Dr. Ben Egelske
Sr Chemical Engineer

Applied Catalysts

Case Studies in Commercializing Catalytic Chemical Technology

SOCMA 2025, Nashville
Booth 310

APPLIED CATALYSTS

Applied Technologies / Applied Catalysts

Parent Company: Applied Ceramics (founded 1967)
Applied Catalysts Established: **1997** (25+ years of proven installations)
Ownership: Family Run & Operated
Manufacturing Sites: United States (SC, GA) + Overseas Partners
Total Employees: 130 (Approx. for whole organization)
Key Values: High Quality, Fast Response, Fair Pricing.

Manufacturing Plant in Laurens, South Carolina

COMPANY STRUCTURE

Applied Technologies / Ceramics
Parent

Applied Catalyst
DBA

Environmental Catalysts
Division

Process Catalyst, Systems & Services (PCSS)
Division

PCSS Division
(Process Catalysts, Systems & Services)

PROCESS CATALYSTS

Manufacturing Capacity -> Tons/day

Granular & Extruded Catalysts

Carbon & Ceramic Monolith Catalysts

Slurry Catalysts

Custom Catalysts

Contract Manufacturing

PROCESS DEVELOPMENT SERVICES

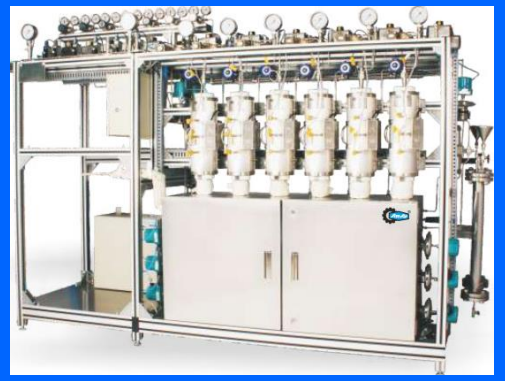
Process Scaleup

Catalytic Process Development

Catalyst Material Development

Molecule Tolling for Market Development

Hydrogenation & Sister Chemistry



MODULAR PROCESS SYSTEMS

Autoclave, CSTR, & Packed Bed Lab Reactors

Turn-Key Skids for Commercial Manufacturing

Recent Projects, 4 Case Studies

Technology & Systems

ACM – Joint Venture (15MM parts / yr)
EPRICON Process SO2->SO3 – 4 Commercial Unit Ops
Tire Pyrolysis Oil – 7.5 Ton/day plant
Hitachi, Hyundai, GM – Technology License (DPF)
Exxon Mobil Advanced Monoliths – Joint Venture

Reductive Alkylation Reactor – Pilot System
Production Line for CO_2 Capture – Commercial System
Production Line for Indoor Air – Commercial System
Laboratory Flow Screening Reactor – Lab System
Fluidized Bed Reactor – Lab System

H_2S Removal 25,000 SCFH – Engineering
Proprietary Oxidation (tons / day) – Engineering
Batch Aldol Condensation – Engineering
Slurry Catalyst Manufacturing – Engineering
Membrane Esterification 40MTPD – Engineering
Oleochemical Hydrogenation 10MM lbs/yr – Engineering
Production Line for Refining Catalysts – Engineering
Laboratory VOC Abatement Systems – Engineering

Custom Catalysts

ACMC-Pd – Hydrogenation
GAC-Pd – Reductive alkylation
Co-Silica extrudate – Hydrogenation
Rh/Alumina – Hydrogenation
Pt/Pd- alumina spheres – Various Chemistries
Sponge Copper – Hydrogenation
Ag/Alumina – Partial Oxidation
Ru/Alumina – Hydrogenation
Sponge Ni & Co – Hydrogenation
Mixed Metal Oxide (1) - Partial Oxidation (1)
Mixed Metal Oxide (2) - Partial Oxidation (2)
Pt/Metal Foil – Hydrogenation
Novel Materials for Indoor Air – Partial Oxidation
Novel materials for VOC abatement
Determining mechanisms of deactivation - Study
Microwave assisted reactors - Study

(1) Oxidation of a Proprietary Indoor Air Pollutant

Ford Jolly
Chemist I

Problem Statement

Develop an indoor air catalyst to maximize destruction rates of a proprietary pollutant.

Materials and Methods

30 m^3 test chamber with reticulating environment.

