

# Alternative Diesel Production

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CRL Engineering

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  - CRL Engineering is not responsible for energy "experiments" rendering bad results after being replicated from this presentation or other presentations given by CRL Engineering

# Chuck Linskens - Education

- ◆ Graduate of UW Stevens Point 1982  
Business Administration
- ◆ Attended Waukesha Technical College  
taking classes in printed circuit design  
and electronics – 1984/1986
- ◆ Graduate of Cal Poly Pomona 1994  
Electrical Engineering – Power Engineer

# Chuck Linskens - Work

- ◆ Generac Corp, Waukesha - generator sales
- ◆ Pensar Corp, WI - printed circuit designer
- ◆ Various companies in Valley and California involved in industrial controls
- ◆ Baldor Generator, Oshkosh - Head Electrical Engineer
- ◆ Started CRL Engineering in 2004

# Alternative Diesel

- ◆ CRL Engineering Project
- ◆ Alternative Diesel – Dairy Farm Electrification and Protein Feed Program
- ◆ Oil Press selection
- ◆ Fuel production
- ◆ Feed production

# Background

- ◆ CRL is a Diesel Generator Set mfg that attempted to implement conventional diesel energy in combination with TOU from WE on the Bill and Sara Wrobleski Dairy
- ◆ Conventional Diesel (D2) could not provide a considerable drop in fuel/electric cost to provide for an acceptable ROI

# Background

- ◆ Rising diesel fuel costs thru 2004-2005 forced CRL to look for an alternative fuel to be competitive with current and future electric rates.



# Fuels

## ◆ Researched Alternative Fuels:

- Methyl Ester (Biodiesel)
- DSE (Cold Mixture of Petroleum and Vegetable Oils)
- Raw Vegetable Oil (typically heated)

# Breakdown on alternative fuels

## ◆ Methyl Ester

- Combination of vegetable oil, potassium or sodium hydroxide) and methanol
- Unwanted byproducts – 15% of mix
- Some heat required - ~150F of entire batch
- Neat Biodiesel (B100) – pure solvent
- Good Viscosity (@104F) - ~ 6cst
- Process takes a long time to make and batches can go bad.
- Energy of Neat Biodiesel - lower than D2

# Breakdown on Alternative Fuels

## ◆ DSE (Diesel Secret Energy)

- Combination of Kerosene, Petrol, Diesel Lubricants & Cetane builders, DSE additive and vegetable oil – 15% Petroleum mixture
- Readily mixed cold in simple containers
- Not a solvent
- Simple fuel filtering
- Good Viscosity(@104F) - ~ 8cst
- No left over byproducts
- Good cold weather alternative diesel - +30F (normal straight formula)
- Energy of DSE – equal to D2

# Breakdown on Alternative Fuels

## ◆ Heated Raw Vegetable Oil

- Oil needs some filtering before dispensing
- Fuel delivery and injection equipment is complicated and typically custom made
- Viscosity – very high
- Not practical for cold climates
- Because of heating requirement – questionable economics

# Biodiesel vs. Alternative Diesel

## ***Biodiesel Production Stats (from biodiesel.org)***

Viscosity of Finished Product = ~ 6cst (@ 104F)

### **Process Inputs**

Alcohol - 12% (methanol)

Catalyst - 1% (lye)

Oil – 87%

### **Process Outputs**

Alcohol - 4%

Fertilizer - 1%

Glycerin - 9%

**Methyl Ester - 86%**

## ***DSE Production Stats***

Viscosity of Finished Product = ~ 8cst (@104F)

### ***Process Inputs = Process Outputs***

10% K1 Kerosene

5% 87OCT Unleaded Gasoline

75% Vegetable oil from oilseeds

.05% DSE additive

.1% Cetane builder and lubrication

(Methyl Ester = Biodiesel Prior to Certification)

# Pros/Cons - DSE to D2

## ◆ Pros

- Good Energy
- Great Lubricity
- PH - ~ 8
- Viscosity – within fuel oil range

# Pros/Cons - DSE to D2

## ◆ Cons

- When DSE fuel gels it takes a long time to thaw – but isn't damaged by the cold
- Vegetable oil mixtures and Biodiesel are more prone to algae buildup than D2 – requires DSE additive and a Biocide (tank prep)
- Filtering of fuel requires time and patience – filters clog easily if base vegetable oil is dirty or has wax/fats that haven't settled

# Where to Get Vegetable Oil

## ◆ Sources

- Restaurants – choices are few on pure vegetable oil
- Pure vegetable oil from a food distributor – economics?
- Off spec oil from large market sources – logistics, economics?
- Oil press – perfect for some dairy farms

# Press Research

## ◆ Why a press?

- If oilseed is available an oil press can feed animals necessary protein.
- Farmer can hold his/her own beans – no need for off-site storage and processing
- Provide oil for diesel equipment, especially power generation
- Provide a quick ROI

# Press Research

## ◆ Choosing a press

- Press construction
- Oil production
- Meal production and quality



# Press Research

## ◆ Press Construction

- Design should be for 24/7 use – 30F - 95F
- Press tube and screw – case hardened steel or iron (with special considerations)
- Heated nozzle and front end of press tube – for increasing oil production and feed quality

# Press Research

## ◆ Oil production

- Ideal press should provide >50% of available seed oil
- Heated nozzle can increase oil production, but can only go so far
- New screw and tube designs help extract more oil than previous designs

