RET Project #2 Biodiesel

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Presentation Overview

- What is biodiesel fuel
- Advantages
- Our research
- Large Scale Production
- Classroom Implementation

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What is Biodiesel?

- A fuel derived from natural oils.
- Sources

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Advantages of Using Biodiesel

- No sulfur produced
- Reduces carbon monoxide by 50%
- Reduces Particulates by 65%
- Simple diesel engine conversion

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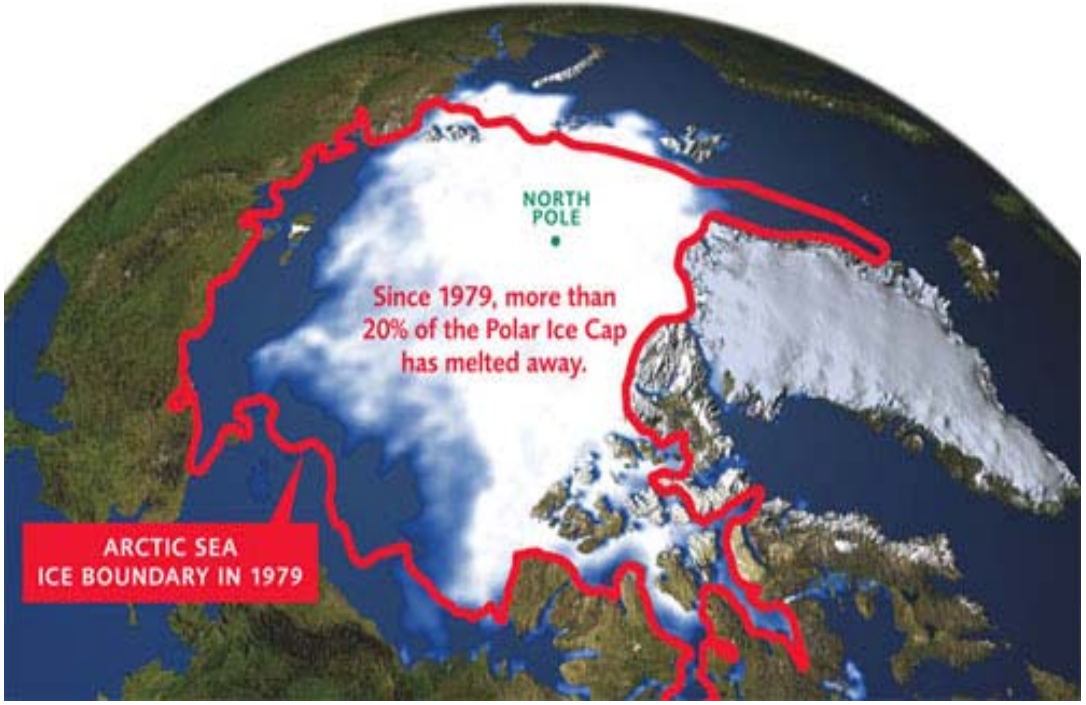
Reduces the carbon dioxide by 78%



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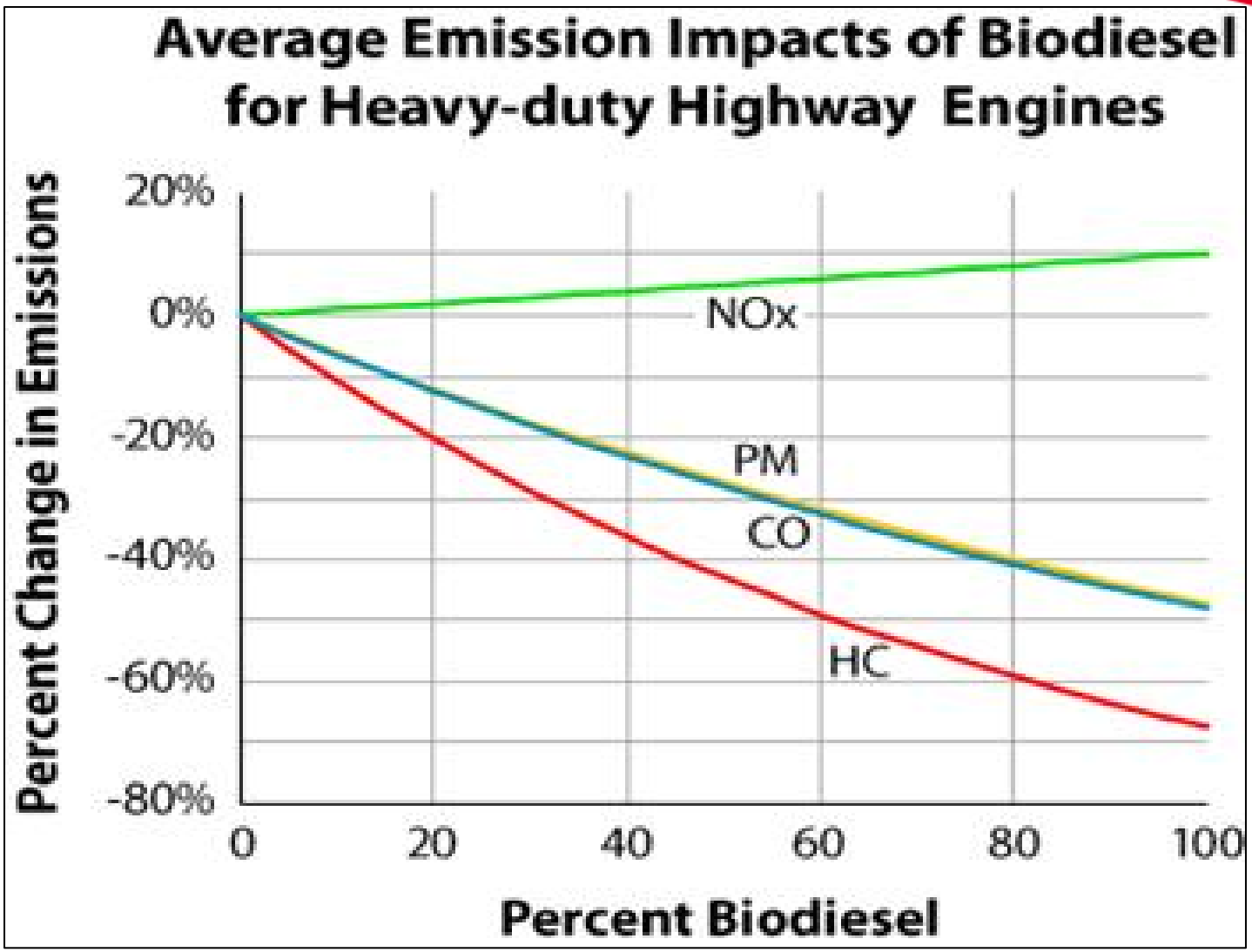

