CHAPTER I
INTRODUCTION

Rising petroleum prices, increasing of the environmental problems from exhaust emissions and global warming crisis have generated an intense international interest in developing alternative non-petroleum fuels for engines. Ethanol has been identified as one of the possible alternative fuels. Ethanol can be produced from crops with high sugar or starch contents. Some of these crops include; sugarcane, sorghum, corn, barley, cassava, sugar beets etc. The use of ethanol in conventional fuels increases the renewable portion of the fuel; it also significantly lowers polluting emissions from the use of the fuel. Gasohol (a mixture of 10% alcohol with 90% gasoline) is already a commercial fuel in over 35 countries of the world including the USA, Canada and France. In Brazil, cars with modified engines have been running for years on neat alcohol (Reeser *et al.*, 1995).

Diesel engines, due to their dominant advantages of high thermal efficiency, rigid and simple structure, and fuel economy, are the major power sources for marine and inland transportation and industrial power plants. They are the most efficient fuel combustion engines known and are expected to remain widely used in the foreseeable future (Lin and Wang, 2004). There are two possible ways to using ethanol in a diesel engine. Firstly, diesel could be injected in the normal way, with a carburetor added to atomize the ethanol, which has been stored in its own tank, into the engine's air stream. Secondly, the ethanol could be blended with diesel. The simplest way is to blend so that no engine modifications are required (Ajav and Akingbehin, 2002).

The blend between diesel and ethanol (10-15%) is called "diesohol" and also known as E-diesel in the United States. It has been considered by the Thai government as one of candidate alternative fuels for diesel substitution. Under most conditions, ethanol readily blends with gasoline at all ratios. Unlike gasoline, diesel fuel is not easily blended with ethanol under all conditions. Particularly troublesome are conditions of low temperature and/or water contamination. Both can result in fuel instability due to phase separation (Li *et al.*, 2005). Therefore, the major drawback in

ethanol-diesel fuel blends (diesohol) is that ethanol is immiscible in diesel over a wide range of temperatures and water contents.

Because all automotive fuels are required to be a clear, single-phase liquid (Wenzel, 2002), the use of additives allows stable blends to be achieved. There are two types of additives: the first are emulsifiers or surfactants (soap like chemicals) that produce microemulsions and the second are cosolvents. Emulsification usually requires heating and blending steps to generate the final blend, whereas cosolvents allow fuels to be "splash-blended", thus simplifying the blending process (Hansen *et al.*, 2005).

Beside the problem of phase stability, the presence of ethanol generates different physicochemical modifications on fossil fuel, notably reductions of cetane number, viscosity, flashpoint as well as gross heat content. Several possibilities can be considered to make compatible the technology of a diesel engine with the properties of the ethanol-based fuels.

In view of the modifications conferred on diesel fuel by the presence of ethanol, the selected additive will intervene at several levels. It will be required to:

- make up the cetane number, reduced by the addition of ethanol, to ensure that the ignition properties are satisfactory;
- intensify the viscosity to ensure adequate lubrication of the injection pumps;
- stabilize the mixture in the presence of a high water content, to ensure fuel homogeneity under all conditions (Satge′ de Caro *et al.*, 2001).

Various commercial surfactants are used as emulsifiers to form ethanol-diesel emulsions. Typically, these surfactants are added at a concentration of $\leq 5\%$. The literature suggests that the various commercially available surfactants include alkanols, decaglycerol mono-oleate (MO750), and alkanolamides (Dzulkefly *et al.*, 2002; Xu *et al.*, 2001). However, the prices of commercial surfactants are still high.

Not only ethanol, but also biodiesel is a renewable fuel that reduces the dependency of non-oil-producing countries on foreign petroleum. Biodiesel is soluble in both diesel and ethanol. Moreover, because of its high cetane number, high

viscosity and high flashpoint, biodiesel is an interesting additive to stabilize and improve some fuel properties of ethanol-diesel fuel blends (diesohol).

Thus, the objective of this research is focused on studying the use of biodiesel (palm oil methyl esters) as an additive in stabilizing ethanol in diesel emulsions, the phase stability of ethanol-biodiesel-diesel three-component systems at different component concentrations, some basic fuel properties such as cetane index, flash point, pour point, density at 15 °C, and heat of combustion are investigated and compared these properties with those of petrodiesel fuel alone.