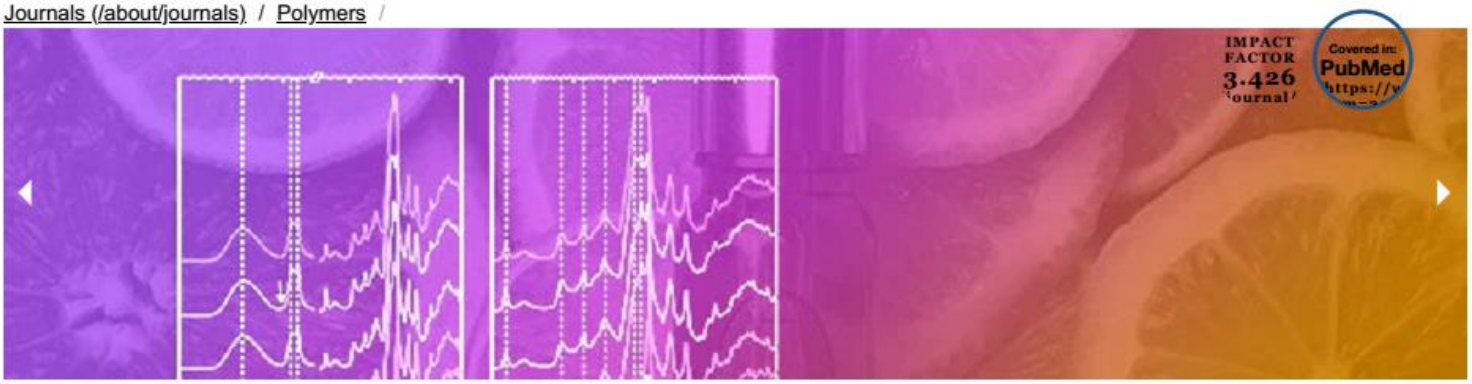
Judul Artikel	:	Cigarette Butt Waste as Material for Phase Inverted Membrane Fabrication Used for Oil/Water Emulsion Separation
Penulis	:	Aris Doyan, Chew Lee Long, Muhammad Roil Bilad, Kiki Adi Kurnia, Susilawati, Saiful Prayogi, Thanitporn Narkkun, dan Kajornsak Faungnawakij
Nama Jurnal	:	Polymers
Penyelenggara/Penerbit	:	Multidisciplinary Digital Publishing Institute (MDPI)
Halaman	:	1-15
Volume	:	13
Web Jurnal	:	https://www.mdpi.com/2073-4360/13/12/1907
URL Dokumen	:	https://www.mdpi.com/2073-4360/13/12/1907/html
DOI	:	https://doi.org/10.3390/polym13121907
Tanggal/Waktu	:	Juni 2021
Satuan	:	12 Issue/Tahun
Volume Kegiatan	:	1



Journal Description

Polymers

Polymers is a **peer-reviewed (https://www.mdpi.com/editorial_process)**, open access journal of polymer science published semimonthly online by MDPI. **Belgian Polymer Group (BPG) (http://www.belgianpolymergroup.be/)**, **European Colloid & Interface Society (ECIS) (http://www.ecis-web.eu/)**, **The Swiss Chemical Society (SCS) (https://scg.ch/index.php?option=com_content&view=article&id=789:scg-membership-en&catid=84&Itemid=430&lang=en)** and **National Interuniversity Consortium of Materials Science and Technology (INSTM) (https://www.instm.it/en/instm.aspx)** are affiliated with *Polymers* and their members receive a discount on the article processing charges.

- **Open Access (https://www.mdpi.com/openaccess)** — free for readers, with **article processing charges (APC) (https://www.mdpi.com/journal/polymers/apc)** paid by authors or their institutions.
- **High Visibility:** indexed within **Scopus (https://www.scopus.com/sourceid/54222)**, **SCIE (Web of Science) (https://mjl.clarivate.com/search-results?issn=2073-4360&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal)**, **Ei Compendex (https://www.engineeringvillage.com/home.url)**, **PubMed (https://pubmed.ncbi.nlm.nih.gov/?term=%22Polymers+%28Basel%29%22%5Bjour%5D&sort=pubdate)**, **PMC (https://www.ncbi.nlm.nih.gov/pmc/journals/3589/)**, **FSTA (https://www.ifis.org/fsta)**, **CAPlus / SciFinder (https://sso.cas.org/as/authorization.oauth2?response_type=code&client_id=scifinder-n&redirect_uri=https%3A%2F%2Fscifinder-n.cas.org%2Fpa%2Foidc%2Fcb&state=eyJ6aXAiOiJERUYiLCJhbGciOiJkaXIiLCJlbmMiOiJBMTI4Q0JDLUhTMjU2Iiwia2lkIjoianMiLCJzdWZmaX)** **Inspec (https://inspec-direct-app.theiet.org/)**, and many **other databases (https://www.mdpi.com/journal/polymers/indexing)**.
- **Journal Rank:** JCR - Q1 (*Polymer Science*) / CiteScore - Q1 (*Polymers and Plastics*)
- **Rapid Publication:** manuscripts are peer-reviewed and a first decision provided to authors approximately 11.5 days after submission; acceptance to publication is undertaken in 2.7 days (median values for papers published in this journal in the second half of 2020).
- **Recognition of Reviewers:** reviewers who provide timely, thorough peer-review reports receive vouchers entitling them to a discount on the APC of their next publication in MDPI journals, in appreciation of the work.
- **Companion journals for *Polymers* include: *Polysaccharides (https://www.mdpi.com/journal/Polysaccharides)*** and ***Macromol (https://www.mdpi.com/journal/macromol)***.

We use cookies on our website to ensure you get the best experience.
Read more about our cookies here (/about/privacy).

Accept (/accept_cookies)

Impact Factor: 3.426 (2019) ; 5-Year Impact Factor: 3.636 (2019)

Latest Articles

Open Access Article (/2073-4360/13/11/1847/pdf)

Wear Assessment of Tibial Inserts Made of Highly Cross-Linked Polyethylene Supplemented with Dodecyl Gallate in the Total Knee Arthroplasty (/2073-4360/13/11/1847)

by **Min Zhang**, **Jia-Yu Wang**, **Jian Su**, **Jian-Jun Wang**, **Shi-Tong Yan**, **Yi-Chao Luan** and **Cheng-Kung Cheng**
Polymers **2021**, *13*(11), 1847; https://doi.org/10.3390/polym13111847 (registering DOI) - 02 Jun 2021

Abstract Background: the wear of tibial insert is still one of primary factors leading to failure of total knee arthroplasty (TKA). Dodecyl gallate (DG) has shown improvements in the oxidation stability of highly cross-linked polyethylene (HXLPE). This study aimed to assess the application of **[...] Read more.**
(This article belongs to the Special Issue **Polymeric Composites for Biomedical Applications (/journal/polymers/special_issues/polymeric_composites_biomedical_applications)**)

► Show Figures

(/polymers/polymers-13-01847/article_deploy/html/images/polymers-13-01847-ag-550.jpg) (/polymers/polymers-13-01847/article_deploy/html/images/polymers-13-01847-g001-550.jpg) (/polymers/polymers-13-01847/article_deploy/html/images/polymers-13-01847-g002-550.jpg) (/polymers/polymers-13-01847/article_deploy/html/images/polymers-13-01847-g003-550.jpg) (/polymers/polymers-13-01847/article_deploy/html/images/polymers-13-01847-g004-550.jpg) (/polymers/polymers-13-01847/article_deploy/html/images/polymers-13-01847-g005-550.jpg) (/polymers/polymers-13-01847/article_deploy/html/images/polymers-13-01847-g006-550.jpg)

Open Access Article (/2073-4360/13/11/1846/pdf)

Capillary Sensor for Detection of Amphetamine Precursors in Sewage Water (/2073-4360/13/11/1846)

by **Monika Wiśnik-Sawka**, **Mirosław Maziejuk**, **Wojciech Fabianowski**, **Urszula Karpińska**, **Maciej Szwast** and **Jerzy Weremczuk**
Polymers **2021**, *13*(11), 1846; https://doi.org/10.3390/polym13111846 (registering DOI) - 02 Jun 2021

Abstract This paper deals with the problem of detecting benzyl methyl ketone (BMK), which is a precursor of amphetamine that can be synthesized in home labs. The focus of our work was to identify an improvement for the analysis of sewage introduced into the **[...] Read more.**
(This article belongs to the Collection **Polymer Applications in Environmental Science (/journal/polymers/special_issues/Polym_Appl_Environ_Sci)**)

► Show Figures

(/polymers/polymers-13-01846/article_deploy/html/images/polymers-13-01846-g001-550.jpg) (/polymers/polymers-13-01846/article_deploy/html/images/polymers-13-01846-g002-550.jpg) (/polymers/polymers-13-01846/article_deploy/html/images/polymers-13-01846-g003-550.jpg) (/polymers/polymers-13-01846/article_deploy/html/images/polymers-13-01846-g004-550.jpg) (/polymers/polymers-13-01846/article_deploy/html/images/polymers-13-01846-g005-550.jpg) (/polymers/polymers-13-01846/article_deploy/html/images/polymers-13-01846-g006-550.jpg) (/polymers/polymers-13-01846/article_deploy/html/images/polymers-13-01846-g007-550.jpg) (/polymers/polymers-13-01846/article_deploy/html/images/polymers-13-01846-g008-550.jpg) (/polymers/polymers-13-01846/article_deploy/html/images/polymers-13-01846-g009-550.jpg)

Open Access Article (/2073-4360/13/11/1845/pdf)

Transcutaneous Drug Delivery Systems Based on Collagen/Polyurethane Composites Reinforced with Cellulose (/2073-4360/13/11/1845)

by **Narcis Anghel**, **Valentina Maria Dinu**, **Liliana Verestiuc** and **Irene Alexandra Spiridon**
Polymers **2021**, *13*(11), 1845; https://doi.org/10.3390/polym13111845 (registering DOI) - 02 Jun 2021

Abstract Designing composites based on natural polymers has attracted attention for more than a decade due to the possibility to manufacture medical devices which are biocompatible with the human body. Herein, we present some biomaterials made up of collagen, polyurethane, and cellulose doped with **[...] Read more.**
(This article belongs to the Special Issue **Cellulose Based Composites (/journal/polymers/special_issues/cellulose_composite)**)

► Show Figures

(/polymers/polymers-13-01845/article_deploy/html/images/polymers-13-01845-g001-550.jpg) (/polymers/polymers-13-01845/article_deploy/html/images/polymers-13-01845-g002-550.jpg) (/polymers/polymers-13-01845/article_deploy/html/images/polymers-13-01845-g003-550.jpg) (/polymers/polymers-13-01845/article_deploy/html/images/polymers-13-01845-g004-550.jpg) (/polymers/polymers-13-01845/article_deploy/html/images/polymers-13-01845-g005-550.jpg) (/polymers/polymers-13-01845/article_deploy/html/images/polymers-13-01845-g006-550.jpg)

We use cookies on our website to ensure you get the best experience.
Read more about our cookies here (/about/privacy).
Accept (/accept_cookies)

Open Access Review (/2073-4360/13/11/1844/pdf)

Potential Uses of Musaceae Wastes: Case of Application in the Development of Bio-Based Composites (/2073-4360/13/11/1844)

by **Juan Pablo Castañeda Niño**, **José Herminsul Mina Hernandez** and **Alex Valadez González**

Search for Articles:

Title / Keyword: Title / Keyword

Author / Affiliation: Aris Doyan

Journal: Polymers

Article Type: All Article Types

Search

polymers

Saved Queries

Sign in to use this feature.

Search Filter

Reset All

Years

Between: 1996 - 2021

Article Types

Select Article Types

Countries / Regions

Search Results (2)

Search Parameters:
Authors = Aris Doyan
Journal = Polymers

Order results: Publication Date

Result details: Normal

Results per page: 50

Show export options

Open Access Article

Cigarette Butt Waste as Material for Phase Inverted Membrane Fabrication Used for Oil/Water Emulsion Separation

by Aris Doyan, Chew Lee Leong, Muhammad Roil Bilad, Kiki Adi Kurnia, Susilawati Susilawati, Saiful Prayogi, Thanitporn Narkkun and Kajornsak Faungnawakij

Polymers **2021**, *13*(12), 1907; **https://doi.org/10.3390/polym13121907** - 08 Jun 2021

Viewed by 145

Abstract The increasing rate of oil and gas production has contributed to a release of oil/water emulsion or mixtures to the

also developed by scimago: SCIMAGO INSTITUTIONS RANKINGS

SJR Scimago Journal & Country Rank

Enter Journal Title, ISSN or Publisher Name

Home Journal Rankings Country Rankings Viz Tools Help About Us

Publish Open Access
Make an impact.
tandfonline.com
OPEN

Polymers

COUNTRY	SUBJECT AREA AND CATEGORY	PUBLISHER	H-INDEX
Switzerland Universities and research institutions in Switzerland	Chemistry Chemistry (miscellaneous) Materials Science Polymers and Plastics	MDPI AG	73

All Certified and Tested
Produced at the Highest Quality and Consistency with Testing and Certificates to F it!
Great River
Open

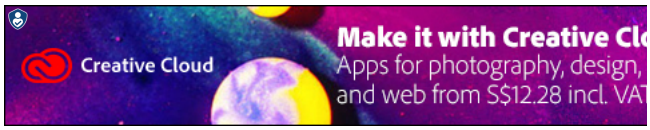
PUBLICATION TYPE	ISSN	COVERAGE	INFORMATION

Journals	20734360	1969, 2009-2020	Homepage How to publish in this journal alboeker@uni-potsdam.de

SCOPE

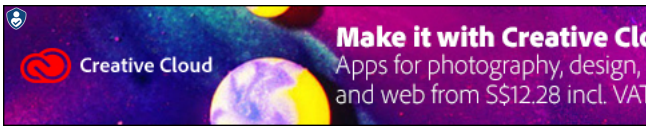
-Polymer Synthesis: synthesis of copolymers, block-polymers, polyesters, elastomer, polyolefins, polyamides, polycarbonates, rubber, thermoplastics, thermosets, methods for polymerization, etc. -Polymer Analysis: characterization and analysis of polymers, polymeric materials and polymer additives, polymerization mechanism, measurement of molecular weight, size, conformation, structure, properties and behavior of polymers, separation, spectroscopy, and scattering techniques, structure-property-processing relationships. -Polymer Physics: crystallization, rheology, swelling, phase separation, viscosity and viscoelasticity, entanglements and crosslinking, mechanical properties, dielectric properties, optical properties, thermal properties, the kinetics of degradation and polymerization, polymers subjected to deformation, flow, and other external fields, polymers at interfaces and in confined spaces. -Polymer Theory and Simulation: numerical simulation for macromolecular systems towards the understanding of underlying physical or physico-chemical mechanisms, modeling of polymer structure and conformation, predictive algorithms of polymerization kinetics and polymerization mechanism, modeling and prediction of the performance of functional polymers, constitutive and multiscale modeling approaches for polymeric systems, kinetic theory of polymers, artificial intelligence, machine learning and data-driven modeling of polymers. -Polymer Processing and Performance: thermoforming, compression and transfer molding, rotational molding, extrusion, injection molding, blow molding, plastic foam molding. -Polymer Applications[...] -Biobased and Biodegradable Polymers[...] -Polymer Recycling[...] -Polymer Composites and Nanocomposites[...]

