Simple Biodiesel Quality Tests
By Graydon Blair, Utah Biodiesel Supply

Water Content Test

ASTM Equivalent: D2709 – Water & Sediment

Why It's Important: Water can cause poor reactions & high soap content. Leads to poor conversions and difficulty washing the fuel.

When To Run: Before Reacting oil into Biodiesel and on completed Biodiesel before storing.

Recommended Limit: Oil - Below 3000 PPM (0.3% By Volume) / Biodiesel – 500 PPM (0.05%)

Test Procedure:

1500 PPM (0.15%) Scale

- Add **30 mL of sample** to vessel. Add **10 mL Reagent B** to vessel. Add **2 packets Reagent A** to vessel
- Screw cap on, shake 3 times for 20 seconds each. Ensure scale doesn't exceed 14 psi
- Set down & wait 1 minute. Shake again every minute up to 15 to 20 minutes. Take reading
- Multiply gauge reading by **0.01** to get % Water Content (or **100** to get PPM)

15000 PPM (1.5%) Scale

- Add **4 mL of sample** to vessel. Add **16 mL Reagent B** to vessel. Add **1 packet Reagent A** to vessel
- Screw cap on, shake 3 times for 20 seconds each. Ensure scale doesn't exceed 14 psi
- Set down & wait 1 minute. Shake again every minute up to 15 to 20 minutes. Take reading
- Multiply gauge reading by **0.1** to get PPM Water Content (or **1000** to get PPM)

Example: 1500 PPM Scale, reading was 12 after 15 minutes. 12 x 100 = 1200 PPM water content

Oil Titration Test

ASTM Equivalent: D664 – Acid Number

Why It's Important:

Used to determine catalyst required to make a batch of Biodiesel. Also used when buying or selling oil feedstock. Also used on finished Biodiesel to determine acidity

When To Run:

Before reacting oil into Biodiesel and anytime FFA% is desired.

Recommended Limits:

Good Oil – 0-4 KOH Titration (0-2.22% FFA)
Average Oil – 5- 7 KOH Titration (2.8-3.8% FFA)
Poor Oil - 8-10 KOH Titration (4.4-5.5% FFA) – Good candidate for acid treatment
Bad Oil -10-18 KOH Titration (5.5-10%FFA) Acid Esterification highly recommended
Nasty Oil – 18+ KOH Titration (10+%FFA) Keep looking, better oil is out there

Test Preparation

1- Make Titration Solution – 1 gram catalyst (NaOH or KOH) to 1 liter distilled water (Only good for 90 days)
2- Add 1 mL oil to 10 mL Isopropyl Alcohol (93% pure or better)
3- Add 2-3 drops Phenolpthalein, Phenol Red, or Turmeric Powder
4- Add measured amounts of titration solution to the oil/alcohol solution while mixing until it turns color & stays changed for 30 second
5- Record how many mL it took to change color. Mark this as
6- Repeat two more times and take the average. Mark this value as **Titration #**

Catalyst Calculation

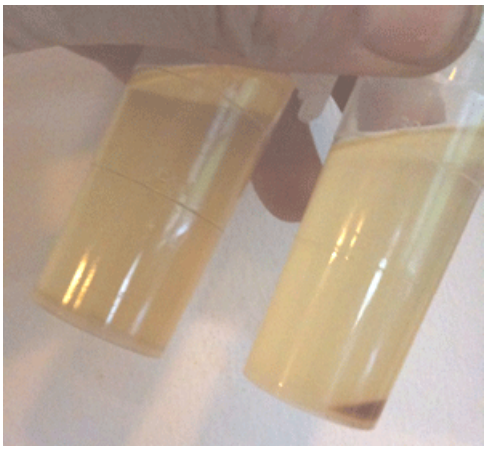
Formula – [Base + Titration #] x Liters of oil to react = Grams Catalyst Required
KOH Base - 7.8 (Assuming 90% KOH Purity, 7/0.90 = 7.8)
NaOH Base – 5.8 (Assuming 95% NaOH Purity, 5.5/.95 = 5.8)

EXAMPLE:
100 liters of oil
Oil Titration # = 5 (KOH Based Titration)
[7.8 + 5] = 12.8, 12.8 x 100 = 1280 grams KOH required
FFA% = 5/1.8 = 2.8% FFA (Approximate)

Handy Conversion Factors:

1 Gallon = 3.785 Liters
1 Pound = 453.59 Grams
FFA% From NaOH Titration - [Titration Value / 1.3] = Approximate FFA%
FFA% From KOH Titration – [Titration Value / 1.8] = Approximate FFA%

Biodiesel 3/27 Conversion Test (a.k.a. Jan Warnqvist Conversion Test)



ASTM Equivalent: D6584, Total Glycerin

Why It's Important:

This test allows you to identify how well the oil feedstock was converted into Biodiesel. It was correlated closely to the ASTM Total Glycerin Test and found to be extremely accurate. It's important to know if you've fully converted all of your oil into Biodiesel. If it's not fully converted, the fuel may not perform well in diesel equipment and won't pass the stringent ASTM Standard for Biodiesel.

