POLYPYRROLE/BACTERIAL CELLULOSE AEROGEL FOR THE EFFICIENT REMOVAL OF BINARY ORGANIC/INORGANIC SOLUTE MIXTURES OF WATER CONTAMINANTS

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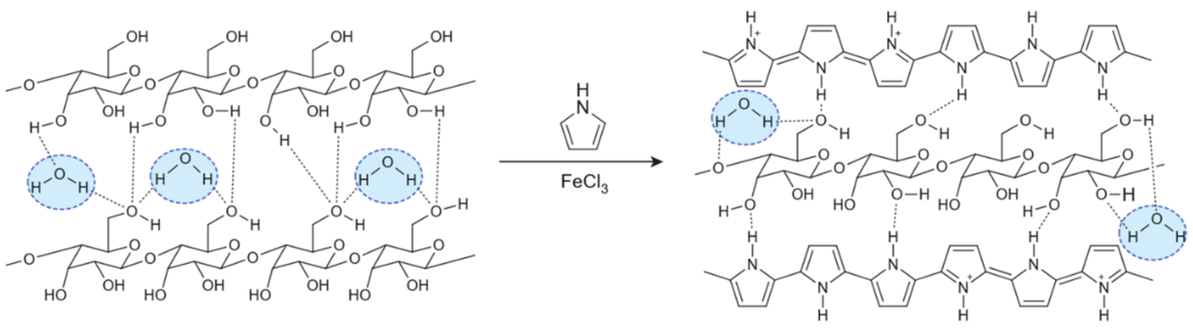
INTRODUCTION

Grape pomace is produced in large quantities as a byproduct of the wine industry. Revaluations of grape pomace waste promote circular economy and sustainability. In this study, bacterial cellulose (BC) pellicles were prepared by static cultivation of *Komagataeibacter xylinus* (ATCC 53524; Manassas, VA, USA) for 7 days onto the enzymatic hydrolysate of grape pomace. Then, the BC hydrogel was coated with polypyrrole (PPy) to prepare BC/PPy composite, which was subsequently transferred into aerogels by freeze-drying. BC/PPy composite was examined for adsorptive removal of hexavalent chromium ions (Cr(VI)) and Reactive Black 5 organic dye (RB) from aqueous solutions in single and binary mixture systems. The adsorption kinetics and equilibrium isotherms of Cr(VI) and RB adsorption were studied using various models. The results indicate that both Cr(VI) and RB adsorption follow pseudo-second order kinetics and the Langmuir isotherm model. The maximum adsorption capacities of Cr(VI) ions (485.4 mg/g) and RB (130.7 mg/g) were achieved at pH 2 and 4, respectively.

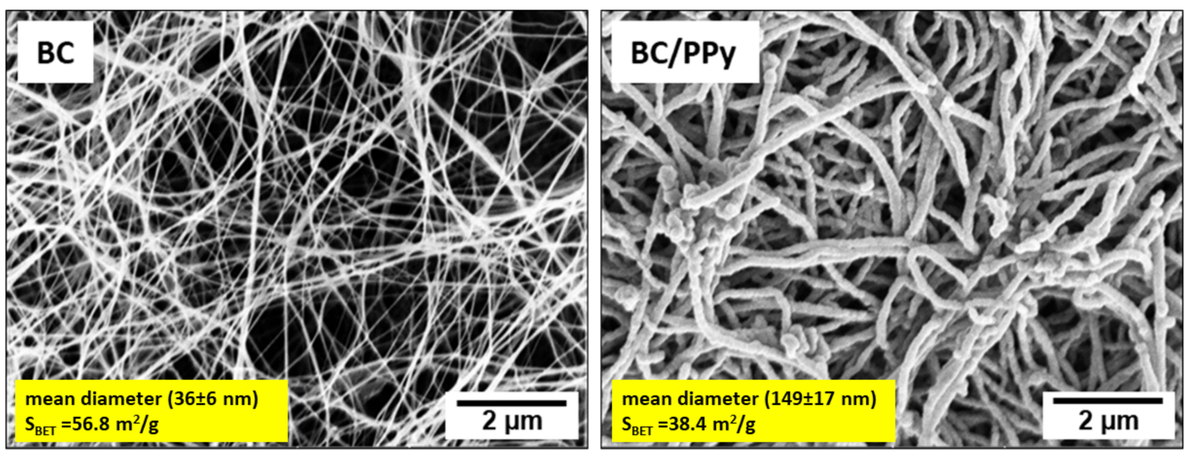
EXPERIMENTAL

Bioconversion of grape pomace to valuable bacterial cellulose.