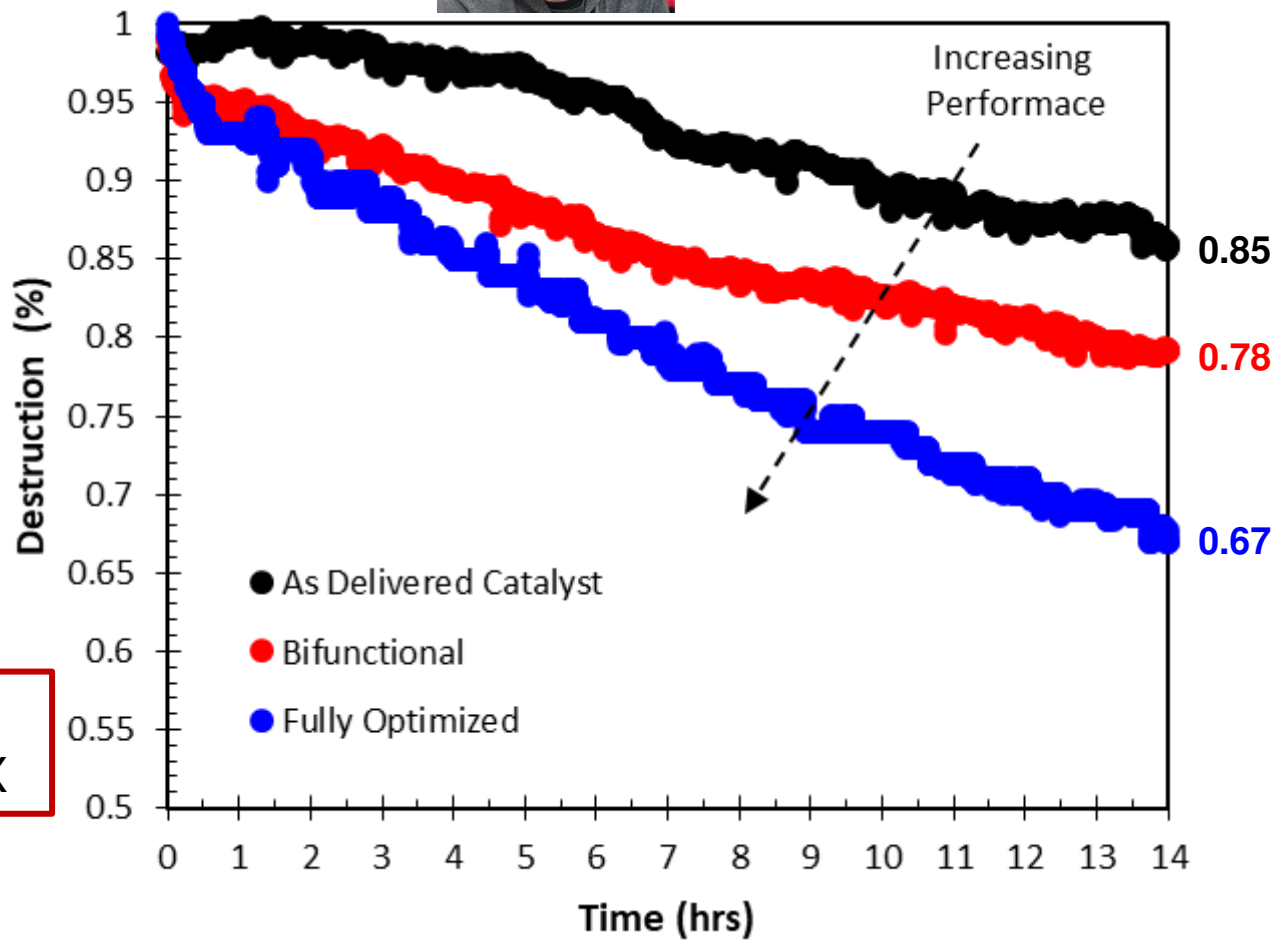
Catalyst Theory

Synergize two materials that perform different catalytic steps.

- Material A -> Strong adsorbent
- Material B -> Destruction catalyst
- Textbook bifunctional effect

Conclusion

Fully optimized material increased performance by 2X



(2) Extruded Catalysts for Oxidation & Other Chemistries

Background

Applied Technologies has extruded inorganic materials since 1967 accumulating 50+ years of application knowledge.

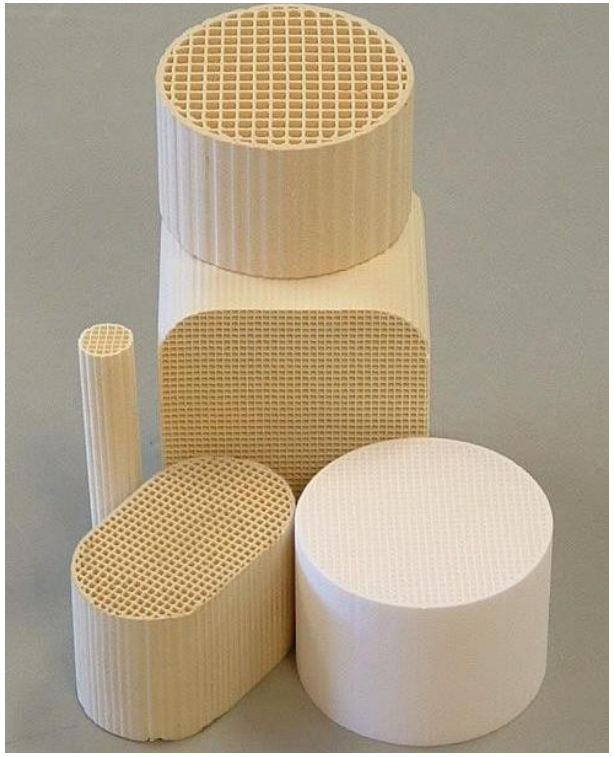
- Custom Products
- Contract Manufacturing