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Graph Courtesy of mygreenproducts.com

RET participant research

Waste cooking oil

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Why this research is important

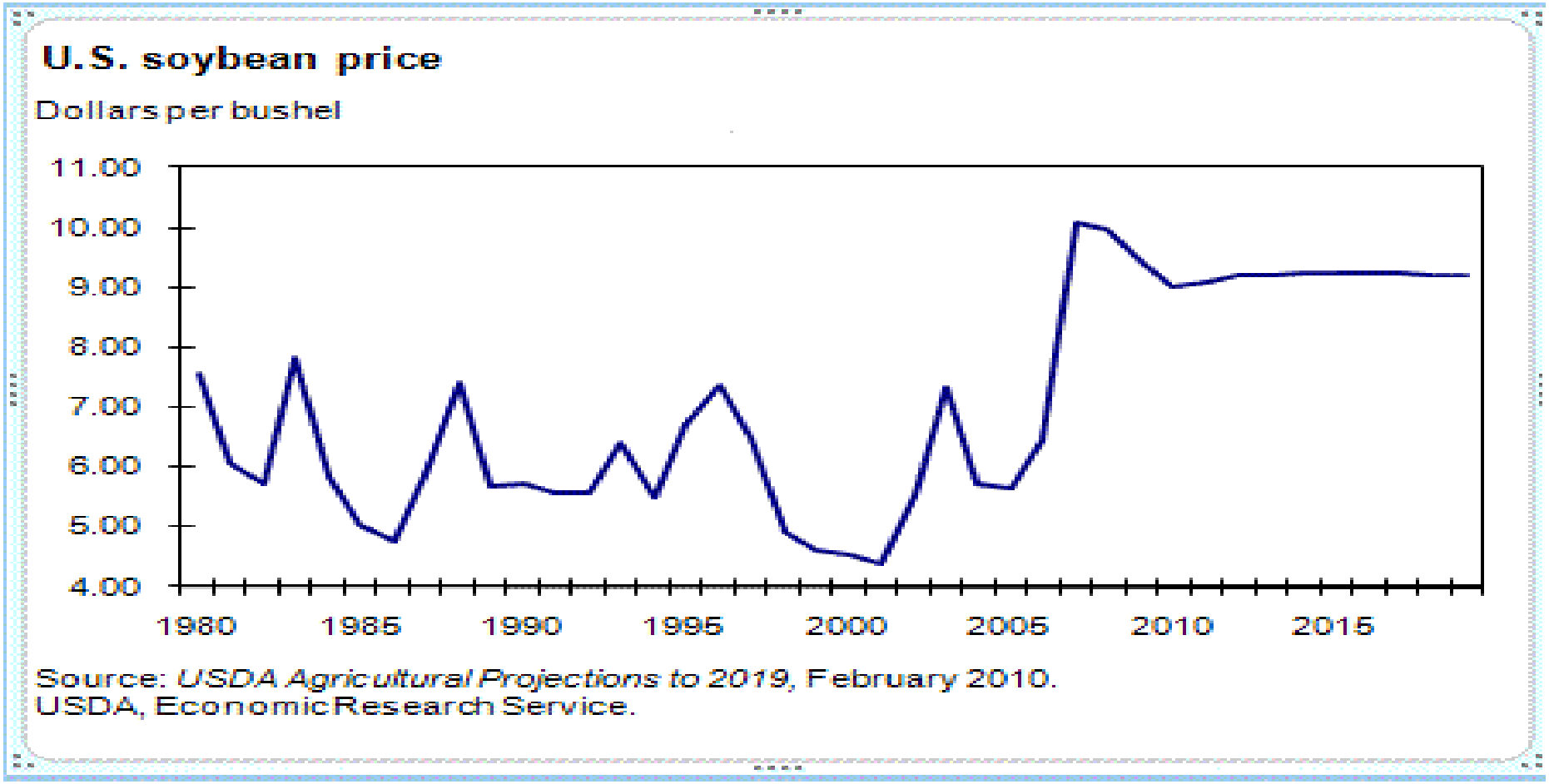

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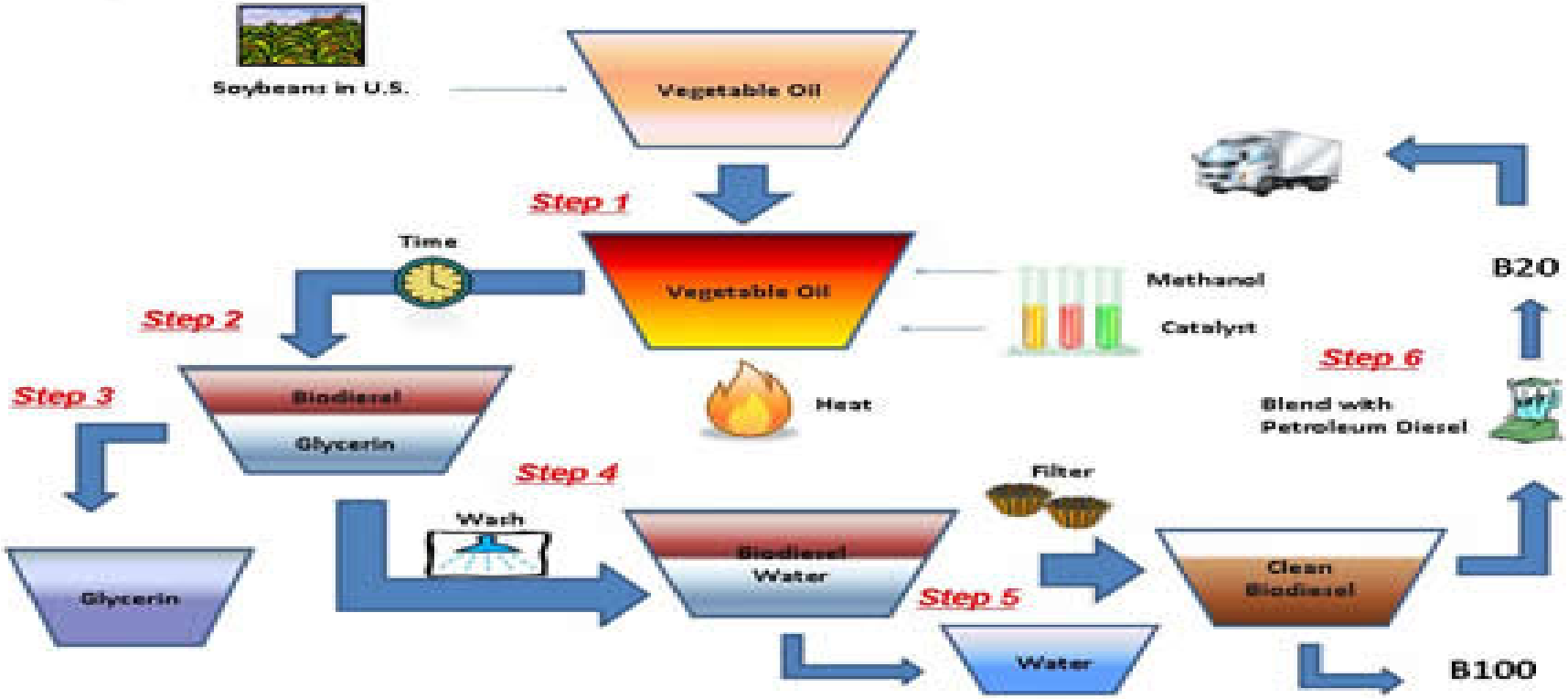