Join the conversation about this journal



Quartiles

FIND SIMILAR JOURNALS



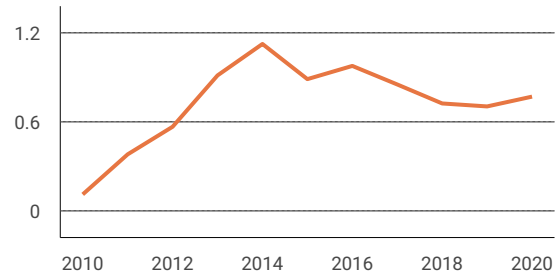
1
Polymer Reviews
USA
82%
similarity

2
Macromolecular Materials and Engineering
DEU
75%
similarity

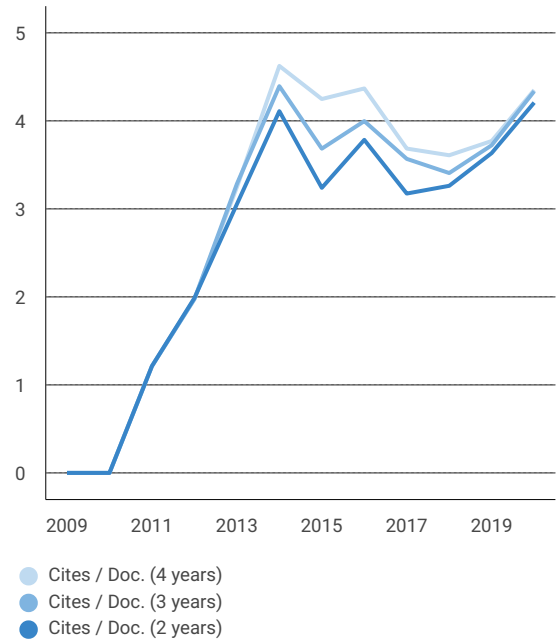
3
Polymer Bulletin
DEU
74%
similarity

4
Express Poly
HUN
7
si

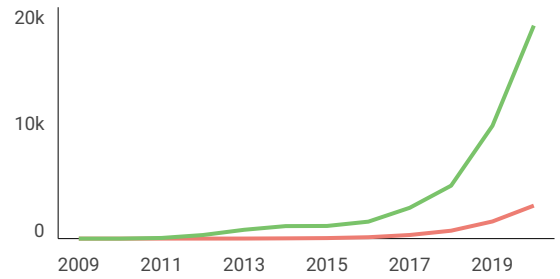
SJR



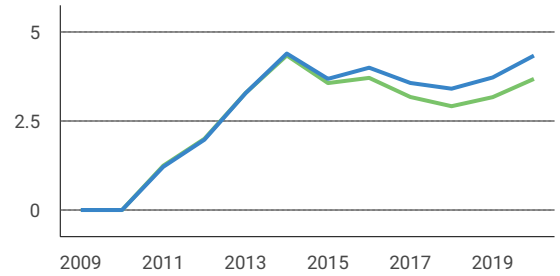
Citations per document



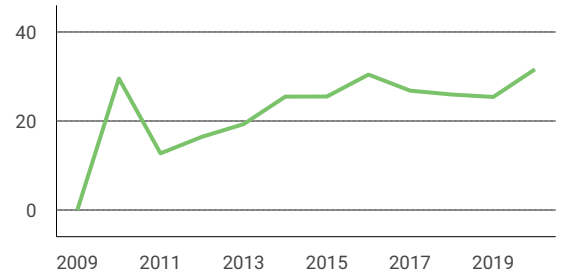
Total Cites Self-Cites



External Cites per Doc Cites per Doc

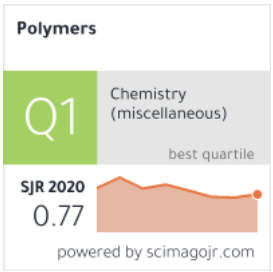


% International Collaboration



Citable documents Non-citable documents

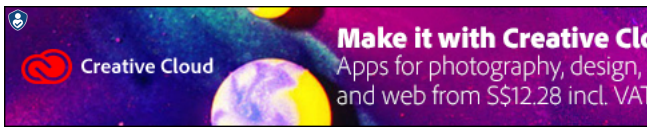
Cited documents Uncited documents



← Show this widget in your own website

Just copy the code below and paste within your html code:

<a href="https://www.scimag



Metrics based on Scopus® data as of April 2021

H **Hay** 1 week ago

Hello, please the rating of this journal in 2019 and 2020 is Q1, is there a way to know the rating in 2021, is it still Q1?

reply

SCImago Team

Melanie Ortiz 1 week ago

Dear Hay,
Thank you for contacting us. Our data come from Scopus, they annually send us an update of the data. This update is sent to us around April / May every year. The SJR for 2020 has been released on 17 May 2021. Therefore, the indicators for 2021 will be available in May/June 2022 and before that date we can´t know what will happen with this journal.
Best Regards, SCImago Team

L **Liew** 5 months ago

is this Free of Charge ?

reply

SCImago Team

Melanie Ortiz 5 months ago

Dear Liew,
thank you for contacting us.
Unfortunately, we cannot help you with your request, we suggest you visit the journal's

homepage or contact the journal's editorial staff , so they could inform you more deeply.
Best Regards, SCImago Team

M **Miguel Diaz M** 6 months ago

In your metrics is there a way to correlate these with JCR impact factor?

reply

SCImago Team

Melanie Ortiz 5 months ago

Dear Miguel,
thank you very much for your comment.
SCImago Journal and Country Rank uses Scopus data as a source and our impact indicator is the SJR. The Journal Citation Report (JCR) is based on the Web of Science (WOS) journal's collection. Therefore, the Source and the methodology used by SJR are different from the JCR.
The SJR indicator is a very sophisticated indicator that is much more complex to calculate and understand than the Impact Factor. To know more about it, click here: https://www.scimagojr.com/files/SJR2.pdf
Best Regards, SCImago Team

M **Mehdi** 3 years ago

Hi

reply

Leave a comment

Name

Email
(will not be published)

Saya bukan robot
reCAPTCHA
Privasi - Persyaratan

Submit

The users of Scimago Journal & Country Rank have the possibility to dialogue through comments linked to a specific journal. The purpose is to have a forum in which general doubts about the processes of publication in the journal, experiences and other issues derived from the publication of papers are resolved. For topics on particular articles, maintain the dialogue through the usual channels with your editor.

Developed by: SCImago

Powered by: Scopus

Follow us on @ScimagoJR

Scimago Lab, Copyright 2007-2020. Data Source: Scopus®

EST MODUS IN REBUS
Horatio (Satire 1,1,106)

polymers

an Open Access Journal by MDPI

Indexed in: PubMed | Indexed in: Ei Compendex | CITESCORE 4.7 SCOPUS | IMPACT FACTOR 3.426

CERTIFICATE OF PUBLICATION

Certificate of publication for the article titled:

Cigarette Butt Waste as Material for Phase Inverted Membrane Fabrication Used for Oil/Water Emulsion Separation

Authored by:

Aris Doyan; Chew Lee Leong; Muhammad Roil Bilad; Kiki Adi Kurnia; Susilawati Susilawati; Saiful Prayogi;
Thanitporn Narkkun; Kajornsak Faungnawakij

Published in:

Polymers **2021**, Volume 13, Issue 12, 1907

MDPI Academic Open Access Publishing since 1996

Basel, June 2021

polymers

an Open Access Journal by MDPI

Cigarette Butt Waste as Material for Phase Inverted Membrane Fabrication Used for Oil/Water Emulsion Separation

Aris Doyan; Chew Lee Leong; Muhammad Roil Bilad; Kiki Adi Kurnia; Susilawati Susilawati; Saiful Prayogi; Thanitporn Narkkun; Kajornsak Faungnawakij

Polymers **2021**, Volume 13, Issue 12, 1907

polymers

MDPI

Article

Cigarette Butt Waste as Material for Phase Inverted Membrane Fabrication Used for Oil/Water Emulsion Separation

Aris Doyan [1,2,*], Chew Lee Leong [3], Muhammad Roil Bilad [3,4,*], Kiki Adi Kurnia[5], Susilawati Susilawati [1,2], Saiful Prayogi [4], Thanitporn Narkkun [6] and Kajornsak Faungnawakij [6]

[1] Master of Science Education Program, University of Mataram, Jl. Majapahit No. 62 Mataram 83125, Indonesia; aris_doyan@unram.ac.id (A.D.); susilawatihambali@unram.ac.id (S.S)
[2] Physics Education, FKIP, University of Mataram, Jl. Majapahit No. 62 Mataram 83125, Indonesia
[3] Department of Chemical Engineering, Universiti Teknologi PETRONAS, Bandar Seri Iskandar 32610, Perak, Malaysia; leongchewlee@gmail.com (C.L.L.)
[4] Faculty of Applied Science and Technology, Universitas Pendidikan Mandalika (UNDIKMA), Jl. Pemuda No. 59A, Mataram 83126, Indonesia; muhammadoilbilad@ikipmataram.ac.id (M.R.B.); saifulprayogi@ikipmataram.ac.id (S.P.)
[5] Department of Marine, Faculty of Fisheries and Marine, Universitas Airlangga, Kampus C Jalan Mulyorejo, Surabaya 60115, Indonesia; kiki.adi@fpk.unair.ac.id (K.A.K.)
[6] National Nanotechnology Center (NANOTEC), National Science and Technology Development Agency (NSTDA), 111 Thailand Science Park, Pathum Thani 12120, Thailand; thanitporn.nar@ncr.nstda.or.th (T.N.); kajornsak@nanotec.or.th (K.F.)

* Correspondence: aris_doyan@unram.ac.id (A.D.) and muhammadoilbilad@ikipmataram.ac.id (M.R.B.)

Abstract: The increasing rate of oil and gas production has contributed to a release of oil-in-water emulsion or mixtures to the environment, becoming a pressing issue. At the same time, pollution of the toxic cigarette butt has also become a growing concern. This study explored utilization of cigarette butt waste as a source of cellulose acetate-based (CA) polymer to develop phase inverted membrane for treatment of oil/water emulsion and compared with commercial polyvinylidene difluoride (PVDF) and polysulfone (PSF). Results show that CA-based membrane from waste cigarette butt offers an eco-friendly material without compromising the separation efficiency, with a pore size range suitable for oil/water emulsion filtration with the rejection of >94.0%. The CA membrane poses good structural property like established PVDF and PSF membranes with equally asymmetric morphology. It also poses hydrophilicity properties with a contact angle of 74.5°, lower than both PVDF and PSF membranes. The pore size of CA demonstrates the CA is within the microfiltration range with a mean flow pore size of 0.17 µm. The developed CA membrane shows a promising oil/water emulsion permeability of 180 L m^{-2} h^{-1} bar^{-1} after five filtration cycles. However, it still suffers a high degree of irreversible fouling (>90.0%), suggesting potential future improvements in terms of membrane fouling management. Overall, this study demonstrates a sustainable approach to addressing oil/water emulsion pollution treated CA membrane from cigarette butt waste.

