

論文 / 著書情報  
Article / Book Information

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Title(English)	Green Solvent-Assisted Hydrothermal Liquefaction of Sewage Sludge: Enhancing Biocrude Quality and Socio-Economic Feasibility
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# **Title: Green Solvent-Assisted Hydrothermal Liquefaction of Sewage Sludge: Enhancing Biocrude Quality and Socio-Economic Feasibility**

## **Abstract**

Addressing the global challenges of population growth, energy demands, and waste management, this dissertation presents innovative strategies for sewage sludge (SS) management. It proposes a comprehensive approach to convert SS into sustainable biofuels and high-value chemicals, considering economic viability, environmental impact, and technological advancements. Key focuses include the use of eco-friendly solvents for advanced hydrothermal liquefaction (HTL) processes and the optimization of biodiesel production. The study demonstrated that Ethyl Acetate (EA) and Ethyl Butyrate (EB) significantly improved the extraction and quality of biocrude derived from SS, minimizing impurities and heteroatoms. Furthermore, a thorough techno-economic analysis showed the economic feasibility and potential profitability of integrating biodiesel production and HTL processes within wastewater treatment plants. Future research directions involve investigating HTL byproducts, advanced characterizations, and assessing SS-derived biodiesel for aviation fuels, aiming to contribute significantly to emissions reduction and sustainable practices in bioenergy and aviation sectors.

## **Dissertation Outline and Draft Chapters**

### **Chapter 1: Introduction and Background of the Study**

Introduce global challenges of fossil fuel dependency, greenhouse gas emissions, and limitations of traditional SS management. Present HTL as a promising alternative for converting SS into valuable products and emphasize the novelty of exploring eco-friendly solvents.

### **Chapter 2: Green Solvent-Assisted Hydrothermal Liquefaction of Sewage Sludge and Biocrude Hydrotreatment for Sustainable Biofuel Production**

Investigate the effectiveness of Ethyl Acetate (EA) and Ethyl Butyrate (EB) in enhancing the HTL process and hydrotreatment of biocrude from SS. Identify optimal conditions and highlight the superior performance of EB in producing high-quality biofuels.

### **Chapter 3: Nitrogen Minimization in Hydrothermal Liquefaction Biocrude from Sewage sludge with Green Extraction Solvents**

Compare conventional solvents like DCM and hexane with green solvents such as EB and EA in converting SS into biocrude. Demonstrate the advantages of EB in terms of biocrude yield, nitrogen content, and energy recovery.

### **Chapter 4: Socio and Techno-economic Study of Biofuel Production from Sewage Sludge via Transesterification and Hydrothermal Liquefaction**

Conduct a techno-economic analysis of biodiesel production and HTL from SS using Aspen Plus simulations. Assess the economic viability and potential profitability of integrating these

processes into Japanese wastewater treatment plants.

#### **Chapter 5: General Conclusions and Impacts of this Research**

Summarize key findings, emphasizing the effectiveness of eco-friendly solvents and the economic feasibility of biodiesel production and HTL from SS. Highlight the potential contributions to sustainable waste management and renewable energy production.

#### **Chapter 6: Limitations of this Research and Future Research**

Discuss study limitations, such as the need for further research on large-scale implementation and solvent recovery. Outline future research directions, including advanced analytical techniques and supportive regulatory frameworks.