CRIMSON
RENEWABLE ENERGY, LP

Biodiesel – Quality, Storage and Blending

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Harry Simpson
President








Who is Crimson ?

- A new subsidiary of Crimson Resource Management Corp., a leading independent California upstream and midstream oil/gas company
- Strong energy industry production, engineering and logistics experience combined with financial strength
- Building the largest biodiesel plants in CA in the next 18 months
  - 30 mil gal/yr biodiesel plant in Bakersfield; estimated completion Spring 2008
  - 45-60 mil gal/yr biodiesel plant in Stockton; estimated completion year-end 2008 or Q1 2009
- We are committed to:
  - Ensuring the highest quality renewable fuels
  - Superior customer support and education
  - Ongoing development and application of new technologies and systems for renewable fuels production
- Currently marketing bulk biodiesel in Central CA and LA metro area

Biodiesel Quality

- What is most important in the biodiesel specification?

What is Most Important in Terms of Fuels Quality?

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ASTM D6751-07 Specification for Biodiesel B100

Property	Test Method	Limits	Units
Flash point, closed cup	ASTM D93	93 min	° C
Water and sediment	ASTM D2709	0.05 max	% volume
Kinematic viscosity @ 40° C	ASTM D445	1.9 - 6.0	mm2/s
Sulfated ash	ASTM D874	0.02 max	% mass
Sulfur			
S 15 Ggade	ASTM D5453	.0015 max	% mass
S 500 grade	ASTM D5453	0.05 max	% mass
Copper strip corrosion	ASTM D130	No. 3 max	
Alcohol content (one of the following must be met)			
Methanol content	EN14110	0.20 max	% volume
Flash point, closed cup	D93	130 min	° C
Cetane number	ASTM D613	47 min	
Cloud point	ASTM D2500	Report to Customer	° C
Carbon residue	ASTM D4530	0.05 max	% mass
Acid number	ASTM D664	0.50 max	mg KOH/g
Free glycerin	ASTM D6584	0.02	% mass
Total glycerin	ASTM D6584	0.24	% mass
Phosphorus	ASTM D4951	10 max	ppm
Vacuum distillation end point	ASTM D1160	360° C max	° C
Oxidative Stability	EN 14112	3 min	hours
Calcium & Magnesium (combined)	EN 14538	5 max	ppm
Sodium & Potassium (combined)	EN 14538	5 max	ppm

Biodiesel Quality

- What is most important in the biodiesel specification?
- Inspection
  - Visual test, basic test kit, lab test
  - Testing the top, middle and bottom – critical for railcars
- Inspection Results -- what matters and what doesn't?
  - Color and smell are not indicators of quality
  - Fuel is not clear – fuel appears cloudy
  - Matter / precipitates on the bottom
- What causes cloudiness in fuel?
  - Fuel does not meet spec; most likely doesn't meet total glycerin and glycerides have precipitated
  - Fuel had dropped below its cloud point and wax crystals have precipitated
  - Fuel has come in contact with water
- Shelf Life
- Is quality dependent on Feedstock? Do certain feedstocks produce better biodiesel?

Do Certain Feedstocks Produce Better Biodiesel?

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- High-quality, in-spec biodiesel can be made from a variety of feedstocks
  - Soy biodiesel is not inherently better
  - Some feedstocks require significant pre-treatment
- Majority of the parameters in ASTM D6751 are processing related, not feedstock dependent

Biodiesel Specifications and Feedstocks

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- The ASTM biodiesel spec is feedstock independent – it addresses differences in feedstock (tan) AND processing quality issues (blue)

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  - Some feedstocks require significant pre-treatment
- Majority of the parameters in ASTM D6751 are processing related, not feedstock dependent
- Over time, the market will become specifications driven and less focused on feedstocks?
  - This evolution is taking place in Europe
  - The market may in effect adopt a stricter standard for certain types of biodiesel, i.e. a total glycerin level of 0.17 for biodiesel made from animal fats

