

Cold Pressed Canola: A Biodiesel Option

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On-farm crushing of oilseed crops & utilizing the oil and meal

Outline

1. Crushing oilseeds for oil & meal
(industrial vs. on-farm)
2. On-farm oilseed presses
(expellers)
3. The oil
4. Biodiesel from oil
5. The meal
6. Issues

Oilseed Crops

Soybean **Canola** Sunflower

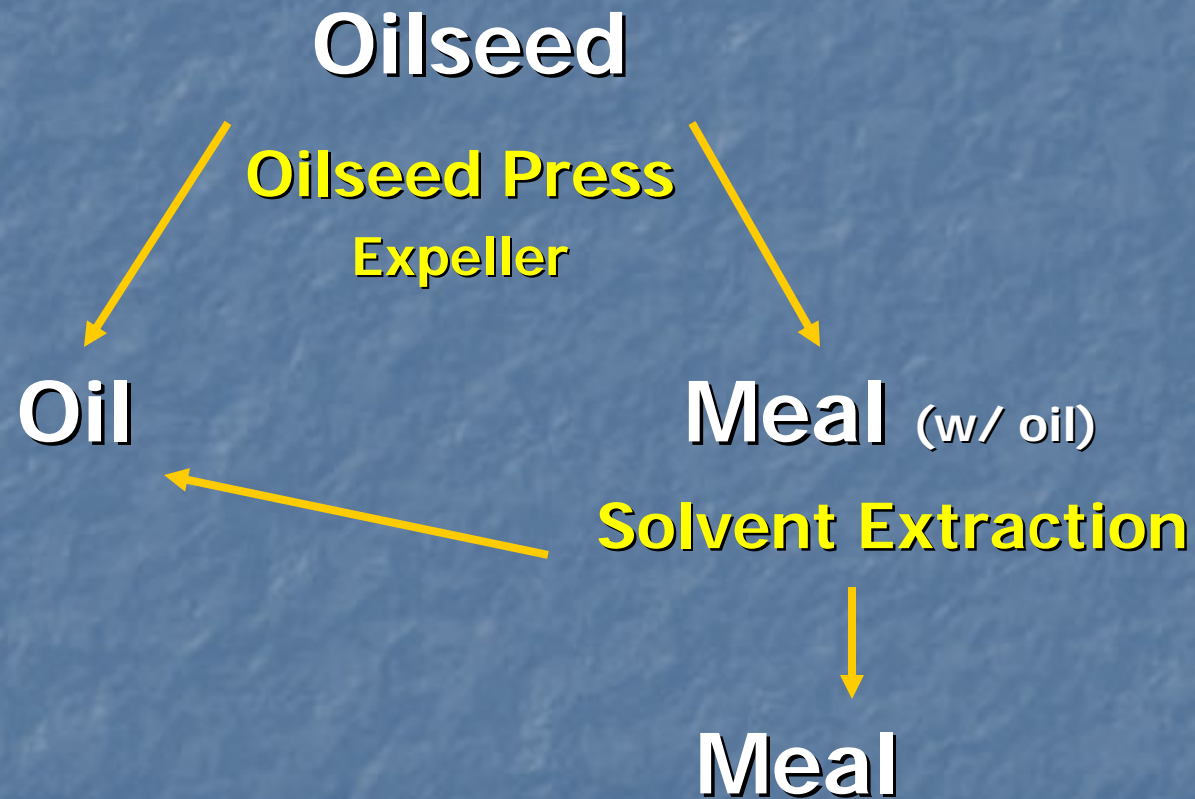
% oil

in seed	20%	40%	40%
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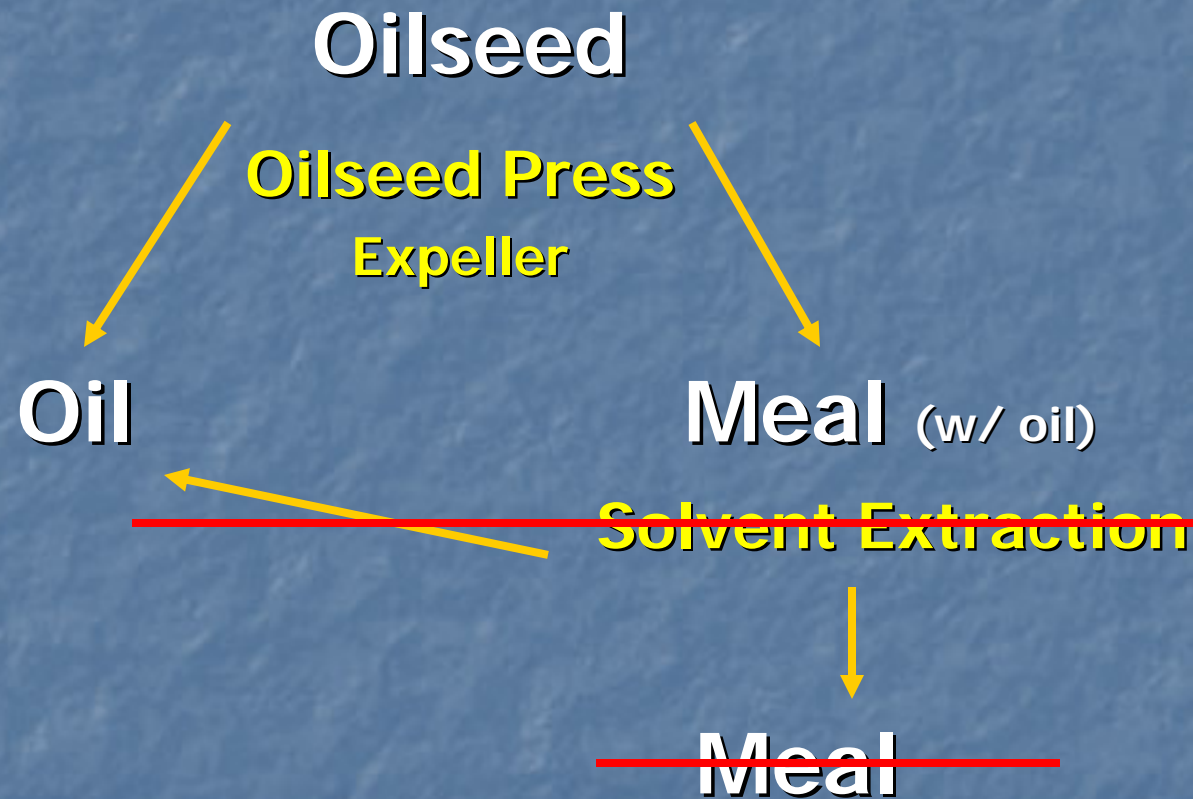
% meal

