CHAPTER III
EXPERIMENTAL

3.1 Materials

All chemicals were obtained from commercial sources and used as-received. Diesel fuel was donated by RPC Co.,Ltd. (Rayong Purifier Public Company Limited, Thailand); the diesel properties are presented in Table 1. Ethanol with two different purity of 99.5% and 95% were obtained from The Royal Chitralada Projects, Thailand. Ethanol was purchased from White House (Milan, Italy) with a purity of > 99.9%. Ethyl acetate with a purity of >99.7% was purchased from Lab-Scan Chemical Company, Thailand.

3.2 Experimental

3.2.1 <u>Emulsion Preparation</u>

All the blends can be prepared by splash blending, a process that requires no special equipment or temperature control (McCormick and Parish, 2001). The ratios of each components (Diesel, Ethanol, Ethyl Acetate) ranging from 0% to 100% with 10% increment. And the experiment were carried out into 3 sets according to the different concentrations of Ethanol (95%, 99.5% and 99.9% purity). In this study, the ethanol-diesel blends fuels were formed by blending together the following components, ethanol, ethyl acetate and diesel fuel. The blending was first to blend ethyl acetate, as a co-solvent, into the ethanol and then stir the mixture using an electromagnetic machine with a stirring speed of 1000 rpm until the diesel is added at first minute. Then follow with a stirring speed of 1000 rpm for 4 minutes to finalize the three components mixing. Ten ml. of this mixture is then produced at room temperature (25°C). After that, the liquid solution is removed into the test tubes. Observation on stabilities of these liquid solutions in the test tubes were studied. The height of water layer, oil layer, emulsifying layer in the test tubes were recorded for choosing the homogenous solution (single-phase liquid) to test another fuel properties.

3.2.2 Effect of Storage Temperature on Emulsion Properties

One of the main concerns of diesohol fuel is stability at low temperatures. The fuel must be fluid and have good filterability in cold periods. At low temperatures components of mixtures must not separate (Makareviciene *et al.*, 2005). In this study, emulsions are stored in glass test tubes for 7 days at various temperatures (10, 20, 30, 40° C) in a water bath (model 9200, Polyscience, IL, USA) to observe the stabilities. After storage, some of the emulsions separated into a number of layers with different visual appearances. The effect of each temperature is reported in Ternary Plot Area and turbidity value. For long term stability, all the blends are observed for 3 months.

3.2.3 The Physico-Chemical Properties of the Single-Phase Emulsion

The presence of ethanol and ethyl acetate generates different physico-chemical modifications of the diesel fuel. A number of properties of diesel fuel must be maintained within certain limits to ensure its successful burning. So it is important to measure the selected blends, within the single phase liquid. These properties include:

3.2.3.1 Cetane

An important fuel property for diesel engine (Diesel fuels have cetane numbers of 45-50). It has an influence on engine start-ability, emissions, peak cylinder pressure and combustion noise. A high cetane number ensures good cold starting ability, low noise and long engine life. Cetane numbers of blended fuel depend on the amount and type of additive used in the blends.

3.2.3.2 Flash Point Temperature

Other properties is Flash Point temperature, (determined by test method ASTM D 93) the lowest temperature at which a fuel will ignite when exposed to an ignition source. The flash point of the fuel affects the shipping and storage classification of fuels and the precautions that should be used in handling and transporting the fuel. In general, flash point measurements are typically dominated by the fuel component in the blend with the lowest flash point. This parameter reflects a fuel's safety, the higher the flashpoint the less likelihood the fuel will accidentally ignite.

3.2.3.3 Kinematic Viscosity

Other properties is kinematic viscosity, a measure of the resistive flow of a fluid under gravity and determined by the test method ASTM D 445. Lower fuel viscosities lead to greater pump and injector leakage reducing maximum fuel delivery and ultimately power output. The addition of ethanol to diesel lowers fuel viscosity and lubricity.

3.2.3.4 Pour Point

Pour point is the temperature at which on further cooling of fuel, results in increased size and number of wax crystals and eventual coalescent of the fuel to form a rigid structure. This temperature is of importance in knowing the behaviour of fuels in cold weather.

3.2.4 Engine Tests

The experiments were performed on the Diesel engine generator, named DG3LE. The specification was 690mm x470mm x555 mm. Generator type was single phase AC generator, single-cylinder, vertical, 4-stroke, air-cooled, and direct injection, for the extra specifications of diesel generator are shown in Appendix A1. These experiments were conducted with eleven different fuels. These are baseline diesel fuel, 10 diesohol with various ratios of ethyl acetate and ethanol. The mixtures were prepared just before the experiments. The engine was coupled to an electrical generator though which load was applied by increasing the current to supply electrical apparatus that used to adjust load. The load condition were defined respectively as 0, 30, 60, 100% load, and their engine speed was set at 1500 rpm correspondingly. Moreover, the experiments evaluated the effects of oxygenated additive ratio and the load on five poisonous emissions: carbon monoxide (CO), carbon dioxide (CO_2), hydrocarbon (HC), oxygen (O_2) and nitrogen oxide (NOx), and also researched the fuel consumption rate. The concentration of each emission was measured by Gas Analyzer Model Eurogas 8020 and collecting the gases emitted from the tailpipe. Besides, the fuel consumption rate was measured by the volume of the fuel dropped in a scaled – cylinder that used to fill the fuel into the engine divided by the time. All the experiments were performed without any modifications on the engine. The figure of diesel generator and gas analyzer are shown in Figures 3.1 and 3.2, respectively.

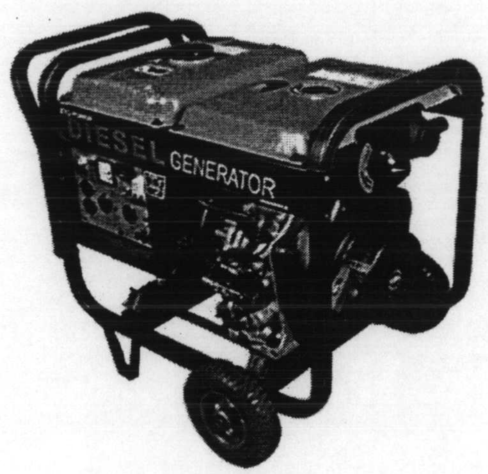

Figure 3.1 The diesel generator model DG3LE.

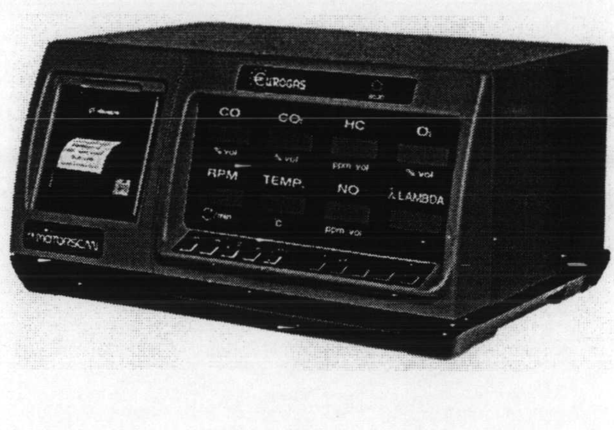

Figure 3.2 The Motorscan Eurogas gas analyzer model 8020.