Keywords: cellulose acetate; cigarette waste; membrane fabrication; crossflow filtration; oily wastewater; phase inversion

Citation: Lastname, F.; Lastname, F.; Lastname, F. Title. *Polymers* **2021**, *13*, x. https://doi.org/10.3390/xxxxx

Academic Editor: Firstname Lastname

Received: date
Accepted: date
Published: date

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Copyright: © 2021 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

Trillions of cigarette butts are hazardous material deposited annually in the environment [1], and they have been identified as the most littered item worldwide [2]. During the year 2016, 5.7 trillion cigarettes were consumed worldwide, and that about 97% of the cigarette filters were composed of cellulose acetate, a modified natural polymer [3]. This figure is expected to increase by 1.6 times in 2025 [4]. The scientific community

has been actively seeking economical and sustainable solutions to tackle the cigarette butt waste pollution issue. To date, the alternatives to handle the pollution include degradation, incineration, recycling, and landfilling. Several studies on converting the waste cigarette butts into usable products were made in various fields, mainly in environmental engineering, buildings and infrastructures, energy storage devices, insecticide, and metallurgical industry [5,6]. Analysis of the potential recycling cigarette butts waste in environmental engineering applications corresponds to about 14.0% of all the possible applications [5]. The utilizations of cigarette butt waste have been mostly focused in buildings and structure applications.

A large volume of oily wastewater is emitted into the environment. The oily wastewater is mainly generated from industries such as petrochemical, petroleum refineries, food manufacturing, and metallurgical [7]. Oily wastewater types include unstable oil/water emulsion (or simply oil/water mixture), stable oil/water emulsion, and free-floating oil [8]. The continuous and increasing discharge of oily wastewater can severely endanger the ecosystem and pollute the environment. Without proper treatment, emulsified oily wastewater can contaminate the groundwater resources in which drinking water and agricultural production are affected [7].

Conventional methods (flotation and coagulation) for the treatment of stable oil/water emulsions are less effective in handling micron-sized emulsion droplets and finely dispersed oil particles [9]. Membrane-based process is seen as one of the emerging methods for treating oil/water emulsion wastewater that has shown effective in handling low concentration of oil (<1000 ppm) in water [10–12]. It outstands the conventional separation techniques for simplicity, continuous, faster, and cost-effectiveness due to their low energy consumption.

The main component of cigarette butt is cellulose acetate (CA) [13], suitable to be converted into polymeric membrane for liquid-based filtration [14]. Cellulose acetate is a cellulose derivative, which possess good transparency and mechanical strength. Almost 90% of cigarettes are manufactured with cellulose acetate filter tips (cigarette butt) [15]. Cigarette butts contain up to 96.0% of cellulose acetate that can be used to form membrane material, as explored in this study. This wa, the circular economy concept can be implemented by providing the opportunity to use cigarette butt waste into economically attractive and usable products [16,17].

A recent study showed that cellulose acetate from waste cigarette butt can be used as raw material for the fabrication of nanofiber membrane [18]. The nanofiber achieved 99.9% of oil droplet separation efficiency when used to treat oil-in-water mixtures. The oil/water mixture treated in this work was a less challenging feed of an oil/water mixture. A more challenging feed in the form of oil/water emulsion separation has not been addressed yet. Electrospun nanofiber membranes are notable for their superiority, high efficiency, simplicity, and low cost [19]. In spite of that, one of the critical limitations of the electrospun nanofiber membranes is their weak mechanical strength. They cannot be used as a standalone system without an additional supporting layer and/or post-treatment, normally in the form of non-woven [20,21]. Moreover, the electrospinning process is relatively slow and requires a longer time to fabricate a membrane. Standard fabrication time for a sheet of nanofiber net in a lab-scale set-up takes up to 100 hours. Nonetheless, little attention has been given to other types of membrane fabrication methods to develop CA-based membranes from waste cigarette butts. Therefore, this study explored the application of cigarette butt as the polymer-based material for membrane fabrication through the established phase inversion method [22] for treating the challenging oil/water emulsion separation. Numerous researches have been conducted to improvise the properties of the membrane from established polymer, such as polyvinylidene difluoride (PVDF) and polysulfone (PSF) through modification of fabrication parameters and post-treatments [23,24].

In this study, we explore the utilization of waste cigarette butt as material for the fabrication of phase inverted membranes. The resulting membrane was compared with

phase inverted membrane fabricated from commercial PSF and PVDF polymers, both polymers are the most used in the commercial membranes for low-pressure filtration (i.e., membrane bioreactor) [25]. After fabrication, all membranes were characterized in terms of mean flow pore size, surface contact angle, morphology, and clean water permeability. Finally, the filtration performance of the membranes was evaluated for filtration of synthetic oil/water emulsion. This approach epitomized a circular economy in which cigarette butt waste was converted into another valuable material for protecting nature when applied for treating wastewater.

2. Materials and Methods

2.1 Materials

The dope solution compositions of the three membranes used in this study are summarized in Table 1. The detail on fabrication and filtration of the plain PVDF and the PSF membranes are available in our earlier reports [10,12]. For fabrication of CA-based membrane, discarded cigarette butts were collected from public smoking areas. There was no specific criterion for pre-screening of the cigarette butts collection. The collected cigarette butts were first cleaned physically by removing any remaining tobacco, wrapping papers, and burnt tips. The cigarette butts went through several cleaning cycles, and each cycle consists of immersing and stirring the butts in boiling water. They were dried thoroughly at 60°C in an air-circulating oven overnight to remove the moisture content. The cleaned cigarette butts was dispersed in N,N-dimethylformamide (DMF, Sigma-Aldrich, USA) solvent and cast atop a stainless steel mesh (37.0 μm mesh size, Guangzhou, China) to provide mechanical strength.

Stabilized oil/water emulsion was synthesized according to earlier work [26] using crude oil (obtained from a crude oil well in Malaysia), distilled water, and sodium dodecyl sulfate (SDS, 98% purity, Sigma Aldrich). The SDS-to-oil ratio of 1:99 (w/w) was mixed in water to obtain 1000 ppm stabilized emulsion via mechanical agitation at a stirring rate of 3500 rpm for 24 h. A small volume of feed samples was subsequently analyzed using particle size and zeta potential analyzer (Malvern, Zetasizer Nano ZSP, Malvern, United Kingdom) to map the oil droplet size distribution. The sizes of the droplets were in multi-modals distribution with peaks at 0.25, 0.9, and 4.0 μm.

Table 1. Summary of materials and weight percentage in membranes evaluated in this study.

Membrane	Polymer	Solvent	Additives	Support
CA	10 wt.% of CA	90 wt.% of DMF	-	Stainless steel mesh
PSF	18 wt.% of PSF	80.9 wt.% of DMAc	1 wt.% of PEG and 0.1 wt.% of LiCl	Nonwoven support
PVDF	15 wt.% of PVDF	85 wt.% of DMAc	-	Nonwoven support

CA: cellulose acetate, PSF: polysulfone, PVDF: polyvinylidene difluoride DMF: dimethylformamide, DMAc: dimethylacetamide, PEG: polyethylene glycol.

2.2 Membrane preparation

For the preparation of CA-based membrane, the dope was prepared by dispersing 10 wt.% of the cleaned cigarette butt in a corresponding amount of DMF without any additive (Table 1). The mixture was stirred for 24 h at 60° C to ensure the formation of a homogeneous solution. The solution was degassed for several hours to release the

entrapped air bubbles before being used for membrane fabrication. The CA membrane was synthesized via the phase inversion method with stainless steel mesh as the support. The dope solution was poured on top of a flat stainless-steel mesh placed on the glass plate. The dope solution was cast over the stainless steel mesh using a doctor blade with a wet thickness of 330 μm to form a thin film. Subsequently, the casted film and the glass plate were directly immersed in the non-solvent bath containing deionized water to undergo the phase inversion. The resulting CA membrane was soaked in deionized water until further use.

2.3 Membrane filtration set-up

The filtration system was operated under full recycling mode by constantly returning the permeate to the feed solution after the volume was periodically (of every 10 mins) measured. The set-up was used to analyze the membrane filtration performance in treating synthetic oil/water emulsion. A peristaltic pump was used to provide a constant transmembrane pressure of 0.2 bar while keeping the feed flowing through the system at a linear velocity of 13.4 cm.s^{-1}. The prepared membrane with an effective area of 36.5 cm^2 was placed in between spacers in a lab-made filtration cell. The filtration was first conducted using deionized water to determine the clean water permeability of the membrane. Each filtration test was conducted for 60 minutes in which a queasy steady-state permeability was obtained.

The filtration flux (J_s, L m^{-2} h^{-1}) and permeability (L, L m^{-2} h^{-1} bar^{-1}) were calculated using Equation (1) and (2), respectively:

$$J_s = \frac{\Delta V}{A_s \, \Delta t} \quad (1)$$

$$L = \frac{J_S}{\Delta P} \quad (2)$$

where ΔV is volume of the collected permeate (L), A_s is effective membrane area (m^2), ΔP is transmembrane pressure (0.2 bar), and Δt is filtration time (h).

2.4 Membrane characterization

The microstructures, cross-section, and surface morphology images of the resulting membrane were processed using a scanning electron microscope (SEM, Zeiss Evo, Germany). The samples were coated using gold to enhance the conductivity for obtaining good images. The pore size distribution of the membranes was determined using a capillary flow porometer (CFP, Porolux 1000, Berlin, Germany). The energy-dispersive X-ray spectroscopy (EDS) was used to define the elemental composition near the surface of the membrane samples. The hydrophilicity of the membrane surface was determined by the static contact angle using a goniometer (Ramé-Hart 260, New Jersey, USA). The chemical bonds of the CA membrane sample were identified using the Fourier transform infrared spectrometer (FT-IR, Frontier 01 Perkin Elmer) in the spectra wavenumber range of 400 to 4,000 cm^{-1}. The concentration of oil content in the feed before and after the filtration tests were studied using a UV-VIS spectrometer (Shimadzu UV-2600, Kyoto, Japan) at a wavelength of 223 nm.

2.5 Membrane fouling identification

Before obtaining the clean water permeability, membrane compaction was performed for 60 mins. The permeability was measured as the average value of the next 30 mins. After measuring the clean water permeability, the filtration of oil/water emulsion feed was conducted for five cycles. Each cycle comprised of 30 mins filtration, followed by 5 mins of membrane flushing with deionized water. From the five filtration cycles, different types of fouling parameters were identified. The total fouling (TF, %), reversible

(*RF*, %) and irreversible fouling (*IR*,%) of the membrane were determined using Equations (3), (4) and (5), respectively:

$$TF_n = \frac{L_o - L_n}{L_o} \quad (3)$$

$$RF_n = \frac{L_{o(n)} - L_{o(n-1)}}{L_n} \quad (4)$$

$$IR_n = \frac{L_n - L_{o(n)}}{L_n} \quad (5)$$

where n is number of filtration cycle, L_o is the clean water permeability at the beginning of the filtration, L_n is average permeability at cycle n, $L_{o(n)}$ is the permeability of clean water at cycle n, $L_{o(n-1)}$ is the permeability of oil-in-water emulsion filtration at cycle *n-1*.

3. Results and Discussion

3.1 Surface and cross-section morphologies

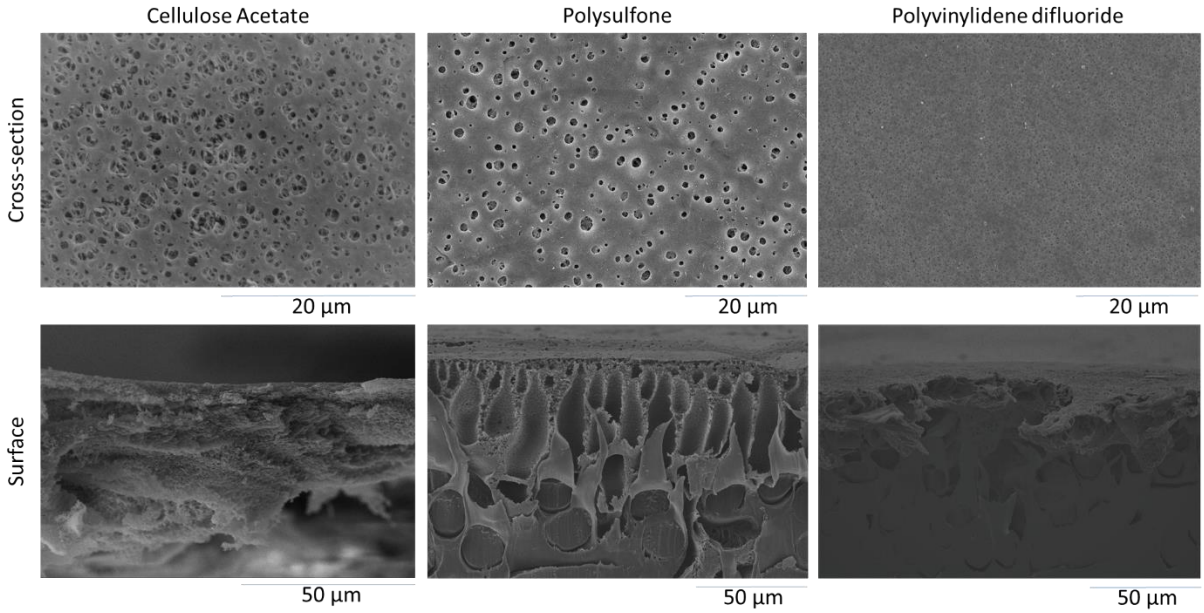


Figure 1. Surface and cross-section SEM images of the membrane samples.

Figure 1 shows the morphological structure of the developed CA, PSF, and PVDF membranes. Based on the top surface SEM images, all samples pose visible surface pores homogeneously distributed. They show the typical morphology of membranes prepared by non-solvent induced phase separation. Most importantly, despite being prepared from waste cigarette butt, the CA membrane also poses good surface property like the ones prepared from the commercial PVDF and PSF polymer, typically used for membranes fabrication. The finding on the microstructure suggesting the potential of a waste cigarette butt for membrane fabrication, which can be applied for oil/water emulsion filtration. The surface pores are within a size range far below most of the oil droplets presented in the oil/water emulsion feed used in this study.