in seed	80%	60%	60%
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Industrial scale oilseed processing:



On-farm oilseed processing:



Oilseed Seed

Oilseed Press

Oil

Meal

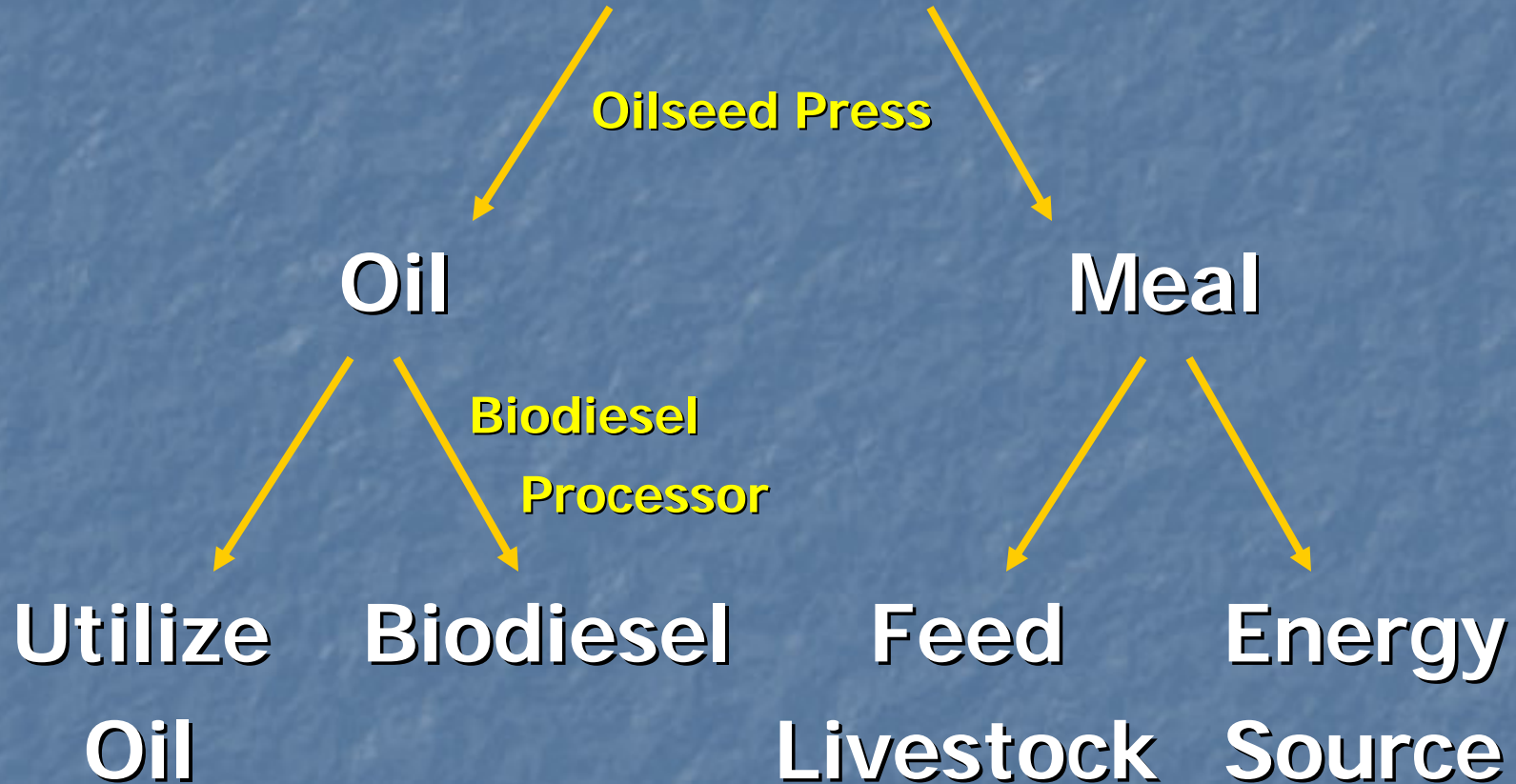
**Biodiesel
Processor**

**Utilize
Oil**

Biodiesel

**Feed
Livestock**

**Energy
Source**



On-farm oilseed presses:

Komet 1, 2 or 4 screw press
(OEKOTEC)

Germany

Kern Kraft

Germany

Täby Press

Sweden

Chinese

China

Goyum

India

KOMET Screw Oil Expeller DD85G-D85-1G

A Two Screw Press.



