Biotechnology and Energy Conservation

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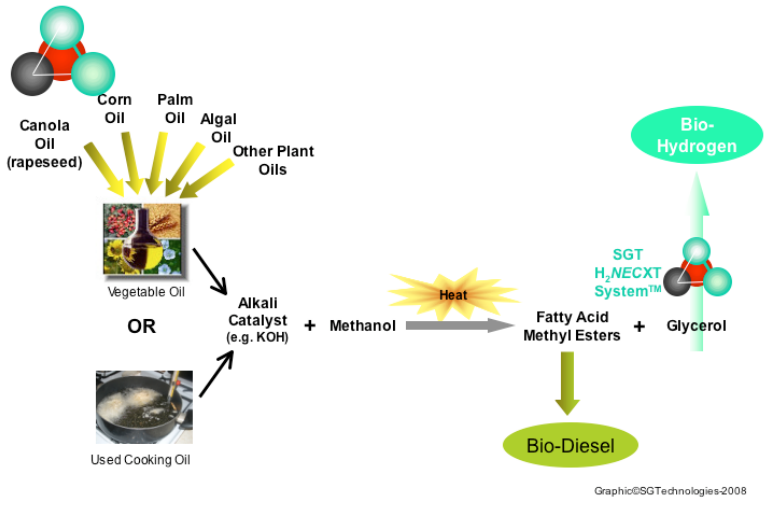
13th Lecture Biodiesel

The Aim:

- Students can explain the method (chemical and enzymatic) of biodiesel production
- Students can describe source of triglyceride as raw material (plant base and algae base) for producing biodiesel

Biodiesel Production Process (http://sgth2.com/bio-diesel_faq)

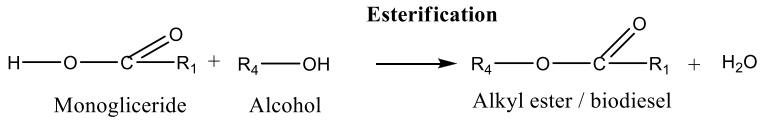


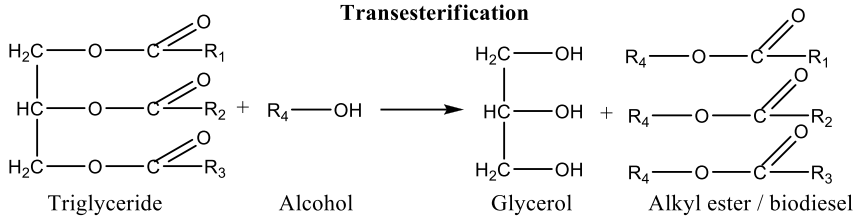
World's Annual Consumption of Oil and Fats

Year	Oils & Fats (Million tons)	Used for Biodiesel (Million tons)
2003	125	1.25 (1%)
2004	131	2.62 (2%)
2005	139	4.17 (3%)
2006	148	7.4 (5%)
2007	153	10.7 (7%)

BIODIESEL

Alkyl ester formed from alcohol and triglyceride (oil)





BIODIESEL (Continue)

Biodiesel process can be chemically or enzymatically

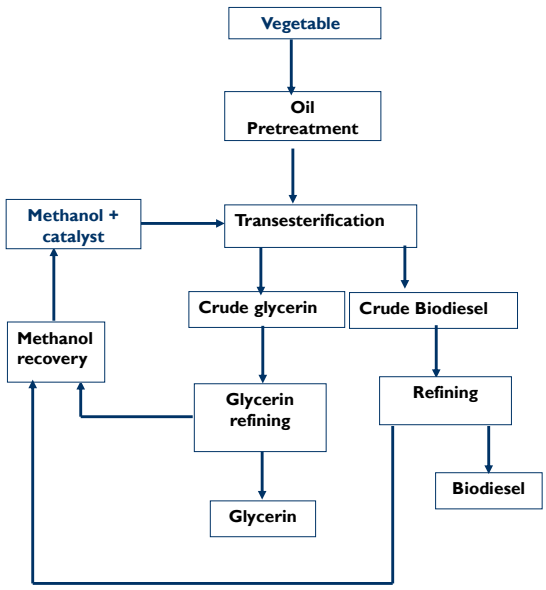
Chemical process:

1. Proses esterifikasi: reaksi antara asam lemak bebas (free fatty acid, FFA) dan alkohol. Dilakukan dengan menambahkan asam sulfat pekat sebanyak 5% dari total kandungan FFA. H_2SO_4 digunakan sebagai katalisator. Sedangkan metanol yang ditambahkan adalah sebanyak 225% dari kandungan FFA minyak. Proses dilakukan pada suhu 70°C selama 1 jam. Pada proses ini asam sulfat pekat dicampurkan terlebih dahulu dalam metanol sampai merata. Campuran hasil esterifikasi ini kemudian diperlakukan lagi untuk reaksi transesterifikasi.
2. Proses transesterifikasi: reaksi antara asam lemak dengan alkohol. Dilakukan dengan menambahkan metanol dan KOH masing-masing sebanyak 10% dan 1% dari minyak yang digunakan. KOH dilarutkan terlebih dahulu dalam metanol sampai merata, kemudian dicampurkan kedalam minyak. Proses ini dilakukan selama 1 jam pada 70°C. Kalium hidroksida (KOH) dipilih digunakan dari pada natrium hidroksida (NaOH) karena KOH dapat memberikan efek pemisahan gliserol yang lebih mudah, diamping itu limbahnya pencuciannya dapat digunakan sebagai pupuk (KCl)