The cross-section images of all membranes show equally asymmetrical morphology, a typical structure of membranes prepared from non-solvent induced phase separation under instantaneous demixing [27], in which a dense surface morphology is supported by a more porous structure underneath. The large surface pores of the CA membrane are all

within the microfiltration range, which also suggests the instantaneous demixing phase separation mechanism. A recent report on the fabrication of CA membrane from commercial CA polymer showed symmetric morphology since it was prepared from different solvent/nonsolvent systems and different polymer concentrations [14]. Detailed discussion on relationships between polymer/solvent/nonsolvent system can be found elsewhere [14,24,28]. The finding suggests that irrespective of the source (i.e., waste cigarette butt), CA membrane could be prepared using the phase inversion method resulting reliable membrane effectively used for filtration, as demonstrated in Section 3.7.

3.2 Membrane pore size and distribution

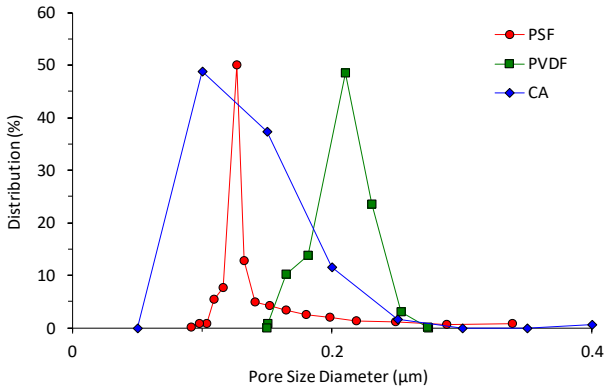


Figure 2. The pore size distribution of the developed cellulose acetate (CA), polysulfone (PSF), and polyvinylidene difluoride (PVDF) membranes.

Figure 2 shows the pore size distribution of the three membrane samples evaluated using a CFP. The y-axis of the figure show the actual distribution of pore of certain size, not the frequency distribution found in a typical histogram. The pore distribution of all memnbrane samples skew to the left indicating of higher populations of smaller pores. The cigarette butt–based CA membrane poses a high pore size population at around 0.10-0.15 µm. The pore size range of the cigarette butt–based CA membrane is suitable for handling the oil/water emulsion because the pores theoretically could retain emulsion droplets with sizes larger than the membrane pore sizes. The sizes of the oil droplets in emulsion are normally in the range of 0.1 to 10 µm [29]. Most of the oil droplets can be effectively removed with a membrane of pore size in the range of 2 to 100 nm. The membrane works based on the size exclusion theory, in which the membrane material rejects particles larger than the pore size. Higher mean flow pore sizes are shown by the PSF and PVDF membranes at 0.127 and 0.210 µm, respectively. It was reported that the typical commercial microfiltration CA-based membrane has a pore size of 0.470 µm [30], most likely because of some differences in fabrication parameters. Indeed, further exploration can still be done to fine-tune the properties of a cigarette butt CA-based membranes according to the required specifications as suggested elsewhere [31–33].

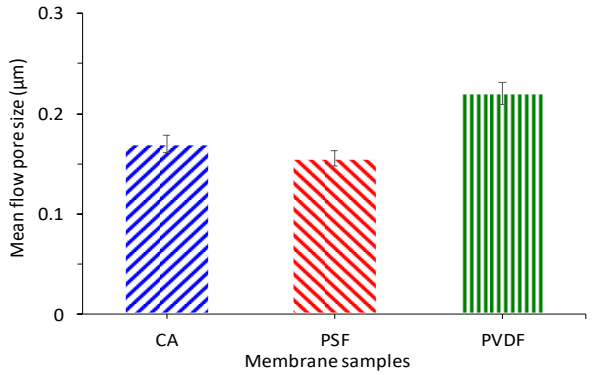


Figure 3. The mean pore size distribution of the cellulose acetate (CA), polysulfone (PSF), and polyvinylidene difluoride (PVDF) membranes.

Figure 3 depicts the mean pore size distribution of CA, PSF, and plain PVDF analyzed with CFP. The CFP test accurately captures the pore size across the thickness and the size distribution shown in Figure 2. It shows that the plain PVDF membrane exhibits the largest mean flow pore size of 0.2206 µm in comparison to CA and PSF, with mean flow pore size of 0.17 and 0.1556 µm, respectively. The SEM images of the plain PVDF membrane show poor surface pore visibility. Figure 3 shows that the pore size of the membranes is comparable and all are expected to effectively retain oil droplets in the oil/water emulsion feeds. In addition to the mean flow pore size and pore size distribution, the specific number of pore per unit of membrane surface is also important to govern the permeability and can distinguish the throughput of membranes despite having similar pore size and distributions.

3.3 Surface contact angle

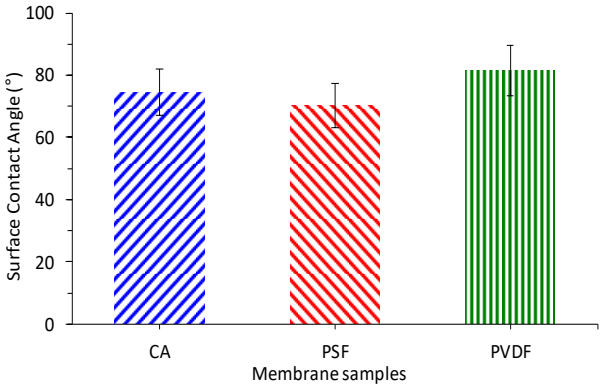


Figure 4. Static contact angle of the developed cellulose acetate (CA), polysulfone (PSF) and polyvinylidene difluoride (PVDF) membranes.

Figure 4 shows the static water contact angle for the three membrane samples used in this study. The static water contact angle is essential in determining the permeability and fouling properties of a membrane. A membrane is considered hydrophilic when the contact angle falls between 0° to 90°. Membranes with hydrophilic properties are ideal in oil/water emulsion treatment when water is the component that is permeating through the membrane pore and vice versa [34,35]. Hydrophilic surface attracts water by creating a hydration layer and prevents oil droplet interaction with the membrane surface, hence improvingimproving oil droplet rejection [36]. As shown in Figure 4, PVDF membrane

demonstrates the most hydrophobic characteristic with a water contact angle of 81.59°, attributed to the low polymer surface free energy [37]. This is followed by CA and PSF membranes with the surface water contact angles of 74.5° and 70.23°, respectively. The surface water contact angle of plain CA membrane from commercial polymers in this study is within the range reported earlier of 50-60° [38–40], which can be attributed to variation surface structure and fabrication parameters and possibly due to presence of impurities that can be further investigated as the follow up study. These findings are encouraging and show a CA membrane based from cigarette butt waste potentially possess a high clean water permeability and good anti fouling property, at least when compared with the PVDF and PSF membranes samples used as reference in this study.

3.4 Fourier transform infrared

The FT-IR spectra in Figure 5 depicts the chemical composition of the prepared cigarette butt-based CA membrane. The FT-IR spectrum of CA shows a peak absorption band at 1747, 1230, and 1050 cm^{-1} which is assigned to the C=O carbonyl stretching, C-O stretching, and CO-O-CO stretching. The peaks at 1371 and 2920 cm^{-1} are attributed to the C-O group and aliphatic group (C-H), respectively. And broad peak at around 3500 cm^{-1} represents the O-H group. Similar findings were reported by Liu et al. that attributed the presence of carbonyl stretching, symmetric, and asymmetric stretching vibrations of C-O-C, respectively, in nanofiber membrane from waste cigarette butt [18].

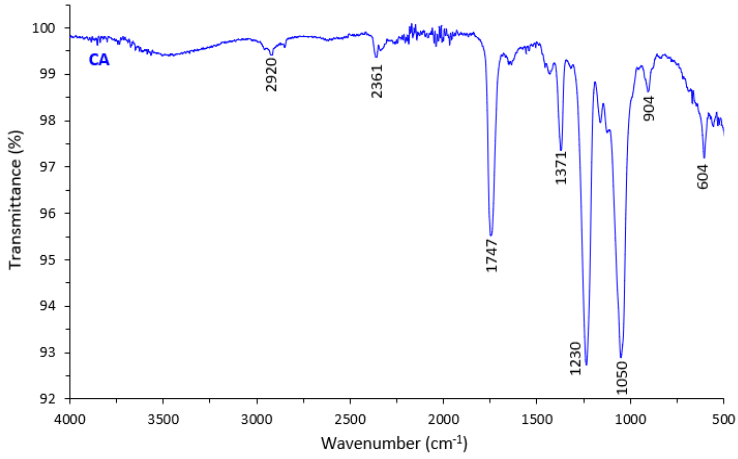


Figure 5. FT-IR spectra of the cellulose acetate membrane.

The spectra shown in Figure 5 resemble the one obtained for phase inverted membrane prepared from commercial CA polymer [40,41]. The presence of impurities is hardly seen from the spectra, indicating that the spectra associate with them might be overlapping with spectra associated with CA. Visually, the presence of impurities could be seen from the grey color of the cigarette butt CA-based membrane. The presence of impurities might affect the resulting membrane properties (i.e., higher water contact angle) and the purification process is thus recommended as the follow-up studies. Polymer purification was shown effective in improving the structure and performance of the resulting membranes [42].

3.5 Energy Dispersive X-Ray Spectroscopy

Table 2 shows the distribution of elemental composition for CA, PSF, and PVDF membranes obtained from EDS mapping. It is observed that the oxygen originating from the hydroxyl group in CA has the highest composition at 48.2%. It is slightly higher than the one obtained from X-ray photoelectron spectroscopy of 42.0% obtained elsewhere [40]. This result indicated the presence of hydrophilic functional groups in the CA membrane, which justifies the CA membrane has higher hydrophilicity properties than the PSF and

the PVDF membranes. The presence of carbon and oxygen is supported by FT-IR analysis. In contrast, the static contact angle measurement suggests that the PVDF membrane demonstrates the most hydrophilic characteristic with a contact angle of water of 81.59°. The abundance of oxygen element in the CA membrane can further be explored to enhance the surface hydrophilicity.

Table 2. The elemental composition of the cellulose acetate (CA), polysulfone (PSF), and polyvinylidene difluoride (PVDF) membranes.

Membrane	Composition (%)			
	C	F	O	S
CA	51.60	0.00	48.20	0.00
PSF	69.02	0.00	26.05	4.92
PVDF	55.55	42.84	1.61	0.00

3.6 Clean water permeability

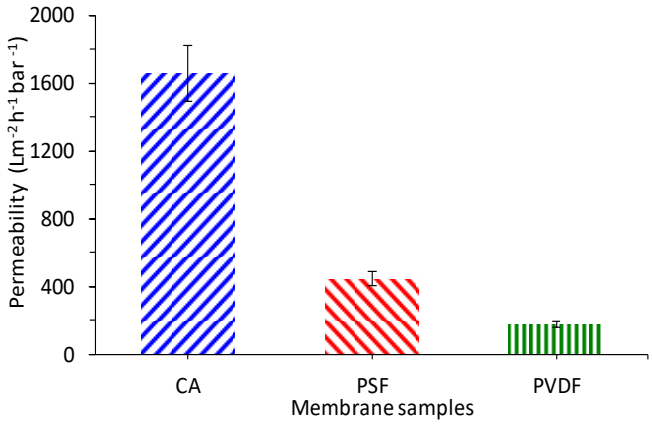


Figure 6. Clean water permeability of the cellulose acetate (CA), polysulfone (PSF), and polyvinylidene difluoride (PVDF) membranes.

Figure 6 shows that the CA membrane outperforms the rest in filtration performance by having the highest permeability compared to PSF and PVDF membranes. Clean water permeability involves the passage of water molecules through the membrane under crossflow filtration. The CA membrane showed the water permeability of 1658 L m^{-2} h^{-1} bar^{-1} significantly higher than the PSF and PVDF membranes clean water permeability of 446 L m^{-2} h^{-1} bar^{-1} and 175 L m^{-2} h^{-1} bar^{-1}, respectively.

When considering the pore size and distribution of the three membrane samples evaluated in this study, significantly high permeability shown by CA membrane can be ascribed by their low surface water contact angle (Figure 4) combined with higher surface pore population. Some membranes can show similar pore size and distribution but differ in pore number, as detailed in an earlier report [43]. When evaluating the surface SEM image in Figure 1, it can be seen that the CA membrane's surface pores are highly populated compared to the rests.

3.7 Filtration performance

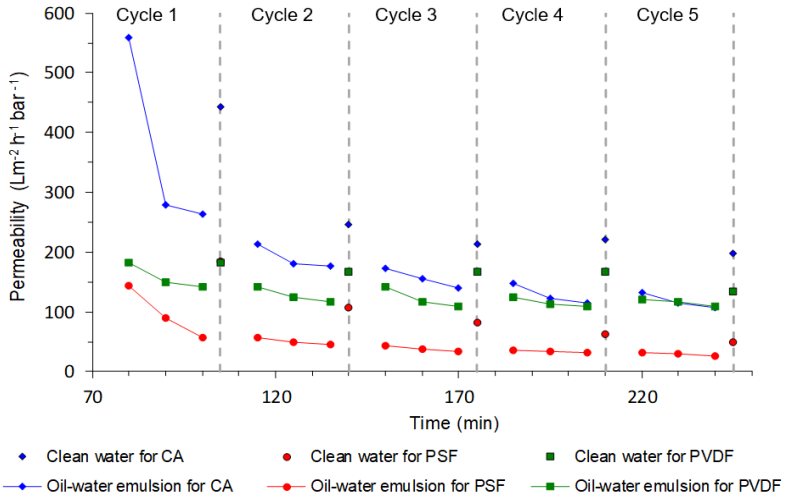


Figure 7. The permeability of the cellulose acetate (CA), polysulfone (PSF), and polyvinylidene difluoride (PVDF) membranes for five cycles in thirty minutes oil-in-water emulsion and five minutes in clean water as a function of filtration time.

