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Adsorption, Optimization, and Kinetic modeling of Methyl Red Removal from Textile-Polluted Water Using Brewery waste as an adsorbent

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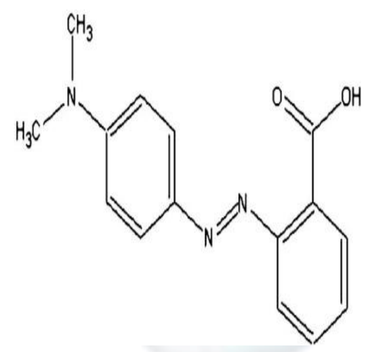
INTRODUCTION & AIM

Water is undeniably fundamental to life on a planetary scale. Indeed, it is truly the lifeblood of our planet, and our dependency on this vital resource is profound. Recognizing and respecting the significance of water is essential for ensuring its sustainable management and equitable access for all. The study focuses on addressing water pollution by utilizing brewery waste as an adsorbent to remove methyl red dye from aqueous solutions. Given water's vital role and pervasive pollution from various human activities, finding efficient and cost-effective solutions is imperative. Brewery waste's potential as an adsorbent offers dual benefits: reducing industrial waste and providing an environmentally friendly approach to water treatment. Investigating its effectiveness underscores its relevance for water and environmental management research,

METHOD

adsorbent: brewery waste



adsorbate: methyl red dye

UV_{254}

Paramètres	MR
Initial concentration Co (mg.L-1)	50
Adsorbent mass m (mg)	50 - 100
Contact time (mn)	60
Stirring speed(trs. mn^{-1})	350
pH	2 à 11

Table 1: Experimental range of variables.

RESULTS & DISCUSSION

- A higher efficiency, reaching 92%, was observed when the pH of the solution was adjusted to 4. This indicates that the process of adsorption of methyl red (RM) dye onto brewery waste was most effective at this pH level

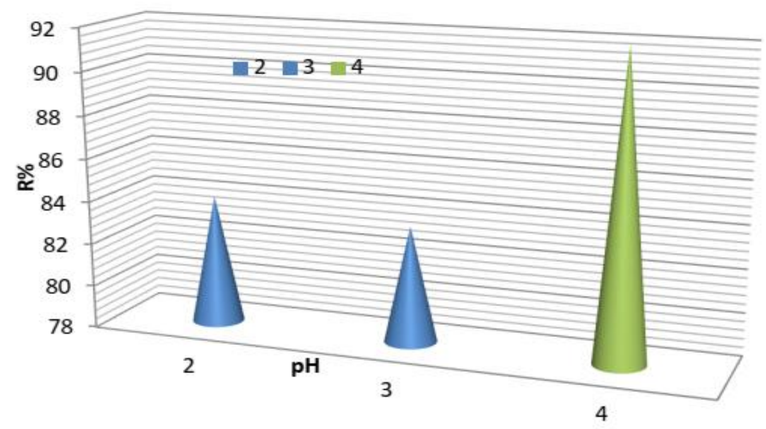


Figure 1: Effect of pH on the removal efficiency of RM on brewery waste

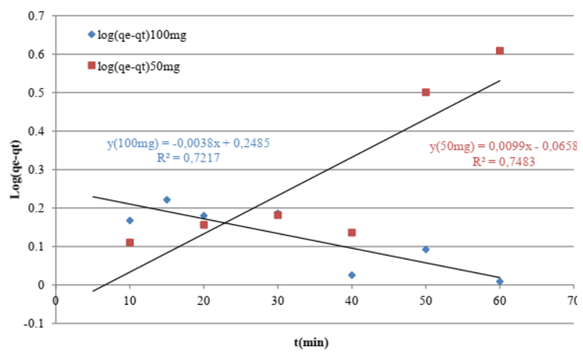


Figure 2: Pseudo first order kinetic model for RM dye adsorption.

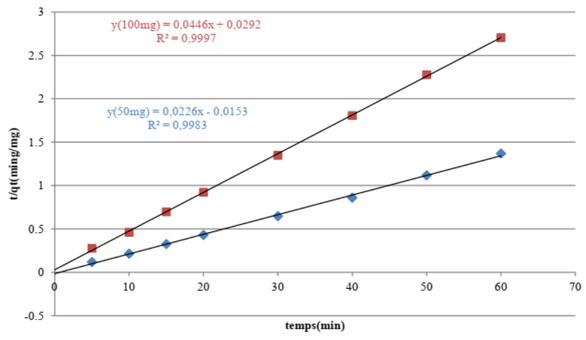


Figure 3: Pseudo second order kinetic model for the adsorption of the RM dye.

- The pseudo-second-order model is the most suitable for describing the behavior of RM by brewery waste. This indicates that the adsorption process follows pseudo-second-order kinetics. The high correlation coefficient associated with this model indicates a strong agreement between the experimental data and the theoretical predictions

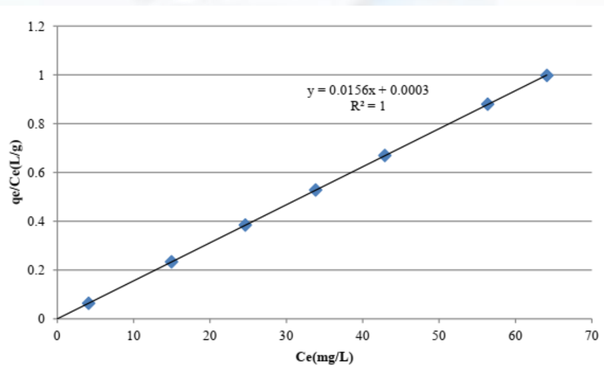


Figure 4: Langmuir model

- the adsorption process was best described by the Langmuir model, with a correlation factor close to unity. The calculated maximum adsorption capacity closely matched the experimental value of 65.4 mg/g.

CONCLUSION

This study aimed to optimize a treatment process for water contaminated with dyes, particularly methyl red (RM), using adsorption onto an industrial waste material,brewery waste. The results demonstrated promising efficacy in removing the organic pollutant. By analyzing various parameters such as pH, adsorbent mass, initial concentration, kinetics, and adsorption isotherms, the goal was to maximize RM adsorption onto brewery waste. The study revealed that the optimal pH for RM adsorption was 4, resulting in a maximum removal of 92%. Adsorption kinetics showed rapid uptake within the first 5 minutes, reaching equilibrium after 20 minutes, indicating saturation of active sites on the adsorbent. The pseudo-second-order model was the most suitable for describing RM adsorption, with a high correlation coefficient. Additionally, the adsorption isotherm confirmed monolayer adsorption behavior consistent with the Langmuir model.

In conclusion, RM adsorption onto brewery waste proved to be an effective process, showing promising potential for treating water contaminated with dyes.