Test Procedure:

1- Add 3 mL of Biodiesel to be tested to 27 mL of fresh, new methanol
2- Both the methanol and Biodiesel should be between 68 to 72 deg. F
3- Shake for about 15 seconds and then allow to sit for 5 minutes
4- Hold the vial at a 45 deg angle (see above) and look for fall out

Recommended Limit:

No Fallout - Biodiesel likely pass ASTM for Total Glycerin
0-1/8" Fallout (at 45 deg. Angle) – Usually ok for most diesel vehicles
1/8-1/4" Fallout (at 45 deg Angle) – Possibly ok for indirect injection diesel engines
1/4"+ Fallout – Complete fail. Recommend reprocessing fuel

Biodiesel Soap Test (Shake Test)

ASTM Equivalent: None. Just a visual check

Why It's Important:

This test can give you a good indication when your Biodiesel is almost completely washed. Once you pass this test, then you can do a Biodiesel Soap Titration (below). If you flunk this test, you'd be wasting your chemicals with a soap titration test as it will definitely fail.

Test Procedure:

1- Fill a glass jar half way full of distilled water
2- Fill the rest of the jar with Biodiesel
3- Cap & shake the jar violently for 45 seconds then allow the jar to sit for at least 1 hour
4- Return & inspect the water that's separated
5- To pass, the water on the bottom should be as crystal clear as when you put it in. If it's at all cloudy, then soap levels are still too high & you need to continue washing

Recommended Limits: Water should be as crystal clear as when you started

Biodiesel Soap Test (Titration Method)

ASTM Equivalent: EN 14538, Sodium & Potassium Combined (see note)

NOTE: This test isn't actually part of the ASTM Standard. Instead, it assumes that if there are soaps in the Biodiesel, they are Sodium or Potassium based and as such can be tied back to the EN 14538 specification.

Why It's Important:

Soap in Biodiesel can plug fuel filters, leave engine deposits, gum up fuel tanks, and cause other problems. The soap test will let you know when all soap has been removed.

Recommended Limits:

41 PPM (For NaOH Reacted Biodiesl) – Likely to pass ASTM
66 PPM (For KOH Reacted Biodiesel) – Likely to pass ASTM
100-200 PPM – Shouldn't pose any real risks to filter plugging or diesel engines
200-300 PPM – It's right on the edge of what you should be using
300-400 PPM – Filter clogging may occur, soap content is getting high
400-500 PPM – It really should be washed again to lower soap content
500+ PPM – Fail – Way too much soap. Rewash the Biodiesel

Test Procedure:

1- Add 100 mL 99% pure Isopropyl Alcohol into a 250 mL Glass Beaker on a magnetic stirrer
2- Dissolve 12 mL of Biodiesel into the Isopropyl Alcohol
3- Add 10-20 drops of Bromophenol Blue to tint the mixture blue to bluish green
4- Using a 1 mL Glass Pipette, add measured amounts of HCL solution until the mixture changes color to yellow
5- Record the amount of HCL used & multiply the amount by the appropriate multiplier based on what catalyst was used (NaOH vs KOH)
6- KOH Multiplier = 320, NaOH Multiplier 304

EXAMPLE: KOH Based batch tested at 0.25 mL HCL, 320 x 0.25 = 80 PPM (14 PPM higher than ASTM estimated)

Methanol Purity Test

ASTM Equivalent: None for Biodiesel. Just a quality check

Why It's Important:

Methanol that isn't pure usually has water as it's contaminant. If too much water is present, when it's used to produce Biodiesel, the water can cause poor reactions and generate excess soap levels. This test is critical to use if you're using reclaimed (recovered) methanol in your Biodiesel production process

Test Procedure:

1- Fill a glass cylinder with enough methanol for the hydrometer to float in it
2- Insert a methanol hydrometer and allow it to stabilize in the methanol
3- Record where the hydrometer intersects with the top of the methanol
- *This is measuring the methanol's Specific Gravity*
4- Using a thermometer, accurately measure & record the temperature
5- Compare your readings with a methanol purity chart
6- Divide the difference by 0.00285
7- Subtract the result from 100
8- This will be the purity of your methanol

EXAMPLE:

A sample of methanol measured 0.789 at 75 deg F
The chart indicates pure methanol should have a specific gravity of 0.7875
0.789 – 0.7875 = 0.0015,
0.0015 / 0.00285 = 0.5263
100 – 0.5263 = 99.4737 or 99.47% pure

Recommended Limit:

Minimum Purity Limit – 97.0%
Recommended Purity - > 98.0%

To learn more about these tests, be sure to visit our website at www.utahbio.com
We have video tutorials for most of the tests and downloadable instructions.

Have a question about a test? Feel free to contact us!

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