

**DESIGN AND DEVELOPMENT OF CONTROL AND IOT BASED
MONITORING SYSTEM IN PYROLYSIS SYSTEM FOR PALM OIL WASTE
CONVERSION**

By

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STATEMENT BY THE AUTHOR

I hereby declare that this submission is my own work and to the best of my knowledge, it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.

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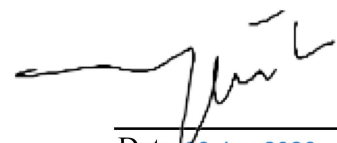
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ABSTRACT

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Indonesia produces more palm oil than any other country, accounting for 58% of the world's supply and generating massive amounts of biomass waste. Pyrolysis can turn this waste into useful products, but it often struggles with unstable temperature control and poor monitoring. This study aims to improve palm oil waste pyrolysis by creating a control system and an IoT-based monitoring setup. The approach uses a dual-stage condenser; theoretical and experimental models of reactor and biomass temperatures; a comparison of the models at various heating rates; a closed-loop PI controller; and an IoT monitoring system. The results show that the new system met all its performance goals. The dual-stage condenser successfully turned the vapors into liquid, but a lower mass flow rate caused condensation to happen prematurely, which stopped the planned separation of thick and light oils. The transfer functions for heater and biomass temperatures had RMSEs below 10%. The PI controller kept the reactor temperature stable in both the simulation and actual implementation. Comparing heating rates, a 10°C/min rate yielded a quicker response but resulted in a lower steady-state temperature and less oil than the 5°C/min rate. The ESP32-based IoT system reliably collected and displayed real-time data remotely.

Keywords: Pyrolysis, Empty Fruit Bunch, Control System, Internet of Things, Palm Oil.



DEDICATION

I dedicate this work to the future of my beloved country, Indonesia, especially to
preserve the beautiful nature.



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