DEVELOPMENT OF DIESEL DUAL FUEL (DDF) CONVERSION SYSTEM OPERATING NATURAL GAS AND DIESEL USING ELECTRONIC CONTROL UNIT (ECU)

Chanon Koythong[1], Yossapong Laoonual[2] and Szathys Songchon[2]

[1]Institute of field robotics (FIBO), King Mongkut's University of Technology Thonburi
[2]Combustion and Engines Research Laboratory (CERL), Department of Mechanical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi

The purpose of this study is to develop a conversion system for modifying a standard diesel engine using both diesel and natural gas as fuels so called a diesel dual fuel (DDF) engine. It has modified distribution pump of diesel fuel and added natural gas supply system by conversion kit. The diesel distribution pump of the diesel engine is modified from the mechanical control to the electronic control. The natural gas can be supplied to the intake manifold of engine via gas injectors with a commercial electronic control unit (ECU). The natural gas is mixing with air inside intake manifoldand sucked into each cylinder, which compressed and ignited the natural gas by pilot injection of diesel fuel. The thermal efficiency of the modified DDF engine is investigated.

Firstly, the diesel distribution pump is studied in order to understand how to change from the mechanical control to the electronic control. Then the fuel control system of diesel and natural gas is designed to be flexible system. The lever of diesel distribution pump is electronically control by a microcontroller (MCU-PIC-18F8722) via the actuator for adjusting amount of diesel fuel supply. In addition, the program of a microcontroller is adapted to be able to detect the knocking condition of the engine.

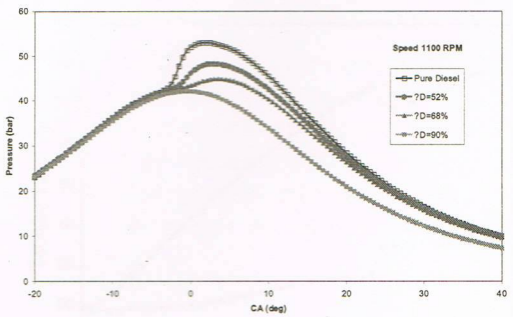

Figure 1. Pressure cylinder at speed 1,100 RPM

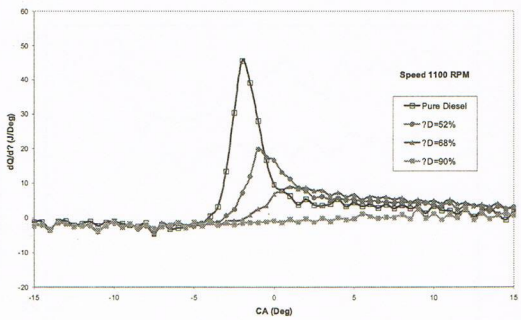

Figure 2. Heat release rate at speed 1,100 RPM

The preliminary results of experiments are presented at the idle operation with various amount of diesel reduced, ΔD = 0, 50, 70 and 90% (or the mass ratio between the natural gas and total fuel, Z=0%, 78%, 92% and 98% respectively) at various idle speed 700, 900 and 1,100 rpm. The rates of heat release of all DDF operations are significant lower than their pure diesel operations. The ignition delay of DDF operation at ΔD = 50% and 70% are longer than their pure diesel operation at approximately one and two crank angles degrees respectively. The idle speed at 900 rpm is chosen for the idle operating condition. Now, the modification of the distribution pump is able to control the amount of diesel fuel supply. In addition, the installation of the commercial ECU of gas injection system is used to control the amount of natural gas. Therefore, the both supply of natural gas and diesel are now independent control and can be varied to any ratio ΔD or Z. The engine testing at various loads will be investigated to find performance and emission of the DDF engine comparison with the standard diesel engine.

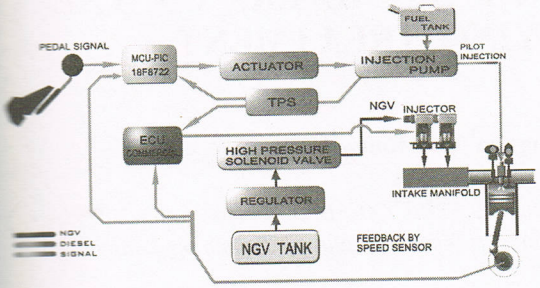

Figure 3. Diesel Dual Fuel system

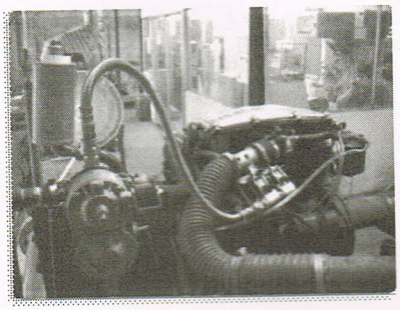

Figure 4. Diesel Dual Fuel engine