

Effects of Minor Components on Cloud Point and Cold Soak Filtration of Soy Biodiesel (B100)

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Components tested in DOE study

- Monoglycerides (0 - 1.0%)
 - Prepared from soy oil
- Sterol glucoside (0 – 40 ppm)
 - Purified (>99%) from the RT filtration of soy biodiesel (commercial)
- Soaps (0 – 40 ppm)
 - Prepared from pure fatty acids soaps per soy FA composition
- Water (0 – 500 ppm)

B100 sample preparation

- Base methyl esters
 - Distilled soy methyl esters (0.02% MG, no sterol glucoside, no soaps)
- Sterol glucoside and soaps were spiked as pyridine and methanol solutions, respectively, then the solvents removed under vacuum.
- MG and water were added 'as is'.

Analysis

- Timed Cold-Soak filtration after 16 hr/40F cold soak
- Cloud point (°C)

Filter test

- **Manual filtration test**
 - Cold Soak Filtration (procedure as of early '07)
 - 300 ml fuel is pulled through a 0.7 μ m/47mm diameter glass fiber filter under 78 kPa vacuum (0.77 atm, 11.31 psi)
 - Sample passes if time to filter does not exceed 2.5 minutes
- **Cold soak**
 - Stored in a 40F bath for 16 hr and then allowed to warm to room temperature before testing

Predicted results for biodiesel with various impurities levels

Mono, %	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
SG, ppm	0	0	10	20	0	0	10	10
Soap, ppm	0	0	0	0	20	30	10	10
Water, ppm	0	500	0	0	0	0	0	500
Filter time, s	110	234	159	228	174	218	199	430
CP, C	1.9	2.5	1.4	1.2	2.8	3.0	2.0	2.9

Predicted results for biodiesel with various impurities levels

Mono, %	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
SG, ppm	0	0	10	20	0	0	10	10
Soap, ppm	0	0	0	0	20	30	10	10
Water, ppm	0	500	0	0	0	0	0	500
Filter time, s	73	156	105	151	156	229	154	332
CP, C	0.6	1.0	0.2	0.0	1.4	1.4	0.7	1.2

Predicted results for biodiesel with various levels of impurities

Mono, %	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
SG, ppm	0	0	10	20	30	0	0	10	10
Soap, ppm	0	0	0	0	0	20	30	10	10
Water, ppm	0	500	0	0	0	0	0	0	500
Filter time, s	54	114	77	111	160	145	237	127	274
CP, C	0.6	0.6	0.1	0.0	-0.1	1.1	1.0	0.5	0.7



Filter tests of various biodiesels

	Cold soak/Manual	MG (%)	Saturated MG (%)
Tallow	fail	0.22	0.090
Animal fat	fail	0.35	0.130
Poultry	fail	0.16	0.049
Canola	pass	1.02	0.075
Soy	fail	0.58	0.093
Soy	fail	0.28	0.045

Filter tests of various biodiesels (continued)

	Cold soak/Manual	MG (%)	Saturated MG (%)
Soy	pass	0.77	0.123
Soy	pass	0.80	0.128
Soy	pass	0.62	0.099
Soy	pass	0.68	0.109
Soy	fail	0.69	0.110
Soy	pass	0.59	0.094
Soy	fail	0.27	0.041

Cloud Point

- While cloud point could be correlated to levels of impurities, the overall change in cloud point was not large (~3C).
- While not “identical test material”, this range is within the test method Reproducibility.

Cold Soak/Filter Test

- Filter test was strongly affected by SG and/or soap.
- SME with 0.6% mono and >20 ppm SG is expected to fail filter test.
- SME with 0.6% mono and >20 ppm soap is expected to fail filter test.
- SME with 0.6% mono and >480 ppm water is expected to fail filter test.

Effect of MG in Commercial Samples on Filter Test

- MG content or saturated MG content could not be correlated to pass/fail in filter test.

Effect of MG (0 – 1.0%)

- **MG alone up to 1.0% is expected to pass filter test.**
- **MG negatively affected CP.**
- **MG had negative interaction with SG, soap, and/or water.**

Effect of SG (0 – 40 ppm)

- SG negatively affected filter test.
- SG did not negatively affect CP.

Effect of soaps (0 – 40 ppm)

- Soaps negatively affected filter test.
- Soaps had very little impact on cloud point.

Effect of water (0 – 500 ppm)

- Water showed interesting interactions with other impurities.
- Water negatively affected CP when MG was present.

Summary

- **MG content or saturated MG content alone was not correlated to pass/fail in filter tests.**
- **Passing filter test is achievable with current typical MG level. It is more important to monitor and control SG and soap and also consider their interaction with water.**