

CHAPTER III

DATA COLLECTION

This chapter presents the various sources of data that are used in this thesis. In order to determine the industry critical success factors, the data and information about the background, characteristics and present situations of the industry are required. Moreover, with a growing demand of green and clean energy, biodiesel gains more and more attention not only in the world's energy area but also in Thai's energy market as well.

3.1 Introduction

With reference Rungcharoenpattanakit (9), data collection is a common process of gathering and obtaining the information from various sources or respondents. For Rungcharoenpattanakit (9), to examine any industry it often involves collecting data from a wide range of information upon the analyzing industry. Examples of typical collective information include the industry characteristics, product trend, market size, market demand and supply of the product, consumption rate and so on.

Particularly for this thesis, obtaining and gathering of information from various sources is of the essence. Many different sources, such as biodiesel news, research articles, biodiesel-related television clips, or even biodiesel-related radio clips, are the fundamental sources in forming the picture of Thai's biodiesel situation.

To reach the objectives of this research of attaining the critical success factors in the set-up of biodiesel, and at the same time, developing a project guideline and procedure for the construction of a biodiesel factory, each of the identified information sources would be indispensable resources in conducting this thesis as it would help to provide different perspectives of Thai's biodiesel industry.

3.2 Collected Data

3.2.1 Biodiesel news

News is one of the very useful resources in providing the update information of an industry, in this case biodiesel industry. To learn more about Thai's biodiesel industry and obtain about Thai's biodiesel news, one of the valuable sources is through the Internet. One of the most notable websites offering update news about Thai's biodiesel industry is Thaienergynews website (23). Apart from it, Thai Bio Energy website (24) is another helpful resource in obtaining news about Thai's biodiesel industry. Moreover, the Department of Alternative Energy Development and Efficiency (25), Ministry of Energy, has a website contains with practical information regarding biodiesel, biodiesel news and its update.

3.2.2 Biodiesel information from Journals

Other than obtaining information through the news, biodiesel information could also be obtained from journals. Through journals, this is another important resource that has a lot of biodiesel information regarding its current progresses. Not only do journals provide useful information about biodiesel, but also they sometimes contain information regarding other coming alternative energies, which could in turn be biodiesel competitors. Examples of journals that provide useful biodiesel information are:

- *Energy Policy and Planning Office Journal* (2), or sometimes refers to as EPPO Journal, it is a journal that comes out in every three month by the Energy Policy and Planning Office, Ministry of Energy, providing essential information regarding all Thai energy activity.

- *Thailand Engineering Journal* (26) is another good source to obtain information regarding biodiesel and other alternative energies. Particularly for the issue of the year 59 vol. 2 March-April 2006, the whole journal is

about renewable energy – presenting information of all the different types of Thai alternative energies including biodiesel.

3.2.3 Biodiesel information from Research Reports

Another resource that help to provide valuable and useful information regarding biodiesel or biodiesel industry it is through the research reports conducted by the experts of this field or from the recognized institutions. Examples of these types of resources are as follows:

- *“Biodiesel Production Technology” by Gerpen et al. (27) of National Renewable Energy Laboratory upon a request of Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy* – this research report provides general information about biodiesel, from its basic chemistry to biodiesel transportation and storage, with an emphasis upon biodiesel’s different production processes.
- *“Business Management for Biodiesel Producers” by Gerpen, J. V. (28) of National Renewable Energy Laboratory upon a request of Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy* – this research report provides useful information of biodiesel in general with a focus in the business aspect of biodiesel production.
- *“Biodiesel: Alternative Energy?” by Jenvanitpanjakul, P. (29) of Environment, Ecology and Energy Department of Thailand Institute of Scientific and Technological Research* – this research report provides useful information of biodiesel in term of its research and development in Thailand, its raw material, biodiesel properties, and a good recommendation in supporting biodiesel in Thailand.
- *“A System Analysis for Sustainable and Commercial Uses of Biodiesel from Palm Oil Production in Thailand” by Vanichseni, T. (30) of Graduate School,*

Kasetsart University – this research report provides information regarding the world and Thailand energy outlook, biodiesel production process and its required standard, and last but not least an economic analysis and viability of biodiesel production via tranesterification process.