OEKOTEC IBG Monforts – Germany

Oil press KK 40/ 2 Standard - F Universal

KERN KRAFT



	KK40/2 Standard	KK40/F Universal
Seed performance:	40 kg/h	40 kg/h
Motor power:	2,2/3,5 kW	4,0 kW
Rpm:	45/90 l/min	15-100 l/min
Voltage:	230/400 V	230/400 V
(xWxH):	480 x 480 x 620 mm	
Weight:	c. 200 kg	
Electrical power consumption:	at rated power output (rapeseed) c. 1,6 kW/h	

KernKraft



Täby Press



Chinese Press

Canola generalities and assumptions:

1 bu = 50 lbs.

Assume a yield of 20 bu/ac or 1,000 lbs/ac.

The two-screw Komet press can process
about 1,000 lbs of seed (or ~1 ac) per day.

Canola seed contains ~ 40% oil,
and the press can extract
about 75% of that oil.

Canola oil and meal production per day:

1,000 lbs of canola pressed per day.

700 lbs of canola meal.

300 lbs of canola oil.

*[1,000 lbs * .40 (%oil) * .75 (%efficiency) =]
300 lbs of canola oil*

*[300 lbs * 7.5gal/lbs =] or 40 gallons of biodiesel*

(half as much soybean biodiesel)

Kim
Odden in Wisconsin
(fall 2006)

PVC Downspouts

Gutter for oil

Meal Auger

Oil Tank
350 gallons

Meal Tank
150 gallons



Seed Auger

Seed Hopper

Oilseed Press

Kraig Lee – Wannaska, MN



Tony & Erik, summer 2007

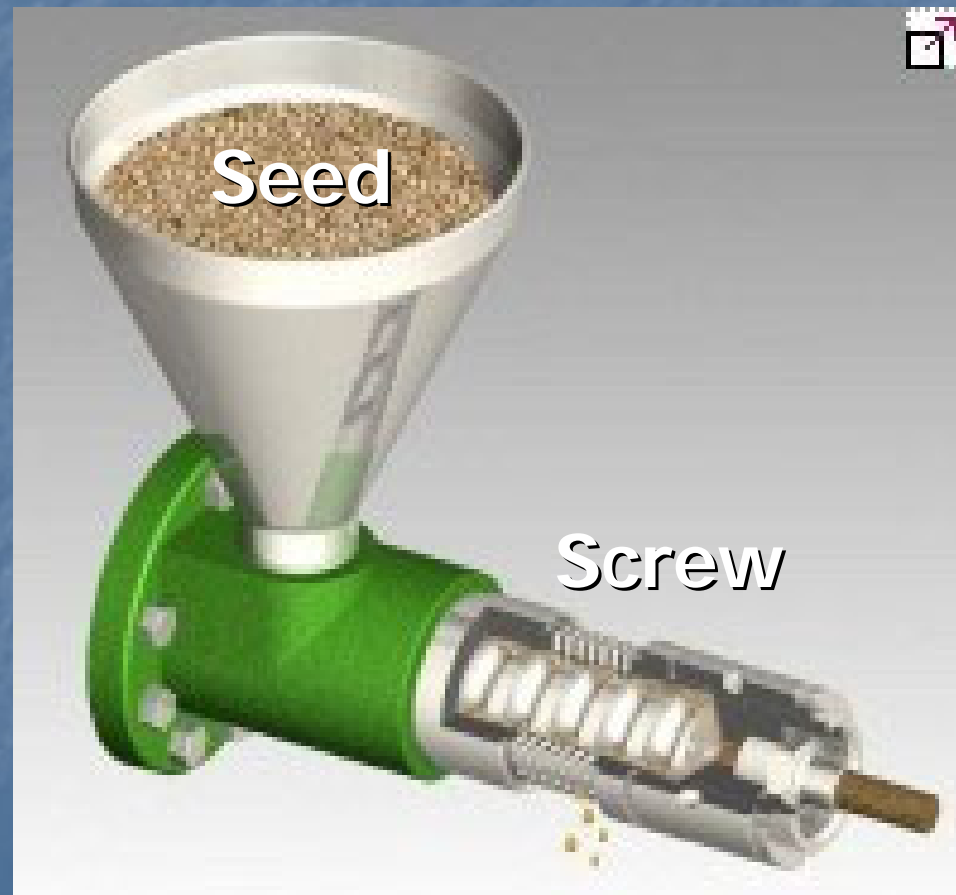


Oil settling totes



UMC – Crookston, January 2008

KOMET Screw Oil Expeller DD85G-D85-1G



Seed

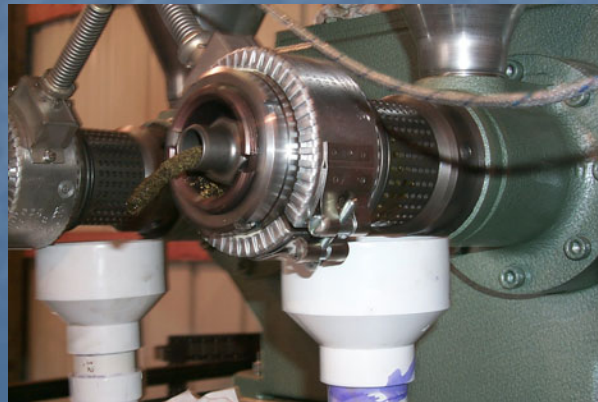
Screw

Oil

Meal
(or Press Cake)

Press Control Parameters:

1. Variable speed control
2. Selection of the press screw
3. Temperature of press head
4. Selection of meal nozzle size



Two screw oilseed press capacity:

The amount of seed processed in a day is dependent on volume and test weight, not seed size.

