SODIUM ALGINATE HYDROGEL BIO-ADSORBENT FOR METHYLENE BLUE DYE REMOVAL

JIRAJEIT SRIWILAI and JIRAPHAT CHAITHEP

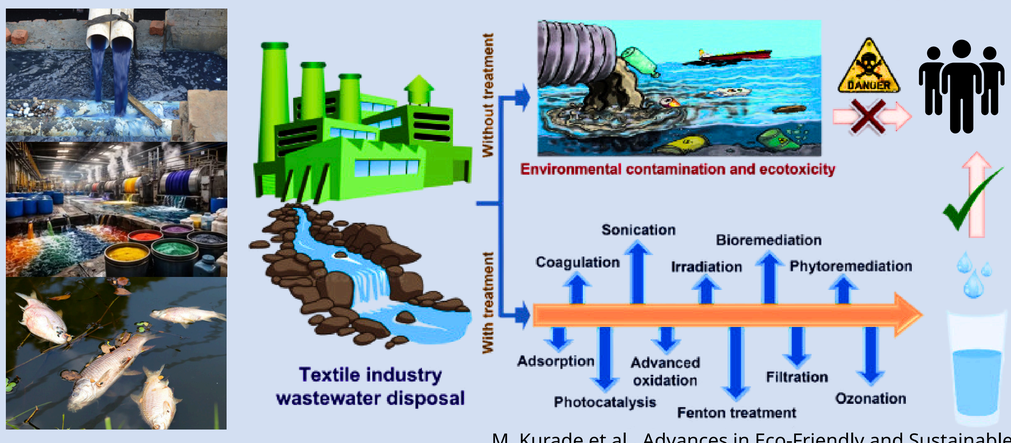
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ABSTRACT This research, bio-adsorbent of sodium alginate (SA) hydrogels cross-linked with glutaraldehyde was prepared and the efficiency of methylene blue dye removal of the hydrogel was investigated. The prepared hydrogels were characterized using compression test. Furthermore, the dye removal capacity of the SA hydrogel was examined under the effects of pH and adsorption time. Characterization results revealed that the glutaraldehyde cross-linked hydrogels exhibited better mechanical strength and excellent thermal stability. From dye adsorption experiments, it was found that an acidic environment at pH 3.0 was the optimal condition for adsorption, yielding the highest dye removal efficiency. The effect of adsorption time revealed that the adsorption rate rapidly increased for 40 minutes and reached the equilibrium within 60 minutes. In addition, the adsorption kinetic and isotherm models were studied. The results showed that the adsorption process of the SA hydrogel followed the pseudo-second-order kinetics and the Freundlich isotherm model, suggesting chemisorption on a heterogeneous surface with multilayer formation. Moreover, the SA hydrogel also demonstrated effective reusability, maintaining high adsorption capacity even after five consecutive cycles.

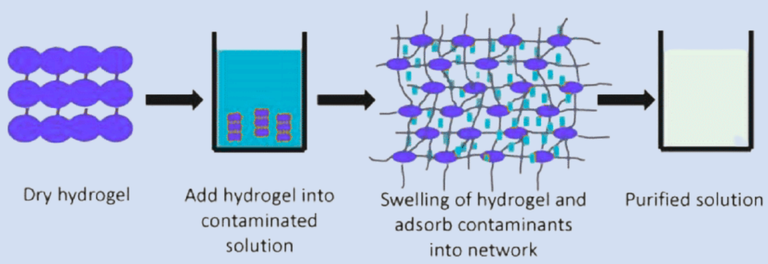
INTRODUCTION

Textile wastewater



M. Kurade et al., Advances in Eco-Friendly and Sustainable Technologies for the Treatment of Textile Wastewater (2023), 1-43.