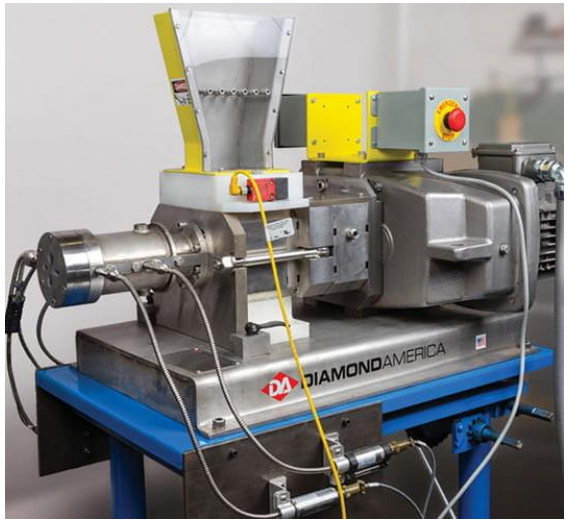
Materials (including but not limited to)

- Alumina
- Silica
- Base metal catalysts
- Precious metal catalysts

Why Applied Catalysts?

- Quickly adapt to execute projects
- Strong understanding of structure-function catalysis
- Extensive history commercializing technology
- Diverse chemistry experience





(3) Tubular Design of a Partial Oxidation Reactor

Problem Statement

Design a tubular reactor for improved performance.

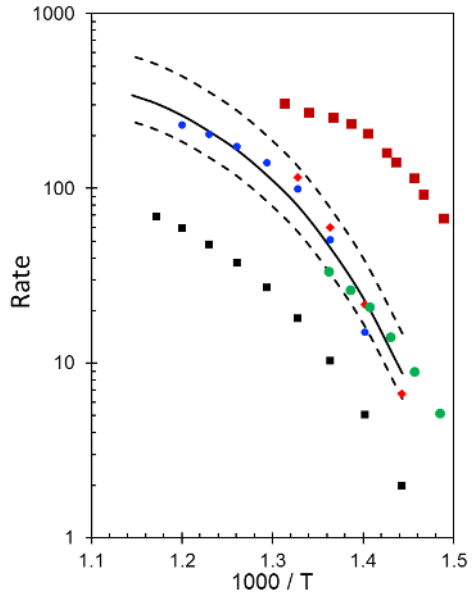
- Increase pressure (Better kinetics)
- Increase heat recovery (More steam)
- Decrease startup time (Reactor preheat)

Materials and Methods

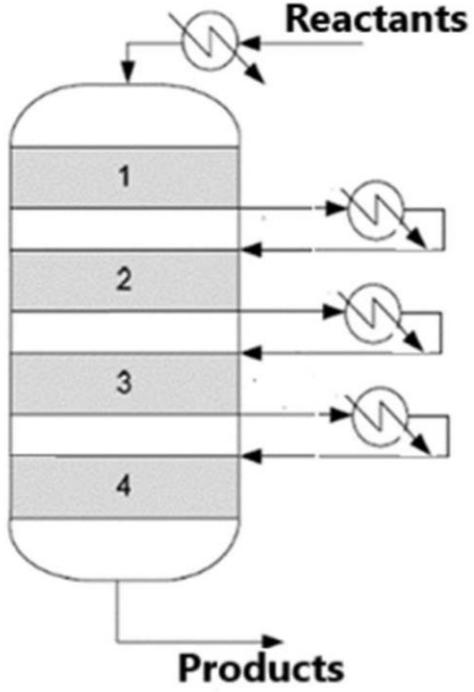
Python model including:

- Mole balance, conv. vs. cat. weight profile
- Energy balance, temp. vs. cat. Weight
- Momentum balance
- Rate Law

