

Using Biofuel to Displace Diesel Fuel

Christopher V. Brown

Energy Sciences and Technology Department

June 11, 2009

BROOKHAVEN
NATIONAL LABORATORY

a passion for discovery



Introduction

- As the worldwide demand and price for energy increases, the move towards more renewable fuels will also increase.
- Renewable fuels derived from biomass sources provides an important contribution to the security and energy balance of the United States.
- Biodiesel, produced from various oil yielding plants, is capable of being implemented directly into diesel vehicles.

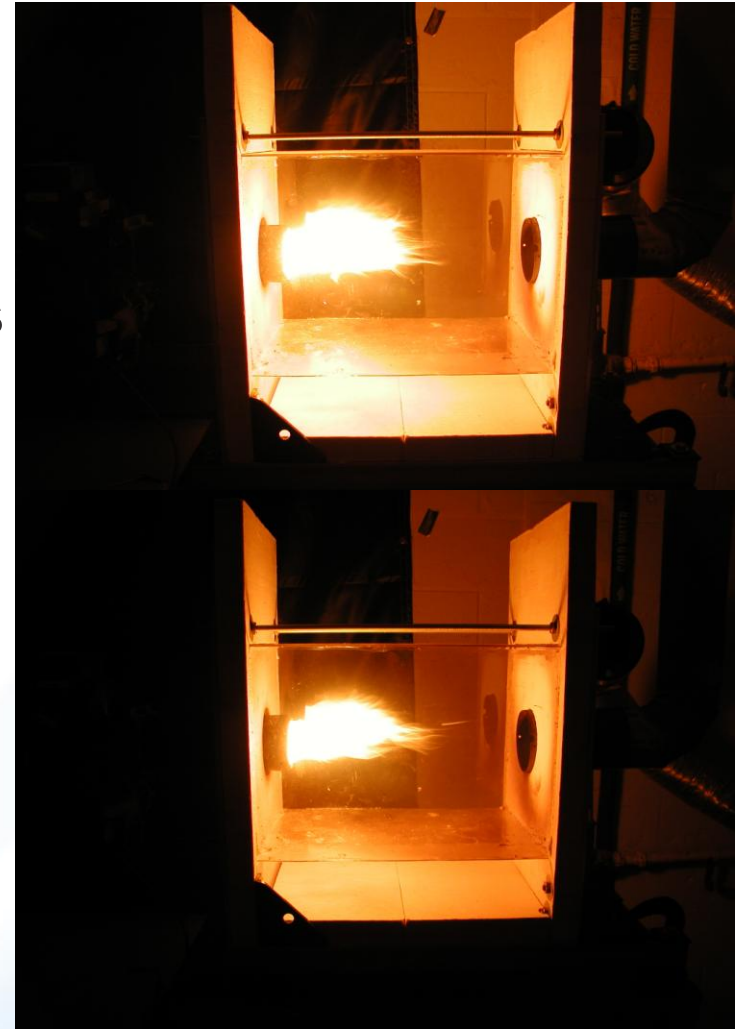


Production

1. Selection of feedstock
 - Waste or virgin oils
2. Pretreatment of feedstock
 - WVO contaminant removal (moisture & food particles)
 - Virgin oil degumming
3. Reacting the vegetable oil
 - Acid Esterification (only waste oils)
 - Sulfuric acid
 - Base Transesterification
 - NaOH, or KOH
4. Fuel washing
 - Dry wash
 - Water wash
 - To remove excess methanol, catalyst, glycerol...

Combustion Characteristics

- Carbon Neutral
- 100% less sulfur dioxide
- 93% less total unburned hydrocarbons
- 75%-90% less aromatic hydrocarbons
- 90% less carcinogenic toxins emitted
- 50% reduction in CO
- 68% reduction in Particulate matter