Hydrogels for contaminant removal in water



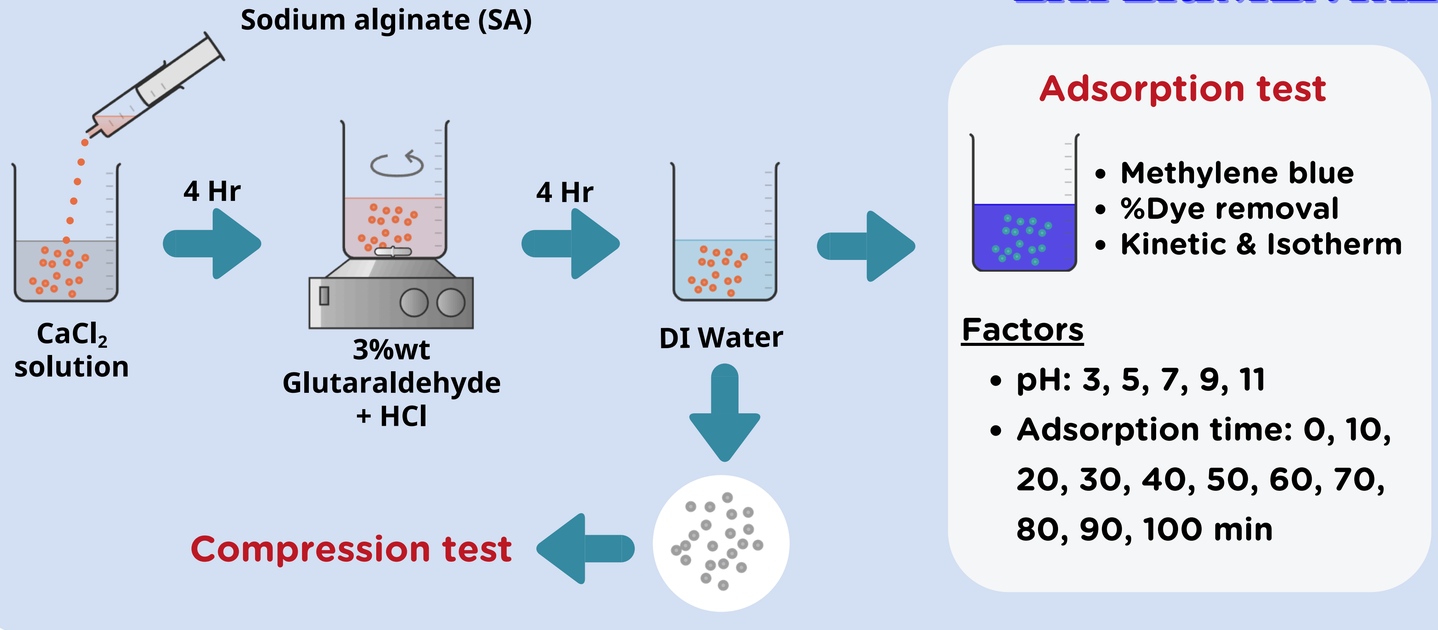
- eco-friendly
- unique functional groups
- achieve higher removal effects

W. Lakshika, et al. (2020), Critical Reviews in Environmental Science and Technology, 51, 1-45.

OBJECTIVES

- To prepare sodium alginate hydrogel beads and evaluate the effects of pH and contact time on the methylene blue removal efficiency.
- To study the kinetic and isotherm of adsorption process of the sodium alginate hydrogel beads.

EXPERIMENTAL



RESULTS & DISCUSSION

SA HYDROGEL BEADS

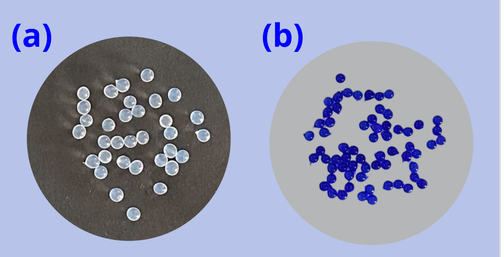


Fig. 1 SA hydrogel beads
(a) before and (b) after adsorption.

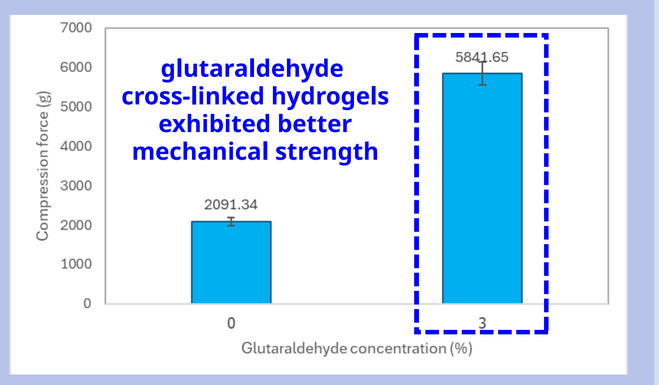


Fig. 2 Compressive force of SA hydrogel beads.