Feedstock-related Performance Differences

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- Each feedstock produces biodiesel with different performance characteristics

	Cetane	Oxidative Stability	Cloud Point / CFPP	NOx
Low saturated Fat Feedstocks				
Soy	47 to 49	Low	Low	Average
Canola	47 to 49	Low	Very Low	Average
Cottonseed	47 to 49	Med	Low	Average
Mustard Seed	47 to 49	Low	Low	Average
Corn	47 to 49	Low	Low	Average
High saturated Fat Feedstocks				
Palm	58 to 63	High	High	Lower
tallow	55 to 59	High	High	Lower
Poultry Fat	52 to 57	High	High	Lower

- Blends of biodiesel made from different feedstocks can be made to achieve various price and performance objectives

Cold Weather Performance of Biodiesel Blends

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	CARB Diesel	Soy Biodiesel		Palm Biodiesel		Tallow Biodiesel	
		B20	B100	B20	B100	B20	B100
Cloud Point (deg F)	-4 to 0	11 to 14	31 to 36	14 to 18	52 to 55	14 to 18	57 to 61
Cold Filter Plug Point (deg F)	-8 to -2	-3 to 2	17 to 24	9 to 13	38 to 48	11 to 15	43 to 47
Pour Point (deg F)	-30 to -16	-4 to 1	26 to 29	14 to 18	49 to 52	15-18	46 to 52

- Differences at the B20 level less significant, B5 even more so
- Additives can lower pour point and CFPP but not cloud point
- Seasonality

Cold Weather Performance of Biodiesel Blends

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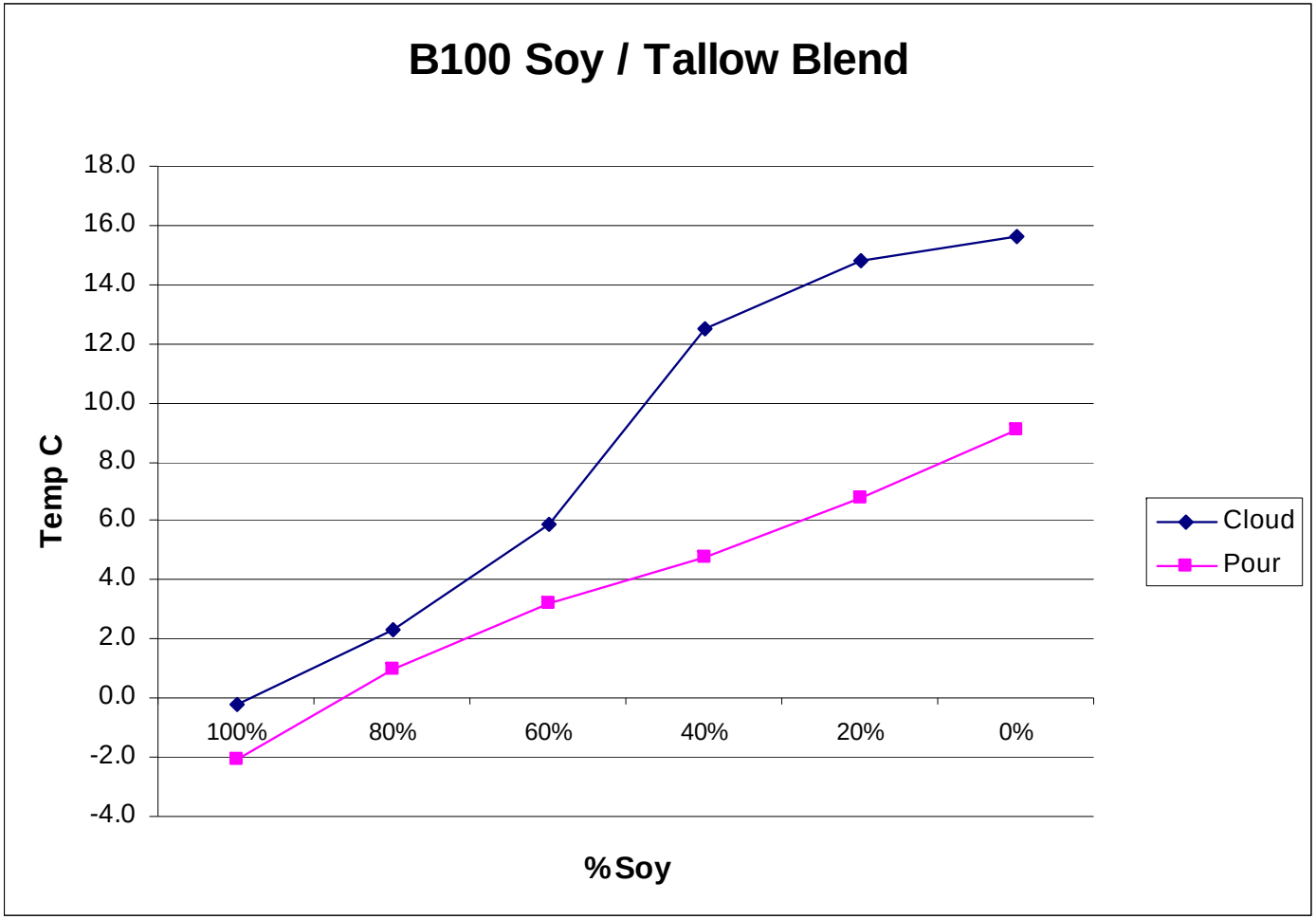