Figure 1: The Biodiesel Production Process



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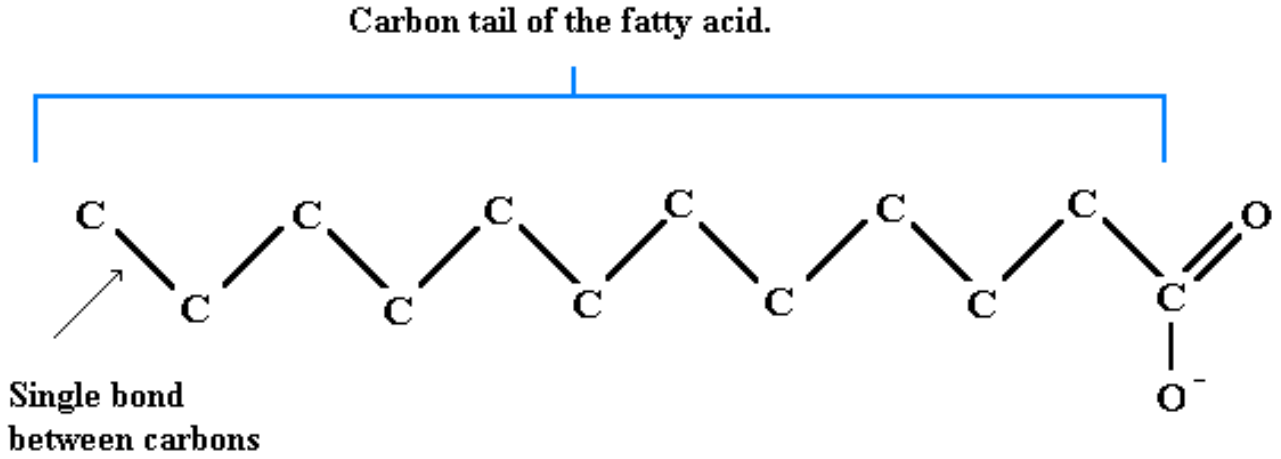
Step One: Titration

- Free Fatty Acid Content
- Actual % of fat in a specific oil sample



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NaOH Titration

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Step 2: Determine Catalyst Amount