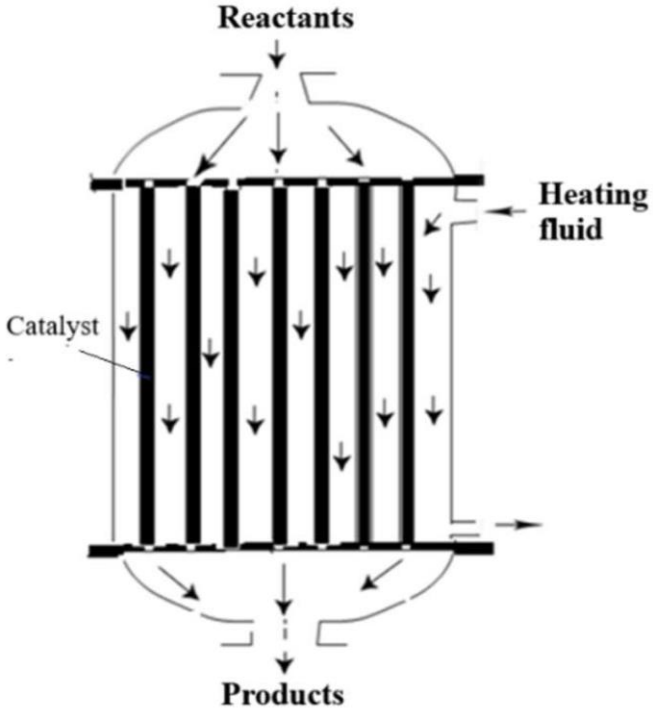
Dr. Greg Tate
Sr. Chemical Engineer



Adiabatic Design



Improved Isothermal Design



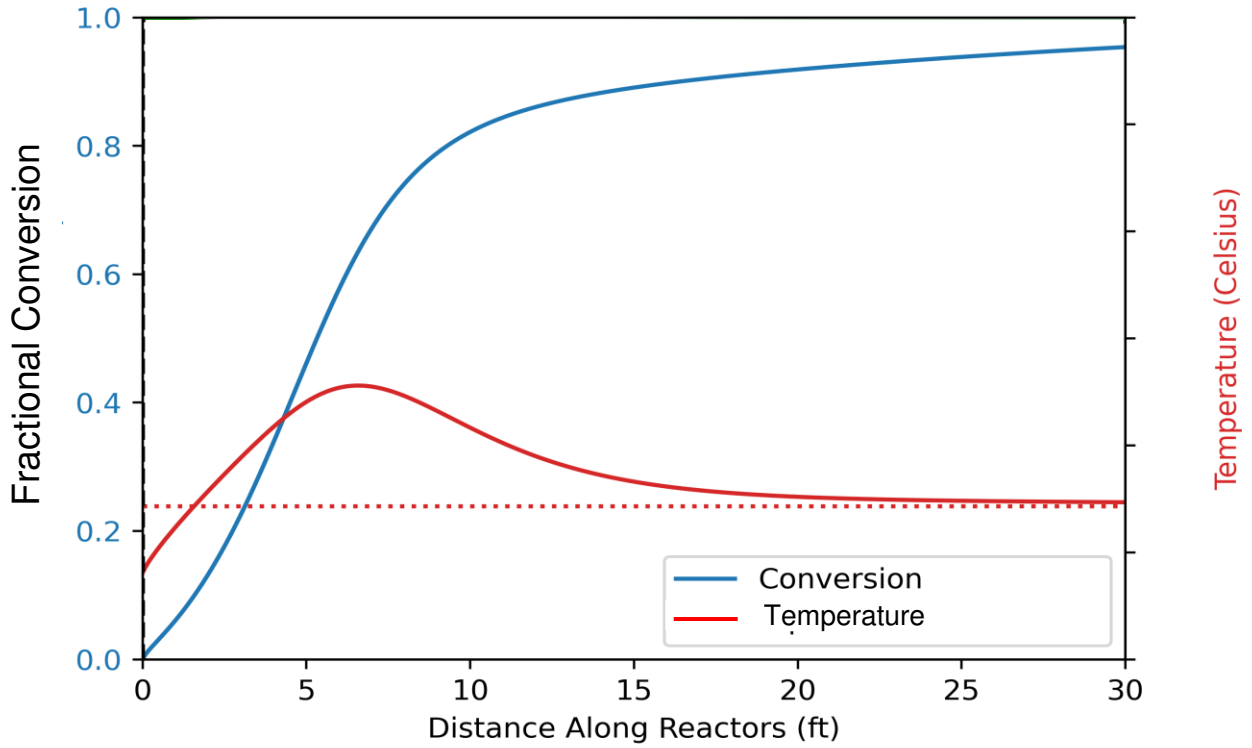
(3) Tubular Design of a Partial Oxidation Reactor

Results

- Exotherm is manageable with tubular design
- Reactor Length -> 30 ft
- Conversion -> 95+%

Conclusion

- Model further used to quickly screen & optimize geometries



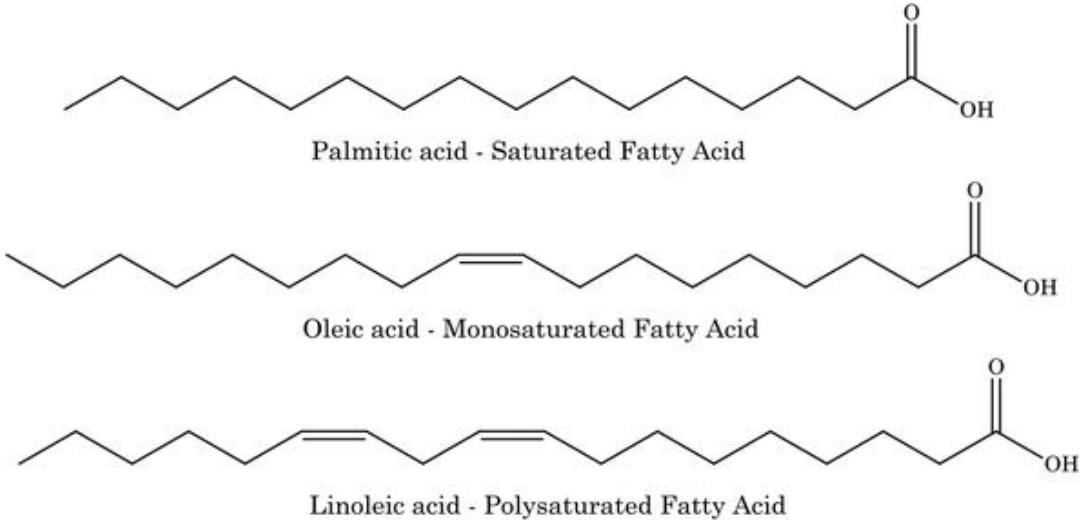
(4) Hydrogenation of Proprietary Oleochemicals

