

Nucleophilic-functionalized β -cyclodextrin-polyethersulfone structures from facile lamination process as nanoporous membrane active layers for wastewater post-treatment: Molecular implications

Adewale Giwa, Shadi W. Hasan



PII: S0376-7388(18)30861-5
DOI: <https://doi.org/10.1016/j.memsci.2018.06.056>
Reference: MEMSCI16273

To appear in: *Journal of Membrane Science*

Received date: 31 March 2018
Revised date: 4 June 2018
Accepted date: 27 June 2018

Cite this article as: Adewale Giwa and Shadi W. Hasan, Nucleophilic-functionalized β -cyclodextrin-polyethersulfone structures from facile lamination process as nanoporous membrane active layers for wastewater post-treatment: Molecular implications, *Journal of Membrane Science*, <https://doi.org/10.1016/j.memsci.2018.06.056>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Nucleophilic-functionalized β -cyclodextrin-polyethersulfone structures from facile lamination process as nanoporous membrane active layers for wastewater post-treatment: Molecular implications

Adewale Giwa^a, Shadi W. Hasan^{b*}

Center for Membrane and Advanced Water Technology, Department of Chemical Engineering, Khalifa University of Science and Technology, Masdar City Campus, P.O. Box 127788, Abu Dhabi, UAE

^aadewale.giwa@ku.ac.ae

^{b,*}shadi.hasan@ku.ac.ae

Abstract

Nanocomposite membranes consisting of functionalized β -cyclodextrin (f β -CD) and polyethersulfone (PES) were fabricated, characterized, and used for low-pressure wastewater post-treatment. The impact of nucleophilic functionalization of β -CD on the performance of these membranes was evaluated via three substitution routes: Crosslinking with nucleophilic dicarboxyl groups (M1) in maleic acid; co-polymerization with excess amino group (M2) in hyperbranched polyethyleneimine (HPEI); and nucleophilic modification with amino and hydroxyl groups (M3) in chitosan. All f β -CD-incorporated membranes were hydrophilic as a result of the highly populated –OH groups at the exterior of β -CD. Although there are higher-energy intermolecular C–O bonds in M1 membrane, less degree of nucleophilic crosslinking restricted kinetic hindrance and led to an increase in the mean pore size of M1 membrane to 52 nm. A dense structure, the lowest mean pore size of 22 nm, and the highest porosity of 45% was imparted to M2 membrane by the flexible C–N linkages provided by HPEI. Nucleophilic attack by the abundant N–H groups in HPEI also improved the tensile strength of M2 membrane reaching 20 MPa. Consequently, the water permeability of M2 membrane was significantly enhanced via β -CD's solution-diffusion property. M1, M2, and M3 membrane water permeability were 61, 239, and 167 LMH bar⁻¹, respectively. M3 membrane showed the highest removal efficiencies for heavy metal ions (92% of Cr⁶⁺, 90% of Zn²⁺, 82% of Fe²⁺, and 87% of Cd²⁺) since it is the most hydrophilic membrane with abundant –OH groups in chitosan. However, M2 membrane displayed the highest removal efficiencies for residual organics, i.e. 67% chemical oxygen demand (COD) and 84% bacteria due to the hydrophobic interior of its dense f β -CD.

Keywords: β -cyclodextrin, polyethersulfone, maleic acid, hyperbranched polyethylenimine, chitosan, wastewater post-treatment.

1. Introduction

Cyclodextrins (CDs) are cyclic oligosaccharides, i.e. compounds made up of sugar molecules bound together in a ring [1,2]. CDs are produced from starch by enzymatic conversion [3]. CDs

Download English Version:

<https://daneshyari.com/en/article/7019759>

Download Persian Version:

<https://daneshyari.com/article/7019759>

[Daneshyari.com](https://daneshyari.com)