Sodium Hydroxide

NaOH

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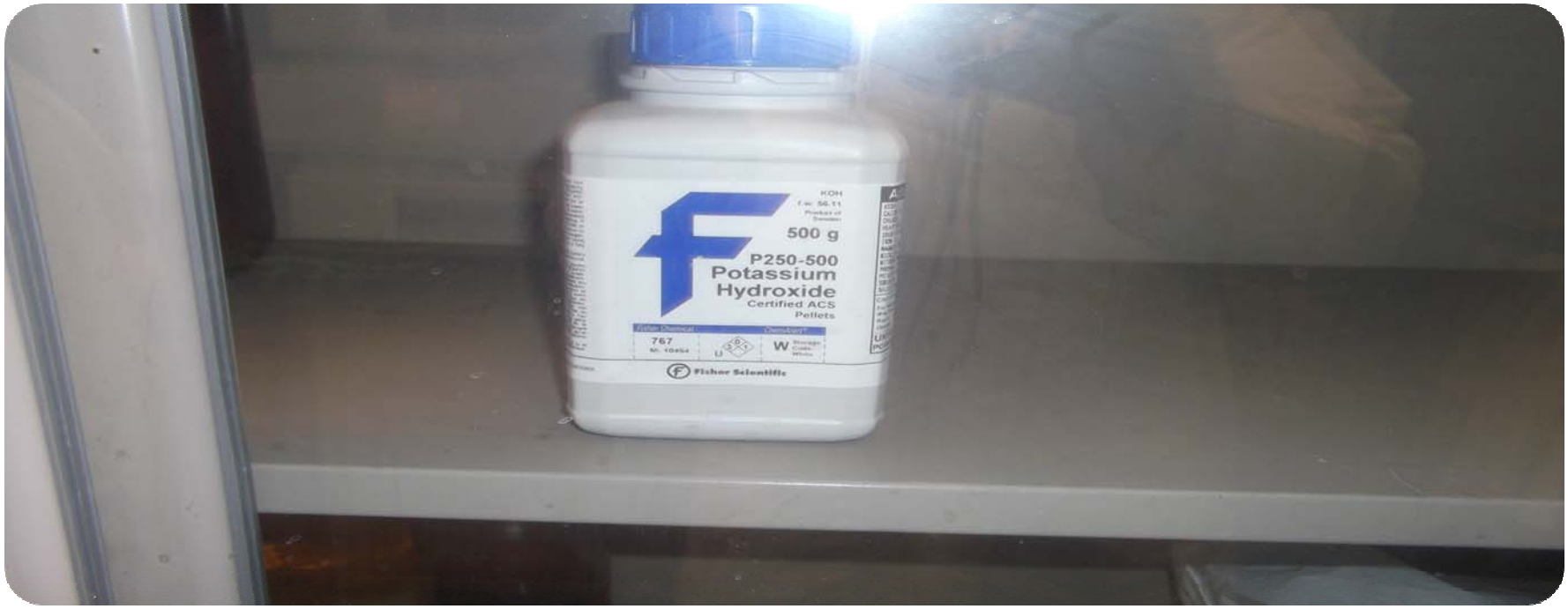
OR Potassium Hydroxide KOH



BUT…. The solvent is 1:1 ratio of Isopropyl Alcohol and Toluene, which is Toxic!!!

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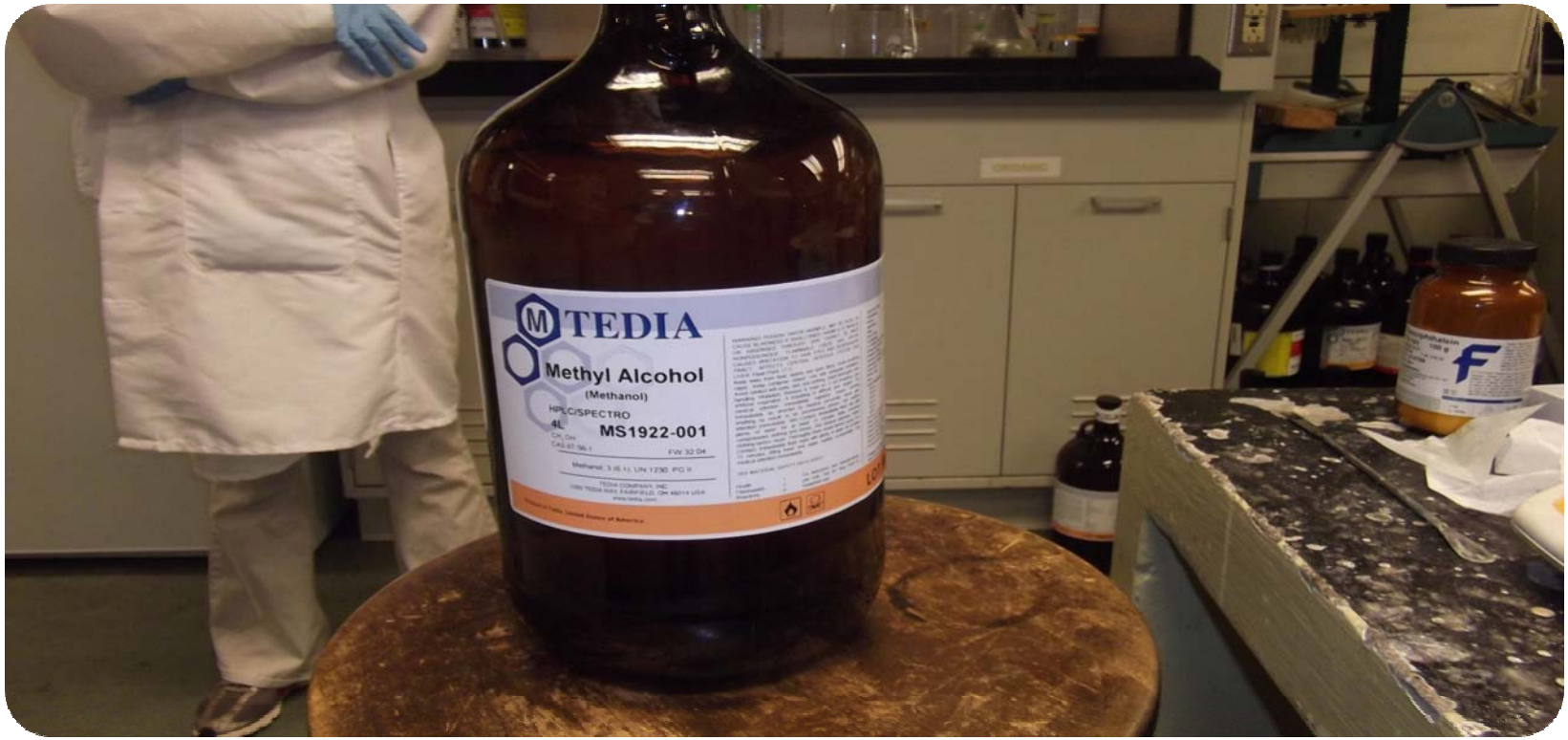
Step 3 : Prepare Solvent Methanol



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Step 4: Add NaOH to Methanol

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Step 5: Heat oil and catalyst solution to 60 degrees Celsius

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Combining the catalyst with the oil at 60 degrees Celsius promotes a Transesterification process which produces crude biodiesel

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Titration of NaOH Vs. KOH

NaOH 0.005 mg/L	KOH 0.1 mol /L
Trial 1 700	750
Trail 2 500	850
Trail 3 700	600
AVG 633	**733**
FFA 1.22%	.987%

