SOCIALIST REPUBLIC OF VIET NAM

Independence – Freedom – Happiness

SUMMARY OF DOCTORAL THESIS

Thssis title: "Research on establishing a compression combustion mode with a two-stage mixture for diesel engines"

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

Research to find a combustion method that incorporates a new, more efficient alternative fuel. PCCI combustion method combined with WCO fuel on diesel engines brings many technical, economic and environmental benefits. Using WCO fuel mixture helps reduce dependence on traditional fuels and reduces NOx and PM emissions that pollute the environment.

a) Theoretical goals

- Research the theoretical basis of the combustion process in diesel engines using the PCCI combustion method;

- Building models and simulating the PCCI combustion process on traditional diesel engines;

- Analyze the influence of input parameters such as fuel ratio, injection timing, injection pressure, on the PCCI combustion process;

- Research on the formation mechanism of NOx and PM emissions components of the PCCI combustion process;

b) Experimental objectives

- Set up test mode for PCCI combustion on traditional diesel engines;

- Experimentally evaluate the influence of injection timing and injection pressure on the combustion and emission process;

- Experimentally evaluate the power and emission characteristics of PCCI engines using biofuel/diesel mixtures combined with an EGR exhaust gas recovery system;

- Compare simulation results and experimental results to evaluate the feasibility of the simulation model.

2. SUBJECTS AND SCOPE OF RESEARCH

a) Research objects

- Diesel engine;
- Biofuel: biodiesel or pyrolysis oil;
- Low temperature combustion process;

b) Research scope

Simulation and experimental research on the PCCI process of diesel engines with a capacity of less than 50 kW that use a biodiesel fuel mixture (B10, B20, B30 and B40)/diesel and comparison with diesel engines that employ traditional diesel fuel (D100).

• Simulation research:

- Ansys Fluent software application; Build a finite element model of a cylindrical engine combustion chamber with 2 flat bottoms, the intake and exhaust ports are arranged on the cylindrical surface, alternating, the fuel nozzle is arranged in the middle of the intake, the fuel is mixed. The combination of diesel and biofuel has the proportion of biofuel varying from 0% to 40%.

- Determine the changes of C10H22, temperature, soot, and NOx in the combustion chamber space at different load levels.

• Experimental study:

- The experimental engine runs in load mode at rated rpm = 1,500 rpm under conditions of EGR exhaust gas recirculation (from 0% to 20%) and two-stage injection.

- Diesel fuel - biofuel mixture with biofuel ratio varying from 0% to 40%;

- Evaluate the power and emission characteristics of a diesel engine working in PCCI mode with the above setup processes;

3. NEW POINTS OF THE THESIS

- Successfully built a model of the PCCI low-temperature combustion process, using two-stage injection and exhaust gas recycling, from a drum transmission diesel engine;

- Successfully established a method to simulate the PCCI low-temperature combustion process using a mixture of diesel and biofuel and compared it with the combustion process of a traditional diesel engine.

- Successfully built a model and experimental method to evaluate the power characteristics and emission characteristics of diesel engines burning in PCCI mode, using diesel fuel - biofuel mixtures with high ratios. The proportion of biofuels varies from 0% to 40%.

4. SCIENTIFIC AND PRACTICAL IMPLICATIONS

a) Scientific

- The thesis is meaningful because it provides a theoretical basis and converts traditional diesel engines into engines that use WCO–diesel fuel combined with PCCI combustion. This study provides a basis for improving the technical features and emissions of traditional diesel engines when they use potential renewable fuel sources in our country.

- This research contributes to the technical assessment of using WCO–diesel as a replacement for diesel. The PCCI combustion method is currently being studied and developed by researchers worldwide.

b) Practical

This project contributes to expanding the ability to diversify fuel sources used for diesel engines. It contributes to improving certain technical indicators and engine emission guidelines for switching to the use of diesel fuel mixed with WCO at a reasonable mixing ratio.

5. STRUCTURE OF THE THESIS

Preamble

Chapter 1: General research

Chapter 2: Low-temperature combustion

Chapter 3: Research and simulation of diesel combustion engines that use the PCCI method with WCO fuel mixtures

Chapter 4: Experimental research

General conclusions and development directions

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