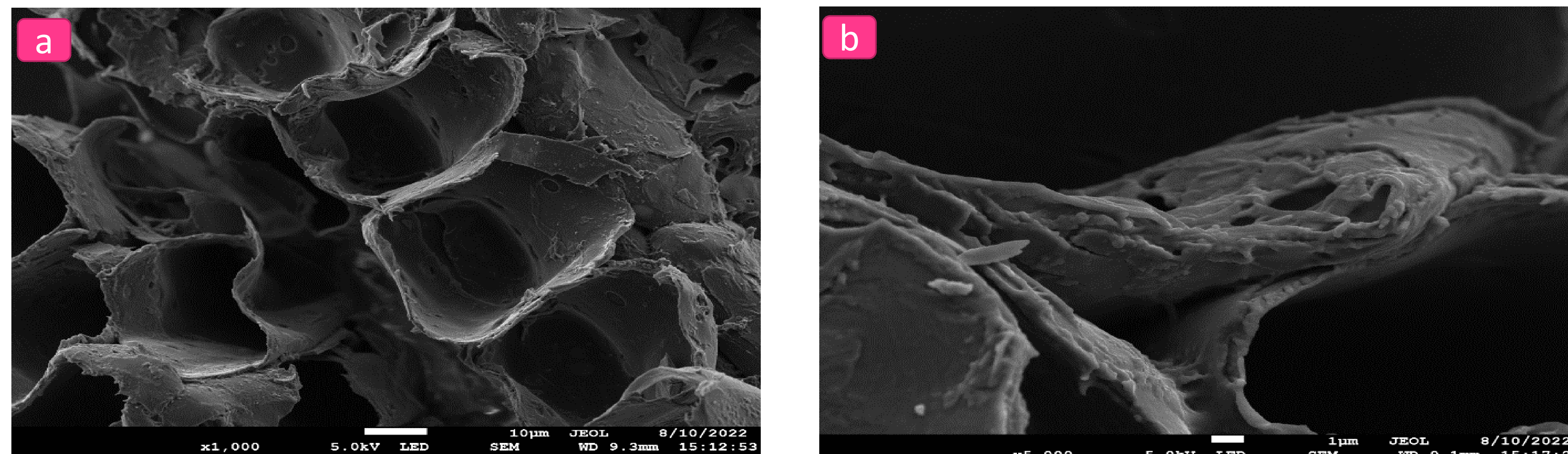


Plate 1 – Scanning Electron Microscopy for formaldehyde-modified watermelon rind before and after adsorption (1a and 1b).

Discussion

- It can be seen from Plate 1a (before adsorption) that the surface of RDS is heterogeneous comprising of different pores of varying sizes. However, major changes to the surface morphology of RDS was observed after adsorption (Plate 2b) which shows the pores have been covered by the dye.
- The FTIR spectra of RDS displays several peaks belonging to different functional groups (Fig. a). The pH_{pzc} of RDS was found to be 7.0.
- It can be observed that as the adsorbent dosage increased, the percentage removal also increased till further increase showed no considerable change. (fig. c). The optimum pH of the adsorption process was observed at pH 5 (78.50 % removal, (fig. d)).
- A gradual increase in percentage removal of congo red onto RDS was observed in all systems as the temperature increased which is indicative of an endothermic reaction, and increase in concentration led to a steady decrease in percentage removal for the two systems studied (congo red only and congo + reactive black 5), (fig. f)

Conclusion and Future Perspective

- Overall, this study has shown that raw danielle-oliveri sawdust has enormous potential as an effective and sustainable adsorbent for water and wastewater treatment and will contribute greatly to a circular economy thereby helping to achieve **SGD6** (Clean Water and Sanitation).
- Future research directions will be channelled towards coupling adsorption with other treatment technologies and also towards developing adsorbents that are efficient and selective for the removal of specific dyes and can be regenerated multiple times.

References

- Bailey, K., Basu, A., & Sharma, S. (2022). The Environmental Impacts of Fast Fashion on Water Quality: A Systematic Review. *Water*, 14(7), 1073. <https://doi.org/10.3390/w14071073>
- Khaled Obaideen, Nabila Shehata, Enas Taha Sayed, Mohammad Ali Abdelkareem, Mohamed S. Mahmoud, A.G. Olabi, The role of wastewater treatment in achieving sustainable development goals (SDGs) and sustainability guideline, *Energy Nexus*, Volume 7, 2022, 100112, <https://doi.org/10.1016/j.nexus.2022.100112>.
- Niinimäki, K., Peters, G., Dahlbo, H., Perry, P., Rissanen, T., & Gwilt, A. (2020). The environmental price of fast fashion. *Nature Reviews Earth & Environment*, 1(4), 189–200. <https://doi.org/10.1038/s43017-020-0039-9s>