CHAPTER I
INTRODUCTION

1.1 Statement of problems

At the present, the diesel fuel is the most important fuel used for transportation vehicles, agricultural and industrial.Therefore, the demanded for diesel fuel has been increased.The consumptions for diesel fuels are being continuously increased is shown in Figure1-1 [1].

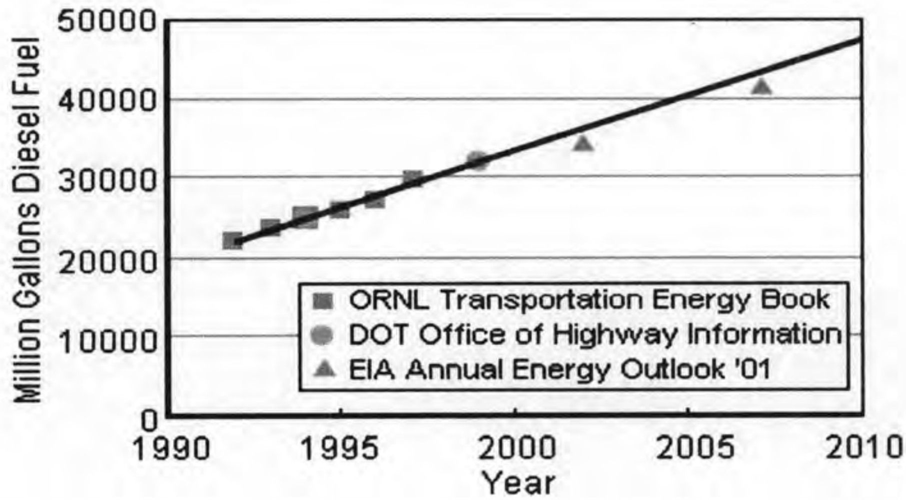

Figure 1-1 Trends in Consumption of Diesel Fuel
From DOE Report NREL/SR-540-32689.

Diesel fuel is a fossil fuel, which in most refineries is made from distillate fractions of crude oil. Crude oil is a mixture of heavy and light hydrocarbons requiring different degrees of heat to produce different products. The boiling range of diesel fuel is approximately 250-350°C. [2]

Diesel normally contains relatively high levels of sulfur, which naturally occurs in crude oils. During combustion, sulfur compounds oxidize to form SO_2 and SO_3. These compounds are part of the diesel engine's particulate emissions, and have an impact on the environment and on health. Furthermore, high sulfur content is highly undesirable for several reasons such as SO_x corrodes engine cylinders, exhaust system, increase carbon deposits in cylinders and on pistons and increased mass of particulate (sulfate aerosols).

For this reason, the Environmental Protection Agency (EPA) has established low sulfur requirements in diesel fuel. A maximum sulfur content of 0.05% by weight is required. This is similar to regulations for diesel in several countries around the world. All countries, which subscribe to European Diesel Specification EN 590, produce diesel with sulfur content below 350 parts per million (ppm), while the agendas of fuel specifications for the year 2007 limit the sulfur content to 15 ppm. In Ministry of Commerce, Thailand limited sulfur in diesel fuel for "on-road" vehicles to a maximum of 2500 ppm or 0.25% by weight.

The low sulfur content in diesel fuel has been achieved by increasing the use of refining process such as hydrotreating or hydrocracking.This process involves the introduction of hydrogen in the refining process to remove sulfur and reduce aromatic hydrocarbons. However, it should be noted that ultra-low sulfur diesel fuels lack the lubricity because the treatments to reduce sulfur also remove some components in fuels that can serve as natural lubricating compounds. Therefore, lubricity additives are required in such fuels. [3]

Lubricity additives are used to compensate for poor lubricity of severely hydrotreated diesel fuels. They contain a polar group that is attached to metal boundary lubricant to protect the two metal surfaces come in contact. According to the present invention, the lubricity additives in low sulfur content are ester, carboxylic acid, amine and amide compounds.

Fatty acid methyl ester or biodiesel have been used for diesel fuel lubricity improvers because they can be easily prepared from fatty acid of vegetable oils, biodegradable, low emissions and low cost to produces. Moreover, biodiesel offers superior lubricity even in very low blends. For example, a 1% blend of biodiesel can improve lubricity by as much as 65% [4]. The fuel lubricity can be measured by the High Frequency Reciprocating Rig (HFRR) and the minimum requirement for an acceptable field performance is down to the 460 μm wear scar diameter (WSD),which provide lubricity improvement.[5]

Furthermore, detergent and dispersant additives are other important factors for diesel engines, because they have prevented deposit in fuel pumps and injectors system from build-up of gum or resinous degradation products in the injectors system. In severe cases this can result in sticking of pump plungers and injector pintles. Potential problems typically only occur on isolated cylinders, which the resultant misfire, causing loss of power and increased exhaust smoke. The functional group of detergent and dispersant in diesel fuel are sulfonate, phenate, salicylate and phosphonate compound.

Sulfonation have been used for diesel fuel detergent and dispersant because they can be easily prepared from fatty acid of vegetable oil and used oleum (SO_3•H_2SO_4) for sulfonating agents. Oleum is relatively inexpensive SO_3 cost and low capital equipment cost to provide the product having an excellent detergent power to keep the surface engine clean.

Soapstock is a relatively inexpensive by product produced from vegetable oil refining, that is rich in the fatty acid that are the precursors of biodiesel. Soapstock consists largely of water, acylglycerides, phosphoglycerides, and free fatty acids. The total fatty acid content, including both free and lipid-linked acids, is 25-30% (weight basis).

Therefore, this research involved the synthesis of lubricity and detergency imporver by using soapstocks of vegetable oil (palm oil and rice bran oil) as substrate. The reaction conversions, performances of products of sulfonated methyl ester compound have been investigated.

1.2 The objective of the research

1. To synthesize sulfonated methyl ester compounds from vegetable oil soapstocks.
2. To study the properties of synthesized sulfonated methyl ester compounds blended with base diesel as lubricity improvers.

1.3 The scope of the research

1. Literature survey of the relevant research works
2. Provide of apparatus and chemical substances
3. Synthesis of sulfonated methyl ester from palm oil and rice bran oil soapstocks by esterification reaction and sulfonation reaction.
4. Characterization of the synthesized sulfonated methyl ester by spectroscopic methods such as FT-IR, FT-NMR, GC-MS and XRF.
5. Determination of lubricity, detergency and important properties of diesel fuel blended with sulfonated methyl ester.
6. Summarize the results.