Figure 7 shows that the CA poses the highest oil/water emulsion permeability for the first 50 min of filtration, maintained at a value of 180 L m^{-2} h^{-1} bar^{-1} at the end of the subsequent filtration cycles. The high performance of the CA membrane can be attributed to the high oxygen content in the membrane that imposes surface hydrophilicity which is beneficial for repelling deposited oil droplets when treating the oil/water emulsion and forming a hydration layer on the membrane surface [36]. The membrane surface has high surface porosity (from a high number of the surface pore, see), as shown on the SEM images in Figure 1, which could offer a better oil/water emulsion permeability than the PSF and the PVDF membranes. The clean water flushing introduced at each filtration cycle helps to improve the permeability of the membrane and remove the oily foulant and reduce the fouling effect on the membrane. It can be observed the water flushing at cycle 2, 3, 4, and 5 improve the subsequent permeability of the membrane in oil/water emulsion. However, the water flushing in cycle 1 does not exhibit an increase of permeability. This may occur due to the strong oil adhesion on the membrane surface that has caused the emulsion permeability to dramatically decrease.

In another study, the permeability of the oil/water emulsion for commercial CA membrane in the first cycle is 1900 Lm^{-2} h^{-1} bar^{-1}. After the first flushing, the permeability decreased significantly to 370 Lm^{-2} h^{-1} bar^{-1}, following the third cycle of 90 Lm^{-2} h^{-1} bar^{-1}. The subsequent cycles show no permeability, which demonstrated the oil particles have wholly clogged the membrane pores suggesting severe membrane fouling also happen to a plain CA membrane made from commercial polymer [30]. Although the commercial CA membrane has a high permeability at the initial phase, it is worth noting that the permeability had a steep decrease. When compared to the CA membrane from cigarette waste, the developed membrane exhibited a relatively slow decrease in the whole five cycles. This constitutes an interesting phenomenon as the developed CA is made of cigarette butt waste. Further comparison with PSF and PVDF membranes optimized for oil/water emulsion filtration was reported earlier [10,42]. The permeability is comparable with the plain CA membranes developed from cigarette butt waste reported in the present study. It suggests that the CA-based membrane from cigarette butt, can further be developed to enhance its filtration performance via fabrication parameter optimization or surface modifications.

3.8 Rejection performance

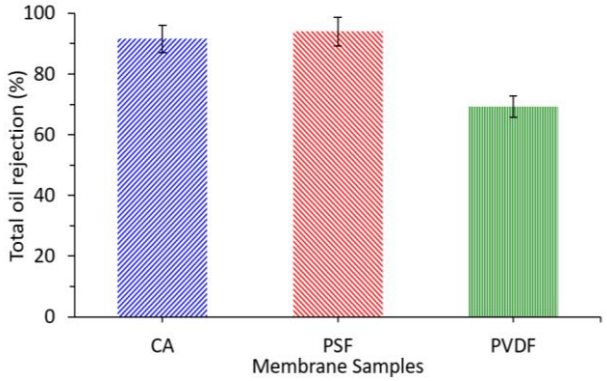


Figure 8. The oil rejection of PW filtration using the cellulose acetate (CA), polysulfone (PSF), and polyvinylidene difluoride (PVDF) membranes.

To evaluate the oil separation efficiency, the oil rejection performances of the CA membrane was evaluated and compared with PSF and PVDF membranes. The CA membrane exhibits an excellent total oil rejection of 91.5%. This shows that the CA membrane developed from cigarette waste is comparable to the established PSF membrane that has achieved the rejection efficiency of 94.0%. In addition, CA could be a promising candidate in achieving a large-scale separation of oil/water emulsion for its greater oil rejection than the PVDF membrane. A study by Liu et al. found that the stainless steel mesh (size 300 and 2300) alone could not separate the oil/water mixture well as the oil and water passed through the mesh unobstructively [18].

A similar study by Ifelebuegu et.al using waste cigarette butt in oil spill clean-up found that waste filters adsorbed 16 to 26 times their weights in various oils, which is a better oil sorption performance than those commercial adsorbents. It also reported that the sorption capacity did not significantly deteriorate after 20 cycles of reuse, with up to 75% sorption capacity retained [44]. Nair reported the highest absorption of dye using the CA membrane prepared from cigarette buds was obtained in slightly acidic conditions with the pH of 6.15 [45].

The finding suggests the effectiveness of the developed CA membrane to separate oil droplets. The good separation can be ascribed from the relatively large difference between the mean flow pore size of 0.17 μm and most of the oil droplets >0.25 μm. Those differences allow the separation through size exclusion mechanisms in which oil droplets were retained on the top of the membrane surface [35,46].

3.9 Membrane fouling analysis

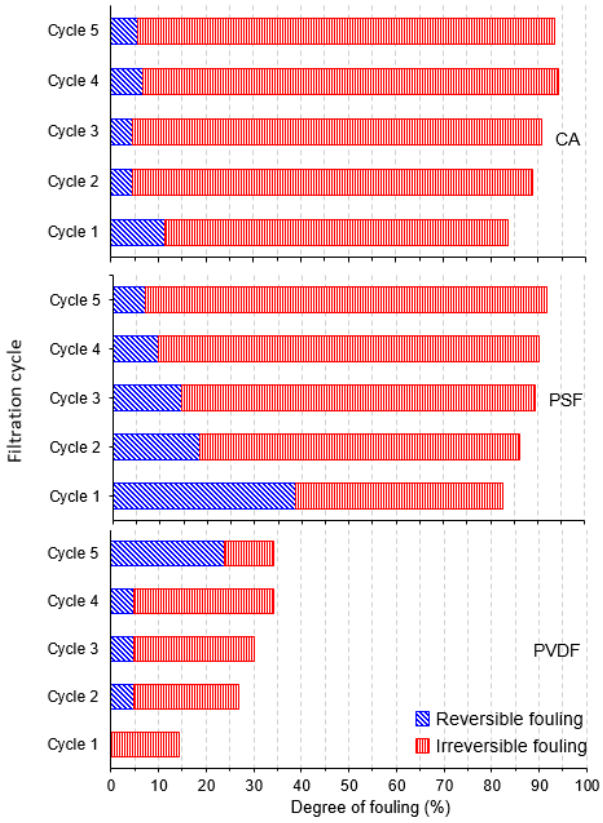


Figure 9. The evolution of membrane fouling in terms of reversible and irreversible fouling.

Figure 9 shows the analysis of membrane fouling based on its reversibility for CA compared to the PSF and the PVDF membranes. As expected, the total fouling for all three types of membranes showed an increasing trend with the increasing filtration cycles. The trend of multiple cycle performance is consistent with our earlier report treating the same feed following similar filtration cycles [10,12,47,48]. The three membranes pose quite distinct fouling reversibility. The total fouling depicted by PVDF at each cycle is relatively lower than the PSF and the CA membranes, indicating a lower degree of permeability loss and better antifouling properties. However, when judging from the actual permeability data in Figure 7, the performance of the PVDF membrane is comparable with the CA membrane. The low degree of fouling in PVDF membrane compared to others is due to its relatively low clean water permeability compared to others (Figure 6). Therefore, the fouling parameters become low since the oil/water emulsion permeability was compared to the initial clean water permeability (Equations 3-5). On the contrary, both CA and PSF demonstrated high total fouling since they pose high clean water permeability accompanied by similar oil/water emulsion permeability.

It is observed from Figure 9 that the membrane fouling in CA and PSF are dominated by irreversible fouling. The CA suffers a relatively high degree of irreversible fouling since the first filtration cycle. It should also be noted that CA has five-folds higher clean water permeability than PSF and PVDF at the initial cycle. It is speculated that the high fouling rate of CA was caused by the rapid compaction of permanent foulant trapped in the pores that occurred during the first cycle resulting in a lower oil/water emulsion permeability. After the first cycle, the rate of foulant accumulation is very small, indicating that the foulant was well consolidated. It is wort noting that the occurrence of membrane fouling can be well managed by implementing membrane cleaning cycles. Under proper fouling management, the lifespan of a membrane can be over 15 years [49].

The finding on high degree of irreversible membrane fouling during the early stage of filtration indicates the possibility of further developing phase inverted cigarette butt-based CA membrane, focusing on combating the irreversible fouling. As demonstrated in earlier report, the incorporation of zirconia (ZrO_2) particles in CA casting solution resulted in a decrease in fouling resistance. The total fouling resistance for pure CA membrane is 7.19×10^{10} m^{-1}. The addition of 7 wt.% of ZrO_2 decreased the total fouling resistance to 2.58×10^{10} m^{-1} [50]. This may due to the increase in hydrophilicity of CA membrane, which increases the interaction of the molecules on the membrane surface.

4. Conclusions

This study unravels the potential of CA from cigarette butt waste as material for membrane fabrication for oil/water emulsion treatment. This utilization of waste can alleviate the environmental problems from cigarette butt waste as well tackling the issue of oil/water emulsion. The CA-based membrane was successfully fabricated via the phase inversion method with a typical structure formed from the instantaneous demixing process. The findings show that CA membrane poses hydrophilicity properties with a contact angle of 74.5°, lower than both PVDF and PSF membranes used as reference. The pore size and distribution are suitable for oil/water separation. Despite being prepared from a waste cigarette, CA also poses good surface property similar to the ones prepared from commercial PVDF and PSF polymer with equally asymmetric morphology. The pore size of CA demonstrates the CA is within the microfiltration range. The developed CA membrane shows a promising flux of 180 Lm^{-2} h^{-1} after multiple filtration cycles of oil/water emulsion. However, it still suffers a high degree of irreversible fouling (>90.0 %), suggesting potential for future improvement through optimization of fabrication parameters or via surface modification. Overall results demonstrate a sustainable approach in handling oil/water emulsion pollution issue by treatment using CA membrane derived from cigarette butt waste.

Author Contributions: Data curation, methodology, validation, writing—original draft preparation, A.D. and C.L.L., Supervision, conceptualization, methodology, validation, writing—review and editing, M.R.B.; validation, writing—review and editing, S.P., K.A.K. and S.S.; methodology and writing—review and editing, T.N. and K.F. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement:

Informed Consent Statement:

Data Availability Statement:

Acknowledgments:

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Torkashvand, J.; Farzadkia, M.; Sobhi, H.R.; Esrafili, A. Littered Cigarette Butt as a Well-Known Hazardous Waste: A Comprehensive Systematic Review. *J. Hazard. Mater.* **2020**, *383*, 121242, doi:10.1016/j.jhazmat.2019.121242.
2. Torkashvand, J.; Godini, K.; Jafari, A.J.; Esrafili, A.; Farzadkia, M. Assessment of Littered Cigarette Butt in Urban Environment, Using of New Cigarette Butt Pollution Index (CBPI). *Sci. Total Environ.* **2021**, *769*, 144864, doi:10.1016/j.scitotenv.2020.144864.
3. Kurmus, H.; Mohajerani, A. The Toxicity and Valorization Options of Cigarette Butts. *Waste Manag.* **2020**, *104*, 104–118, doi:10.1016/j.wasman.2020.01.011.