Source: University of Idaho, July 2007

Cold Weather Performance of Biodiesel Blends

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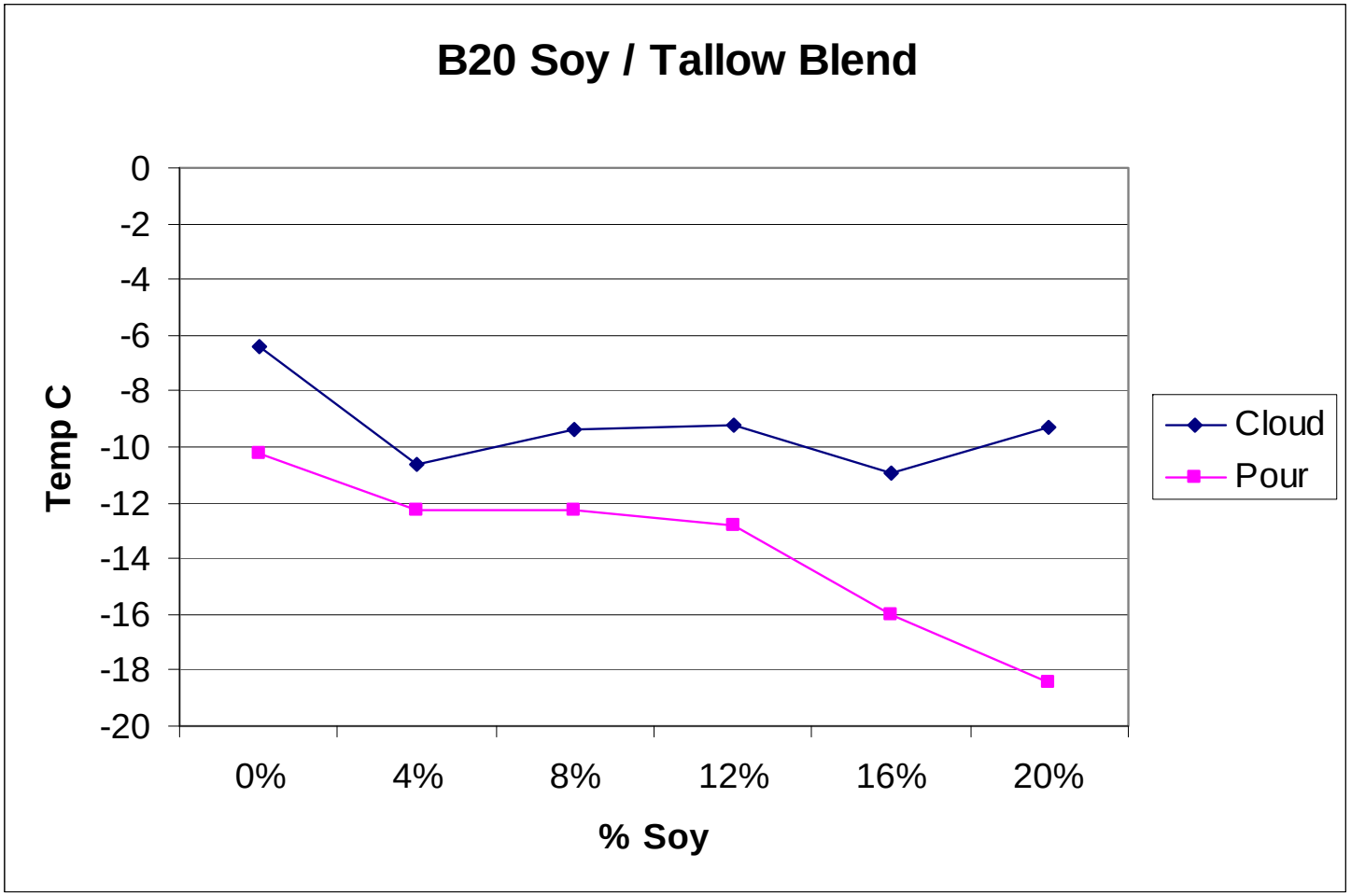