The drier the input material, the higher the extraction capacity of the machine.

Oilseed Seed

Oilseed Press

Oil

Meal

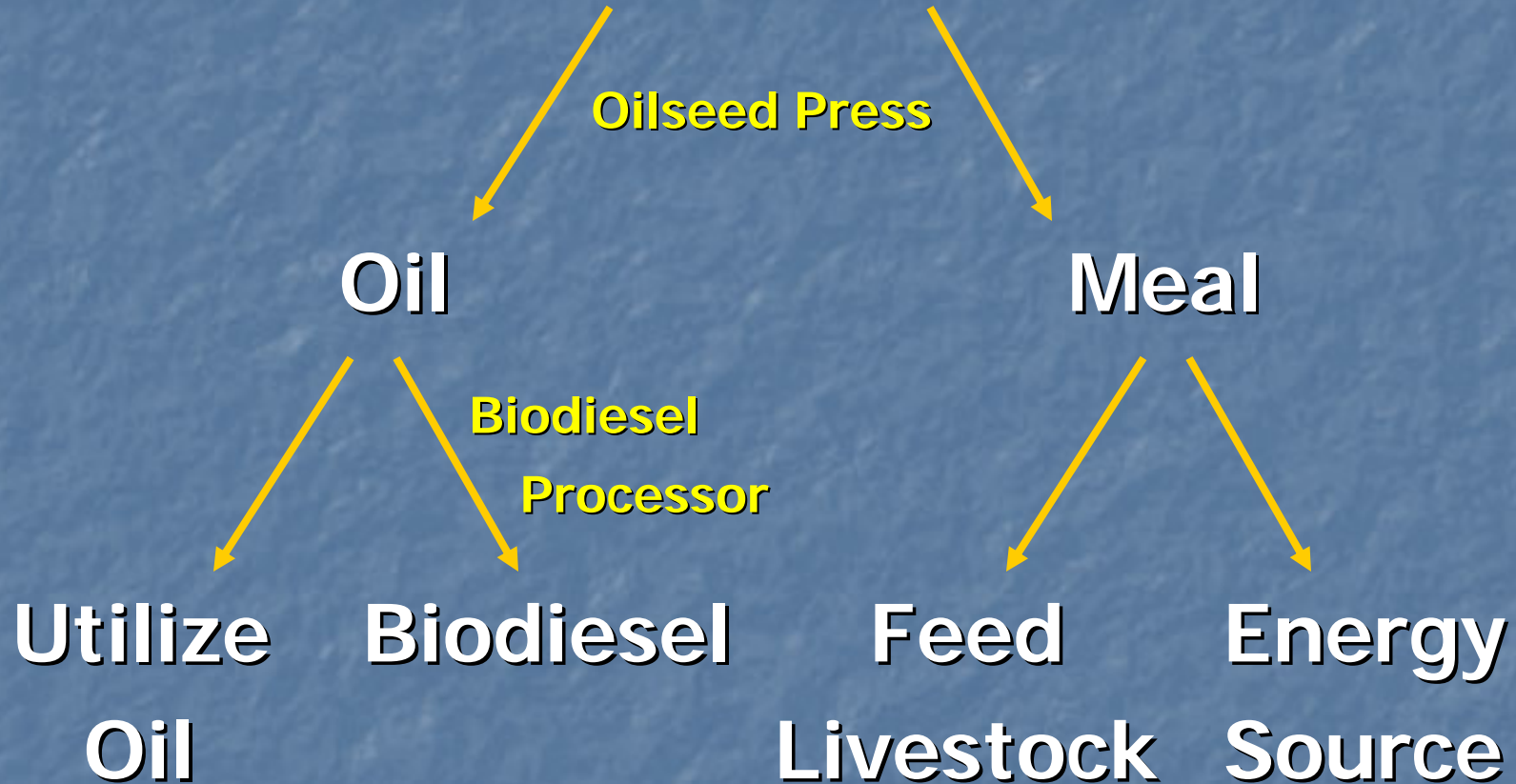
**Biodiesel
Processor**

**Utilize
Oil**

Biodiesel

**Feed
Livestock**

**Energy
Source**



**Oilseed oil => crude vegetable oil
or straight vegetable oil (SVO):**

1. Sell it:

a. For human consumption.

b. For conversion to biodiesel.

(contract manufacturing of biodiesel)

2. Use it directly.

3. Make biodiesel from it.

Oilseed oil =>

Filter oil !!!

2. Use it directly.

- a. Burn it as a replacement for heating fuel (fuel oil).
- b. Use it in a diesel engine.
- c. Use it in a 'modified' diesel engine.

Filtered oilseed oil as an energy source:

Oil burners:

KingBuilt (Eau Claire, WI)

www.KingBuilt.com

Filter oil !!!

Filtered oil fueling diesel engines with a two tank system:

- Heat up engine
(with diesel or biodiesel)
- Then start using filtered crude oil
- Before turning off engine, use diesel

Filter oil !!!

