CHAPTER I

INTRODUCTION

1.1 Motivations

Oil crisis problems become the major issue nowadays because all over countries in the world face increasing of the oil price in the world market. An increase in demand for petroleum fuel in order to serve an economic development in several sectors resulted to higher demand, especially for industries and transportation. To solve this problem, alternative fuels have been introduced and promoted by the government. Among several alternatives fuel, gasohol and biodiesel are the ones that the government play crucial strategies on and promote them as the policy in the National Plan. The purpose of alternative fuel is not only for reducing fossil fuel import but it is also expected that it will be better for the environment in term of less air pollution release. There is a report shown benefit of usage biodiesel that it can reduce carbon dioxide emission by 20-25% when compared with fossil fuel (http://www.pttplc.com/en /document pdf/ biofuel_ en.pdf). Moreover, it results to reduction of the public health risk due to less air pollution emission. Consequently, the Thai government announced the policy on an expansion of biodiesel production and its utilization in order to replace gasoline fuel and reduce oil import and oil trade imbalance in country. The government set the target of the use biodiesel from agriculture product up to 10 % of the diesel use overall the country by year 2012 (http://www.manager.co.th /Science/View News aspx ?NewsID =94800000 781 43).

In general, biodiesel is produced from vegetable that contain oil in their seeds which has been reported that there are more than 350 oil bearing crops such, soybean, rapeseed, sunflower palm, etc. (Ayhan, 2005). The oil will be extracted from these vegetable seeds and be processed including esterification to be biodiesel. Biodiesel is normally blended with fossil diesel before being used. When compared to petroleum diesel, biodiesel is found to be more environmental friendly since it releases less pollutant. (http://www.pttplc.com/en /document pdf/ biofuel_ en.pdf). Palm oil is one of the interested oil bearing crop due to the tremendous growth of the oil palm industry in many parts of global production. Especially, palm oil plays an important role in economy plant and is grown as industrial plantation in the south of Thailand. Palm oil occupies 70% of Thai vegetable oil market, and is estimated to be worth 40,000 million Baht per annum. In year 2003, the production of palm oil was estimated to be 680,000 tons. It expected that in 2006 the national consumption will increase up to 718,000 tons. (Chavalparit et al., 2006).

Furthermore, there have been several studies conducted on palm oil as a diesel fuel substitute since 1985. The researches are in accordance with His Majesty the King's initiative because of oversupply of palm oil in the market as well as the impact of rising oil prices. Purified palm diesel have sold in Thailand's market and found that no impacts are reported on such diesel engines, while it helps promote lubricity and antiwears in fuel injection pump as well as reduce pollutant in exhausted emission. (http://www.pttplc.com /en /document pdf/ biofuel_en.pdf).

Palm fruit gives the oil from 2 parts: the first one is the palm oil extracted from shell and another one is extracted from palm kernel. Palm oil and palm kernel oil is very popular vegetable oil for biodiesel. Ministry of Energy set the target for biodiesel producing from 176 million liters in year 2006 to 722 million liters in year 2011. In addition, the ministry of agriculture and co-operatives have the strategy for promoting the palm oil cultivation and they set the target for an expansion the palm plantation areas up to 10 million rais in the year 2029 and also plan to increase the average production of palm from 2.04 million rais (326,400 hectares) to 3.67 million rais (587,200 hectares) in year 2007 (http://www. manager.co.th /Science /ViewNews.aspx? NewsID=94800000 78143). Besides palm oil, other vegetable oils such as soybean oil, corn oil, peanut oil, sunflower oil, coconut oil, etc. are also considered as an alternative for biodiesel as mentioned earlier (http://www.pttplc.com/en/document pdf/biofuel_en.pdf).