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Storage

- Do you need heated storage?
  - Depends on feedstock used for biodiesel, weather, temp of biodiesel when received vs how quickly the tank is turned
  - Insulated tanks at a minimum are strongly recommended
- Water in tank = disaster
  - Agriculture sector – tanks for irrigation pumps
  - Use of dessicant filter, internal floating roofs, nitrogen blankets
- How long can you store biodiesel?
  - Typically 6 mos for soy/canola-based biodiesel
  - 9-12 mos for animals fats and palm-based biodiesel

Blending

- Key issues are:
  - Temperature of the diesel vs temperature of the biodiesel
  - Thoroughness of the blend
- Biodiesel temperature must be above cloud point
- Temperature of #2 Diesel coming out of the rack must be higher than cloud point of biodiesel
- Best blend is achieved through in-line ratio blending
  - Next best is sequential blending followed by splash blending
- Each compartment in trailer must be blended
  - When splash blending, make sure that the biodiesel is distributed evenly across each compartment

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THANK YOU

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Biodiesel versus Conventional Diesel

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Selected Properties of Typical No. 2 Diesel and Biodiesel Fuels

Fuel Property	Diesel	Biodiesel (B100)	Units
Fuel standard	ASTM D975	ASTM D6751	
Lower heating value	~129,050	~118,170	Btu/gal
Kinematic viscosity @ 40° C	1.3 - 4.1	1.9 - 6.0	mm 2/s
Specific gravity @ 60° C	0.85	0.88	kg/l
Density	7.079	7.328	lb/gal
Water and sediment	0.05 max	0.05 max	% volume
Carbon	87	77	wt %
Hydrogen	13	12	wt %
Oxygen	0	11	
Sulfur	**0.0015 max**	**0.0 to 0.0024**	wt %
Boiling point	**180 to 340**	**315 to 350**	° C
Flash point	**60 to 80**	**130 to 170**	° C
Cloud point	**. -15 to 5**	**. -3 to 12**	° C
Pour point	**. -35 to -15**	**. -15 to 10**	° C
Cetane number	**40 to 55**	**47 to 65**	
Lubricity SLBOCLE	**2,000 to 5,000**	**>7,000**	grams
Lubricity HFRR	300 to 600	<300	microns

Source: U.S. Department of Energy, Biodiesel Handling and Use Guidelines (2nd Edition, March 2006)