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Methylene blue removal on biodegradable adsorptive membranes fabricated from sugarcane bagasse pulp: Characterization and performance study

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KEYWORDS

Adsorptive membranes, Sugarcane bagasse pulp, Methylene blue, Charcoal carbon.

SHORT SUMMARY

In order to avoid negative effects on the environment and conserve water resources, dye-containing wastewater should be treated properly utilizing eco-friendly technologies. Wastewater treatment using low-cost by-products from agricultural waste has been acknowledged as a viable option. They make it possible to remove contaminants from wastewater while also contributing to waste minimization, recovery, and reuse. In this study, sugarcane bagasse pulp waste was used for membranes fabrication. The pore size of the fabricated membranes was found to be on the micro-scale. To enhance the removal efficiency of the fabricated membranes, charcoal carbon was applied to the membrane surface by two different methods. The first one included surface coating with charcoal paste while the other one involved mixing the sugarcane bagasse pulp particles with the carbon before formulating it in the form of the sheets. The efficiency of the two fabricated adsorptive membranes on methylene blue dye removal was compared. The mixed fabricated membrane was found to have higher efficiency than the coated one. FTIR and SEM analyses were conducted on the membranes for surface characterization.

EXTENDED ABSTRACT

Introduction

The escalating population is causing rapid expansion in both agricultural and industrial sectors leaving massive amounts of waste behind. This huge amount of industrial waste has been discharged into the Aqua systems causing serious contamination problems affecting not only the environment but also human health [1]. One of the industries with the most rapid growth is textiles. Its wastes contain significant levels of toxic pigments, heavy metals, suspended particles, and aromatic chemicals. Adsorptive membranes are mainly applied to remove the soluble micropollutants that cannot be easily removed with conventional treatment methods [2]. In this study, Adsorptive membranes are fabricated using sugarcane bagasse pulp (SCBP) waste together with the charcoal carbon which will act as the adsorbent. Furthermore, different fabrication techniques were compared, and the adsorption study was done using methylene blue as a pollutant.

Materials and method

SCBP membrane was fabricated according to the composition 60% Bagasse pulp,15% glycerol, 5% starch and the rest is distilled water. The bagasse pulp is first added to the water and the mixture is mixed by using a homogenizer. A beaker containing starch and glycerol is heated to 150 ℃

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for 15 minutes. The glycerol and starch mixture is then added the bagasse and is then mixed again using the homogenizer for 20 minutes before being formulated in the form of a membrane sheet. To increase the removal efficiency of the fabricated membrane. Charcoal activated carbon was added to the membrane in two different methods. The first one included mixing the bagasse pulp with the charcoal particles before the sheet formulating while the other one included surface coating of the membrane with charcoal paste. *Scanning electron microscope (SEM) was performed on the fabricated membranes for surface analys*is

Results and Discussion

SEM results of SCBP membrane, mixed membrane, and the surface coated membrane are shown in figures 1,2, and, 3 respectively. SEM analysis of the SCBP membrane surface shows pores' absence. Therefore, there will be no place for physical adsorption to take place. Although the charcoal carbon is porous [3], The SEM analysis of the surface coated membrane shows the absence of these pores. This is contributed to the fact that charcoal particles are trapped in the membrane pores. Hence, the pores responsible for physical adsorption decrease, and consequently, the removal efficiency declines. On the other hand, Mixed membrane SEM analysis shows the presence of charcoal pores. Hence, Mixed membrane gives the highest removal efficiency in removing the methylene blue particles.

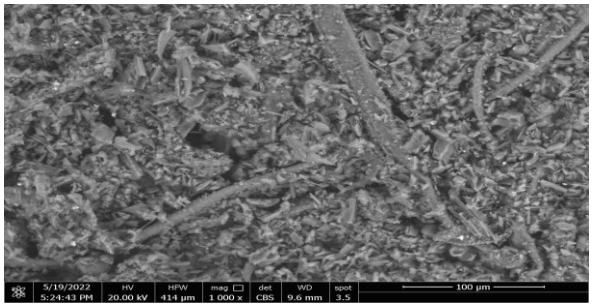

Figure 1 SEM analysis of SCBP membrane

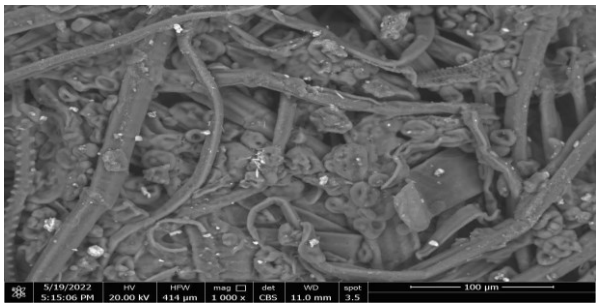

Figure 2 SEM analysis of surface coated membrane

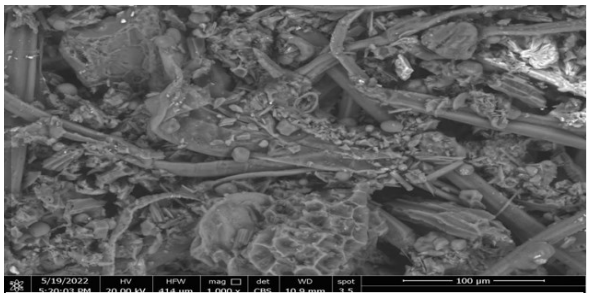

Figure 3 SEM analysis of mixed membrane

Conclusion

Mixed membrane showed high potential for removing methylene blue particles compared to both SCBP and surface coated membranes. It achieved a removal efficiency of 99.4% for methylene blue particles which proved the effectiveness of the mixed membrane for textile wastewater treatment.

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