Hunter Brown
Chemical Engineer

Problem Statement

Develop a hydrogenation process for two different oleochemicals

1) Palm oil derived
2) Modified oil with sucrose core

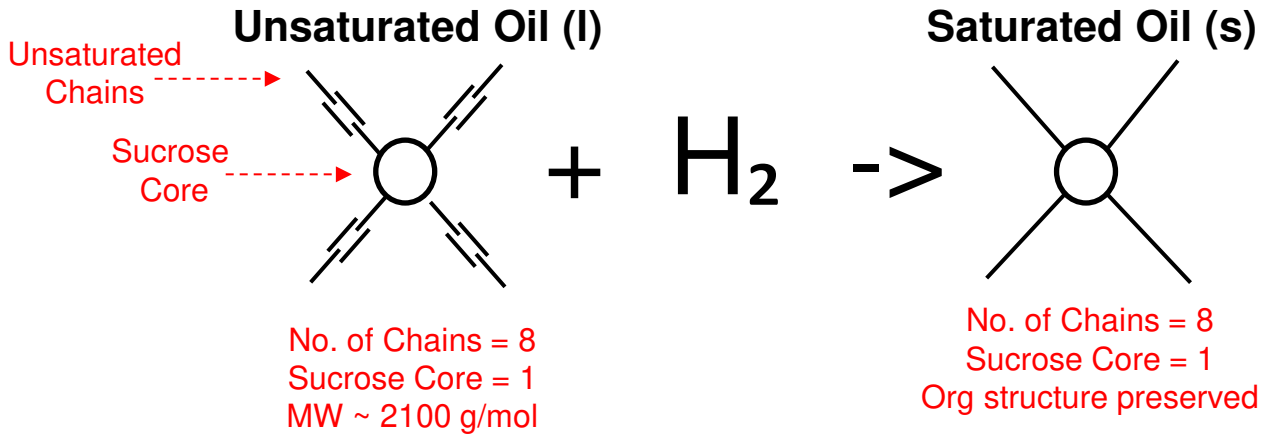


Theory (Batch Systems)

- 10-15% product loss on filtration
- High catalyst attrition rate (fines)
- Slow production method with multiple steps.