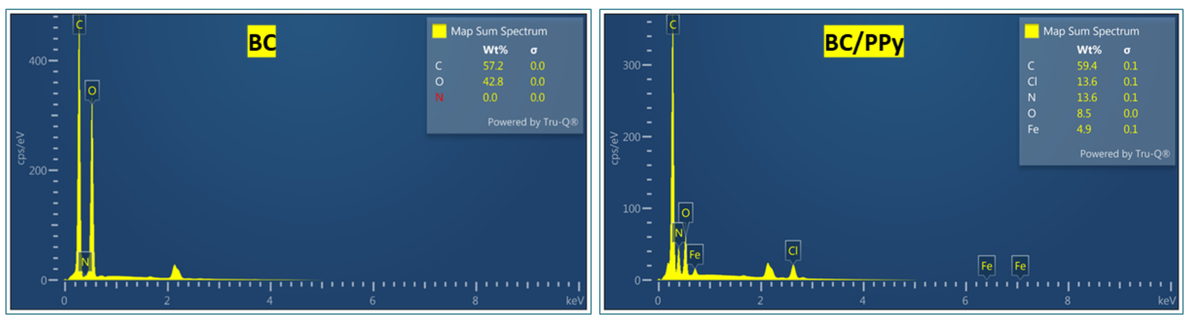


In-situ oxidative polymerization of pyrrole onto BC fibers.

CHERECTERIZATION

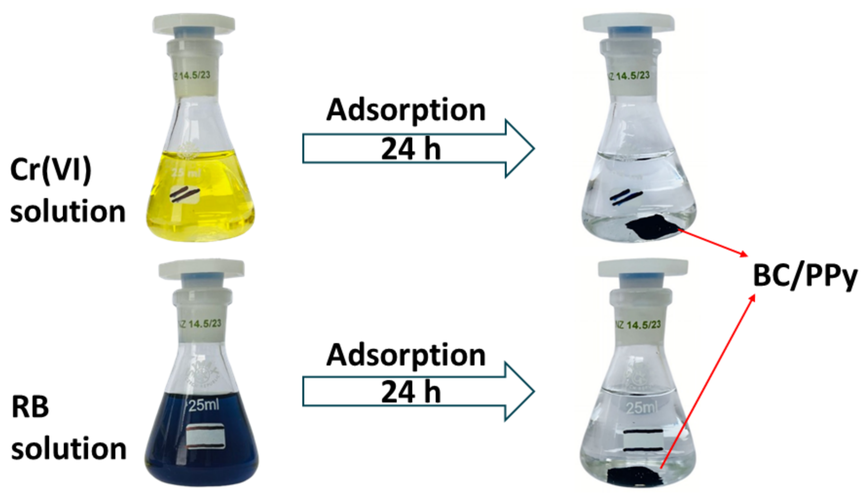


SEM micrographs of BC before and after coating with PPy.

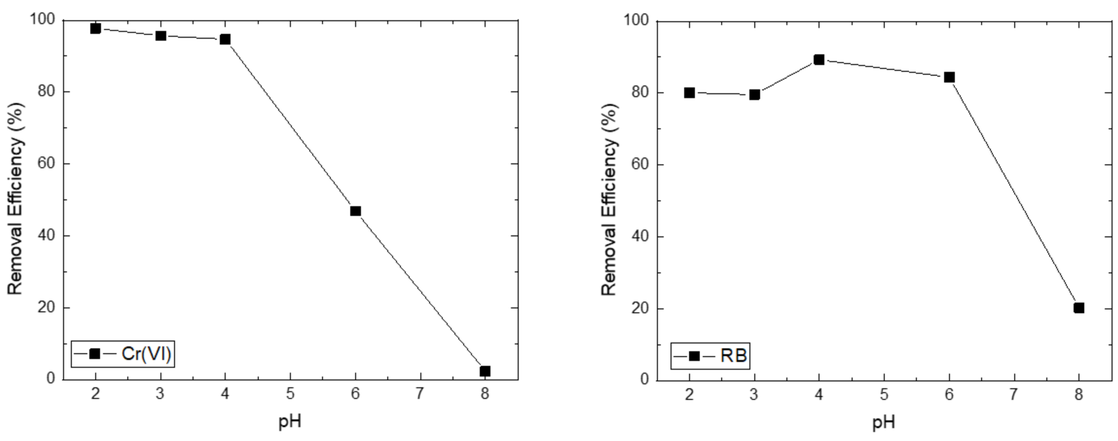


SEM-EDX spectra of BC before and after coating with PPy.