# Press Research

## ◆ Feed production and quality

- Meal should be low in oil to get most out of oil press
- Meal should be heated to provide desired bypass factors
- Meal can be taken in for analysis for bypass and protein factors

## Ration Summary Report

Northeast Wisconsin Technical College  
 Lena, WI  
 Phone: 920-498-5699  
 Dairy Name:  
 Provided to: Chuck & Bill

Ration: Soybean -

Catalog: Mep30\_Rations.MDB  
 Date: 12/23/2006 Units: lb-Mcal/lb  
 Prepared by: Mark

Cow Profile: Holstein Lactating Lactation #: 2 BCS: 2.5 Wt: 1346 lb Milk: 88 lb Fat: 3.6 % Protein: 3.2 % Days In Milk: 60

Feed Name	Feed Ingredient Profile																
	AsFed	DM	DM%	NEI	CP	RDP	RUP	ADF	NDF	NFC	Fat	Met	Lys	Ca	P	Se	Vit E
Soybean curd			88.0	0.78	24.0	70	30	5.0	11.0	58.5	0.80	0.37	1.48	0.26	0.64	0.21	
Soybean hulls			91.0	0.76	12.1	70	30	48.9	65.2	15.5	2.10	0.14	0.75	0.55	0.21		
Soybean oil			99.0	2.15							99.90						
Soybean meal 44 %			89.0	0.92	49.0	70	30	9.3	14.0	28.2	1.50	0.65	2.98	0.30	0.68	0.26	
Soybean meal 48 %			89.0	0.91	55.0	70	30	6.0	10.0	27.5	1.00	0.76	3.28	0.29	0.70	0.25	
Soybean meal expelle			90.0	0.90	47.5	60	40	10.0	15.0	25.5	5.30	0.63	2.90	0.29	0.68		
Soybean ml 43%, w./			90.0	0.91	48.5	65	35	12.5	23.0	19.9	1.70	0.64	2.96	0.33	0.68	0.30	
Soybean whole, raw			90.0	0.98	42.8	75	25	10.0	15.0	17.7	19.00	0.59	2.57	0.27	0.65	0.12	
Soybean whole, roast			91.0	0.99	42.8	50	50	10.0	15.0	17.7	19.00	0.59	2.57	0.27	0.65	0.12	
<b>Totals</b>																	
Requirements		49.730		39.50							2.49	54	166	0.393	0.199	6.78	565
Difference		0.00		0.00							0.00	0	0	0.000	0.000	0.00	0
Concentrations																	

↑  
 By Pass  
 ↓  
 Ruminant  
 Undegradable  
 Protein

Ratios Unavailable when Dry Matter is 0

AminoCow® - The Mepron Dairy Ration Evaluator - A service of Degussa.



# Fuel Production

## ◆ Fuel Equipment

- Filter station - pumps, filters, hoses
- Tanks – initial, settling and final
- Additives – what to use when

# Fuel Production

## ◆ Filter Station

- Provide for initial filtering of oil
- Provide for final filtering of oil



# Fuel Production

## ◆ Bulk Tanks

- Initial – heated (winter) and lined with disposable liner
- Settling – no heat, uses magnets and stir ingredients
- Final – equipment like generator tanks



# Fuel Production

## ◆ Additives

- Give lubricity to fuel
- Add Cetane – obtain highest available (+4)
- Homogenize and Stabilize
- Protect fuel from bacterial growth



# Feed Production

- ◆ 24 hour production of feed produces ~800lbs of meal and ~11gallons of oil from ~880lb of raw beans.
- ◆ Feed is rationed via a TMR with other ingredients

# Economics

## ◆ Feed and Energy

- Feed - oil press easily pays for itself when compared to other alternatives.
- Fuel converted into electric is comparable to electric rates from utilities
- Fuel converted into electric utilizing "time of use" plans, "supercharge" ROI

# Is the Fuel Good for All Diesel Engines?

◆ NO!

- DSE fuel should only be used for engines larger than 40kW (~50Hp) without modification
- Small Diesel engines need to have fuel system altered to handle DSE fuel

# DSE Fuel Considerations

## ◆ Cold weather

- Fuel filters should be large and heated
- Fuel lines should be heated
- Fuel tanks should be heated if used in cold temps – put tanks in warmer area
- Engine's fuel and injection pumps should be heated

# DSE Fuel Considerations

## ◆ Bugs in the fuel

- Hygiene of oil press collection
- Hygiene of oil filtering and transfer
- Hygiene of fuel additions, settling and mixing
- Hygiene of final fuel filtering
- Adding Biocide if above is not handled – costs will be incurred, but fuel not wasted
- Fuel should be used as soon as it is made to avert costs to clean the fuel again

# Conclusions

- ◆ Feed and oil energy from oilseeds is worth the price of admission.
- ◆ DSE fuel or Methyl Ester can be used in large engines from pressed oil
- ◆ Feed made from an oil press keeps costs low and is made for dairy animals
- ◆ Care must be taken to preserve and use alternative fuels

# CRL Engineering

- ◆ Custom builder of Diesel generator sets
- ◆ Full machining and fabricating capabilities
- ◆ Full engineering capabilities:
  - Mechanical Engineering
  - Chemical Engineering
  - Electrical Engineering – including comprehensive electrical testing/analysis, engine controls and generator facilities wiring.
  - Grant writing

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