Feedstocks and Properties

Feedstocks

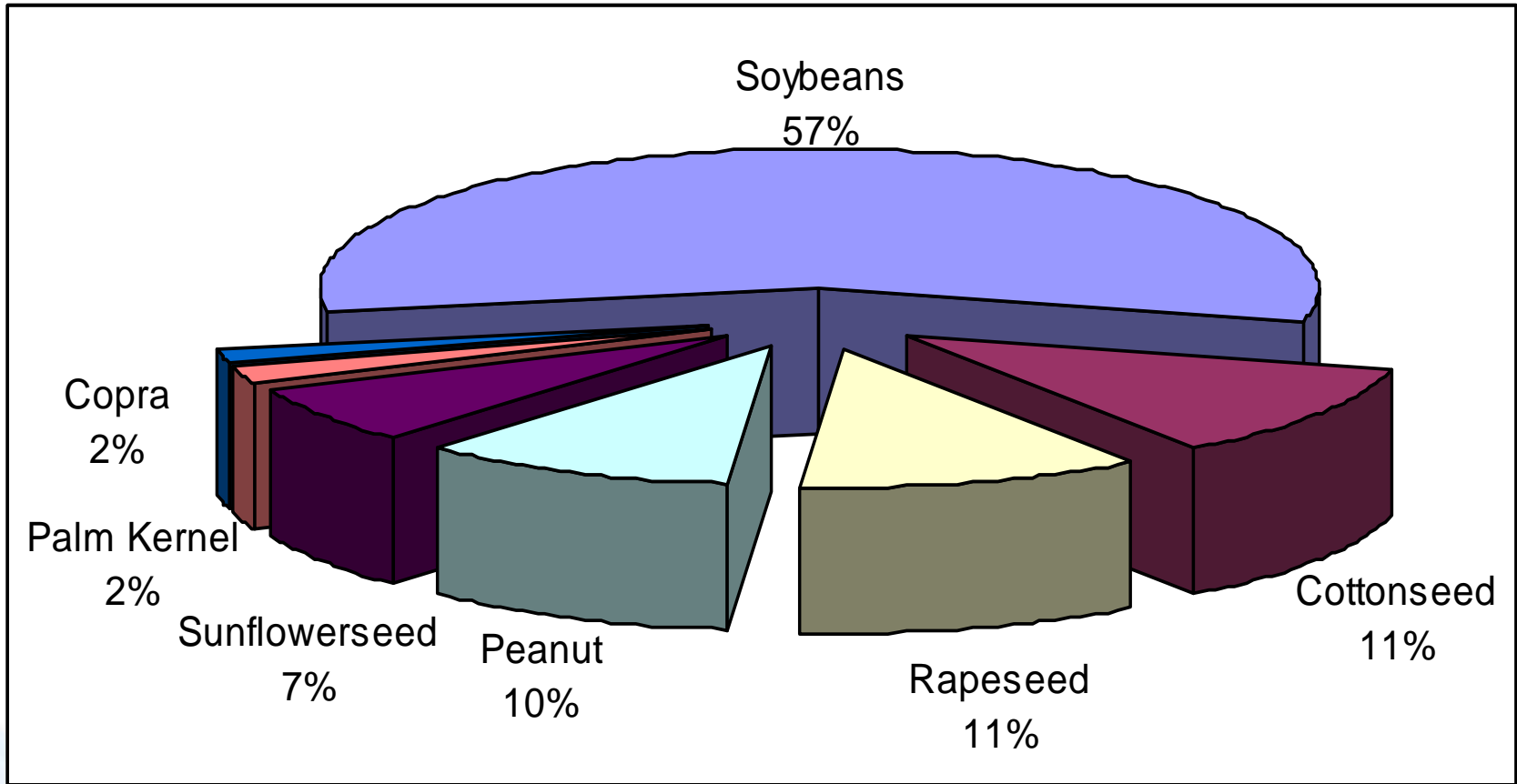
- canola
- Soy
- waste cooking oils
- jatropha
- algae
- palm
- animal fats

Varying Properties

- Yield
- cold flow properties
- emissions and combustion performance
- stability
- production methods



2001 Worldwide Oilseed Production



USDA

Feedstock Yields

- Soy 46 gal/acre
- Canola 122 gal/acre
- Palm 635 gal/acre
- Jatropha 195 gal/acre
- Algae ? gal/acre

