ภาคผนวก ง การทบทวนเอกสารที่เกี่ยวข้องเกี่ยวกับการผลิตไบโอดีเซล (Reviewed Literatures of Biodiesel Production)

ตารางที่ ง-1 การผลิตน้ำมันดีเซลชีวภาพจากวัตถุดิบชนิดต่าง ๆ (Production of Biodiesel from Several Raw Materials)

Author / Year	Title	Materials	Objectives	Methods / Analysis	References
1.1 Zheng, *et al* (2006)	Acid-catalyzed production of biodiesel from waste frying oil	WVO derived from **Rape seed oil**, Methanol, Conc. Sulfuric acid	- To study the effects of feed composition, temperature, and rate of mixing on the kinetics of the acid-catalyzed transesterification reaction. - To determine the optimal conditions for the reaction.	Esterification & Transesterification / GPC	Biomass & Bioenergy Vol. 30
1.2 Ghadge, *et al* (2005)	Biodiesel production from mahua (Madhuca indica) oil having high free fatty acids	**Mahua oil**, Methanol, Sulfuric acid, Potassium Hydroxide	- To determine the optimize conditions for the pretreatment process and to study the properties of the biodiesel production from mahua oil.	Esterification & Transesterification / ASTM D 6751-02, DIN EN 14214	Biomass & Bioenergy Vol. 28
1.3 Zhang, *et al* (2003)	Biodiesel production from waste cooking oil: 1. Process design and technological assessment	Refined & WVO derived from **Canola oil**, Methanol, Conc. Sulfuric acid, Sodium hydroxide	- To study an economic feasibility of each process (alkai & acid – catalyzed system) in the commercial scale by using process simulation and design (HYSYS).	Esterification & Transesterification / UNIQUAC, NRTL & HYSYS	Bioresource Technology Vol. 89

Author / Year	Title	Materials	Objectives	Methods / Analysis	References
1.4 Al-Widyan, *et al* (2002)	Experimental evaluation of the transesterification of waste palm oil into biodiesel	Waste **Palm oil**, Ethanol, Sulfuric acid, Hydrochloric acid	- To examine the possibility of transesterifying a WVO for the production of biodiesel. - To study the effect of catalyst concentration, catalyst type, and excess alcohol on conversion efficiency (yield).	Transesterification / Model of Newtonian fluid	Bioresource Technology Vol. 85
1.5 Foidl, *et al* (1996)	Jatropha curcas L. as a source for the production of biofuel in Nicaragua	**Jatropha curcas oil**, Methanol, Ethanol, Potassium Hydroxide	- To study the chemical and fuel properties of methyl and ethyl ester which produced from Jatropha curcas oil?	Transesterification / GC	Bioresource Technology Vol. 58
1.6 Darnoko, *et al* (2000)	Kinetics of Palm Oil Transesterification in a Batch Reactor	**Palm oil**, Methanol, Potassium Hydroxide	- To study the kinetics parameters of transesterification (that can be used to predict the extent of the reaction at any time under particular conditions).	Transesterification / GC	JAOCS Vol. 77
1.7 Dorado, *et al* (2004)	Kinetic Parameters Affecting the Alkali-Catalyzed Transesterification Process of Used Olive Oil	Used **olive oil**, Methanol, Ethanol, Potassium Hydroxide, Sodium Sulphate	- To study the kinetic parameters that affecting a low-cost transesterification process by using waste olive oil.	Transesterification / GC	Energy & Fuels Vol. 18