4. Hamzah, Y.; Umar, L. Preparation of Creating Active Carbon from Cigarette Filter Waste Using Microwave-Induced KOH Activation. *J. Phys. Conf. Ser.* **2017**, *853*, 012027, doi:10.1088/1742-6596/853/1/012027.
5. Marinello, S.; Lolli, F.; Gamberini, R.; Rimini, B. A Second Life for Cigarette Butts? A Review of Recycling Solutions. *J. Hazard. Mater.* **2020**, *384*, 121245, doi:10.1016/j.jhazmat.2019.121245.
6. Li, L.; Jia, C.; Zhu, X.; Zhang, S. Utilization of Cigarette Butt Waste as Functional Carbon Precursor for Supercapacitors and Adsorbents. *J. Clean. Prod.* **2020**, *256*, 120326, doi:10.1016/j.jclepro.2020.120326.
7. Yu, L.; Han, M.; He, F. A Review of Treating Oily Wastewater. *Arab. J. Chem.* **2017**, *10*, S1913–S1922, doi:10.1016/j.arabjc.2013.07.020.
8. Um, M.-J.; Yoon, S.-H.; Lee, C.-H.; Chung, K.-Y.; Kim, J.-J. Flux Enhancement with Gas Injection in Crossflow Ultrafiltration of Oily Wastewater. *Water Res.* **2001**, *35*, 4095–4101, doi:10.1016/S0043-1354(01)00155-5.
9. Chakrabarty, B.; Ghoshal, A.K.; Purkait, M.K. Ultrafiltration of Stable Oil-in-Water Emulsion by Polysulfone Membrane. *J. Membr. Sci.* **2008**, *325*, 427–437, doi:10.1016/j.memsci.2008.08.007.
10. Barambu, N.U.; Bilad, M.R.; Bustam, M.A.; Huda, N.; Jaafar, J.; Narkkun, T.; Faungnawakij, K. Development of Polysulfone Membrane via Vapor-Induced Phase Separation for Oil/Water Emulsion Filtration. *Polymers* **2020**, *12*, 2519, doi:10.3390/polym12112519.
11. Nawi, N.I.M.; Sait, N.R.; Bilad, M.R.; Shamsuddin, N.; Jaafar, J.; Nordin, N.A.H.; Narkkun, T.; Faungnawakij, K.; Mohshim, D.F. Polyvinylidene Fluoride Membrane Via Vapour Induced Phase Separation for Oil/Water Emulsion Filtration. *Polymers* **2021**, *13*, 427, doi:10.3390/polym13030427.
12. Nawi, N.I.M.; Ong Amat, S.; Bilad, M.R.; Nordin, N.A.H.M.; Shamsuddin, N.; Prayogi, S.; Narkkun, T.; Faungnawakij, K. Development of Polyvinylidene Fluoride Membrane via Assembly of Tannic Acid and Polyvinylpyrrolidone for Filtration of Oil/Water Emulsion. *Polymers* **2021**, *13*, 976, doi:10.3390/polym13060976.
13. Puls, J.; Wilson, S.A.; Hölter, D. Degradation of Cellulose Acetate-Based Materials: A Review. *J. Polym. Environ.* **2011**, *19*, 152–165, doi:10.1007/s10924-010-0258-0.
14. Saljoughi, E.; Sadrzadeh, M.; Mohammadi, T. Effect of Preparation Variables on Morphology and Pure Water Permeation Flux through Asymmetric Cellulose Acetate Membranes. *J. Membr. Sci.* **2009**, *326*, 627–634, doi:10.1016/j.memsci.2008.10.044.
15. Mohajerani, A.; Kadir, A.A.; Larobina, L. A Practical Proposal for Solving the World's Cigarette Butt Problem: Recycling in Fired Clay Bricks. *Waste Manag.* **2016**, *52*, 228–244, doi:10.1016/j.wasman.2016.03.012.
16. D'Adamo, I. Adopting a Circular Economy: Current Practices and Future Perspectives. *Soc. Sci.* **2019**, *8*, 328, doi:10.3390/socsci8120328.
17. Cucciniello, R.; Cespi, D. Recycling within the Chemical Industry: The Circular Economy Era. *Recycling* **2018**, *3*, 22, doi:10.3390/recycling3020022.
18. Liu, W.; Cui, M.; Shen, Y.; Zhu, G.; Luo, L.; Li, M.; Li, J. Waste Cigarette Filter as Nanofibrous Membranes for On-Demand Immiscible Oil/Water Mixtures and Emulsions Separation. *J. Colloid Interface Sci.* **2019**, *549*, 114–122, doi:10.1016/j.jcis.2019.04.057.
19. Abd Halim, N.S.; Wirzal, M.D.H.; Hizam, S.M.; Bilad, M.R.; Nordin, N.A.H.M.; Sambudi, N.S.; Putra, Z.A.; Yusoff, A.R.M. Recent Development on Electrospun Nanofiber Membrane for Produced Water Treatment: A Review. *J. Environ. Chem. Eng.* **2021**, *9*, 104613, doi:10.1016/j.jece.2020.104613.
20. Bilad, M.R.; Westbroek, P.; Vankelecom, I.F.J. Assessment and Optimization of Electrospun Nanofiber-Membranes in a Membrane Bioreactor (MBR). *J. Membr. Sci.* **2011**, *380*, 181–191, doi:10.1016/j.memsci.2011.07.003.

21. Mohd Asri, M.A.N.; Abd Halim, N.S.; Wirzal, M.D.H.; Mohd Yusoff, A.R.; Bilad, M.R. Thermal Annealing Surface Modification: Effect on Surface and Performance of Electrospun Nylon 6,6 Nanofiber Membrane for Wastewater Treatment. *J. Penelit. Dan Pengkaj. Ilmu Pendidik. E-Saintika* **2021**, *5*, 56, doi:10.36312/e-saintika.v5i1.395.
22. Lalia, B.S.; Kochkodan, V.; Hashaikeh, R.; Hilal, N. A Review on Membrane Fabrication: Structure, Properties and Performance Relationship. *Desalination* **2013**, *326*, 77–95, doi:10.1016/j.desal.2013.06.016.
23. Nady, N.; Franssen, M.C.R.; Zuilhof, H.; Eldin, M.S.M.; Boom, R.; Schroën, K. Modification Methods for Poly(Arylsulfone) Membranes: A Mini-Review Focusing on Surface Modification. *Desalination* **2011**, *275*, 1–9, doi:10.1016/j.desal.2011.03.010.
24. Kang, G.; Cao, Y. Application and Modification of Poly(Vinylidene Fluoride) (PVDF) Membranes – A Review. *J. Membr. Sci.* **2014**, *463*, 145–165, doi:10.1016/j.memsci.2014.03.055.
25. Judd, S.; Judd, C. Commercial Technologies. In *The MBR Book*; Elsevier, 2011; pp. 289–357 ISBN 978-0-08-096682-3.
26. Pichot, R.; Spyropoulos, F.; Norton, I.T. O/W Emulsions Stabilised by Both Low Molecular Weight Surfactants and Colloidal Particles: The Effect of Surfactant Type and Concentration. *J. Colloid Interface Sci.* **2010**, *352*, 128–135, doi:10.1016/j.jcis.2010.08.021.
27. Mazinani, S.; Darvishmanesh, S.; Ehsanzadeh, A.; Van der Bruggen, B. Phase Separation Analysis of Extem/Solvent/Non-Solvent Systems and Relation with Membrane Morphology. *J. Membr. Sci.* **2017**, *526*, 301–314, doi:10.1016/j.memsci.2016.12.031.
28. Barzin, J.; Sadatnia, B. Theoretical Phase Diagram Calculation and Membrane Morphology Evaluation for Water/Solvent/Polyethersulfone Systems. *Polymer* **2007**, *48*, 1620–1631, doi:10.1016/j.polymer.2007.01.049.
29. Chen, W.; Su, Y.; Zheng, L.; Wang, L.; Jiang, Z. The Improved Oil/Water Separation Performance of Cellulose Acetate-Graft-Polyacrylonitrile Membranes. *J. Membr. Sci.* **2009**, *337*, 98–105, doi:10.1016/j.memsci.2009.03.029.
30. Li, F.; Gao, R.; Wu, T.; Li, Y. Role of Layered Materials in Emulsified Oil/Water Separation and Anti-Fouling Performance of Modified Cellulose Acetate Membranes with Hierarchical Structure. *J. Membr. Sci.* **2017**, *543*, 163–171, doi:10.1016/j.memsci.2017.08.053.
31. Baldino, L.; Cardea, S.; Reverchon, E. Supercritical Phase Inversion: A Powerful Tool for Generating Cellulose Acetate-AgNO3 Antimicrobial Membranes. *Materials* **2020**, *13*, 1560, doi:10.3390/ma13071560.
32. Guillen, G.R.; Pan, Y.; Li, M.; Hoek, E.M.V. Preparation and Characterization of Membranes Formed by Nonsolvent Induced Phase Separation: A Review. *Ind. Eng. Chem. Res.* **2011**, *50*, 3798–3817, doi:10.1021/ie101928r.
33. Thakur, V.K.; Voicu, S.I. Recent Advances in Cellulose and Chitosan Based Membranes for Water Purification: A Concise Review. *Carbohydr. Polym.* **2016**, *146*, 148–165, doi:10.1016/j.carbpol.2016.03.030.
34. Pornea, A.M.; Puguan, J.M.C.; Deonikar, V.G.; Kim, H. Robust Janus Nanocomposite Membrane with Opposing Surface Wettability for Selective Oil-Water Separation. *Sep. Purif. Technol.* **2020**, *236*, 116297, doi:10.1016/j.seppur.2019.116297.
35. Elnabawy, E.; Elsherbiny, I.M.A.; Abdelsamad, A.M.A.; Anis, B.; Hassan, A.; Ulbricht, M.; Khalil, A.S.G. Tailored CNTs Buckypaper Membranes for the Removal of Humic Acid and Separation of Oil-in-Water Emulsions. *Membranes* **2020**, *10*, 97, doi:10.3390/membranes10050097.
36. Yalcinkaya, F.; Boyraz, E.; Maryska, J.; Kucerova, K. A Review on Membrane Technology and Chemical Surface Modification for the Oily Wastewater Treatment. *Materials* **2020**, *13*, 493, doi:10.3390/ma13020493.
37. Moradi, R.; Karimi-Sabet, J.; Shariaty-Niassar, M.; Koochaki, M. Preparation and Characterization of Polyvinylidene Fluoride/Graphene Superhydrophobic Fibrous Films. *Polymers* **2015**, *7*, 1444–1463, doi:10.3390/polym7081444.

38. Guezguez, I.; Mrabet, B.; Ferjani, E. XPS and Contact Angle Characterization of Surface Modified Cellulose Acetate Membranes by Mixtures of PMHS/PDMS. *Desalination* **2013**, *313*, 208–211, doi:10.1016/j.desal.2012.11.018.
39. Han, B.; Zhang, D.; Shao, Z.; Kong, L.; Lv, S. Preparation and Characterization of Cellulose Acetate/Carboxymethyl Cellulose Acetate Blend Ultrafiltration Membranes. *Desalination* **2013**, *311*, 80–89, doi:10.1016/j.desal.2012.11.002.
40. Ang, M.B.M.Y.; Devanadera, K.P.O.; Duena, A.N.R.; Luo, Z.-Y.; Chiao, Y.-H.; Millare, J.C.; Aquino, R.R.; Huang, S.-H.; Lee, K.-R. Modifying Cellulose Acetate Mixed-Matrix Membranes for Improved Oil–Water Separation: Comparison between Sodium and Organo-Montmorillonite as Particle Additives. *Membranes* **2021**, *11*, 80, doi:10.3390/membranes11020080.
41. Andrade, M.C.; Pereira, J.C.; de Almeida, N.; Marques, P.; Faria, M.; Gonçalves, M.C. Improving Hydraulic Permeability, Mechanical Properties, and Chemical Functionality of Cellulose Acetate-Based Membranes by Co-Polymerization with Tetraethyl Orthosilicate and 3-(Aminopropyl)Triethoxysilane. *Carbohydr. Polym.* **2021**, *261*, 117813, doi:10.1016/j.carbpol.2021.117813.
42. Hołda, A.K.; De Roeck, M.; Hendrix, K.; Vankelecom, I.F.J. The Influence of Polymer Purity and Molecular Weight on the Synthesis of Integrally Skinned Polysulfone Membranes. *J. Membr. Sci.* **2013**, *446*, 113–120, doi:10.1016/j.memsci.2013.06.023.
43. Fernandes, C.S.; Md Nordin, N.A.H.; Bilad, M.R.; Matsuura, T.; Putra, Z.A.; Wirzal, M.D.H.; Jaafar, J. Explication of Hydrophobic Silica as Effective Pore Former for Membrane Fabrication. *Appl. Surf. Sci. Adv.* **2021**, *3*, 100051, doi:10.1016/j.apsadv.2020.100051.
44. Ifelebuegu, A.; Lale, E.; Mbanaso, F.; Theophilus, S. Facile Fabrication of Recyclable, Superhydrophobic, and Oleophilic Sorbent from Waste Cigarette Filters for the Sequestration of Oil Pollutants from an Aqueous Environment. *Processes* **2018**, *6*, 140, doi:10.3390/pr6090140.
45. Nair, K.; Sambhudevan, S.; Shankar, B. Synthesis, Characterization and Dye Absorbing Properties of Cellulose Acetate from Used Cigarette Buds. *Mater. Today Proc.* **2019**, *18*, 5006–5011, doi:10.1016/j.matpr.2019.07.494.
46. Nagasawa, H.; Omura, T.; Asai, T.; Kanezashi, M.; Tsuru, T. Filtration of Surfactant-Stabilized Oil-in-Water Emulsions with Porous Ceramic Membranes: Effects of Membrane Pore Size and Surface Charge on Fouling Behavior. *J. Membr. Sci.* **2020**, *610*, 118210, doi:10.1016/j.memsci.2020.118210.
47. Nawi, N.I.M.; Sait, N.R.; Bilad, M.R.; Shamsuddin, N.; Jaafar, J.; Nordin, N.A.H.; Narkkun, T.; Faungnawakij, K.; Mohshim, D.F. Polyvinylidene Fluoride Membrane Via Vapour Induced Phase Separation for Oil/Water Emulsion Filtration. *Polymers* **2021**, *13*, 427, doi:10.3390/polym13030427.
48. Mat Nawi, N.I.; Chean, H.M.; Shamsuddin, N.; Bilad, M.R.; Narkkun, T.; Faungnawakij, K.; Khan, A.L. Development of Hydrophilic PVDF Membrane Using Vapour Induced Phase Separation Method for Produced Water Treatment. *Membranes* **2020**, *10*, 121, doi:10.3390/membranes10060121.
49. Cote, P.; Alam, Z.; Penny, J. Hollow Fiber Membrane Life in Membrane Bioreactors (MBR). *Desalination* **2012**, *288*, 145–151, doi:10.1016/j.desal.2011.12.026.
50. Arthanareeswaran, G.; Thanikaivelan, P. Fabrication of Cellulose Acetate–Zirconia Hybrid Membranes for Ultrafiltration Applications: Performance, Structure and Fouling Analysis. *Sep. Purif. Technol.* **2010**, *74*, 230–235, doi:10.1016/j.seppur.2010.06.010.