3.3 General Information

3.3.1 Biodiesel

Biodiesel is a renewable energy developed to be used with diesel engines. At the present time, with the high fluctuation in the energy market and a growing demand of a green and clean energy, many countries are turning to biodiesel as one of their solution of the alternative energies.

With reference to Gerpen (28), biodiesel is defined as the mono-alkyl esters of fatty acids derived from vegetable oils or animal fats. In other words, biodiesel is obtained when a vegetable oil or animal fats interacts with an alcohol (usually methanol) and a catalyst (sodium or potassium hydroxide) that helps to speed up the reaction to obtain a fatty acid alkyl ester. From the reaction, a valuable by-product is produced, glycerol. This process, in which used to transform vegetable oil or animals fats into a fatty acid alkyl ester, is called the tranesterification process. Scientifically, tranesterification is a process in which triglyceride molecules are transformed into smaller, straight-chain molecules by using the displacement of alcohol with the help of either sodium hydroxide or potassium hydroxide acting as a catalyst.

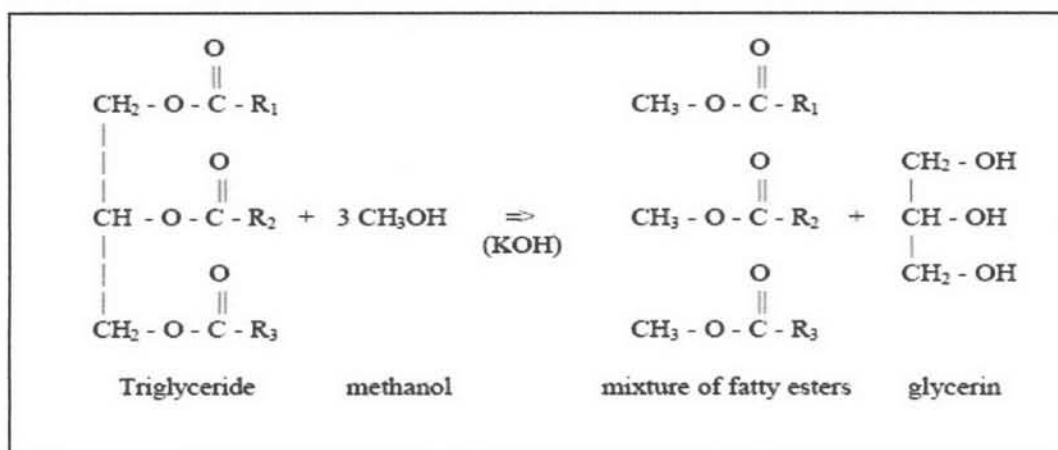


Figure 3.1: Tranesterification process

Source: Clements and Gerpen (31)

To produce biodiesel commercially, it follows the same principle of the tranesterification reaction. The first step in producing biodiesel is to prepare its raw material. Crude palm oil (biodiesel's raw material), or sometimes is referred to in short as CPO, needs to go through pretreatment processes. Examples of the pretreatment processes include degumming, refining, bleaching, deodorization, fractionation, and hydrogenation. By letting the CPO goes through with these processes, it removes impurities; such as phospholipids, lecithin, or gums, present in the crude palm oil. Next, an alcohol (Methyl or Ethyl Alcohol) and a base catalyst would be mixed together. Then, the mixture obtained would later be added to the treated crude oil palm in a mixing tank or a reactor tank – tranesterification process. After the mixture (CPO, an alcohol and a base catalyst) has been tranesterified, then neutralizing acid would be put in. Later, the mixture would be separated into 2 phases of methylesters (with small amount of glycerin and methanol) and glycerin – crude biodiesel. Then, the crude biodiesel would then be purified, and the methanol remained in the crude biodiesel would be recovered to obtain better quality methylesters. Finally, biodiesel is obtained.

For the glycerin recovery, the first step is to be re-neutralized. Glycerin would be neutralized with an acid to remove any excess residues, catalyst or soaps to obtain

what is known as ‘crude glycerin’. Also, any remained methanol would be recovered. Then, the obtained crude glycerin would be further purified to be sold as pharmaceutical-grade glycerin. Example of a complete biodiesel production process is shown in Figure 3.2.