Author / Year	Title	Materials	Objectives	Methods / Analysis	References
1.8 Tomasevic, *et al* (2003)	Methanolysis of used frying oil	Used **sunflower frying oil**, Methanol, Potassium hydroxide or Sodium Hydroxide	- To find out the most appropriate parameters of reaction for the methanolysis of the used frying sunflower oil.	Transesterification / TLC	Fuel Processing Technology Vol. 81
1.9 Felizardo, *et al* (2006)	Production of biodiesel from waste frying oils	WVO (produced from **sunflower seed**) , methanol, Sodium Hydroxide, Magnesium Sulphate	- To determine the optimum conditions for biodiesel production using waste frying oils as raw material in the transesterification process.	Transesterification / GC	Waste Management Vol. 26
1.10 Bannwal, *et al* (2005)	Prospects of biodiesel production from vegetable oils in India	**Vegetable oil**	- To review the possibilities of using neat vegetable oils and biodiesel, the processes available, fuel characteristics, performance analysis and economic analysis of biodiesel production in India.	-	Renewable & Sustainable Energy Reviews Vol. 9
1.11 Freedman, *et al* (1986)	Transesterification Kinetics of Soybean Oil	**Soybean oil**, Methanol, or 1-butanol, Sodium Hydroxide	- To study the kinetic parameters & other process conditions for the biodiesel production process from soybean oil.	Transesterification / GC	JAOCS Vol. 63

ตารางที่ ง-2 การศึกษาลักษณะการเผาไหม้ การปลดปล่อยก๊าซ และผลที่มีต่อเครื่องยนต์ดีเซลของน้ำมันดีเซลชีวภาพ (The Combustion, Emission characteristics, & the Effect on the diesel engine of Biodiesel)

Author / Year	Title	Materials	Objectives	Methods / Analysis	References
2.1 Scholl, K.W., *et al* (1993)	Combustion of soybean oil methyl ester in a direct injection diesel engine	Methyl ester produced from **soybean oil**	- To investigate the combustion of soybean oil methyl ester in a direct injection diesel engine, and compare it to that of a conventional diesel fuel.	A direct injection diesel engine / Flue Gas Analyzer	SAE Special Publications
2.2 Tashtoush, G., *et al* (2003)	Combustion performance and emissions of ethyl ester of a waste vegetable oil in a water-cooled furnace	**WVO**, Ethanol, Hydrochloric acid	- To evaluate the biodiesel that produced as a fuel in liquid burners such as in residential heating boilers where diesel fuel is used. - To evaluate the feasibility study of any potential fuel from combustion behavior and the aspects of heat transfer and emissions.	A water-cooled furnace / Flue Gas Analyzer	Applied Thermal Engineering Vol. 23

Author / Year	Title	Materials	Objectives	Methods / Analysis	References
2.3 Rakopoulos, *et al* (2006)	Comparative performance and emissions study of a direct injection Diesel engine using blends of Diesel fuel with vegetable oils or bio-diesels of various origins	Vegetable oils or bio-diesels of various origins, i.e. **cottonseed, sunflower oil** and their ME, as well as rapeseed oil methyl ester, palm oil methyl ester, corn oil and olive kernel oil.	- To evaluate and compare the use of various Diesel fuel supplements at blend ratios of 10/90 and 20/80, in a standard, fully instrumented, four stroke, direct injection (DI), Ricardo/Cussons `Hydra' Diesel engine located at the authors' laboratory.	Ricardo/Cussons `Hydra' Diesel engine / Flue Gas Analyzer	Energy Conversion & Management Vol. 47
2.4 Pramanik, *et al* (2003)	Properties and use of jatropha curcas oil and diesel fuel blends in compression ignition engine	**Jatropha curcas oil**, commercially diesel oil	- To decrease the viscosity of jatropha curcas oil by dilution with diesel. - To see the effect of heating on reduction in viscosities of the blends (biodiesel + diesel). - To evaluate the engine performance using the prepared blends as fuel.	Fuel properties & Engine test were determined corresponded to standard method	Renewable Energy Vol. 28

ตารางที่ ง-3 การศึกษาการเสื่อมสภาพของไบโอดีเซลและวัตถุดิบ (The Degradation Effect of Biodiesel and Raw Materials)