Basically, the vegetable oil can be extracted by methods including solvent extraction, traditional method and mechanical extraction. Extraction is the important process in order to achieve highly yield. Extraction with n-hexane is a widely use approach for obtaining vegetable oils from their seeds such as peanut, soybean, sunflower, corn, palm kernel (Mattil et al., 1964). Solvent extraction is the suitable process for industrial vegetable oil extraction due to achieve highly yield of oil from extraction. However, hexane; a conventional solvent for oil extraction, is the highly volatile solvent. It is classified as a hazardous air pollutant (HAPs) by US Environmental Protection Agency and is considered that vegetable oil plants represent as a potential major source. Although, extraction of oil by hexane yield high percentage, hexane leaks and expose to atmospheric environment is a major concern, especially the extraction of soybean oil, peanut oil, cottonseed and corn oil (http://www.epa. gov /ttn /chief /ap42 /ch09 /bgdo cs/b9s11-1.pdf). It is estimated that 0.7 kg hexane per ton of vegetable seed is released into environment. (http://www.epa.govfedrgstrEPAAIR2000MayDay-26a12794.html). Exposure to hexane at 125 ppm for 3 months cause peripheral nerve damage, muscle wasting, and atrophy. From this reason, to investigate alternatives solvent extraction to replace hexane becomes an interest aspect. Moreover, the United States Environmental Protection Agency set the new rule in order to reduce hexane emission by 25 % then the new approach for alternative solvent extraction based on the technology that does not use toxic compound in extraction process should be promoted (Tyson et al., 2004). Surfactant-aqueous based system is thus introduced as an alternative solvent. This approach is also considered as clean technology concept. To achieve high yield of extraction, a microemulsion system is introduced in association since microemulsions provide low interfacial tension and then can enhance the extraction of oil from seed meal.

Microemulsion is a system consisting of at least 3 components: water, oil and surfactant. The application of microemulsions have been numerous due to their unique properties namely, thermodynamically stable, ultra low interfacial tension (IFT), large interfacial area and high solubilization of immiscible liquid (Bidyut and Satya, 2001). Microemulsion plays the key role for using as solvent replacement in my research because of the application of microemulsion system for reducing interfacial tension at oil seed surface in order to enhance extracted oil from the seed. However, another important property of microemulsion system on high solubilization which is not the desirable phase of extraction (the free oil phase is desirable for this process) is usually occurred in association with low IFT. Thus, to design a microemulsion system for oil extraction, it needs to minimize interfacial tension as well as minimizing solubilization. To obtain this purpose, an investigation on a microemulsion system will be the first phase of the study. There are some research studies on possibility of microemulsion formation system between vegetable oil and various type of surfactant. Raman et al. (2003) studied the microemulsion formed by mixture of non-ionic surfactant with palm oil and its derivatives. Rajib and Bidyut (2004) studied the microemulsion of eucalyptus oil and mixed surfactant (AOT + Brij35) and buthanol. Hsu and Nacu (2003) studied the behavior of soybean oil in water emulsion stabilized by non ionic surfactant. In addition, Klongklaew et al.(2005) found that soybean oil can be extracted from seed by using microemulsion system. The optimum condition in his study was found in the mixing surfactant 0.1% Alfoterra-5PO and 3% Comperlan and achieved the maximum soybean oil extraction 85.77% for soybean size 0.212-0.425 mm with the contact time for 30 min. To extend the study on using microemulsion for vegetable oil extraction, in this study the investigation for soybean oil properties from extraction by microemulsion was carried out. Furthermore, palm kernel oil is another additional selected seed for the study to examine the yield of oil extraction by using surfactant-aqueous based microemulsion system.

1.2 Objectives:

The main objective of this research was to study the surfactant aqueous-based to compare to the conventional method using hexane for vegetable oil extraction from seeds by microemulsion technique.

The specific objectives are:

1. To investigate microemulsion formation systems and their behavior with palm kernel oil.
2. To determine the yield of oil extraction from the selected systems for palm kernel oil.
3. To examine oil properties from the surfactant aqueous based microemulsions extraction.
4. To compare the efficiency of hexane extraction and surfactant aqueous-based extraction as well as properties of the extracted oil.

1.3 Hypotheses:

The microemulsion system is expected to be able to extract oil from soybean seeds and palm kernel as well as providing good quality product as compared to conventional extraction process (e.g. hexane extraction).

1.4 Scopes of the Study:

The scope of the study was corresponding to the objectives which could be divided in to 3 parts:

1. Mixed of nonionic surfactant and anionic extended surfactants were used to extract both soybean and palm kernel oil by microemulsion technique.
2. Phase behavior study of selected surfactant systems with soybean oil and palm kernel oil was determined by their phase transition and interfacial tension.
3. The yield of oil free phase and quality of the oil were the key parameters for determination of the optimum condition for oil extraction.