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Amount of Catalyst In 6 Test Batches

Batch	Amount of Oil (ml)	Amount of Methanol (ml)	Amount of NaOH (g)
1	100	20	.1
2	100	20	.2
3	100	20	.3
4	100	20	.4
5	100	20	.5
6	100	20	.6

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Results for Varying Catalyst Amount

Results	
1	No production of biodiesel
2	Formed soap, no viable results
3	Very good separation
4	Very good separation
5	Less produced
6	No separation because too much NaOH inhibits the separation

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Step 6: Small Batch Production

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Transesterification treatment

	Batch 1	Batch 2	Batch 3
Waste Cooking Oil (ml)	600	300	1000
NaOH (g)	2.1	1.05	3.5
Methanol (ml)	120	60	200

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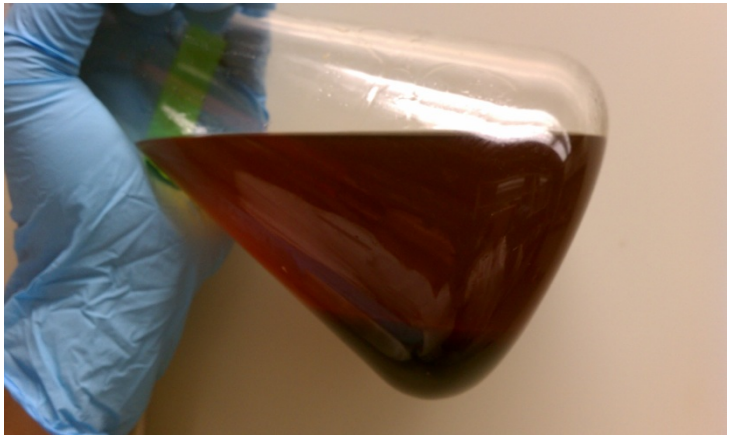
Biodiesel and Glycerin



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Biodiesel and Glycerin

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Measuring Biodiesel Produced

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Small Batch
Biodiesel Production Results

Production (ml)	Batch 1 (ml)	Batch 2 (ml)	Batch 3 (ml)
Biodiesel	620	305	1023
Glycerin	30	17	133

Small Batch #3 is best

10% Glycerin Yield

Practice of Procedure

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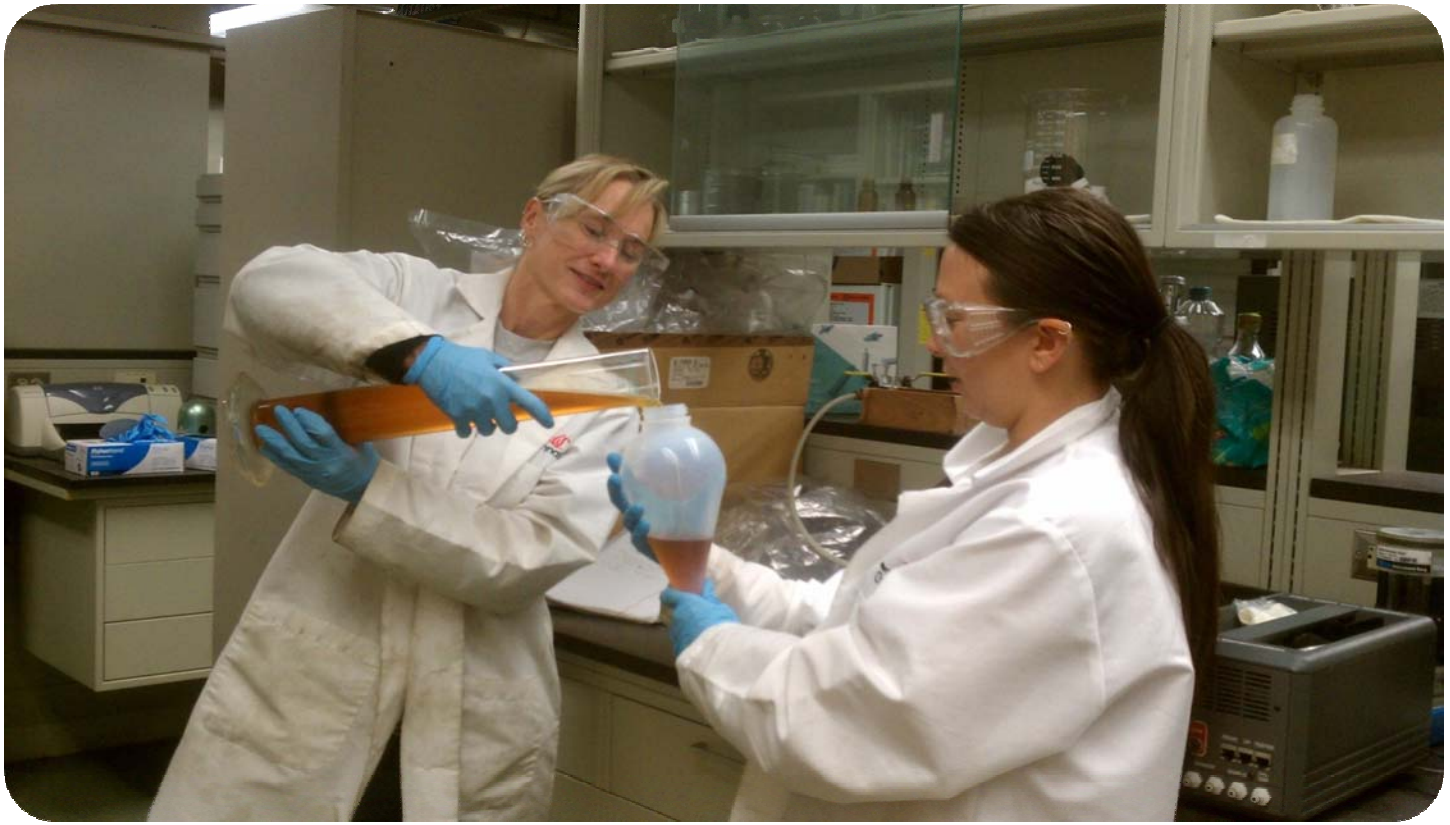
Transferring Biodiesel to be Washed



