



CATILIN

PRESENTATION TO THE

***IOWA STATE UNIVERSITY
BIOECONOMY CONFERENCE***

SEPTEMBER 2008

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VP, OPERATIONS**

Today's Biodiesel Challenges

- Today's biodiesel producers face many challenges.....
 - Feedstock availability and cost
 - Tight margins
 - Product quality demands
- Producers need a production platform that
 - Can use a flexible feedstock base that can be changed due to price and availability
 - Allows them to build plants and operate at the lowest possible cost
 - Produces high quality product that meets or exceeds the ever tightening quality specifications demanded by their customers
- Current biodiesel catalysts add to the difficulty of meeting these challenging and changing demands

Current Catalyst Technology

- **Majority of producers utilize a liquid homogeneous catalyst**
 - Sodium (or Potassium) Methoxide or Hydroxide
 - Catalysts are hazardous and difficult to handle
 - Process requires difficult pH control to maintain quality
 - Catalyst is used only once and must be neutralized to remove from the final products
 - Water washing is extensively used to process products
- **A second evolving technology utilizes fixed solid catalyst beds**
 - Process operates at much higher temperature and pressure
 - Capital costs are higher than standard design biodiesel plants
 - Utility costs are increased

CATILIN CATALYST

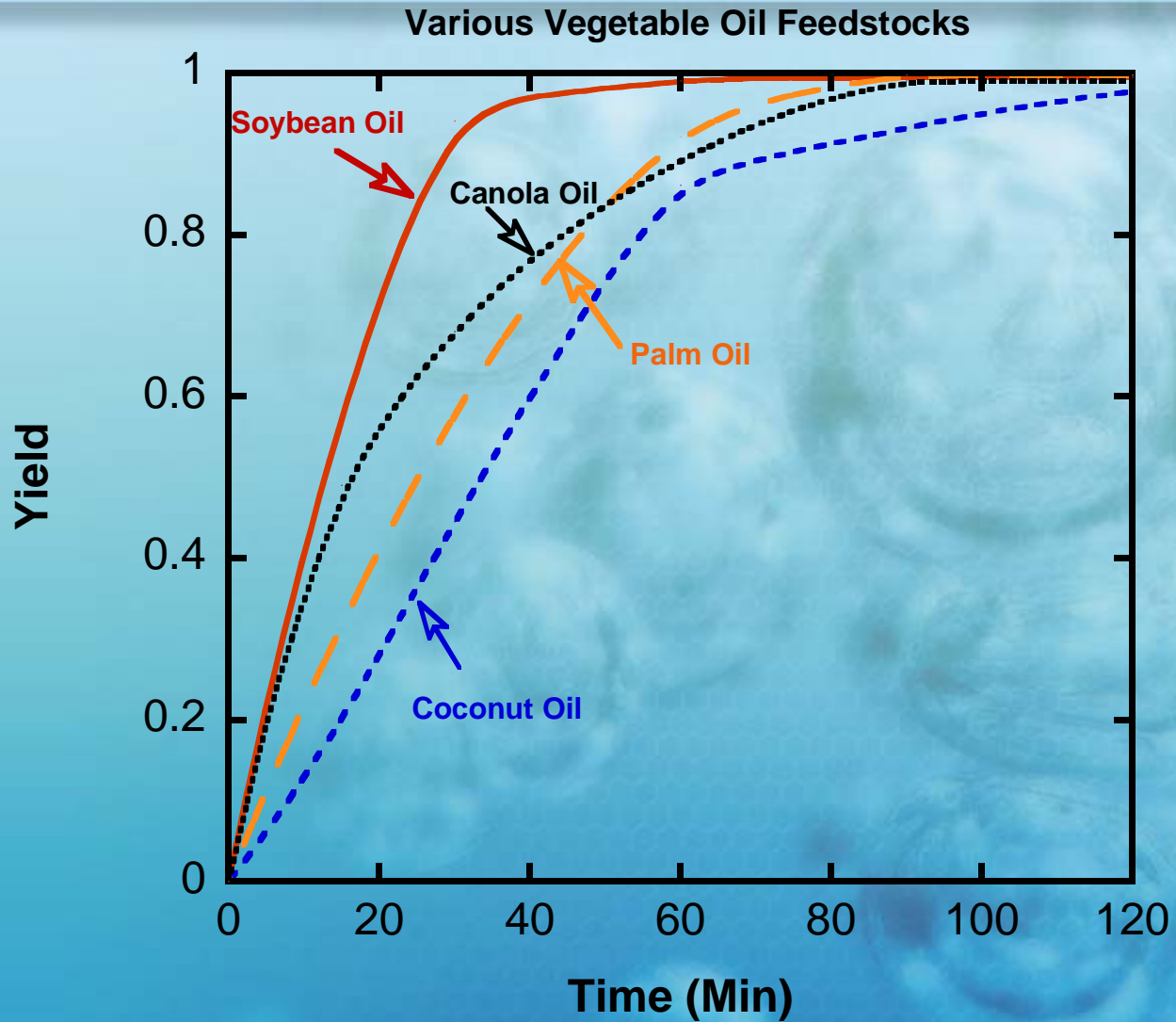
DEVELOPMENT HISTORY

- Catilin has introduced a new solid heterogeneous catalyst that can significantly reduce production costs and quality issues
 - Developed over last 5 years by a team at ISU
 - Research effort led by Dr. Victor Lin
 - Three generations of catalysts
 - First generation is a patented mesoporous calcium silicate (MCS) for esterification and transesterification reactions
 - Second and third generation catalysts are heterogeneous transesterification catalysts for low FFA feedstock
 - Third generation catalyst is currently in Bench Top and Pilot Plant production