User Menu

Home (/user/myprofile)
Manage Accounts (/user/manage_accounts)
Change Password (/user/chgpwd)
Edit Profile (/user/edit)
Logout (/user/logout)

Submissions Menu

Submit Manuscript (/user/manuscripts/upload)
Display Submitted Manuscripts (/user/manuscripts/status)
Display Co-Authored Manuscripts (/user/manuscripts/co-authored)
English Editing (/user/pre_english_article/status)
Discount Vouchers (/user/discount_voucher)
Invoices (/user/invoices)
LaTex Word Count (/user/get/latex_word_count)

Reviewers Menu

Volunteer Preferences (/volunteer_reviewer_info/view)

Article Information Overview

Manuscript ID	**polymers-1223672**
Status	Website online
DOI	10.3390/polym13121907
Publication Certificate	Download Publication Certificate (PDF) (/publication/article/certificate/571038)
Banner	Download Banner (PDF) (/publication/articler/banner/571038)
Website Links	Abstract (https://www.mdpi.com/2073-4360/13/12/1907) HTML version (https://www.mdpi.com/2073-4360/13/12/1907/htm) PDF version (https://www.mdpi.com/2073-4360/13/12/1907/pdf) Manuscript (https://www.mdpi.com/2073-4360/13/12/1907/manuscript)
Article type	Article
Title	Cigarette Butt Waste as Material for Phase Inverted Membrane Fabrication Used for Oil/Water Emulsion Separation
Journal	*Polymers* (https://www.mdpi.com/journal/polymers)
Volume	13
Issue	12
Section	Polymer Applications (https://www.mdpi.com/journal/polymers/sections/Polymer_Applications)
Special Issue	Polymer Nanocomposite Membranes for Environmental Applications (https://www.mdpi.com/journal/polymers/special_issues/Polymer_Nanocomposite_Membranes_Environmental_Applications)

Abstract

The increasing rate of oil and gas production has contributed to a release of oil/water emulsion or mixtures to the environment, becoming a pressing issue. At the same time, pollution of the toxic cigarette butt has also become a growing concern. This study explored utilization of cigarette butt waste as a source of cellulose acetate-based (CA) polymer to develop a phase inverted membrane for treatment of oil/water emulsion and compare it with commercial polyvinylidene difluoride (PVDF) and polysulfone (PSF). Results show that the CA-based membrane from waste cigarette butt offers an eco-friendly material without compromising the separation efficiency, with a pore size range suitable for oil/water emulsion filtration with the rejection of >94.0%. The CA membrane poses good structural property similar to the established PVDF and PSF membranes with equally asymmetric morphology. It also poses hydrophilicity properties with a contact angle of 74.5°, lower than both PVDF and PSF membranes. The pore size of CA demonstrates that the CA is within the microfiltration range with a mean flow pore size of 0.17 µm. The developed CA membrane shows a promising oil/water emulsion permeability of 180 L m^{-2} h^{-1} ba after five filtration cycles. However, it still suffers a high degree irreversible fouling (>90.0%), suggesting potential future

improvements in terms of membrane fouling management. Overall, this study demonstrates a sustainable approach to addressing oil/water emulsion pollution treated CA membrane from cigarette butt waste.

Keywords cellulose acetate; cigarette waste; membrane fabrication; crossflow filtration; oily wastewater; phase inversion

data

Data is of paramount importance to scientific progress, yet most research data drowns in supplementary files or remains private. Enhancing the transparency of the data processes will help to render scientific research results reproducible and thus more accountable. Co-submit your methodical data processing articles or data descriptors for a linked data set in *Data (https://www.mdpi.com/journal/data)* journal to make your data more citable and reliable.

- Deposit your data set in an online repository, obtain the DOI number or link to the deposited data set.
- Download and use the Microsoft Word template (https://www.mdpi.com/files/word-templates/data-template.dot) or LaTeX template (https://www.mdpi.com/authors/latex) to prepare your data article.
- Upload and send your data article to the *Data (https://www.mdpi.com/journal/data)* journal here (/user/manuscripts/upload?form%5Bjournal_id%5D=176&form%5Barticle_type_id%5D=47).

Submit To Data (/user/manuscripts/upload?form%5Bjournal_id%5D=176&form%5Barticle_type_id%5D=47)

Author Information

Submitting Author: Muhammad Roil Bilad

Corresponding Authors: Aris Doyan, Muhammad Roil Bilad

Author #1: Aris Doyan

Affiliation: 1. Master of Science Education Program, University of Mataram, Jl. Majapahit No. 62, Mataram 83125, Indonesia
2. Physics Education, FKIP, University of Mataram, Jl. Majapahit No. 62, Mataram 83125, Indonesia

E-Mail: aris_doyan@unram.ac.id

Author #2: Chew Lee Leong

Affiliation: 3. Department of Chemical Engineering, Universiti Teknologi PETRONAS, Bandar Seri Iskandar 32610, Malaysia

E-Mail: leongchewlee@gmail.com

Author #3: Muhammad Roil Bilad

Affiliation: 3. Department of Chemical Engineering, Universiti Teknologi PETRONAS, Bandar Seri Iskandar 32610, Malaysia
4. Faculty of Applied Science and Technology, Universitas Pendidikan Mandalika (UNDIKMA), Jl. Pemuda No. 59A

Pendidikan Mandalika (UNDIKMA), Jl. Pemuda No. 59A, Mataram 83126, Indonesia
5. Faculty of Integrated Technologies, Universiti Brunei Darussalam, Jalan Tungku Link, Gadong BE1410, Brunei

E-Mail muhammadoilbilad@ikipmataram.ac.id

Author #4 Kiki Adi Kurnia (https://orcid.org/0000-0002-6858-0510)

Affiliation 6. Department of Chemistry, Faculty of Mathematics and Natural Sciences, Institut Teknologi Bandung, Bandung 40132, Indonesia

E-Mail kurnia.kikiadi@gmail.com

Author #5 Susilawati Susilawati (https://orcid.org/0000-0001-8858-5282)

Affiliation 1. Master of Science Education Program, University of Mataram, Jl. Majapahit No. 62, Mataram 83125, Indonesia
2. Physics Education, FKIP, University of Mataram, Jl. Majapahit No. 62, Mataram 83125, Indonesia

E-Mail susilawatihambali@unram.ac.id

Author #6 Saiful Prayogi

Affiliation 4. Faculty of Applied Science and Technology, Universitas Pendidikan Mandalika (UNDIKMA), Jl. Pemuda No. 59A, Mataram 83126, Indonesia

E-Mail saifulprayogi@ikipmataram.ac.id

Author #7 Thanitporn Narkkun

Affiliation 7. National Nanotechnology Center (NANOTEC), National Science and Technology Development Agency (NSTDA), 111 Thailand Science Park, Pathum Thani 12120, Thailand

E-Mail thanitporn.nar@ncr.nstda.or.th

Author #8 Kajornsak Faungnawakij (https://orcid.org/0000-0002-4724-0613)

Affiliation 7. National Nanotechnology Center (NANOTEC), National Science and Technology Development Agency (NSTDA), 111 Thailand Science Park, Pathum Thani 12120, Thailand

E-Mail kajornsak@nanotec.or.th

Manuscript Information

Received Date 30 April 2021

Revised Date 2 June 2021

Accepted Date 3 June 2021

Published Date 8 June 2021

Submission to First Decision (Days) 10

Submission to Publication (Days) 38

Round of Revision	2
Size of PDF	4040 KiB
Word Count	5205
Page Count	15
Figure Count	10
Table Count	2
Reference Count	51

Editor Decision

Decision	Accept after minor revision
Comments	The authors have tried to address the concerns raised. Following very minor corrections are needed: -There should be a schematic for the membrane fabrication -The quality (in text) in the figure should be improved -Some of the relevant references may be cited such as Polymers 2021, 13(11), 1743; Polymers 2021, 13(11), 1716; Materials Today Chemistry 17, 100302 (2020); Chemical Reviews 120 (17), 9304–9362 (2020)
Decision Date	27 May 2021

Review Report

Reviewer 1	Review Report (Round 1) (/user/manuscripts/review/17841888?report=11925566)
	Review Report (Round 2) (/user/manuscripts/review/17841888?report=12202637)
Reviewer 2	Review Report (Round 1) (/user/manuscripts/review/17842024?report=11925660)
	Review Report (Round 2) (/user/manuscripts/review/17842024?report=12202628)

APC information

Journal APC:	2,200.00 CHF
Discount Voucher:	707b171a05fefd01 (500.00 CHF) (mroil.bilad@utp.edu.my)
Total Payment Amount:	1,700.00 CHF

Previously Published Papers

Susilawati, S.; Prayogi, S.; Arif, M.F.; Ismail, N.M.; Bilad, M.R.; Asy'ari, M. Optical Properties and Conductivity of PVA–H_3PO_4 (Polyvinyl Alcohol–Phosphoric Acid) Film Blend Irradiated by γ-Rays. *Polymers* **2021**, *13*, 1065. doi: 10.3390/polym13071065 (https://doi.org/10.3390/polym13071065)

Mohammed, H.G.; Albarody, T.M.B.; Susilawati, S.; Gohari, S.; Doyan, A.; Prayogi, S.; Bilad, M.R.; Alebrahim, R.; Saeed, A.A.H. Process Optimization of In Situ Magnetic-Anisotr[illegible]ark Plasma Sintering of M-Type-Based Barium Hexaferrite $BaFe_{12}O_{19}$. *Materials* **2021**, *14*, [illegible] doi: 10.3390/ma14102650 (https://doi.org/10.3390/ma14102650)

Doyan, A.; Susilawati, S.; Prayogi, S.; Bilad, M.R.; Arif, M.F.; Ismail, N.M. Polym[illegible]m Blend of Polyvinyl Alcohol, Trichloroethylene and Cresol Red for Gamma Radiation Dos[illegible] *Polymers* **2021**, *13*, 1866. doi: 10.3390/polym13111866 (https://doi.org/10.3390/polym13[illegible])

Related Papers Published in MDPI Journals

If you have any questions or concerns, please do not hesitate to contact polymers@mdpi.com (mailto: polymers@mdpi.com).

© 1996-2021 MDPI (Basel, Switzerland) unless otherwise stated

Disclaimer Terms and Conditions (https://www.mdpi.com/about/terms-and-conditions) Privacy Policy (https://www.mdpi.com/about/privacy)

User Menu

Home (/user/myprofile)

Manage Accounts (/user/manage_accounts)

Change Password (/user/chgpwd)

Edit Profile (/user/edit)

Logout (/user/logout)

Submissions Menu

Submit Manuscript (/user/manuscripts/upload)

Display Submitted Manuscripts (/user/manuscripts/status)

Display Co-Authored Manuscripts (/user/manuscripts/co-authored)

English Editing (/user/pre_english_article/status)

Discount Vouchers (/user/discount_voucher)

Invoices (/user/invoices)

LaTex Word Count (/user/get/latex_word_count)

Reviewers Menu

Volunteer Preferences (/volunteer_reviewer_info/view)

Journal: Polymers (https://www.mdpi.com/journal/polymers) (ISSN 2073-4360)

Manuscript ID: polymers-1223672

Type: Article

Number of Pages: 16

Title: Cigarette Butt Waste as Material for Phase Inverted Membrane Fabrication Used for Oil/Water Emulsion Separation

Authors: Aris Doyan * , Chew Lee Leong , Muhammad Roil Bilad * , Kiki Adi Kurnia , Susilawati Susilawati , Saiful Prayogi , Thanitporn Narkkun , Kajornsak Faungnawakij

Abstract: The increasing rate of oil and gas production has contributed in a release of oil-in-water emulsion or mixtures to the environment which has become a pressing issue. At the same time, pollution of the toxic cigarette butt has also become the growing concern. This study explores utilization of cigarette butt waste as source of cellulose acetate-based (CA) polymer to develop phase inverted membrane for treatment of oil/water emulsion and compared with commercial polyvinylidene difluoride (PVDF) and polysulfone (PSF). Results show that CA-based membrane from waste cigarette butt offers an eco-friendly material without compromising the separation efficiency, with pore size range suitable for oil/water emulsion filtration with rejection of >94.0%. The CA membrane poses good structural property like that of established PVDF and PSF membranes with equally asymmetric morphology. It also poses hydrophilicity properties with contact angle of 74.5°, lower than both PVDF and PSF membranes. The pore size of CA demonstrates the CA is within the microfiltration range with mean flow pore size of 0.17 μm. The developed CA membrane shows a promising oil/water emulsion permeability of 180 L m-2 h-1 bar-1 after five filtration cycles. However, it still suffers a high degree of irreversible fouling (>90.0%), suggesting potential for future improvements. Overall, this study demonstrates a sustainable approach in addressing issue of oil/water emulsion pollution treated CA membrane from cigarette butt waste.

The coverletter for this review report has been saved in the database. You can safely close this window.

Authors' Responses to Reviewer's Comments (Reviewer 1)

Author's Notes: Please see the attachment.

Author's Notes File: Report Notes (/user/review/displayFile/17841888/khBHsV4W?file=author-coverletter&report=11925566)

English language and style

( ) Extensive editing of English language and style required
( ) Moderate English changes required
(x) English language and style are fine/minor spell check required
( ) I don't feel qualified to judge about the English language and style

	Yes	Can be improved	Must be improved	Not applicable
Does the introduction provide sufficient background and include all relevant references?	(x)	( )	( )	( )
Is the research design appropriate?	(x)	( )	( )	( )
Are the methods adequately described?	( )	(x)	( )	( )
Are the results clearly presented?	( )	(x)	( )	( )
Are the conclusions supported by the results?	( )	(x)	( )	( )

Comments and Suggestions for Authors

The manuscript entitled: "Cigarette Butt Waste as Material for Phase Inverted Membrane Fabrication Used for Oil/Water Emulsion Separation" is an extended work dealing with the sustainable use of cigarette butt that are normal wastes for the fabrication of membranes for oil/water separation.