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Step 7: Biodiesel and Water Settling

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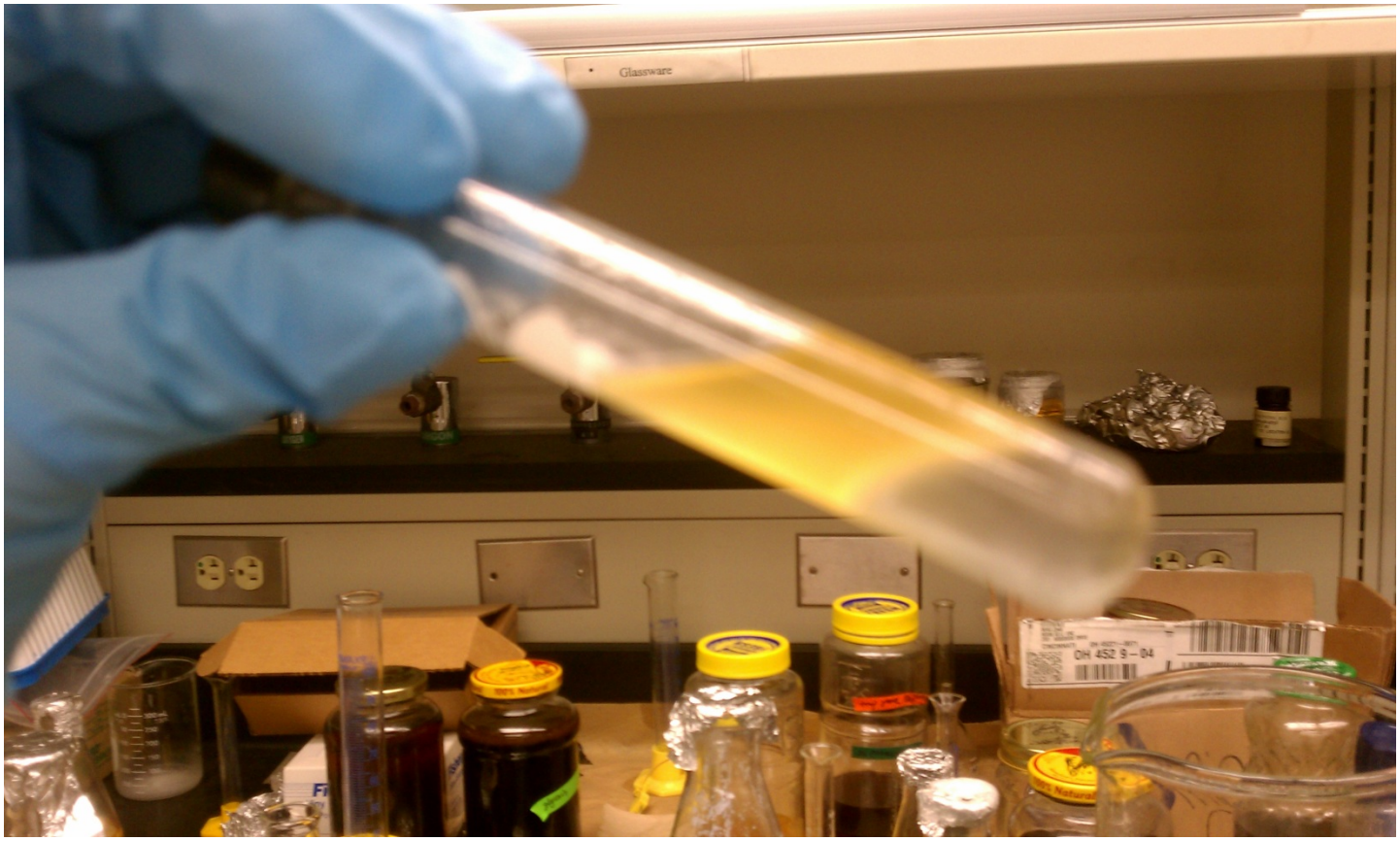
Final Step: Test for Biodiesel Purity



Biodiesel Separates from water in 30 seconds or less

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More Research: High FFA Feedstock Oil

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Acid Esterification

Extra step for high FFA content in the feedstock oil

How does FFA content increase in oil?

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Acid Esterification Goal

To reduce the FFA content in the feedstock oil to less than 1%

Then proceed with Transesterification

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High FFA Feedstock Oil

Calculated 8.1 % FFA

- Dark in color
- High Viscosity
- Odor

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Acid Esterification Procedure

- Start with 332 mL oil
- Mix .95mL sulfuric acid to
- 81.11mL of methanol in beaker
- Add mixture to oil at 60 degrees Celsius
- Stir for one hour while heating

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Results:

Calculated the acid value after titration

SUCCESS !

FFA content reduced to **.58 %**

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Now…After Acid Esterification