Filtered oilseed oil

directly fueling special tractors:

Deutz tractors

Deutz – which already manufactures engines specially designed for operation with 100% RME biodiesel – simplifies farmer fuel requirements still further with its “Natural Fuel Engines” fully guaranteed for fuelling with crude, unprocessed vegetable oil.

Certain Deutz Fahr tractors and a new Fendt model will be launched with the pioneer engines which range from 80hp to 330hp.

Filter oil !!!

<http://www.gminsidenews.com/forums/showthread.php?t=55897>

Be Aware:

The University of Minnesota

Center for Diesel Research

Is very critical and skeptical of directly using
oilseed oil in diesel engines.

“Many research studies have shown it just
doesn’t work.”

FuelMeisterII Dual biodiesel processor system

Makes
biodiesel
from SVO
or WVO.

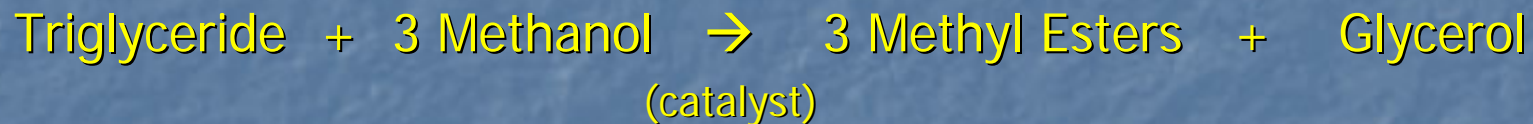
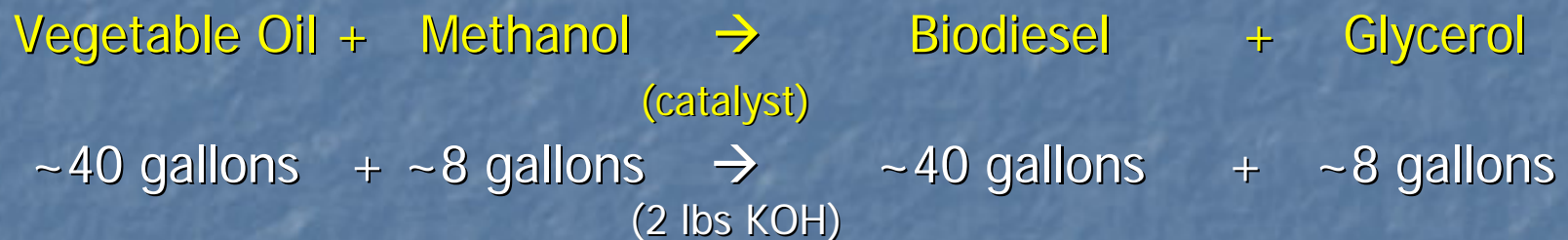
Makes
40 gallons
per batch.



Azure Biodiesel
Company
Sully, Iowa

Making biodiesel from vegetable oil:

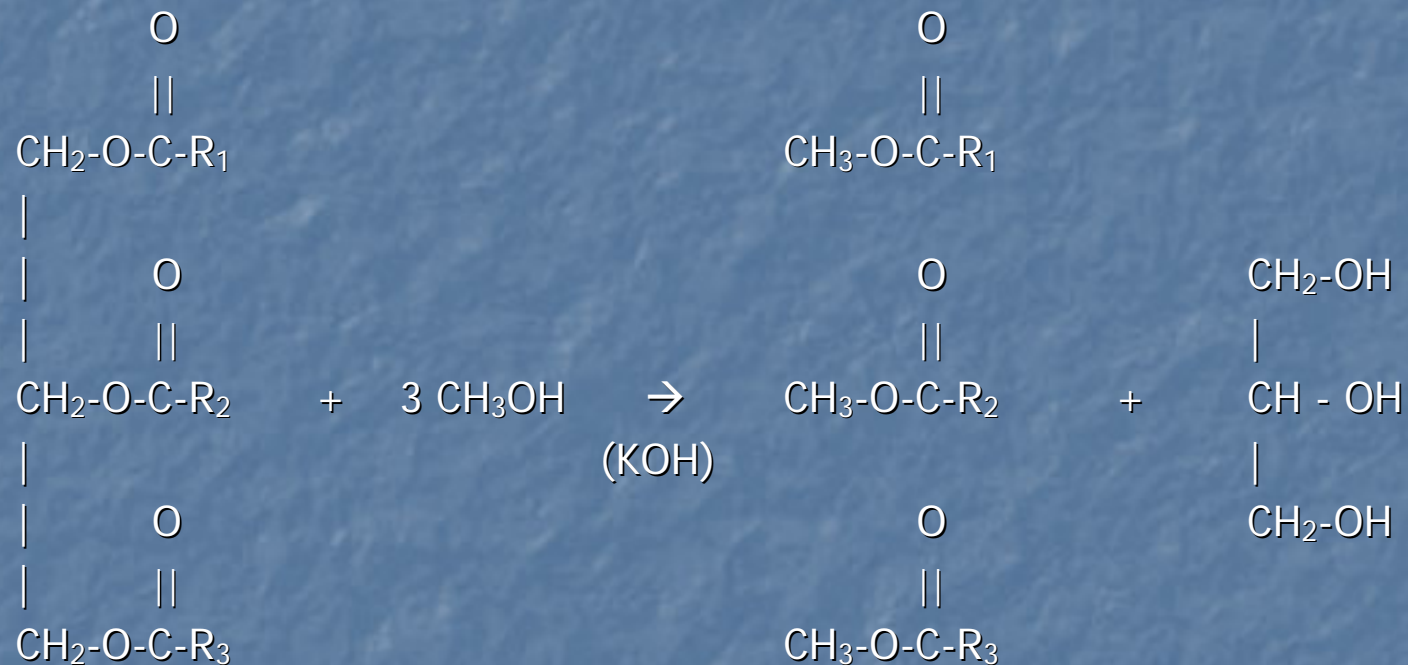
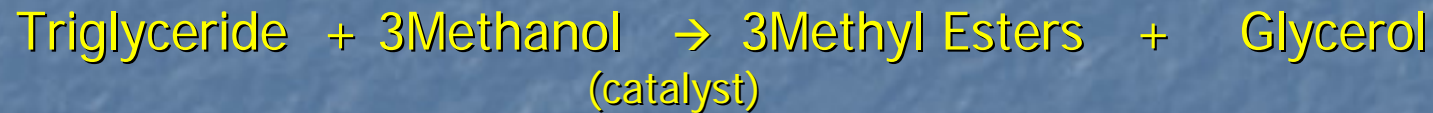
(transesterification reaction of vegetable oil)