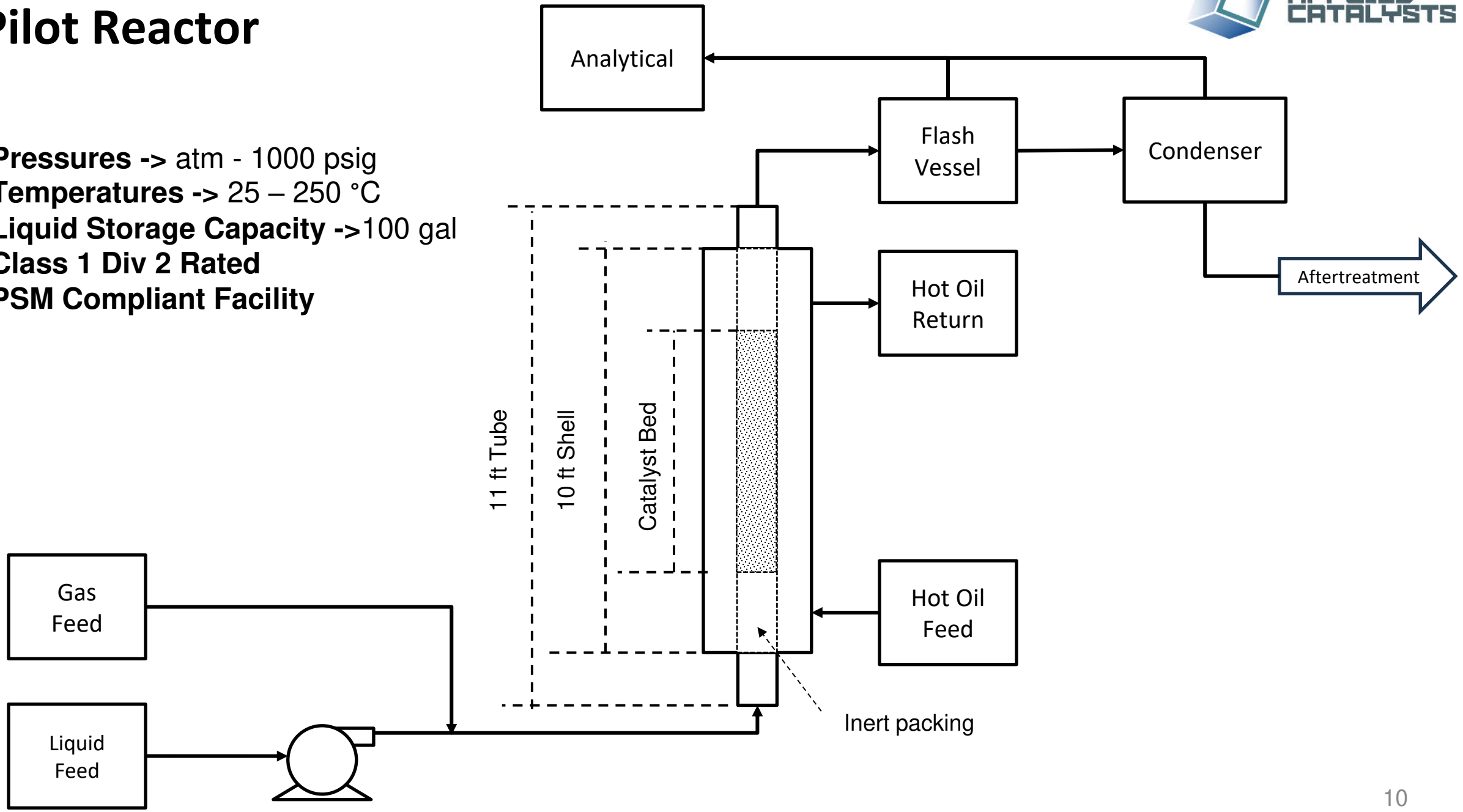
Materials and Methods

- Use flow configuration
- 11 ft show tube reactor
- Screen catalysts
- Optimize process conditions



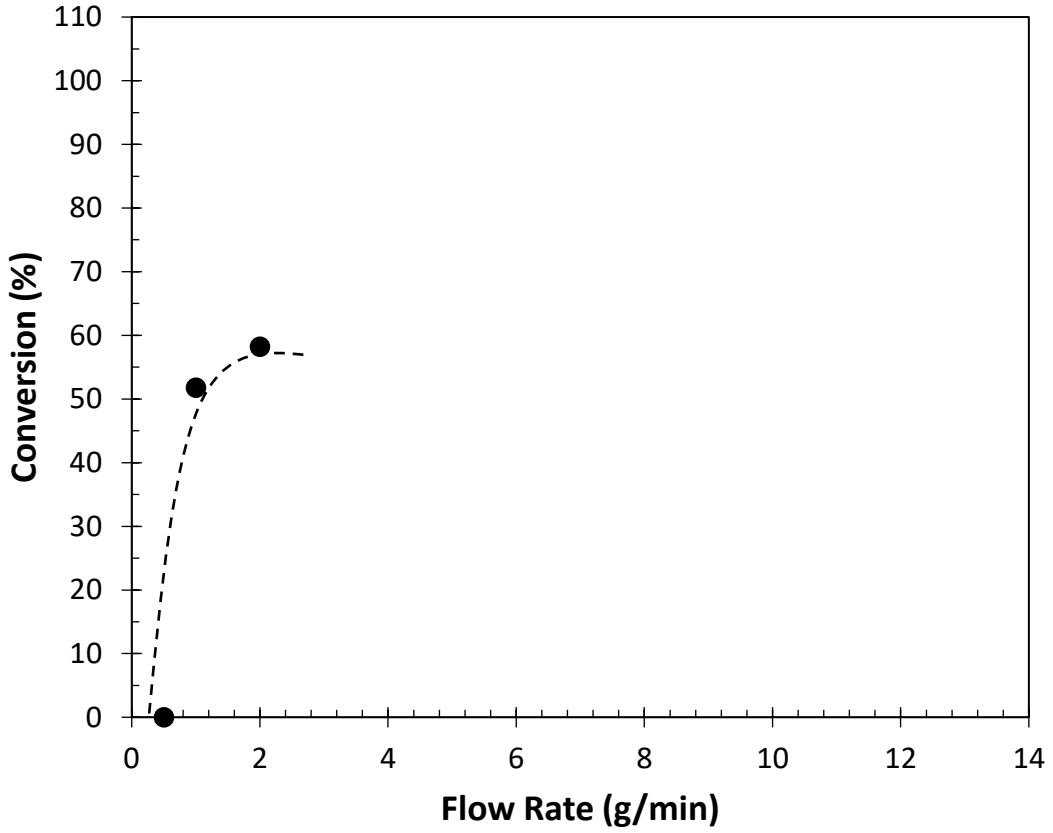
Pilot Reactor

Pressures -> atm - 1000 psig
Temperatures -> 25 – 250 °C
Liquid Storage Capacity ->100 gal
Class 1 Div 2 Rated
PSM Compliant Facility