BIODIESEL (Continue)

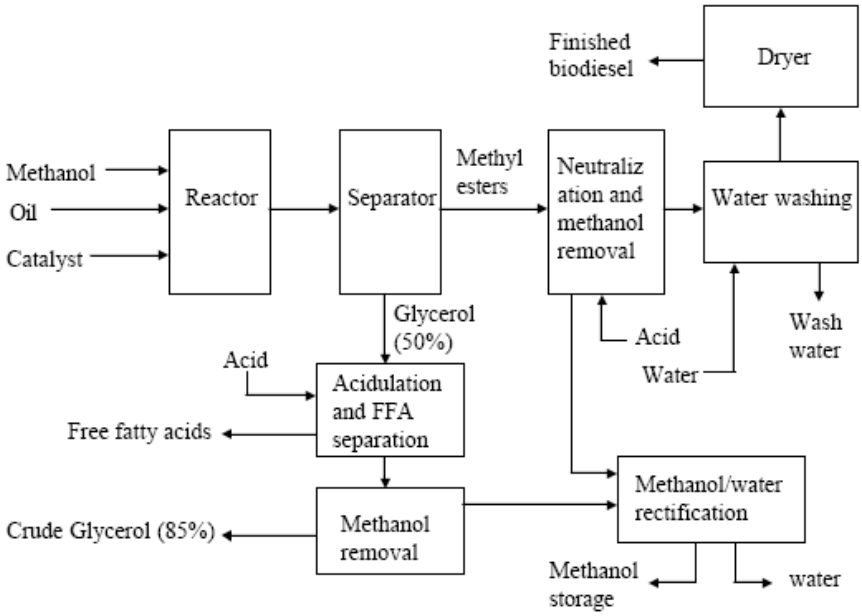
Enzymatic method:

Esterification and transesterification occur in the same time, enzyme used is lipase, which has hydrolase and esterase activities. Processed by mixing oil and alcohol, as well as the lipase in buffer, then incubate at optimum temperature of enzyme by shaking gently for about 4 h.

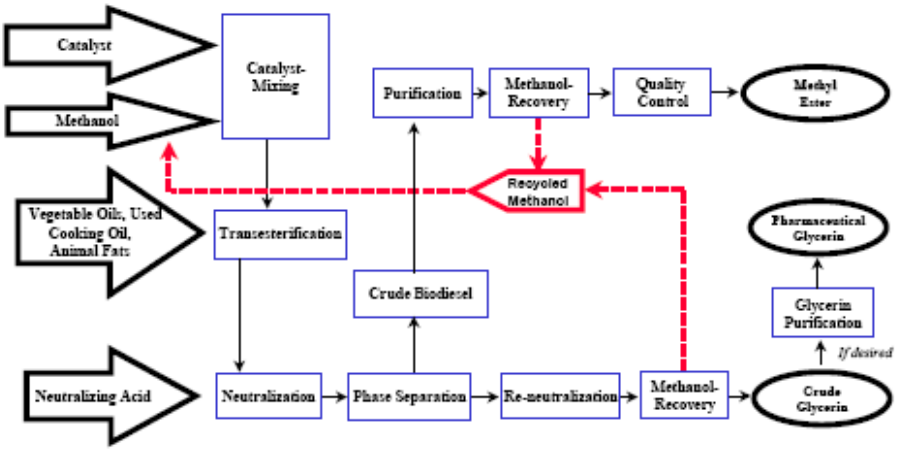


Processes for Biodiesel

Process Flow Schematic for Biodiesel Production



Biodiesel Production Process



Spec Bio solar

No	Characteristics	Unit	Limit
1	Cetane number		Min 51
2	Mass specific	kg/m^3	820-860
3	Viscosity	mm^2/s	2,0-4,5
4	Sulfur	ppm	Max 500
5	Flame point (titik nyala)	°C	Min 55
6	Decant point (titik tuang)	°C	Max 18
7	Carbon residue	% m/m	Max 0,30
8	Water content	mg/kg	Max 500
9	Oxidation stability	g/m^3	Max 25
10	Biological growth		None
11	FAME	% v/v	Max 10
12	Methanol and ethanol	% v/v	Not detected
13	Ash	% m/m	Max 0,01
14	Sediment	% m/m	Max 0,01
15	Strong acid number	mg KOH/g	0
16	Total acid number	mg KOH/g	Max 0,3
17	Lubricity	Micron	Max 400

SNI Biodiesel

No	Characteristics	Unit	Limit
1	Cetane number		Min 51
2	Mass specific at 15°C	kg/m^3	850-890
3	Kinematic viscosity at 40°C	mm^2/s	2,3-6,0
4	Sulfur	ppm	Max 100
5	Flame point (titik nyala)	°C	Min 100
6	Flash point (titik kabut)	°C	Max 18
7	Cooper corrosion (3 h at 50°C)		Max No.3
8	Carbon residue in original sample, or in 10% distillation residue	%-m	Max 0,05 Max 0.03
9	Distillation temp 90°C	°C	Max 360
10	Iodium number	%-m	Max 115
11	Halphen test		Negative
12	Sulfated ash	%-m	Max 0,02
13	Water and sediment	%-v	Max 0,05
14	Phosphor	ppm	Max 10
15	Acid number	mg KOH/g	Max 0,8
16	Free glycerin	%-m	Max 0,02
17	Total glycerin	%-m	Max 0,24
18	Alkyl ester content	%-m	Min 96,5

Bio-diesel Refinery Waste and Bio-Hydrogen Production