The volume of biodiesel produced will be about equal to the input volume of vegetable oil.

The catalyst is not consumed in the reaction, and is removed in the glycerol and wash water.

Transesterification reaction of vegetable oil:



Comparison of fuel properties

Oil	Viscosity (cS)	Cloud point (°F)	Cetane number	Heat energy (BTU/lb)	Weight density (lb/gal)	Heat energy (BTU/gal)
Soybean	35	24	38	17,035	7.6	129,500
Soy ester	5	34	45	17,260	7.7	132,900
Sunflower	33	23	37	17,035	7.6	129,500
Sunflower ester	5	34	49	16,366	7.3	119,500
Canola	37	25	37	17,072	7.6	129,700
Canola ester	6	50	54	17,390	7.2	125,200
Crambe	54	50	44	17,404	7.5	130,500
#2 Diesel	3	5	47	19,494	7.1	138,400

<http://extension.missouri.edu/explore/agguides/agengin/g01990.htm>

Canola Meal (AURI) 9,667

Biodiesel Issues:

Quality control & ASTM D6751 standards

Safety – handling of methanol and KOH

Environmental issues – waste water, emissions

Glycerol glut – what to do with it

Economics & Economy of scale

Biodiesel standards

American Society of Testing and Materials

ASTM D 6751

International standards:

EN 14214 (describes the minimum requirements for biodiesel that has been produced from canola (rapeseed) fuel stock (also known as R.M.E. or rapeseed methyl esters))

(See wikipedia for actual standards.)

Biodiesel standards

The standards ensure these important factors in the fuel production process are satisfied:

- Complete reaction.

- Removal of glycerol.

- Removal of catalyst.

- Removal of alcohol.

- Absence of free fatty acids.

- Low sulfur content.

Oilseed meal

Oilseed meal is NOT all the same:

'Pressed' oilseed meal has *more oil* than 'solvent extracted' oilseed meal.

'Pressed' oilseed meal has *more energy* than 'solvent extracted' oilseed meal.

'Pressed' oilseed meal has *more value* than 'solvent extracted' oilseed meal.

(does it?)

Oilseed meals as a feed:

----- Solvent Extraction -----

Parameter	Canola	Soybean	Sunflower
CP (%)	41.0	49.0	38.9
TDN (%)	76.0	84.0	64.0
NE _m (MCal/lb)	0.80	0.94	0.65
NE _g (MCal/lb)	0.52	0.64	0.35
ADF (%)	16.0	7.0	28.0
Ca (%)	0.60	0.33	0.39
P (%)	0.94	0.71	1.06

The Ranch Hand, NDSU Vol 4 No 5, May 2007
Greg Lardy, NDSU Animal/Range Science

Canola nutrient content:

Parameter	----- Meal -----		- Seed -
	solvent	pressed*	
CP (%)	41.0	31.3	21.0
TDN (%)	76.0	83.8	115.0
NE _m (MCal/lb)	0.80	0.95	1.34
NE _g (MCal/lb)	0.52	0.66	0.97
ADF (%)	16.0	21.5	12.0
Ca (%)	0.60	0.62	0.35
P (%)	0.94	0.99	0.68

* *Wannaska sample
July 2007 (as is)*

*The Ranch Hand, NDSU Vol 4 No 5, May 2007
Greg Lardy, NDSU Animal/Range Science*

Oilseed meal as an energy source:

Burn the meal?

Seed / Pellet burners:

Heatmor (Warroad)

Central Broiler (Greenbush)

Northwest Manufacturing, Inc.
(Red Lake Falls)

Oilseed meal as an energy source:

Burn the meal?

AURI 'Pellet' Durability Testing:

Canola cake analysis (Oct 30, 2007)

<u>Moisture</u>	<u>Ash</u>		<u>Energy</u>	
	as is	dried	as is	dried
		basis		basis
<u>%</u>	<u>%</u>	<u>%</u>	<u>BTU/lb</u>	<u>BTU/lb</u>
9.32	5.90	6.51	8,766	9,667

(Fall 2007, Komet 6mm nozzle – canola)

Oilseed meal as an energy source:

Burn the meal?

