OIL REMOVAL IN PRODUCED WATER USING OIL PALM EMPTY FRUIT BUNCHES BIOSURFATANTS WITH VARIED STIRRING SPEEDS AND HEATING TIMES

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BOGOR
2025

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ABSTRACT

DYLAN KHRISNAYA. Oil Removal in Produced Water using Oil Palm Empty Fruit Bunches Biosurfactants with Varied Stirring Speeds and Heating Times. Supervised by JOANA FEBRITA and ALLEN KURNIAWAN.

Produced water from oil and gas operations contains hazardous pollutants such as oil and grease (O&G), chemical oxygen demand (COD), and ammonia. This study evaluates biosurfactants derived from oil palm empty fruit bunches (OPEFB) as an eco-friendly alternative for oily wastewater treatment. Sodium lignosulfonate was synthesized under varying stirring speeds (300–500 rpm) and heating durations (0.5–2.5 h), and applied at 2%, 4%, and 6% (v/v) dosages. Optimal O&G removal occurred at 500 rpm and 2.0 h (68.97% and 73.73%, respectively). The 6% dosage achieved the highest O&G removal (76.96%) but also led to COD (46.94%) and ammonia (71.31%) increases. Statistical analysis confirmed that biosurfactant dosage significantly affected all parameters ($p < 0.05$). The Freundlich isotherm best described the adsorption behavior, supported by high correlation coefficients and non-significant ANOVA results. These findings indicate that OPEFB-based biosurfactants are promising for O&G removal in produced water, though further optimization is needed to minimize secondary pollution.

Keywords: Biosurfactant, SLS, OPEFB, produced water, oil removal

ABSTRAK

DYLAN KHRISNAYA. Oil Removal in Produced Water using Oil Palm Empty Fruit Bunches Biosurfactants with Varied Stirring Speeds and Heating Times. Dibimbing oleh JOANA FEBRITA dan ALLEN KURNIAWAN.

Air terproduksi dari eksplorasi minyak dan gas mengandung polutan berbahaya seperti minyak dan lemak (O&G), kebutuhan oksigen kimia (COD), dan amonia. Penelitian ini mengevaluasi biosurfaktan berbasis tandan kosong kelapa sawit (TKKS) sebagai alternatif ramah lingkungan untuk pengolahan limbah berminyak. Natrium lignosulfonat disintesis dengan variasi kecepatan pengadukan (300–500 rpm) dan lama pemanasan (0,5–2,5 jam), serta diuji pada dosis 2%, 4%, dan 6% (v/v). Penghilangan O&G tertinggi dicapai pada 500 rpm dan 2,0 jam (68,97% dan 73,73%), sementara dosis 6% menghasilkan efisiensi tertinggi (76,96%) namun meningkatkan COD (46,94%) dan amonia (71,31%). Analisis statistik menunjukkan bahwa dosis biosurfaktan berpengaruh signifikan terhadap semua parameter ($p < 0,05$). Model isoterm Freundlich paling sesuai untuk seluruh kontaminan, dengan koefisien korelasi tinggi dan hasil ANOVA yang tidak signifikan. Hasil ini menunjukkan bahwa biosurfaktan TKKS memiliki potensi sebagai solusi pengolahan O&G dalam air terproduksi, namun diperlukan optimalisasi lebih lanjut untuk menekan pencemaran sekunder.

Kata kunci: Air terproduksi, biosurfaktan, NLS, penghilangan minyak, TKKS

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Undergraduate thesis
as the requirement to obtain Bachelor's Degree in
Civil and Environmental Engineering Department

CIVIL AND ENVIRONMENTAL ENGINEERING DEPARTMENT
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BOGOR
2025

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Exam Date:
2 July 2025

Graduate Date: 21 JUL 2025

PREFACE

All praise and gratitude the author offers to Allah subḥānahu wa ta‘ālā for His abundant blessings, which have enabled the completion of this scientific work. The theme chosen for this research, conducted from January 2025 to June 2025, focuses on tsunami mitigation planning, under the title "Oil Removal in Produced Water using Oil Palm Empty Fruit Bunches Biosurfactants with Varied Stirring Speeds and Heating Times".

The author would like to express sincere thanks and appreciation to the individuals and parties who played significant roles in the research and completion of this thesis, especially to:

1. Ir. Joana Febrita, S.T., M.T., as the first academic supervisor, for her guidance, advice, constructive criticism, and valuable suggestions throughout the research and writing process.
2. Dr. Eng. Ir. Allen Kurniawan, S.T., M.T., as the second academic supervisor, for providing the opportunity to join the biosurfactant research team from OPEFB and for his guidance and direction during the entire course of this study.
3. Father Joko, Mother Juwita, Sister Keke, Brother Rino, Brother Kenji, Gula, Kimmy, and the extended family for their endless love, support, and prayers.
4. Aura Putri Zafira, for her companionship and support throughout the research and writing process.
5. Fellow team members of the OPEFB research project and thesis groupmates, for their assistance and encouragement during the entire process.
6. Andre, Farhat, and Tarina, dear friends who stood by the author throughout the research and thesis completion.
7. All fellow students of the Civil and Environmental Engineering Department, Class of 58, for their full support during the research and thesis writing journey.

May this scientific work be beneficial to those who need it and contribute to the advancement of knowledge.

Bogor, July 2025

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