

Abstract

[Research Title]

Development of Kolbe electrolysis system for complete utilization of soapstock discharged from vegetable oil refining

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Principal Investigator :	Hiomori Kousuke
(PI ORCID) :	ORCID0000-0001-9223-0871
Principal Institution :	Tohoku University Aoba 6-6-07, Aoba-ku, Sendai, JAPAN Tel: +81-22-795-7256 Fax: : +81-22-795-7256 E-mail: kousuke.hiomori.e8@tohoku.ac.jp
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[Abstract]

In the production of vegetable oils, a byproduct known as "soapstock" has traditionally lacked effective utilization methods. This study aimed to develop a new technology that utilizes the Kolbe electrolysis reaction to exploit all components of soapstock as carbon and inorganic salt sources without generating waste. The focus of this research was to determine the feasibility of this idea and identify any challenges. A membrane-integrated electrolytic cell was designed and fabricated to separate the generated hydrocarbons and caustic soda simultaneously with the reaction, and conditions for efficient reaction were explored both experimentally and theoretically using mathematical models. Based on these findings, the fabrication of a flow electrolytic cell was also carried out. The use of mathematical models in this process enabled practical design considerations for the actual device. The investigation also confirmed that carbon electrodes are a viable and economical option, and key points for selecting carbon materials were clarified.

Furthermore, an investigation into the raw materials, which had been insufficiently characterized in the literature, identified the actual components of soapstock and classified them based on the soapstock generation process. Electrolysis experiments using potentially contaminating components and real samples clarified their impact. Tests conducted over approximately 24 hours revealed no significant differences compared to experiments using reagents. Based on these experimental results and consultations with vegetable oil manufacturers, the electrolysis process was designed and evaluated using a process simulator. The results suggested that the proposed process could not only treat soapstock, which is otherwise considered waste, but also generate energy. The introduction of this process could potentially reduce the need for new purchases of caustic soda and fuel used in vegetable oil plants, indicating that this technology could offer a highly environmentally compatible solution for processing soapstock.

[References]

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Kolbe Electrolysis for Recycling Non-Aqueous Fatty Acid Salts

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