The manuscript deserves to be suggested for publication after some minor clarifications to the following points:

1. The pore size distribution image is very strange. Can the authors state if there is a specific function followed for the pore sizes?
2. What is the process of obtaining the cigarette butts?
3. Did the authors consider comparing pure CA and also CA for cigarette butts?
4. It is not clear how the cigarette-butt CA polymer was recovered. Please give some details of the cleaning process.
5. Fouling experiments indicate that the membranes will end up in the waste after the operation which is somehow contradictory to the concept of this work. Is there any modification method of the produce CA membranes for the better rinsing of the membranes after the use for the separation of oil/water?
6. last but not least, sustainability is a key factor, however, energy efficiency is also extremely important. The process proposed for the cleaning of the cigarette butts seems to be of high costs due to the use of cleaners and also of the material for a short time due to the feature of the separation. What do the authors believe, is this method good in order to obtain a sustainable concept or an optimized one?

Submission Date	30 April 2021
Date of this review	11 May 2021 01:41:47

© 1996-2021 MDPI (Basel, Switzerland) unless otherwise stated

Disclaimer **Terms and Conditions (https://www.mdpi.com/about/terms-and-conditions)** **Privacy Policy (https://www.mdpi.com/about/privacy)**

User Menu

Home (/user/myprofile)
Manage Accounts (/user/manage_accounts)
Change Password (/user/chgpwd)
Edit Profile (/user/edit)
Logout (/user/logout)

Submissions Menu

Submit Manuscript (/user/manuscripts/upload)
Display Submitted Manuscripts (/user/manuscripts/status)
Display Co-Authored Manuscripts (/user/manuscripts/co-authored)
English Editing (/user/pre_english_article/status)
Discount Vouchers (/user/discount_voucher)
Invoices (/user/invoices)
LaTex Word Count (/user/get/latex_word_count)

Reviewers Menu

Volunteer Preferences (/volunteer_reviewer_info/view)

Journal	Polymers (https://www.mdpi.com/journal/polymers) (ISSN 2073-4360)
Manuscript ID	polymers-1223672
Type	Article
Number of Pages	16
Title	Cigarette Butt Waste as Material for Phase Inverted Membrane Fabrication Used for Oil/Water Emulsion Separation
Authors	Aris Doyan * , Chew Lee Leong , Muhammad Roil Bilad * , Kiki Adi Kurnia , Susilawati Susilawati , Saiful Prayogi , Thanitporn Narkkun , Kajornsak Faungnawakij
Abstract	The increasing rate of oil and gas production has contributed in a release of oil-in-water emulsion or mixtures to the environment which has become a pressing issue. At the same time, pollution of the toxic cigarette butt has also become the growing concern. This study explores utilization of cigarette butt waste as source of cellulose acetate-based (CA) polymer to develop phase inverted membrane for treatment of oil/water emulsion and compared with commercial polyvinylidene difluoride (PVDF) and polysulfone (PSF). Results show that CA-based membrane from waste cigarette butt offers an eco-friendly material without compromising the separation efficiency, with pore size range suitable for oil/water emulsion filtration with rejection of >94.0%. The CA membrane poses good structural property like that of established PVDF and PSF membranes with equally asymmetric morphology. It also poses hydrophilicity properties with contact angle of 74.5°, lower than both PVDF and PSF membranes. The pore size of CA demonstrates the CA is within the microfiltration range with mean flow pore size of 0.17 μm. The developed CA membrane shows a promising oil/water emulsion permeability of 180 L m-2 h-1 bar-1 after five filtration cycles. However, it still suffers a high degree of irreversible fouling (>90.0%), suggesting potential for future improvements. Overall, this study demonstrates a sustainable approach in addressing issue of oil/water emulsion pollution treated CA membrane from cigarette butt waste.

Review Report Form

English language and style	( ) Extensive editing of English language and style required ( ) Moderate English changes required (x) English language and style are fine/minor spell check required ( ) I don't feel qualified to judge about the English language and style

	Yes	Can be improved	Must be improved	Not applicable

Does the introduction provide sufficient background and include all relevant references?	(x)	( )	( )	( )
Is the research design appropriate?	(x)	( )	( )	( )
Are the methods adequately described?	(x)	( )	( )	( )
Are the results clearly presented?	(x)	( )	( )	( )
Are the conclusions supported by the results?	(x)	( )	( )	( )

Comments and Suggestions for Authors	The revised version can now get accepted
Submission Date	30 April 2021
Date of this review	19 May 2021 20:17:08

© 1996-2021 MDPI (Basel, Switzerland) unless otherwise stated

Disclaimer **Terms and Conditions (https://www.mdpi.com/about/terms-and-conditions)** **Privacy Policy (https://www.mdpi.com/about/privacy)**

User Menu

Home (/user/myprofile)

Manage Accounts (/user/manage_accounts)

Change Password (/user/chgpwd)

Edit Profile (/user/edit)

Logout (/user/logout)

Submissions Menu

Submit Manuscript (/user/manuscripts/upload)

Display Submitted Manuscripts (/user/manuscripts/status)

Display Co-Authored Manuscripts (/user/manuscripts/co-authored)

English Editing (/user/pre_english_article/status)

Discount Vouchers (/user/discount_voucher)

Invoices (/user/invoices)

LaTex Word Count (/user/get/latex_word_count)

Reviewers Menu

Volunteer Preferences (/volunteer_reviewer_info/view)

Journal: Polymers (https://www.mdpi.com/journal/polymers) (ISSN 2073-4360)

Manuscript ID: polymers-1223672

Type: Article

Number of Pages: 16

Title: Cigarette Butt Waste as Material for Phase Inverted Membrane Fabrication Used for Oil/Water Emulsion Separation

Authors: Aris Doyan * , Chew Lee Leong , Muhammad Roil Bilad * , Kiki Adi Kurnia , Susilawati Susilawati , Saiful Prayogi , Thanitporn Narkkun , Kajornsak Faungnawakij

Abstract: The increasing rate of oil and gas production has contributed in a release of oil-in-water emulsion or mixtures to the environment which has become a pressing issue. At the same time, pollution of the toxic cigarette butt has also become the growing concern. This study explores utilization of cigarette butt waste as source of cellulose acetate-based (CA) polymer to develop phase inverted membrane for treatment of oil/water emulsion and compared with commercial polyvinylidene difluoride (PVDF) and polysulfone (PSF). Results show that CA-based membrane from waste cigarette butt offers an eco-friendly material without compromising the separation efficiency, with pore size range suitable for oil/water emulsion filtration with rejection of >94.0%. The CA membrane poses good structural property like that of established PVDF and PSF membranes with equally asymmetric morphology. It also poses hydrophilicity properties with contact angle of 74.5°, lower than both PVDF and PSF membranes. The pore size of CA demonstrates the CA is within the microfiltration range with mean flow pore size of 0.17 μm. The developed CA membrane shows a promising oil/water emulsion permeability of 180 L m-2 h-1 bar-1 after five filtration cycles. However, it still suffers a high degree of irreversible fouling (>90.0%), suggesting potential for future improvements. Overall, this study demonstrates a sustainable approach in addressing issue of oil/water emulsion pollution treated CA membrane from cigarette butt waste.

The coverletter for this review report has been saved in the database. You can safely close this window.

Authors' Responses to Reviewer's Comments (Reviewer 2)

Author's Notes: Please see the attachment.

Author's Notes File: Report Notes (/user/review/displayFile/17842024/DWAYc3EM?file=author-coverletter&report=11925660)

English language and style

( ) Extensive editing of English language and style required
( ) Moderate English changes required
( ) English language and style are fine/minor spell check required
(x) I don't feel qualified to judge about the English language and style

	Yes	Can be improved	Must be improved	Not applicable
Does the introduction provide sufficient background and include all relevant references?	(x)	( )	( )	( )
Is the research design appropriate?	( )	(x)	( )	( )
Are the methods adequately described?	( )	(x)	( )	( )
Are the results clearly presented?	( )	(x)	( )	( )
Are the conclusions supported by the results?	(x)	( )	( )	( )

Comments and Suggestions for Authors

The work "Cigarette Butt Waste as Material for Phase Inverted Membrane Fabrication Used for Oil/Water Emulsion Separation" is interesting and useful for the research field.

Some requests and suggestions:

how many cigarettes have the cellulose acetate as butts?

how is reason to compare with the selected commercial membranes?

figure 1 need consistency, and also f image is unclear!

a comparison with cellulose acetate membrane were welcome!

Submission Date: 30 April 2021

Date of this review: 04 May 2021 06:52:51

© 1996-2021 MDPI (Basel, Switzerland) unless otherwise stated

Disclaimer **Terms and Conditions (https://www.mdpi.com/about/terms-and-conditions)** **Privacy Policy (https://www.mdpi.com/about/privacy)**

User Menu

Home (/user/myprofile)

Manage Accounts (/user/manage_accounts)

Change Password (/user/chgpwd)

Edit Profile (/user/edit)

Logout (/user/logout)

Submissions Menu

Submit Manuscript (/user/manuscripts/upload)

Display Submitted Manuscripts (/user/manuscripts/status)

Display Co-Authored Manuscripts (/user/manuscripts/co-authored)

English Editing (/user/pre_english_article/status)

Discount Vouchers (/user/discount_voucher)

Invoices (/user/invoices)

LaTex Word Count (/user/get/latex_word_count)

Reviewers Menu

Volunteer Preferences (/volunteer_reviewer_info/view)

Journal: Polymers (https://www.mdpi.com/journal/polymers) (ISSN 2073-4360)

Manuscript ID: polymers-1223672

Type: Article

Number of Pages: 16

Title: Cigarette Butt Waste as Material for Phase Inverted Membrane Fabrication Used for Oil/Water Emulsion Separation

Authors: Aris Doyan * , Chew Lee Leong , Muhammad Roil Bilad * , Kiki Adi Kurnia , Susilawati Susilawati , Saiful Prayogi , Thanitporn Narkkun , Kajornsak Faungnawakij

Abstract: The increasing rate of oil and gas production has contributed in a release of oil-in-water emulsion or mixtures to the environment which has become a pressing issue. At the same time, pollution of the toxic cigarette butt has also become the growing concern. This study explores utilization of cigarette butt waste as source of cellulose acetate-based (CA) polymer to develop phase inverted membrane for treatment of oil/water emulsion and compared with commercial polyvinylidene difluoride (PVDF) and polysulfone (PSF). Results show that CA-based membrane from waste cigarette butt offers an eco-friendly material without compromising the separation efficiency, with pore size range suitable for oil/water emulsion filtration with rejection of >94.0%. The CA membrane poses good structural property like that of established PVDF and PSF membranes with equally asymmetric morphology. It also poses hydrophilicity properties with contact angle of 74.5°, lower than both PVDF and PSF membranes. The pore size of CA demonstrates the CA is within the microfiltration range with mean flow pore size of 0.17 μm. The developed CA membrane shows a promising oil/water emulsion permeability of 180 L m-2 h-1 bar-1 after five filtration cycles. However, it still suffers a high degree of irreversible fouling (>90.0%), suggesting potential for future improvements. Overall, this study demonstrates a sustainable approach in addressing issue of oil/water emulsion pollution treated CA membrane from cigarette butt waste.

Review Report Form

English language and style

( ) Extensive editing of English language and style required
( ) Moderate English changes required
( ) English language and style are fine/minor spell check required
(x) I don't feel qualified to judge about the English language and style

	Yes	Can be improved	Must be improved	Not applicable

Does the introduction provide sufficient background and include all relevant references?	(x)	( )	( )	( )
Is the research design appropriate?	(x)	( )	( )	( )
Are the methods adequately described?	(x)	( )	( )	( )
Are the results clearly presented?	(x)	( )	( )	( )
Are the conclusions supported by the results?	(x)	( )	( )	( )

Comments and Suggestions for Authors	The work "Cigarette Butt Waste as Material for Phase Inverted Membrane Fabrication Used for Oil/Water Emulsion Separation" in remake form should be published in POLYMERS journal. The author responded to all suggestions and corrections which were recommended!
Submission Date	30 April 2021
Date of this review	18 May 2021 13:26:05

© 1996-2021 MDPI (Basel, Switzerland) unless otherwise stated

Disclaimer **Terms and Conditions (https://www.mdpi.com/about/terms-and-conditions)** **Privacy Policy (https://www.mdpi.com/about/privacy)**

[Polymers] Manuscript ID: polymers-1223672 - APC Invoice

External Inbox ×

MDPI Billing 1:47 PM (1 hour ago)

to Aris, me, Chris, Billing, Polymers

Dear Dr. Doyan,

Please find attached the invoice for your recently accepted paper. Follow this link to adjust the currency, change the address, or add comments, as necessary: https://susy.mdpi.com/user/manuscript/82e7bde22652e84c821a13c7e0e89a27/invoice/1161252.

For immediate payment by credit card, visit https://payment.mdpi.com/1161252.

If you would like to use a different method of payment, click here: https://www.mdpi.com/about/payment. Please include the invoice ID (polymers-1223672) as reference in any transaction.

APC invoice amount: 1700.00 CHF
Manuscript ID: polymers-1223672
Type of manuscript: Article
Title: Cigarette Butt Waste as Material for Phase Inverted Membrane Fabrication Used for Oil/Water Emulsion Separation
Authors: Aris Doyan *, Chew Lee Leong, Muhammad Roil Bilad *, Kiki Adi