

Background on Biodiesel

Jon Van Gerpen
University of Idaho
Dept. of Biological and Agricultural
Engineering

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Outline

- What is biodiesel?
- Where does it come from?
- Advantages and disadvantages
- How much does it cost?
- Summary

What is biodiesel?

- **Definition:** Biodiesel consists of the alkyl monoesters of fatty acids derived from vegetable oils or animal fats.
- Soydiesel is biodiesel made from soybean oil
- Methyl soyate = soydiesel = soy methyl esters

The biodiesel reaction

- Produced by a chemical reaction between methanol (or ethanol) and an oil or fat.
- 100 lb Soybean oil + 10 lb methanol
→ 100 lb biodiesel + 10 lb glycerin
- Requires a catalyst (such as caustic soda)
- Producers add extra alcohol to drive the reaction to completion (sometimes 100% more)

Biodiesel: What is it not?

- **Unprocessed vegetable oil.** Vegetable oil can be used in some diesel engines (especially if heated) but tends to cause performance to deteriorate over time.
- **Mixtures or emulsions of vegetable oil and alcohol.** Major advances have been made in alleviating concerns about cetane number and lubricity. Flash point is still the primary obstacle.

Applications of biodiesel

- As a neat fuel (B100). 100% biodiesel qualifies as an alternative fuel for fleet alternatively fueled vehicle mandates.
- As a medium-level blend (B20-B50). Blends can be used to meet Energy Policy Act mandates (B20 = 1/5 vehicle). Proposed Federal road exemption of \$0.01 per gal if biodiesel.
- As a low-level blend (1% - 2%). Small amounts of biodiesel can restore lubricity to low-sulfur fuels. Minnesota to require 2% in 2005.

Advantages of Biodiesel

- Biodegradable, nontoxic, renewable
- Very favorable energy balance, 3.2 to 1.
- Lower emissions (Example: DDC Series 50)
 - Carbon monoxide: 38% lower
 - Unburned HC: 83% lower
 - Oxides of Nitrogen: 12.7% higher
 - Particulates: 52% lower
 - Smoke and odor are much better

Advantages of Biodiesel

- Requires no engine modifications (except replacing some fuel lines on older engines).
- Can be blended in any proportion with petroleum diesel fuel.
- High cetane number and excellent lubricity.
- Very high flashpoint (>300°F)
- Can be made from waste restaurant oils and animal fats.

Disadvantages of biodiesel

- Lower energy content

	<u>Btu/lb</u>	<u>Btu/gal</u>
No. 2 Diesel	18,300	129,050
Biodiesel	16,000	118,170
	(12.5% less)	(8% less)

- Since diesel engines will inject equal volumes of fuel, power will drop 8%.

Disadvantages of biodiesel

- Soybean oil-based biodiesel will start to crystallize at around 0°C. This can be mitigated by blending with diesel fuel or with additives.
- Biodiesel is less oxidatively stable than petroleum diesel fuel. Old fuel can become acidic and form sediments and varnish. Additives can prevent this.
- Cost and supply are problems. Soybean oil is widely available but expensive. Inedible animal fats and waste greases are inexpensive but have limited supply.

Cost of Biodiesel

- Cost is very feedstock sensitive (first-use oils such as soybean are more expensive than recycled oils).
- Processing cost is generally estimated to be about \$0.20 - \$0.50/gallon.
- With current subsidies, biodiesel is \$1.30-\$1.50/gallon (without road tax).

Summary

- Biodiesel is an alternative fuel for diesel engines that can be produced from renewable materials.
- Biodiesel can be used neat, as a blend such as B20, or as a low-level lubricity additive.
- Biodiesel's advantages include lower black smoke and particulate emissions.
- Biodiesel's disadvantages include higher cost and lower energy content per gallon.