Author / Year	Title	Materials	Objectives / Results	Methods / Analysis	References
3.1 Canakci, M., *et al* (1999)	Accelerated oxidation processes in biodiesel	Biodiesel produced from vegetable oil	- To accelerate & study the effects of oxidation processes in biodiesel. - The results show the impact of time, oxygen flow rate, temperature, metals, and feedstock type on the rate of oxidation. - This oxidation also results in increases in peroxide value, acid value, and viscosity.	Measured Peroxide Value, Acid Value, & Kinematic viscosity	Transactions of the American Society of Agricultural Engineers Vol. 42
3.2 Liang, C., *et al* (1998)	Comparison of four accelerated stability methods for lard and tallow with and without antioxidants	Animal Fats (Lard & Tallow)	- To evaluated the oxidative stability of lard and tallow with and without antioxidants by four accelerated stability methods. - The results indicated that the oxidative stability of animal fats and the relative effectiveness of an antioxidant in the fats could have different mechanisms and the Rancimat method may be the least reliable method compared with AOM, oxygen bomb test, and Schaal oven test.	Rancimat method, Active Oxygen Method, oxygen bomb test, and Schaal oven test	JAOCS Vol. 75

Author / Year	Title	Materials	Objectives / Results	Methods / Analysis	References
3.3 Leung, D. Y. C., *et al* (2006)	Degradation of biodiesel under different storage conditions	Biodiesel produced from rapeseed oil	- To investigate the biodiesel degradability characteristics under different storage situations. - The study provides insights on how biodiesel degrades with time under specific conditions. - So, this information will be useful to both biodiesel producers and users for designing their biodiesel storage system and for maintaining the quality of biodiesel in the fuel or storage tank.	Acid Value measurement, % Purity & Composition by GC	Bioresource Technology Vol. 97
3.4 Dunn, R.O.(2005)	Effect of antioxidants on the oxidative stability of methyl soyate (biodiesel)	Soybean oil Fatty Acid Methyl Ester (SME), Antioxidants such as phenolic antioxidants; BHA, BHT, etc.	- To study the effectiveness of five such antioxidants , tert-butylhydroquinone (TBHQ), butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), propyl gallate (PrG) and a-Tocopherol in mixtures with SME. - Finally, this study recommends BHA or TBHQ (concentrations up to 3000 ppm) for safeguarding biodiesel from effects of autoxidation during storage.	The pressurized-DSC (P-DSC) for determined the oxidation temperature (OT). Acid Value, Peroxide Value, & Kinematic Viscosity measurement	Fuel Processing Technology Vol. 86

Author / Year	Title	Materials	Objectives / Results	Methods / Analysis	References
3.5 Bouaid, A., *et al* (2007)	Long storage stability of biodiesel from vegetable and used frying oils	Biodiesel produced from fresh Vegetable & used frying oil	- The study was conducted for a period of 30-months. At regular intervals, samples were taken to measure the following parameters: acid value (AV), peroxide value (PV), viscosity (ν), iodine value (IV) and insoluble impurities (II). - Results showed that AV, PV, ν and II increased, while IV decreased with increasing storage time of samples. However, slight differences were found between samples exposed and not exposed to daylight before a storage time of 12 months. But after this period the differences were significant.	Acid Value, Peroxide Value, Iodine Value, & Viscosity measurement.	Fuel (2007)
3.6 Mittelbach, M., *et al* (2001)	Long storage stability of biodiesel made from rapeseed and used frying oil	Biodiesel produced from fresh Rapeseed & used frying oil	- To study the degree of physical & chemical deterioration of biodiesel produced from rapeseed & used frying oil under different storage conditions. - The results showed that 1. The viscosity & neutralization numbers rose during storage owing to the formation of dimers & polymers and to hydrolytic cleavage of methyl esters into FA. 2. The value for the induction period of the distilled product was very low, the induction period values for the undistilled samples decreased very rapidly during storage, esp. with exposure to light & air.	Thermal Oxidative Stability Testing, Acid Value & Viscosity measurement.	JAOCS Vol.78