Feedstock Concerns

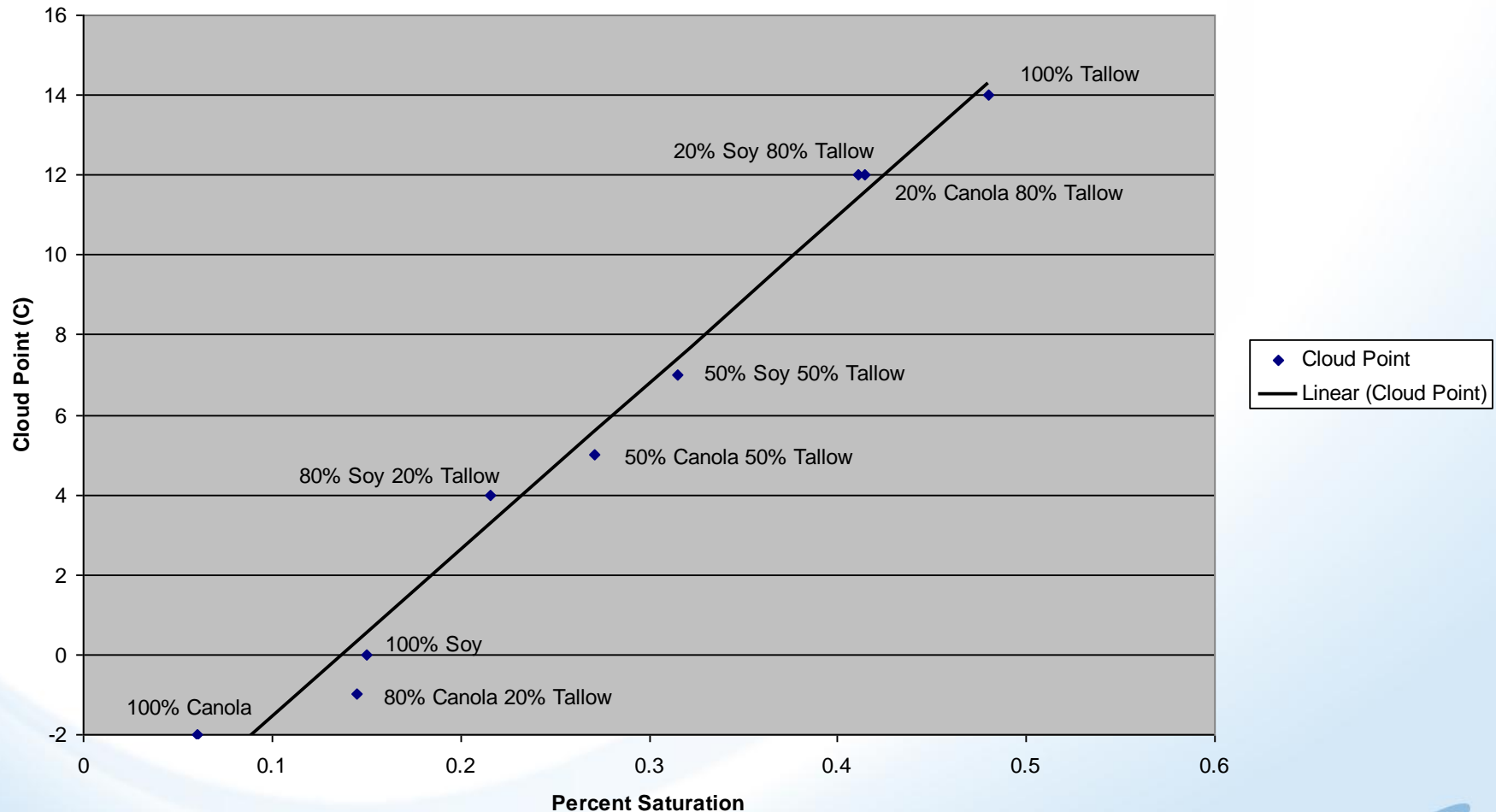
- Yield, availability, price, FFA content for waste oils
- Percent of Saturated vs Unsaturated fatty acids in the triglyceride feedstock
 - Directly Correlates to percent of saturated and unsaturated esters in the produced biodiesel.
- Biodiesel with a high composition of unsaturated esters has much better cold flow properties!
 - Canola based has one of the best cold flow properties

Cold Flow Properties

Feedstock (ME)	Percent Saturation	Cloud Point (°C)
Canola	6%	-2
Soy	15%	0
Tallow	48%	14

