

5th International Scientific Conference on Pervaporation, Vapor Permeation and Membrane Distillation

20th – 23rd June 2017

ORGANISING COMMITTEE

Programme Booklet

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**NICOLAUS COPERNICUS
UNIVERSITY
IN TORUŃ**
Faculty of Chemistry



Toruń 2017

ISBN: 978-83-231-3846-4

Wydawnictwo Naukowe UMK, 2017

Printed and bound by Printing House of Wydawnictwo Naukowe UMK (Drukarnia
Wydawnictwa Naukowego UMK)

Authors are fully responsible for the content of the abstracts.
No technical nor language corrections were made during editing.

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Separation of Water-Alcohol Mixtures with Montmorillonite Modified Chitosan and Chitosan/Polyvinyl Alcohol Membranes

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Keywords: Chitosan, Poly(Vinyl Alcohol), Nanocomposites, Pervaporation, Dehydration

The research that revealed enhancements of many materials properties by mixing them with appropriately modified clay minerals (e.g. montmorillonite, MMT) and synthetic clays was a key moment in polymer/silicate nanomaterials development. Polymeric nanocomposites broaden fields of applications of polymeric materials. Among others, biodegradable polymer-based nanocomposites exhibit a big potential for their applications as high-performance materials, also as a membranes in different separation techniques [1, 2].

Data given in a literature indicate the opportunity to replace synthetic polymers with natural ones in membrane separation processes. For this purpose, chitosan is one of the widely investigated natural polymers. Chitosan is a linear polysaccharide composed of β -(1 \rightarrow 4)-2-amino-2-deoxy-D-glucopyranose and β -(1 \rightarrow 4)-2-acetamido-2-deoxy-D-glucopyranose (Fig. 1a). It can also be presented as a homopolymer of β -(1 \rightarrow 4)-2-amino-2-deoxy-D-glucopyranose [3]. In some cases highly hydrophilic poly(vinyl alcohol) (Fig. 1b), biodegradable synthetic polymer, can be used to enhance hydrophilic properties of new membrane.

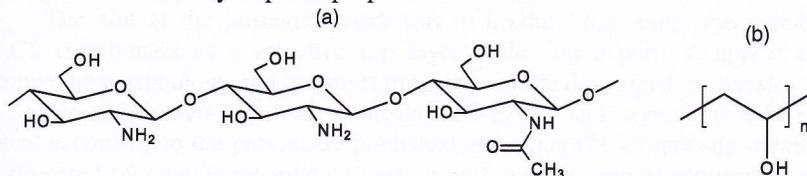


Figure 1. Chemical structures of (a) chitosan and (b) poly(vinyl alcohol)

In the present study new chitosan and chitosan/ montmorillonite membranes crosslinked with glutaraldehyde (Ch/GA and Ch/MMT/GA) as well as chitosan/MMT/poly(vinyl alcohol) nanocomposite membranes (Ch/PVA/MMT) were obtained by dissolution and solvent evaporation technique. The structure and morphology of the new materials were determined using atomic force microscopy (AFM), scanning electron microscopy (SEM), Fourier transform infrared

spectroscopy (FTIR) and Energy Dispersive X-Ray (EDX) techniques. Changes in surface hydrophilicity were also characterized by contact angle measurements. The results showed that MMT is uniformly dispersed in the Ch/GA and Ch/PVA matrix. SEM micrographs revealed that obtained membranes are dense and non-porous with low surface roughness.

Separation properties of membranes in pervaporative dewatering of water/alcohol mixtures were examined. Two-component water/ethanol and water/isopropanol solutions of different composition were used. All pervaporation experiments were performed at 30°C. The nanocomposite Ch/PVA/MMT membranes exhibit better separation properties in comparison with Ch/GA and Ch/MMT/GA membranes in dewatering of both alcohols.

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