Biodiesel Reaction Efficiency (27/3 Test)

Learning Goals:

- Students will understand variables that effect reaction efficiency
- Students will understand test methods for determining reaction efficiency
- Students will be introduced to Le Châtelier's principles of chemical equilibrium

Background:

In this lab we are going to test the efficiency of the transesterification reaction. We will compare two different samples of biodiesel. These samples should differ in some way: made by different students, different amounts of catalyst, different oils, etc.

The test gives a qualitative analysis of residual glycerin in the biodiesel product, a sign of incomplete reaction. The glycerin will settle on the bottom of the test jar in small droplets. More glycerin droplets indicates a less complete reaction. If glycerin is observed, the biodiesel is highly likely to fail industrial standard testing. If no glycerin is observed, the biodiesel sample is of high quality but may not pass industrial standards. To get a definitive answer you need a quantitative result instead of the qualitative result returned by this test. Gas chromatography is used to get quantitative results of residual free glycerin, monoglycerides, diglycerides, and triglycerides.

Materials:

- 50 mL Graduated Cylinder
- Small Sample Jar with Lid (x 2)
- 54 mL of Methanol (27 mL for each test)
- 3 mL of Biodiesel Sample 1
- 3 mL of Biodiesel Sample 2

Procedure:

Laboratory Safety

Caution: The methanol you will be working with is highly flammable and toxic and the base is caustic. Everyone should put on safety goggles and gloves. Check that you are wearing long pants and closed-toed shoes.

Reaction Efficiency Test – 27/3 Test

1. Measure 27 mL of methanol
2. Add methanol to small sample jar
3. Measure 3 mL of biodiesel sample 1
4. Add to the sample jar
5. Cap the jar
6. Shake thoroughly
7. Allow the sample to settle for 15 minutes
8. Repeat procedure for Sample 2

After 15 minutes, compare the test jars. We are looking for small droplets of glycerin that will form along the bottom of the small test jar. More glycerin indicates a less complete biodiesel reaction and results in a low quality fuel. If no glycerin settles out then the biodiesel is very high quality.

Clean Up

- Clean all glassware and bench space.
- Biodiesel can be used in candles or tiki torches (not suitable for use in an engine)
- **Glycerin contains excess methanol**. This can be boiled off under a fume hood (not a student activity) and the methanol-free glycerin can be used to make soap (See "Soap Lab")
- Wash water can be sent down the drain