RESULTS

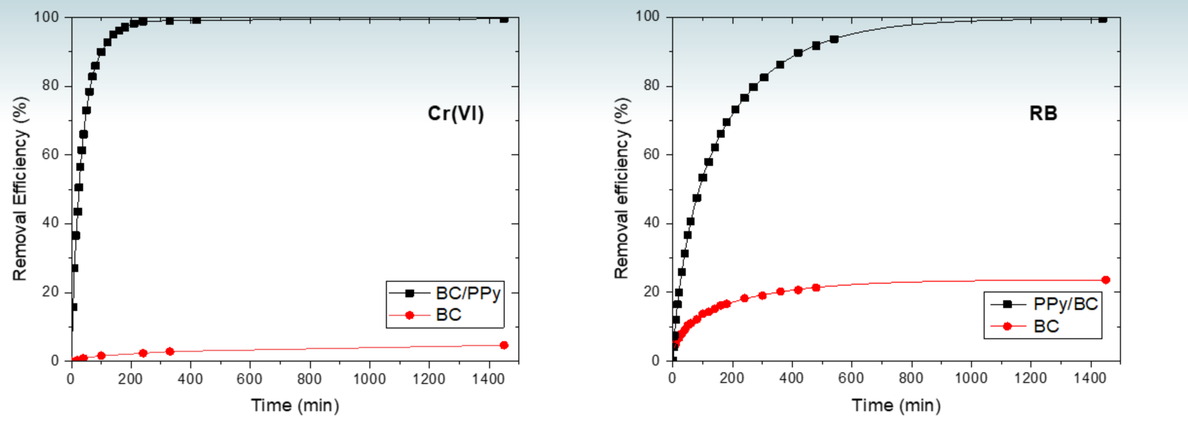


Photographs of Cr(VI) and RB solutions before and after being treated with BC/PPy.

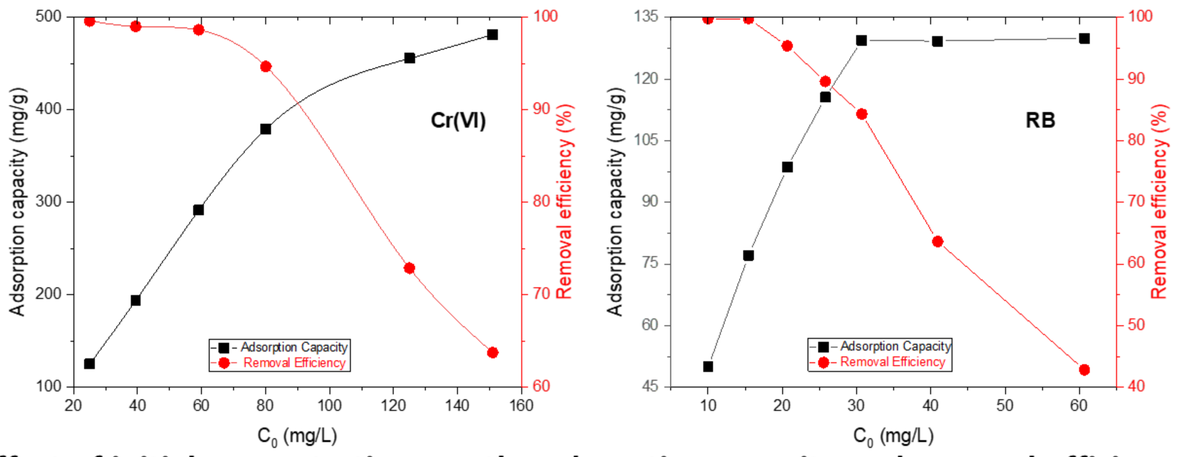


Effect of initial pH on BC/PPy removal efficiency of Cr(VI) and RB.