Oil FFA content below 1% can now undergo Transesterification process

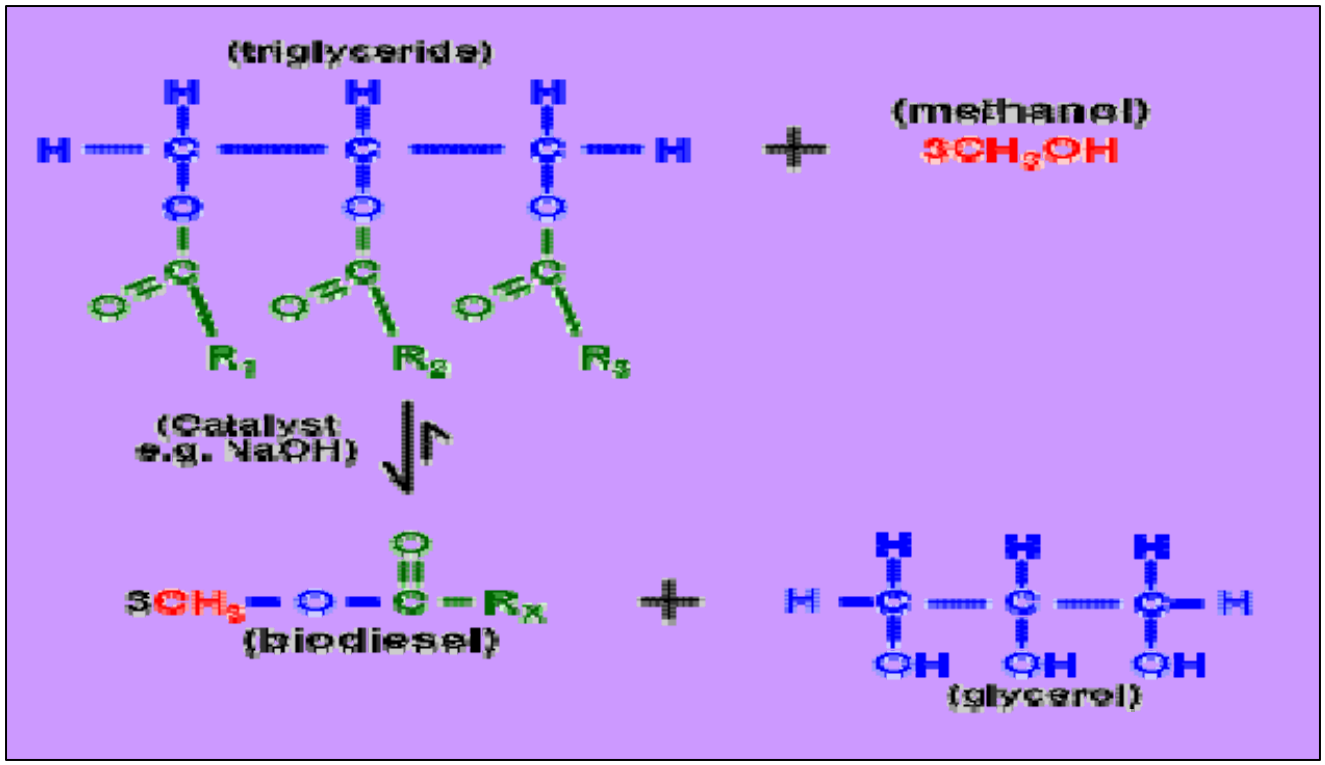

Image from http://savingplanetearth.co.uk/DieselInfo.htm

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Conclusion:

Acid Esterification process can be used when the FFA content of feedstock oil is high

Application:

More feedstock oil is now available for the production of biodiesel at low to no cost

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Final Research Using Waste oils and Canola

- UC
- Zoo
- Canola

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Calculated FFA Content

Oil type	Canola	Zoo	uc
Trial 1 (µl)	75	325	200
Trial 2 (µl)	100	400	200
Average (µl)	87.5	362.5	200
FFA content (%)	.338	1.4	.772

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Product Amounts

Oil	Biodiesel (ml)	Glycerol (ml)
Zoo	103	12
UC	102	11
Canola	101	10

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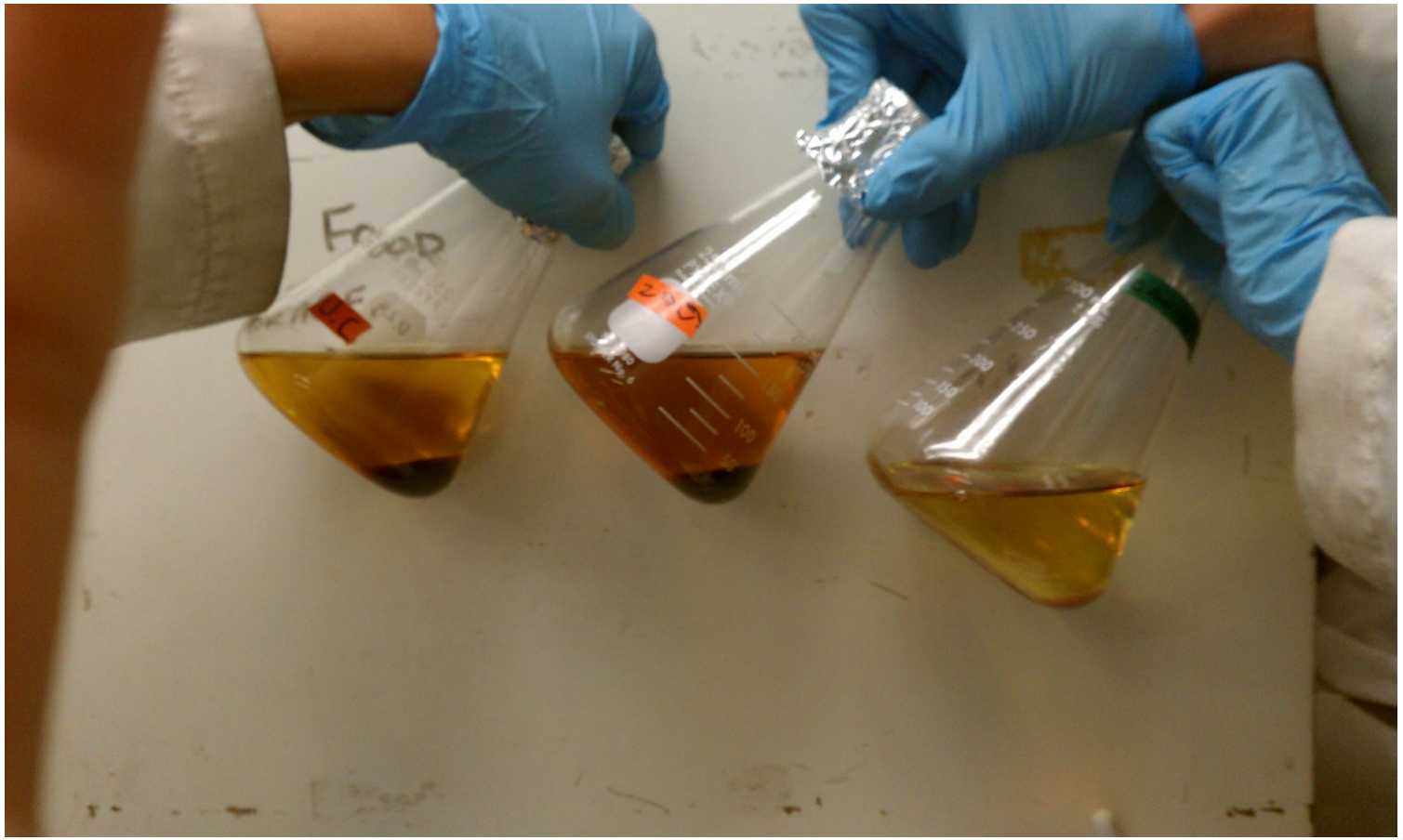
Biodiesel and glycerin in the 3 oils