Author / Year	Title	Materials	Objectives / Results	Methods / Analysis	References
3.7 Dunn, R.O.(2005)	Oxidative stability of soybean oil fatty acid methyl esters by oil stability index (OSI)	Soybean oil fatty acid methyl esters (SME)	- To examine the Oil Stability Index as a parameter for monitoring the oxidative stability of soybean oil FAME (SME). - The results showed that 1. OSI may be used to measure relative oxidative stability of SME samples as well as to differentiate between samples from different producers. 2. OSI was more sensitive than iodine value in detecting the effects of oxidative degradation in its early stages when monitoring SME during storage.	Oxidative Stability instrument, Iodine Value measurement.	JAOCS Vol. 82
3.8 Du Plessis, L. M., *et al* (1985)	Stability studies on Methyl and Ethyl fatty acid esters of Sunflower seed oil	Fatty acid esters with high Linoleic acid (of Sunflower seed oil)	- To study the long-term engine tests for Fatty acid esters with high linoleic acid for obtain more information on optimal storage requirements & general stability characteristics. - The results showed that storage of esters in contact with air, esp. at a temperature above 30 °C, caused of significant increases in peroxide, ultraviolet absorption, free fatty acid, viscosity, and ansidine values.	Peroxide, Ultraviolet absorption, Free Fatty Acid, Viscosity, and Ansidine values measurements	JAOCS Vol. 62

Author / Year	Title	Materials	Objectives / Results	Methods / Analysis	References
3.9 Monyem, A, *et al* (2001)	The effect of biodiesel oxidation on engine performance and emissions	The neat biodiesels (from soybean oil-based), 20% blends, and the base fuel (No. 2 diesel)	- To evaluate the impact of oxidized biodiesel on engine performance and emissions. - The results showed that 1. The engine performance of the neat biodiesels & their blends was similar to that of No.2 diesel fuel with the same thermal efficiency, but higher fuel consumption. 2. When compared with unoxidized biodiesel, oxidized neat biodiesel produced 15 and 16% lower exhaust carbon monoxide and hydrocarbons, respectively. No statistically significant difference was found between the oxides of nitrogen and smoke emissions from oxidized and unoxidized biodiesel.	- Engine performance Testing such as brake specific fuel consumption (BSFC), thermal efficiency, etc. - Emissions data were collected using the Labview program.	Biomass and Bioenergy Vol. 20
3.10 Mittelbach, M., *et al* (2003)	The influence of antioxidants on the oxidation stability of biodiesel	Biodiesel produced from rapeseed oil, sunflower oil, used frying oil, beef tallow, both undistilled & distilled.	- To investigate the influence of different synthetic and natural antioxidants on the oxidation stability, using the Rancimat instrument. - The results showed that 1. The four synthetic antioxidants PY, PC, TBHQ, and BHA produced the greatest enhancement of the induction period. 2. A good correlation was found between the improvement of the oxidation stability and the FA composition.	A Rancimat instrument	JAOCS Vol. 80

Author / Year	Title	Materials	Objectives / Results	Methods / Analysis	References
3.11 Thompson, J. C., *et al* (1998)	Two-year storage study with methyl and ethyl esters of rapeseed	Rapeseed Methyl ester (RME) & Rapeseed Ethyl ester (REE)	- To determine the extent of deterioration of RME & REE in storage conditions between stored in glass & steel containers at room temperature (inside) & at the local ambient outdoor temperatures (outside). - The results showed that 1. On the average, the esters increased over time in all of the testing properties with the exception of heat of combustion, which decreased. 2. Regression models are presented to predict the deterioration with time. 3. Engine power varied less than 2% for both Biodiesel fuels compared to the stored counterparts while smoke density decreased 3.2% for the stored RME and increased 17.5% for stored REE.	Measurement of Peroxide Value, Acid Value, Density, Viscosity, and Heat of Combustion.	Transactions of the American Society of Agricultural Engineers Vol. 41