METHYLENE BLUE ADSORPTION EFFICIENCY

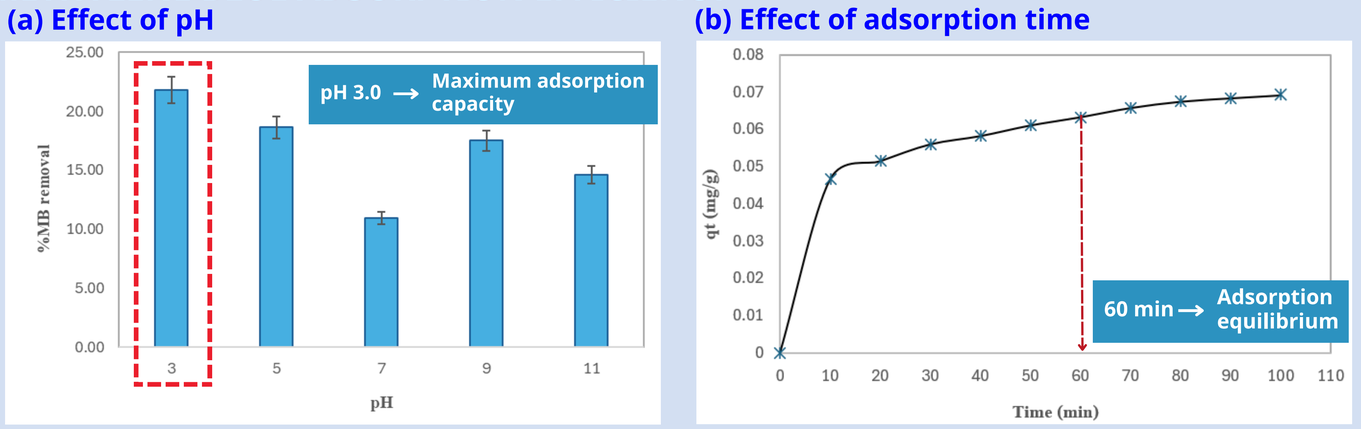
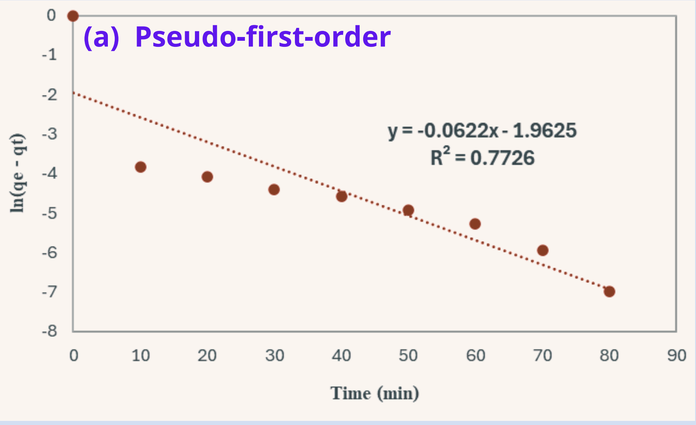


Fig. 3 Effect of (a) initial pH and (b) adsorption time on methylene blue removal efficiency.