AURI 'Pellet' Durability Testing:

"These are not ideal durability results, however 77% pellet durability for the pre-sieved sample would be very similar to what the feed industry could produce with a material containing the same level of oil content."

(Fall 2007, Komet 6mm nozzle – canola)

Economics

of crushing oilseeds
on-farm

Value of seed (per pound)

= oil value & meal value

= (oil value + meal value)

- cost to separate oil & meal

press ~\$4,000-20,000

= (biodiesel value + meal value) –

(cost to separate oil & meal

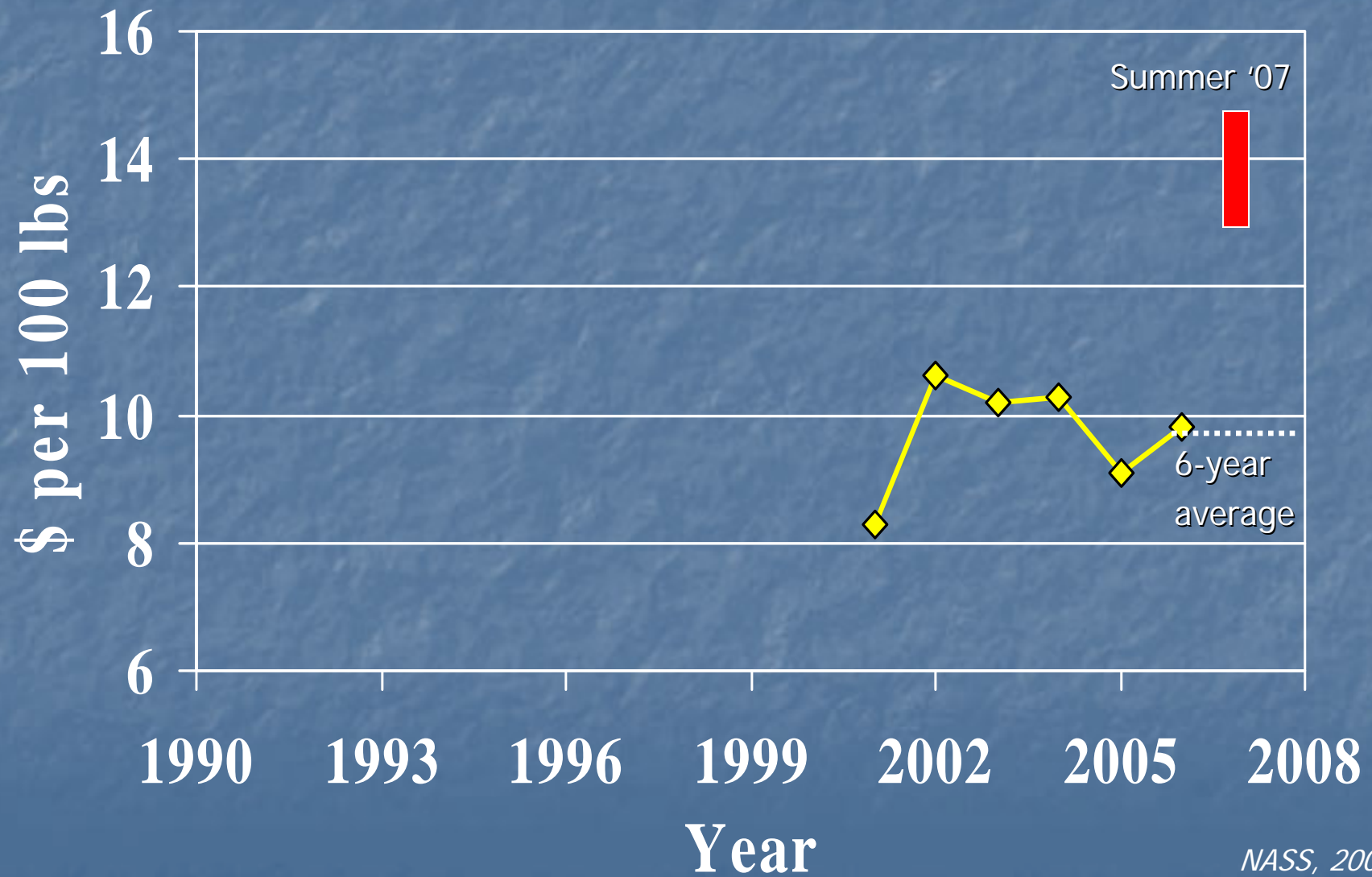
+ cost to produce biodiesel)

~\$0.60/gallon – chemicals

~\$3,000 for processor

Minnesota Canola Price

more recently
24



1 lb pressed canola contains 0.7 lb meal and 0.3 lb oil

Assume:

Value of canola seed **\$0.24/lb**.

Value of meal is \$300/ton or \$0.15/lb.

Value of biodiesel produced is \$3.00/gal.

1 gallon of oil weighs 7.5 lb and converts to 1 gallon biodiesel.