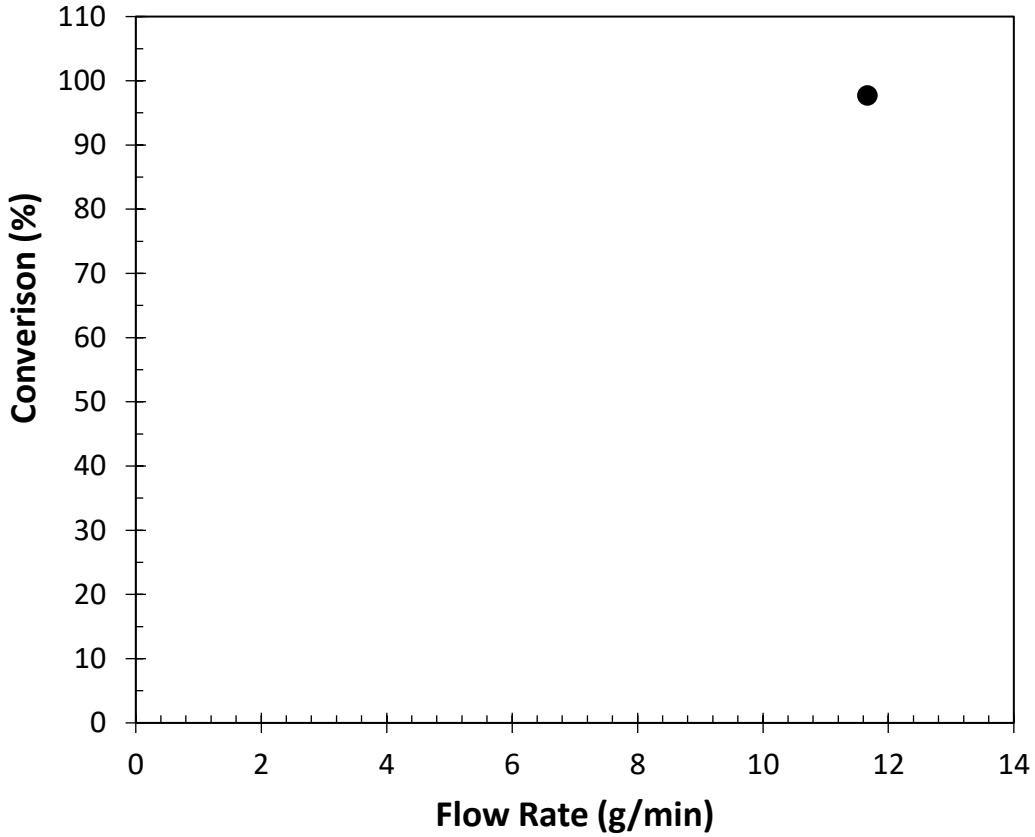


Flow Effect

Palm Oil Derivative



Sucrose Core



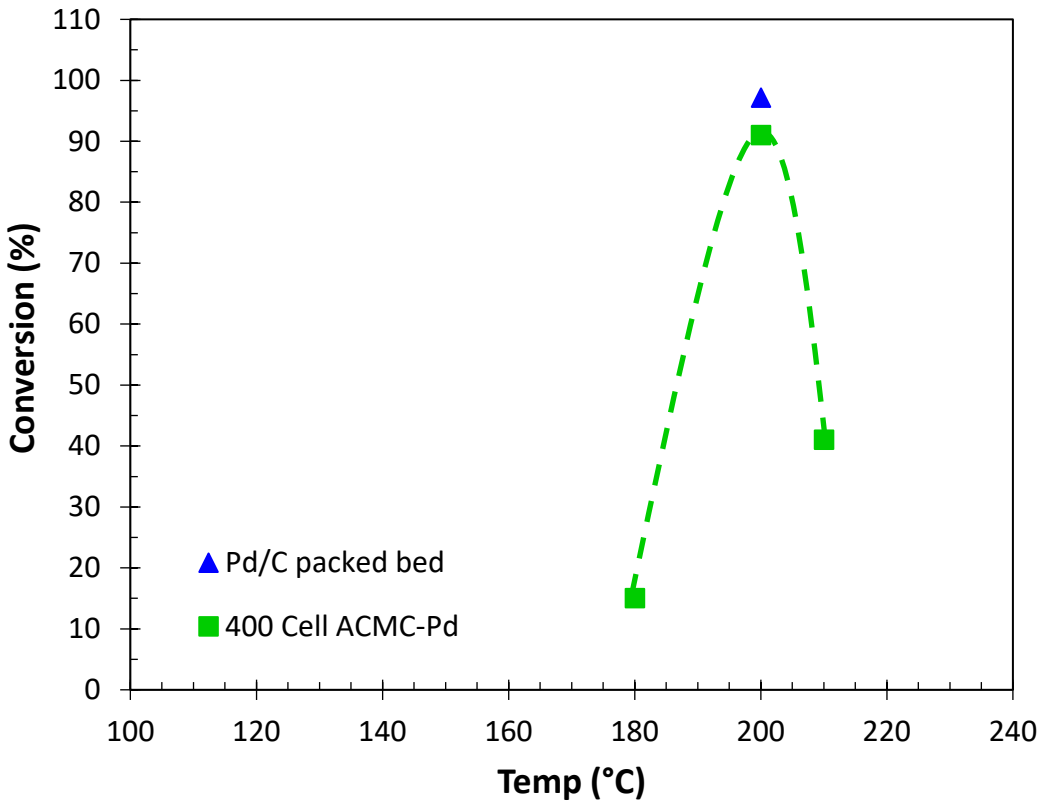
Conclusions

Palm oil system is heavily mass transfer limited

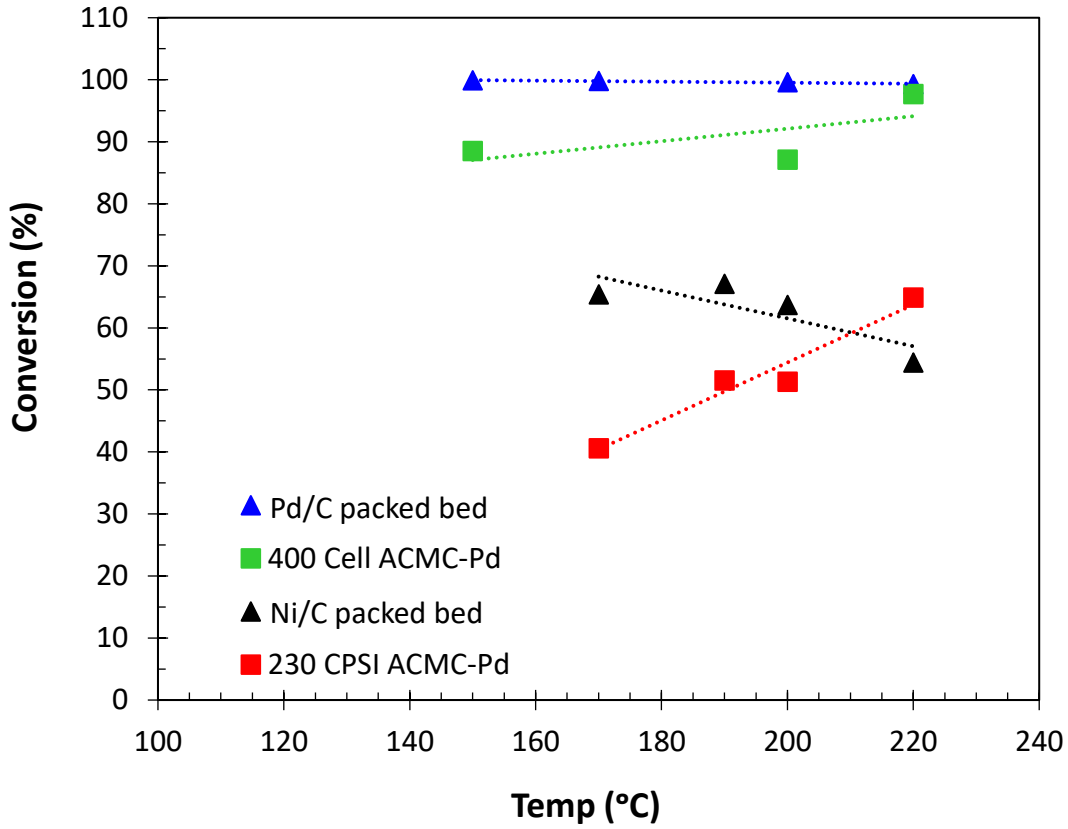
Need to increase rates!

Temperature Effect

Palm Oil Derivative



Sucrose Core



Conclusions
System is hydrogen starved
Poor solubility with higher temperatures

Scaleup to Commercial Volumes

Palm Oil Derivative

4500 ton/ year Reactor Sizing

- Tube Diameter: 1.18 in
- Tube Length: 30 ft
- **Number of Tubes: 5500**
- Shell Diameter: 125 ft
- L/D: 0.24
- **Catalyst Volume: 1289 ft3**
- Not feasible in flow. Recommend batch reactor configuration

Sucrose Core

4500 ton/ year Reactor Sizing

- Tube Diameter: 1.18 in
- Tube Length: 10 ft
- **Number of Tubes: 39**
- Shell Diameter: 1 ft
- L/D: 11.40
- **Catalyst Volume: 131 ft3**

Conclusions
Different oils require different hydrogenation technology
Always run the chemistry!

Conclusions

Applied Technologies (1967) -> 50+ years of extrusion

Applied Catalysts (1997) -> 25-year history of precious metal and base metal catalysts

Applied Catalysts Offers

Catalyst Manufacturing

Batch and continuous catalysts with Mt/day manufacturing capacity

Development Services

Custom Catalyst Development, Catalytic Process Engineering

Catalytic Reactor Systems

Turnkey Lab, Pilot, and Production Reactor Systems

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Questions?

Booth 310

Dr. Ben Egelske
Sr Chemical Engineer

Lee Mitchell
President

APPLIED CATALYSTS