CATALIN CATALYSTS

- **CATALIN'S Catalysts:**
 - Are solid (powder) heterogeneous catalysts
 - Are used in a water free process
 - Don't require neutralization and pH control systems
 - Run in smaller, less capital intensive plants
 - Are recyclable
 - React at industry standard temperature and pressures
 - Can be easily implemented in existing facilities
 - Can be used with a wide range of low FFA feedstocks
 - Have been proven in Bench Top and Batch Pilot Plant production
 - Can reduce operational costs by \approx \$0.20/ gallon
 - Produce a higher quality Biodiesel and Glycerin

Reaction Kinetics



CATILIN CATALYST

CAT III : ASTM BIODIESEL TEST RESULTS

Analysis	Result	Units	ASTM/EN Limit	Pass / Fail
Oxidation Stability	8.3	Hours	3 US/ 6 EN	PASS
Flashpoint	>150	deg C	130 (min)	PASS
Water & Sediment	ND	% volume	0.05 (max)	PASS
Viscosity Kinematic	4.09	mm ² /sec	1.9-6.0	PASS
Sulfated Ash	ND	% mass	0.02 max	PASS
Sulfur (Total)	ND	PPM	15	PASS
Copper Corrosion	1A	3 Hr/50 deg C	NO. 3 max	PASS
Cloud Point	2.5	deg C	N/A	
Carbon Residue	ND	% mass	0.05 max	PASS
Acid Number	0.19	mg KOH/g	0.5 max	PASS
Free Glycerin	0.002	% mass	0.02 max	PASS
Monoglyceride	0.088	% mass	N/A	
Diglyceride	0.016	% mass	N/A	
Triglyceride	0.003	% mass	N/A	
Total Glycerin	0.11	% mass	0.24 max	PASS
Boiling Temp-Dist Temp	344	deg C	360 max	PASS
Phosphorus	ND	% mass	0.001	PASS
Magnesium	ND	PPM	5 max combined w/ Mg	PASS
Calcium	ND	PPM	5 max combined w/ Ca	PASS
Potassium (ppm)	ND	PPM	5 max	PASS
Methanol	ND	% volume	0.2 max	PASS

CATILIN CATALYST

CRUDE GLYCEROL QUALITY RESULTS

Analysis	Level Found	Units
Karl Fisher Moisture	0.5	%
Glycerol	90-98	%
Methanol	1-3	%
Ash	<1	%
Calculated Weight	10.5	lbs/gallon
MONG (Material Organic Non Glycerol)	1-4	%
Specific gravity	1.259	g/mL @ 4 deg C

Catilin Operations

Commercializing Our Catalyst

2002-2006

ISU Research



2007

Carver Lab



2008

BECON Pilot Plant



2009

BECON & Beta



- Catalyst Research

- Developed new generation catalysts
- Developed post treatment process
- Produced ASTM Biodiesel
- Developed Pilot Plant design technology

- Implemented Pilot Plant Batch operations
- Produced ASTM Biodiesel
- Developed Process technology for CFP
- Demonstrated technology for potential customers
- Initiated CFP Pilot Plant modifications

- Startup BECON CFP
- Demonstrate CFP process for customers @ BECON
- Convert Beta Plants to Catilin catalyst

CATILIN TEAM

NAME	ROLE	BACKGROUND
Victor Lin	Founder	<ul style="list-style-type: none">• Professor, Dept of Chemistry, ISU and Ames Lab• PhD, University of Pennsylvania• NSF and US Fed Lab award winner
Larry Lenhart	President / CEO	<ul style="list-style-type: none">• Executive in Residence, Mohr Davidow Ventures• CEO: Requisite, Contivo, and CAT Technology• Managing Partner: Deloitte, AT Kearney
Wayne Turner	VP, Operations	<ul style="list-style-type: none">• 30 years petrochem experience with Dow Chemical• 10 years Dow Houston Operations Site Manager• Experience in plant startups, new product development
Jennifer Nieweg	Project Manager	<ul style="list-style-type: none">• PhD, Organic Chemistry• Graduate student in Lin Lab• 5 years developing new catalyst technology
Carla Wilkinson	Research Scientist	<ul style="list-style-type: none">• PhD, Inorganic Chemistry• Asst Professor, Centro Universitario Univates in Brazil• Post-doctorate work in Lin Lab 2 yr
Yang Cai	Research Scientist	<ul style="list-style-type: none">• PhD, Inorganic Chemistry• 3 yrs postdoctoral work in Lin lab• Experience in catalyst research

INTRODUCTION TO CATILIN

- CATILIN is a startup company headquartered on the Iowa State University campus in Ames utilizing labs and a pilot plant leased from ISU
- CATILIN has developed and demonstrated a new heterogeneous biodiesel production catalyst that eliminates many of the production issues associated with the current industrial processes
- Current plans are to fully develop the technology over the next several months, and begin commercialization activities in early 2009

Contact

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Revolutionizing Production with
Nano-Technology Catalyst