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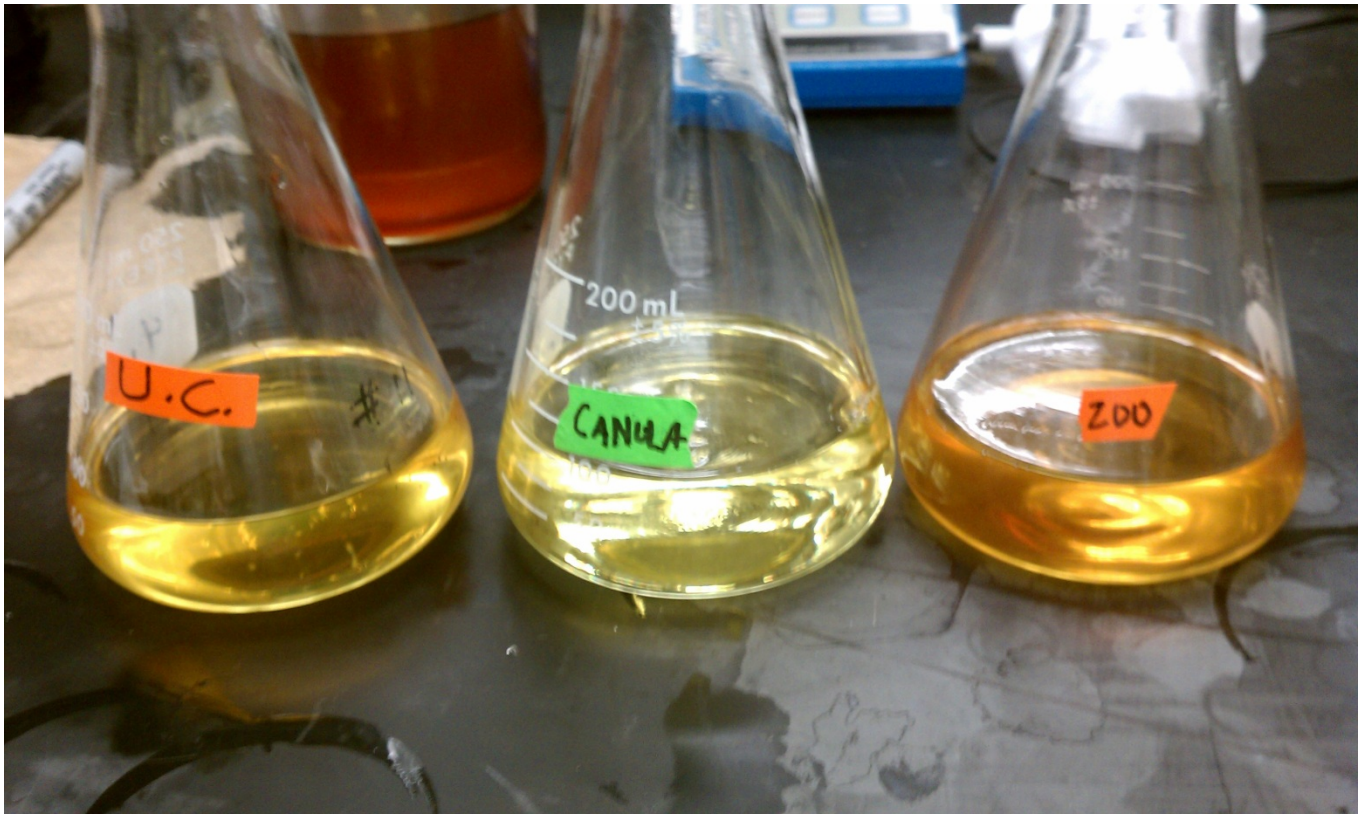
Biodiesel after Separation



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Washing Biodiesel

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GC-MS Results for Purity

	relative percentage				
ME	canola bd		UC bd		Zoo bd
C8:0	0.65%		2.63%		3.08%
C10:0	0.62%		0.43%		0.57%
C12:0	0.31%		0.68%		0.41%
C14:0	0.81%		2.16%		3.30%
C16:2	0.42%		0.00%		0.23%
C16:1	2.53%		0.95%		2.56%
C16:0	21.31%		33.83%		30.33%
C18:3	4.97%		10.62%		1.61%
C18:2	36.41%		17.13%		33.92%
C18:1	29.79%		25.69%		20.35%
C18:0	1.97%		5.21%		3.55%
C20:0	0.21%		0.67%		0.11%

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Current Large Scale Production

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Blending Tanks

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Mixing Tanks

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http://images.search.yahoo.com/search/images;_ylt=A0PDoS5qtR1OjRMAFbGJzbkF?fr2=sg-gac&sado=1&p=global%20warming%20icecaps%20melting&fr=yfp-t-701&ei=utf-8&x=wrt

http://forum.xcitefun.net/change-in-earths-shape-due-to-global-warming-t48485.html

http://savingplanetearth.co.uk/DieselInfo.htm

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