SOCIALIST REPUBLIC OF VIET NAM

Independence – Freedom – Happiness

SUMMARY OF DOCTORAL THESIS

Thesis title: **"STUDY AND EVALUATION OF THE APPLICABILITY OF PYROLYTIC OIL ORIGINATED FROM WASTE RUBBER FOR DIESEL ENGINES"**

Major:	Mechanical engineering
Code:	9520116
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1. OBJECTIVES OF THE THESIS

Investigating and evaluating the sources of waste rubber and the pyrolysis technology for pyrolytic oil production;

Analyzing the feasibility of using pyrolysis oil from waste rubber (PRO) as fuel for diesel engines based on techno-economical characteristics and fuel properties;

Developing the simulation and experimental procedure to test the applicability of PRO in diesel engines;

a) Examining and assessing the performance, emission characteristics, as well as economic indicators of the test engine using PRO as potential fuel; Theoretical goals

Study on the theoretical basis of the combustion process in diesel engines;

Investigating the properties of the PRO fuel;

Developing an Ansys Fluent-based model aiming to simulate the combustion process in diesel engines using PRO as fuel;

Analyzing the impact of the blending ratio of PRO and diesel fuel on engine behaviors including performance and emission characteristics;

b) Experimental objectives

Establishing experimental protocols to evaluate the combustion and emissions processes of the test engine at various blending ratios (0%, 10%, 20%, 30%, 40%, and 80%) and load conditions (25%, 50%, 75%, and 100%);

Experimentally evaluating the performance and emission characteristics of the engine running on various fuel blends and loads, in which the test engine is Kirloskar TV1 (5.2KW@1500rpm). Comparing the results achieved from simulations with experimental data;

2. OBJECTS AND SCOPE

a) Research objects

The object of this thesis is pyrolysis waste rubber-derived fuel that is collected from municipal solid waste in Vietnam and diesel engines possessing power < 50 KW;

b) Research scope

The process of pyrolysis for converting waste rubber collected from municipal solid waste in Vietnam into fuel;

The properties of the fuel obtained from blending PRO with diesel fuel at various ratios (0%, 10%, 20%, 30%, 40%, and 80%);

Application of Ansys Fluent software to build a finite element model of a diesel engine, which has the combustion chamber in a cylindrical engine with two flat ends, intake and exhaust ports located on the cylinder surface opposite each other, and the fuel injection nozzle positioned in the middle of the intake, fueled with the above-mentioned PRO/diesel fuel blends and operated at various loads (25%, 50%, 75%, and 100%) at fixed speed of 1500 rpm;

Determining the changes in octane, temperature, soot, and NOx in the combustion chamber at different load levels by simulation;

Evaluating the performance and emissions characteristics of a small diesel engine with power < 50kW, fueled with the above-mentioned PRO/diesel fuel blends and operated at various loads (25%, 50%, 75%, and 100%) at a fixed speed of 1500 rpm;

3. NEW POINTS OF THE THESIS

Investigating and providing theoretical foundations for the optimal temperature

for the pyrolysis process of rubber in a sealed rotary kiln aiming to get the highest yield of PRO;

Successful construction of a combustion process model based on Ansys Fluent software for a diesel engine fueled with PRO/diesel fuel blends;

Successfully developed a model and experimental method to evaluate the performance and emission characteristics of a small diesel engine running on PRO/diesel fuel blends and operating at various loads;

Study on the applicability of fuel derived from the rubber pyrolysis process to diesel engines;

Determining the optimal blending ratio for PRO and diesel fuel to get the optimal techno-economic indicator;

4. SCIENTIFIC AND PRACTICAL IMPLICATIONS

a) Scientific implications

Laying the groundwork for enhancing the technical features and emissions of traditional diesel engines by utilizing alternavtive fuel derived from waste sources available in Vietnam;

Succesfully building and developping the model of using PRO for small diesel engine aiming to achieve waste-to-fuel goals of Vietnamese government towards net-zero strategy;

b) Practical implications

Deversifying the fuel sources using for engines to educe the dependence on fossil fuel;

5. STRUCTURE OF THE THESIS

Preamble

CHAPTER 1. OVERVIEW

CHAPTER 2. THEORETICAL BASIS

CHAPTER 3. SIMULATION STUDY

CHAPTER 4. EXPERIMENTAL STUDY

General conclusions and development directions

Ho Chi Minh city, February 20 th, 2024

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