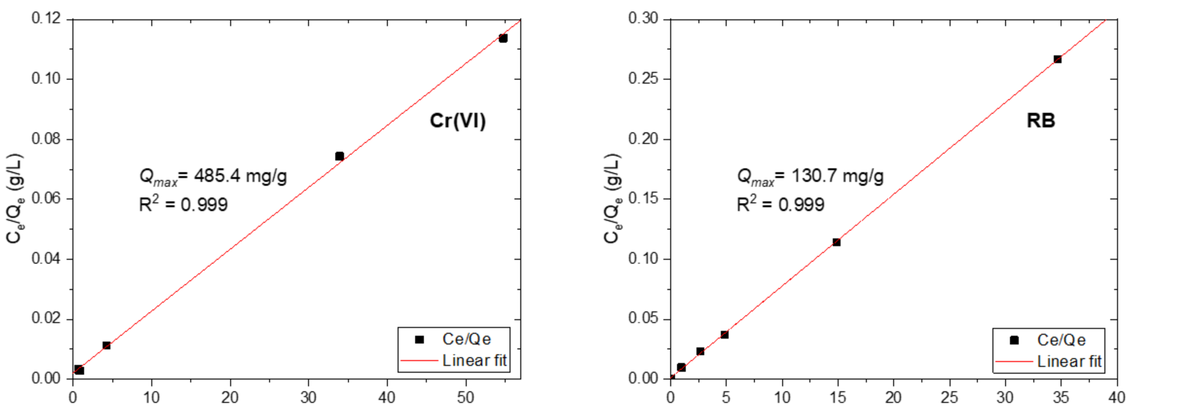
RESULTS



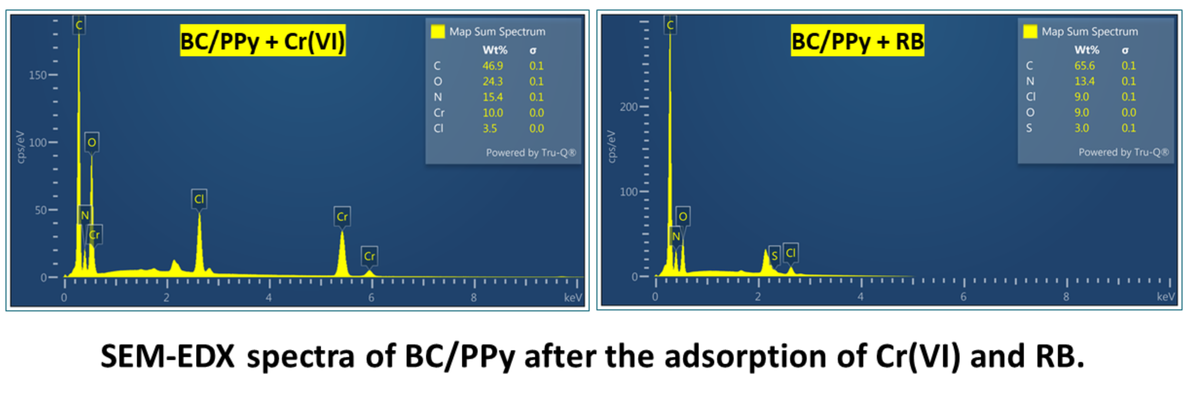
Removal efficiencies of Cr(VI) and RB onto BC and BC/PPy over time.



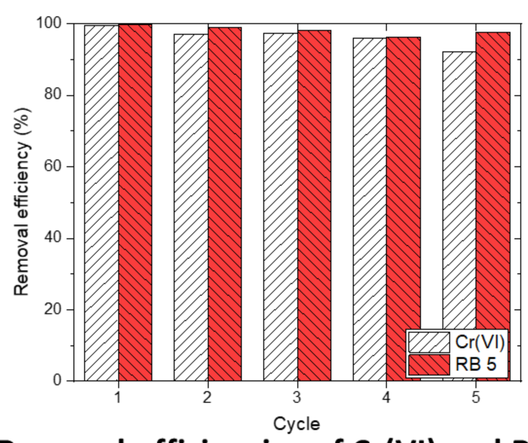
Effect of initial concentrations on the adsorption capacity and removal efficiency of Cr(VI) and RB by BC/PPy.



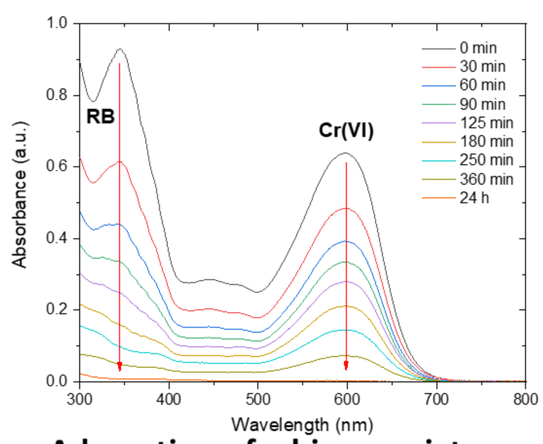
Langmuir isotherm modeling of Cr(VI) and RB adsorption onto BC/PPy.



SEM-EDX spectra of BC/PPy after the adsorption of Cr(VI) and RB.



Removal efficiencies of Cr(VI) and RB at multiple regeneration cycles.



Adsorption of a binary mixture of Cr(VI) and RB onto BC/PPy.

CONCLUSIONS

- PPy was uniformly deposited onto BC fibers, resulting in an increase in the BC fibers' diameter from 36±6 to 149±17 nm.
- Low-cost and reusable BC/PPy aerogels showed a much higher adsorption capacity of Cr(VI) and RB compared to neat BC.
- The BC/PPy adsorbent has demonstrated high stability with removal efficiencies of 92.1% for Cr(VI) ions and 97.7% for RB achieved after 5 regeneration cycles.
- BC/PPy adsorbent demonstrated excellent performance in treating a binary mixture of Cr(VI) and RB, achieving removal efficiencies of 99% for Cr(VI) and 99.6% for RB within 24 hours.

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