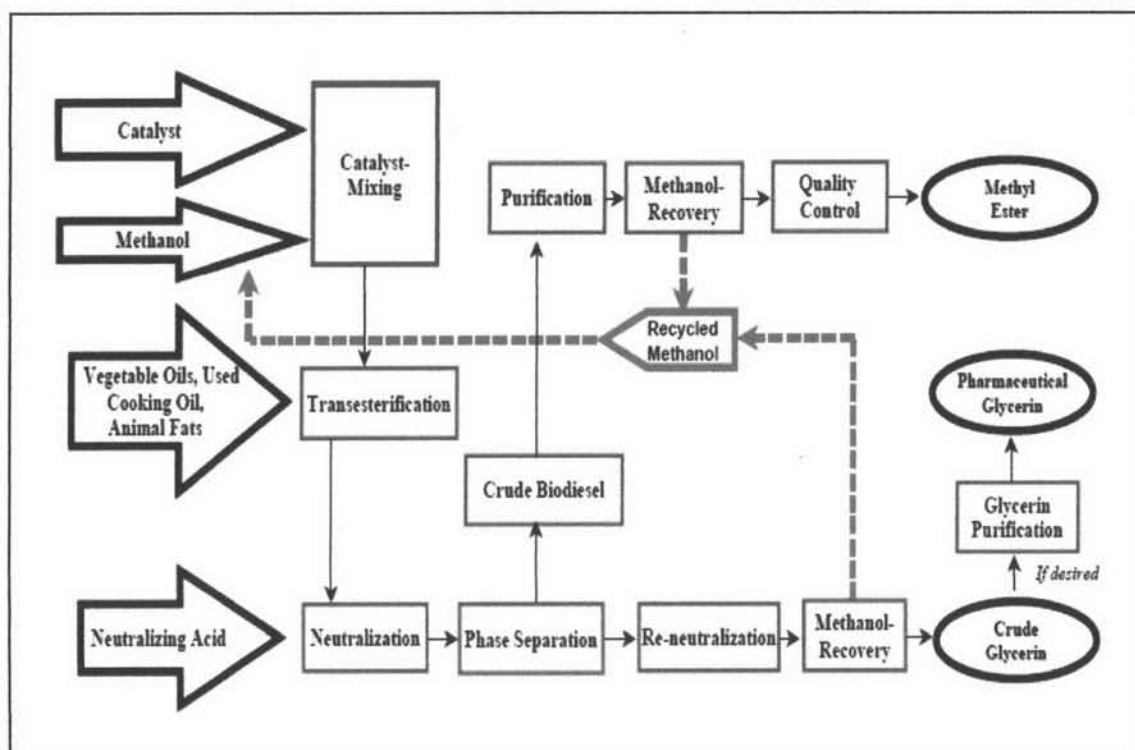


Figure 3.2: Biodiesel production process

Source: National Biodiesel Board (32)

According to Ministry of Energy, to produce biodiesel for a commercial purpose, the biodiesel produced must be in compliance with the Thai's Commercial Biodiesel Standard. At the moment, there are actually two types of Biodiesel Standard in Thailand. The first one is a biodiesel standard applied for biodiesel producers who wish to sell their biodiesel as a fuel. Another standard, however, is for those communities who wish to produce biodiesel and specifically use the produced biodiesel with their agricultural engines – not as a vehicle fuel. In this research, only Thai's Biodiesel Standard for Commercial as shown in table 3.1 would be referred to;

as in this case setting up a biodiesel factory would be to produce biodiesel as fuel for a commercial purpose.