ADSORPTION KINETIC & ISOTHERM



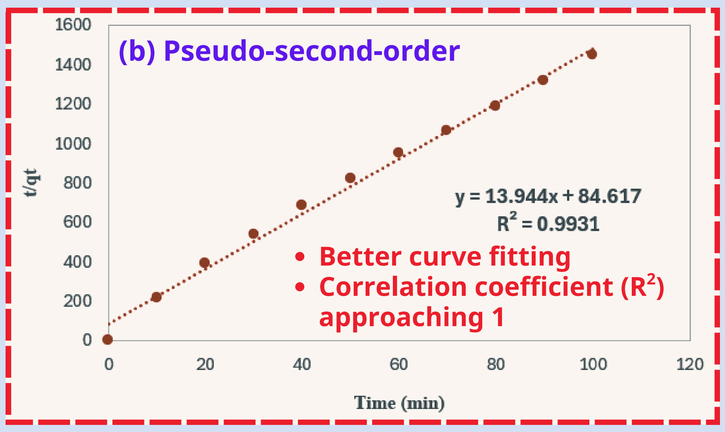
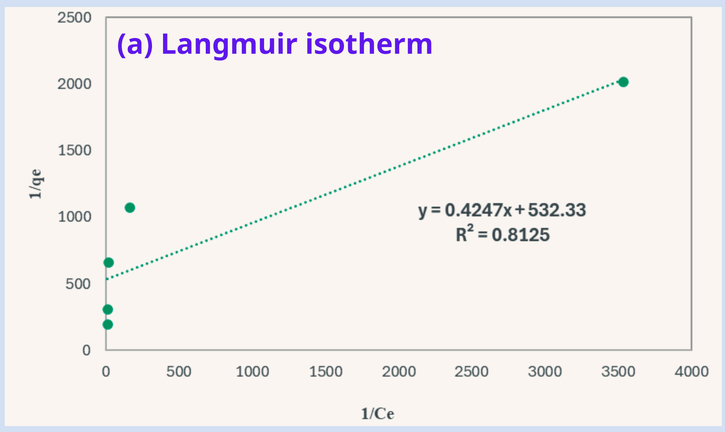


Fig. 4 MB adsorption kinetics of (a) Pseudo-first-order and (b) Pseudo-second-order.



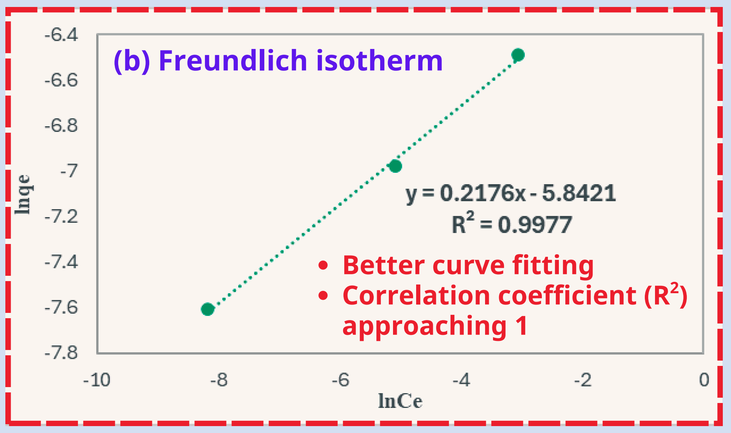


Fig. 5 MB adsorption isotherms of (a) Langmuir and (b) Freundlich isotherm.

REUSABILITY

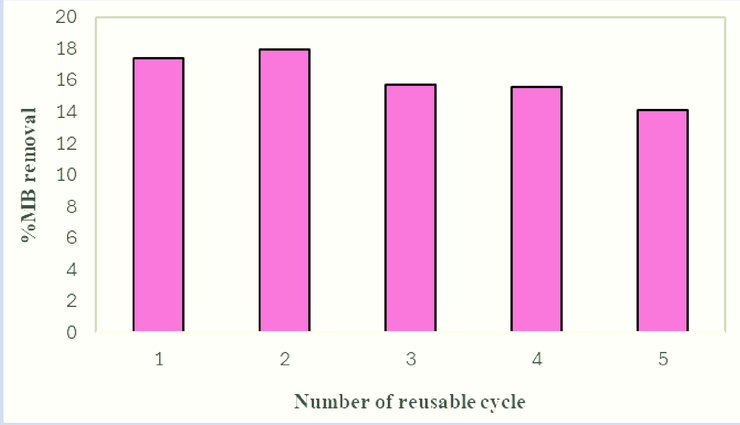
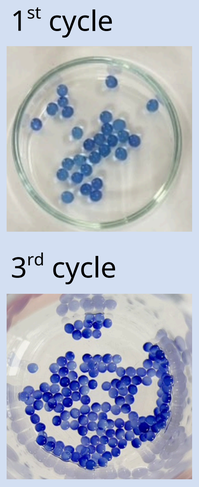


Fig. 6 The reusability of Sodium alginate beads.



CONCLUSIONS

- MB removal efficiency is pH-dependent which the maximum adsorption observed at pH 3.0 and reached equilibrium at 60 min.
- The adsorption process of the SA hydrogel followed the pseudo-second-order kinetics and the Freundlich isotherm model.
- The SA hydrogel also demonstrated effective reusability.