Cold Flow Properties

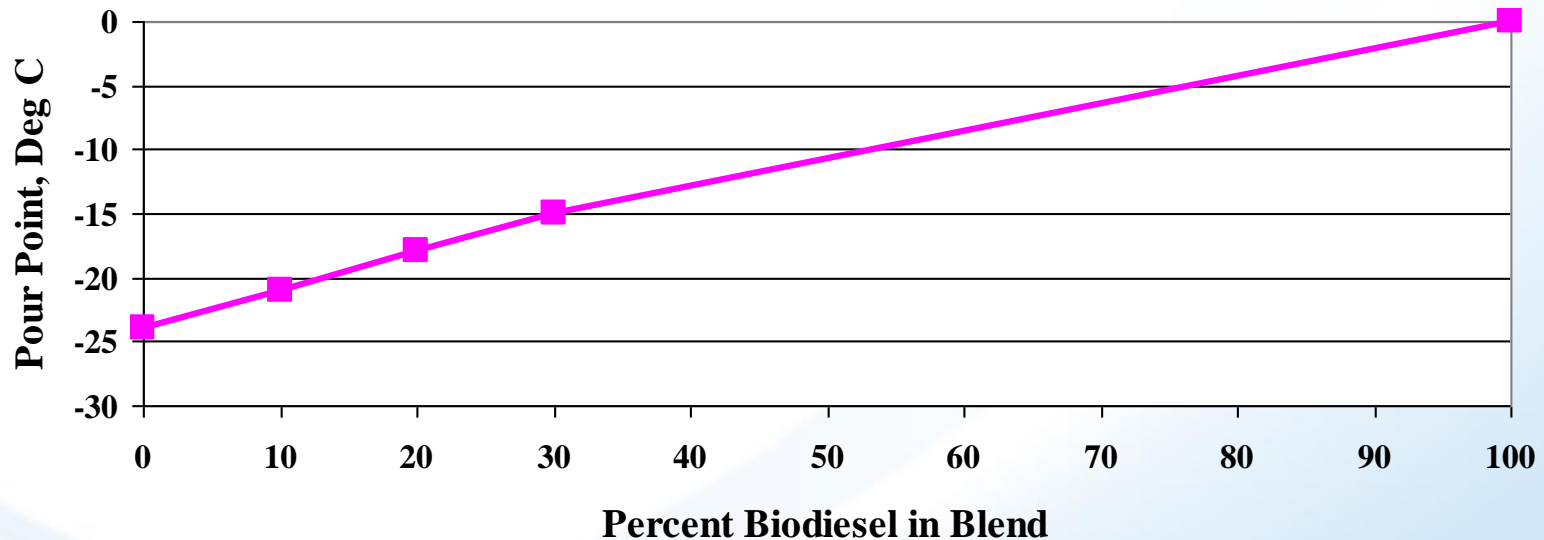
Percent Saturation vs. Cloud Point



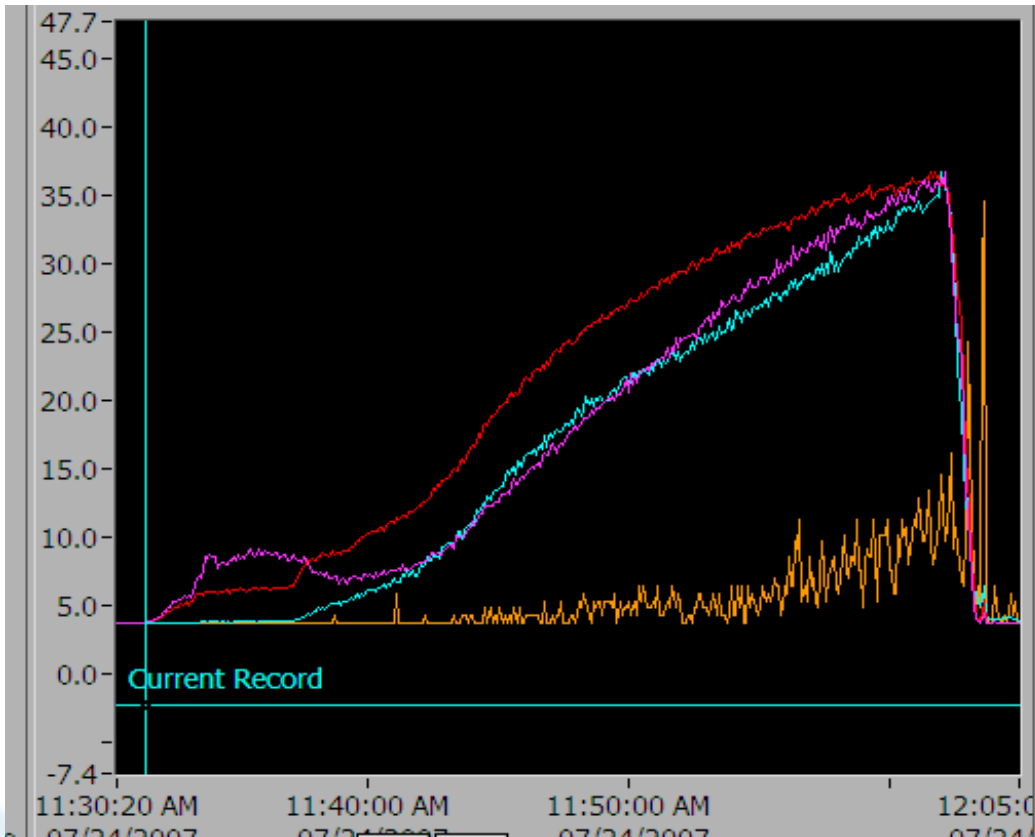
Cold Flow Solutions: Blending

- Blending with diesel fuel for desirable operating temperatures.

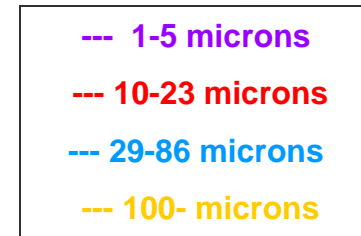
Pour Point of Heating Oil Blends



Cold Flow Solutions: Crystal Fractionation



Crystal Chord length



Nucleation Temperature:	0.1
Agglomeration Temperature:	-1.8
Cloud Point:	0.0

Cold Flow Solutions

- Crystal Fractionation
 - Separate saturated and unsaturated esters producing two grades of fuel
- Heated fuel lines, tanks, and fuel filters
- Additives, (pour point depressants)

Chris Brown
Brookhaven National Laboratory
(631) 344-5730
brown@bnl.gov