Table 3.1: Thai's Commercial Biodiesel Standard

List	Properties	Units	Typical value	Testing Procedure
1	Methyl Ester	% wt.	96.5 min.	EN 14103
2	Density at 15°C	kg/m ³	860 min. to 900 max.	ASTM D1298
3	Viscosity at 40°C	cSt	3.5 min. to 5.0 max.	ASTM D445
4	Flash point	°C	120 min.	ASTM D93
5	Sulphur	% wt.	0.0010 max.	ASTM D2622
6	Carbon residue, on 10% distillation residue	% wt.	0.30 max.	ASTM D4530
7	Cetane number	--	51 min.	ASTM D613
8	Sulfated Ash	% wt.	0.02 max.	ASTM D874
9	Water	% wt.	0.050 max.	ASTM D2709
10	Total Contaminate	% wt.	0.0024 max.	ASTM D5452
11	Copper Strip Corrosion	--	no. 1 max.	ASTM D130
12	Oxidation Stability at 110°C	hours	6 min.	EN 14112
13	Acid Value	mg KOH/g	0.50 max.	ASTM D664
14	Iodine Value	g Iodine/100 g	120 max.	EN 14111
15	Linolenic Acid Methyl Ester	% wt.	12.0 max.	EN 14103
16	Methanol	% wt.	0.20 max.	EN 14110
17	Monoglyceride	% wt.	0.80 max.	EN 14105
18	Diglyceride	% wt.	0.20 max.	EN 14105
19	Triglyceride	% wt.	0.20 max.	EN 14105
20	Free glycerin	% wt.	0.02 max.	EN 14105
21	Total glycerin	% wt.	0.25 max.	EN 14105
22	Group I metals (Na+K)	mg/kg	5.0 max.	EN 14108 and EN14109
	Group II metals (Ca+Mg)	mg/kg	5.0 max.	prEN 14538
23	Phosphorus	% wt.	0.0010 max.	ASTM D4951
24	Additive (if present)	Need approval from the Director General of Department of Energy Business		

Source: Department of Alternative Energy Development and Efficiency (25)

3.3.2 Biodiesel Industry

At the present, Thailand is encountering with an energy crisis situation along with the rest of world facing with a high fluctuation of crude oil price. As one of the dependent crude oil importers, Thailand has spent much greater amount purchasing the same amount of crude oil due to a sharp increased in crude oil price. This affects Thai's trade balance negatively. As a result, Thai government is now trying to reduce the oil import dependency. One of the approaches considered by the Thai government to reduce the oil import dependency is to look for other alternative energies. Hence, biodiesel is one of the identified solutions.

Thai government, lead by Energy Policy and Planning Office and Department of Alternative Energy Development and Efficiency; Ministry of Energy and together with many related governmental agencies such as: Ministry of Agricultural and Cooperation, Ministry of Commerce, Ministry of Industrial, Ministry of Finance, and Thai's Board of Investment, is now encouraging and promoting in both the production and the consumption of biodiesel with the intention of helping the country to reduce the oil import dependency and at the same time creating the energy stability for Thailand.

With the cooperation among these governmental agencies, they have come up with the alternative energy strategic plan: to promote NGV, Gasohol and Biodiesel. Particularly for biodiesel, Thai government is trying to incorporate biodiesel to diesel fuel. By 2012, Thai government is hoping that Thailand would compulsory be selling B10 fuel (90% diesel and 10% biodiesel) for all diesel vehicles throughout Thailand (26). Moreover, with the projection by Department of Energy Business; Ministry of Energy, that the demand of diesel fuel would be about 85 million litres per day in 2012, it results consequently that the expected demand of biodiesel would also be as high as 8.5 million litres per day in 2012 as well (with the condition that B10 is replacing diesel fuel countrywide).

Currently, with the proposed biodiesel strategic plan, Minister of Energy, Dr. Piyasvasti Amranand, admitted that it is encountering with some difficulties. One of which faces at the moment is from the raw material perspective (24). Despite a Thai government plan that by 2012 Thailand would expand its palm plantation by 6 million rai to support the biodiesel production at a rate of 8.5 million liters per day, the rate of palm plantation expansion is not satisfying. According to Preechajarn, S. (33), although the Thai Cabinet has approved a budget allocation of 1,300 million Baht (for extension services of 800 million Baht and for project management of another 500 million Baht) to help expanding the palm plantation, the result is rather questionable. With no guarantee in the price of fresh palm and palm oil, many palm planters refuse to move out of rubber trees into new palm trees.

In term of biodiesel distribution, there are only two fuel distributors involved: Petroleum Authority of Thailand (PTT) and Bangchak Petroleum PCL. At the moment, there are altogether 35 biodiesel service stations providing B5 fuel – distributing in total of 2.85 million liters of blended biodiesel (B5) per month. Out of the 35 service stations, 23 service stations are belonged to Petroleum Authority of Thailand (PTT) and the rest of 12 stations are operated by Bangchak Petroleum PCL (35). Hence, Thai government is encouraging fuel distributors like Petroleum Authority of Thailand (PTT) and Bangchak Petroleum PCL to increase the number of biodiesel service stations from 35 stations to 200 stations by the end of 2550. And eventually, biodiesel service stations would be encouraged to be set-up throughout Thailand for every Thai citizen to be accessible to this type of alternative energy.