Then:

Meal	$0.7\text{lb} \times \$0.15 \text{ per lb} =$	<u>\$0.105/lb</u>
Oil	$0.3\text{lb} \times (1\text{gal}/7.5\text{lb}) \text{ is } 0.04 \text{ gal biodiesel},$ $0.04 \text{ gal biodiesel} \times (\$3.00/\text{gal}) =$	<u>\$0.120/lb</u>
Oil + Meal Total		\$0.225/lb

Canola

Value of seed

\$/bu	\$/lb (1 bu = 50 lb)
5.00	0.10
7.50	0.15
10.00	0.20
12.50	0.25

Meal

\$/ton	\$/lb	% of seed	Value of 1 lb seed
150	0.075	.7	0.053
200	0.100	.7	0.070
250	0.125	.7	0.088
300	0.150	.7	0.105
350	0.175	.7	0.123

Oil

Price of diesel

\$/gal	\$/lb	% of seed	Value of 1 lb seed
2.00	0.27	.3	0.080
2.50	0.33	.3	0.100
3.00	0.40	.3	0.120
3.50	0.47	.3	0.140
4.00	0.53	.3	0.160
4.50	0.60	.3	0.180

Economics

of crushing oilseeds
on-farm

- Currently it doesn't pencil out for canola.
- Pencils out at a break even for soybeans.
- Really pencils out with organic soybeans.
- Drivers:
 - value of seed
 - price of energy (diesel)
 - price of meal

Conclusions

of crushing oilseeds
on-farm

- Farm-scale presses exist.
- Canola is a good oilseed to crush.
- There must be value in the meal as well as the oil.
- There are numerous options in creating value.
- Greatest value is human or animal feed.
- Both oil and meal can be used as an energy source.
- Oil has more energy than meal.
- Canola oil is a desired biodiesel.
- Best fit: oilseed and livestock producer.

The success of biodiesel homebrewing, and micro-economy-of-scale operations, continues to shatter the conventional business myth that large economy-of-scale operations are the most efficient and profitable.

It is becoming increasingly apparent that small-scale, localized, low-impact energy keeps more resources and revenue within communities, reduces damage to the environment, and requires less waste management.

Can we document this scientifically?

Comment on wikipedia.com under 'biodiesel'

Acknowledgment of funding support

Northwest Minnesota

Region Sustainable Development Partnership

Minnesota Department of Agriculture

Minnesota Pollution Control Agency

Agricultural Utilization and Research Institute

University of Minnesota UROP

Questions / Comments



UNIVERSITY OF MINNESOTA

UNIVERSITY OF MINNESOTA

Extension
SERVICE



MINNESOTA DEPARTMENT OF
AGRICULTURE

NORTHWEST MINNESOTA
REGIONAL SUSTAINABLE DEVELOPMENT PARTNERSHIP



**Minnesota Pollution
Control Agency**

**Wannaska
Renewable
Energy**

A Farm Scale Bio-Diesel Project

Demonstration at Wannaska, Wednesday 27 June 2007

**1 lb pressed conventional soybean contains
0.85 lb meal and 0.15 lb oil**

Assume:

Value of soybean seed **\$0.20/lb** (\$12.00/bu).

Value of meal is \$350/ton or \$0.175/lb.

Value of biodiesel produced is \$3.00/gal.

1 gallon of oil weighs 7.5 lb and converts to 1 gallon biodiesel.

Then:

Meal	0.85 lb x \$0.175 per lb =	<u>\$0.149/lb</u>
Oil	0.15 lb x (1gal/7.5lb) is 0.02 gal biodiesel, 0.02 gal biodiesel x (\$3.00/gal) =	<u>\$0.060/lb</u>
Oil + Meal Total		<u>\$0.209/lb</u>

Conventional Soybean

Value of seed

	\$/bu	\$/lb (1 bu = 60 lb)
	5.00	0.083
	7.50	0.133
	10.00	0.167
	12.50	0.200

Meal

Oil

Price of diesel

\$/ton	\$/lb	% of seed	Value of 1 lb seed	\$/gal	\$/lb	% of seed	Value of 1 lb seed
150	0.075	.85	0.064	2.00	0.27	.15	0.040
200	0.100	.85	0.085	2.50	0.33	.15	0.050
250	0.125	.85	0.106	3.00	0.40	.15	0.060
300	0.150	.85	0.128	3.50	0.47	.15	0.070
350	0.175	.85	0.149	4.00	0.53	.15	0.080
				4.50	0.60	.15	0.090

1 lb pressed **ORGANIC soybean** contains
0.85 lb meal and 0.15 lb oil

Assume:

Value of soybean seed **\$0.37/lb** (\$22.00/bu).

Value of meal is \$850/ton or \$0.425/lb.

Value of biodiesel produced is \$3.00/gal.

1 gallon of oil weighs 7.5 lb and converts to 1 gallon biodiesel.

Then:

Meal	0.85 lb x \$0.425 per lb =	<u>\$0.361/lb</u>
Oil	0.15 lb x (1gal/7.5lb) is 0.02 gal biodiesel;	
	0.02 gal biodiesel x (\$3.00/gal) =	<u>\$0.060/lb</u>
Oil + Meal Total		\$0.421/lb

Organic Soybean

Value of seed

\$/bu \$/lb (1 bu = 60 lb)

17.50 0.292

20.00 0.333

22.50 0.375

25.00 0.417

Meal

Oil

Price of diesel

\$/ton	\$/lb	% of seed	Value of 1 lb seed	\$/gal	\$/lb	% of seed	Value of 1 lb seed
750	0.375	.85	0.319	2.00	0.27	.15	0.040
800	0.400	.85	0.340	2.50	0.33	.15	0.050
850	0.425	.85	0.361	3.00	0.40	.15	0.060
900	0.450	.85	0.382	3.50	0.47	.15	0.070
950	0.475	.85	0.404	4.00	0.53	.15	0.080
				4.50	0.60	.15	0.090