Albemarle’s Role in Polyolefin Catalyst
Presentation Overview

- Albemarle overview
- Albemarle's Role in PO catalysts
  - Case study
- ActivCat™ – Transformational Activator Technology
- Latest Development & Conclusions
Albemarle Corporation

...who we are

2007 Net Sales - $2.33 billion

- Provider of unique technical solutions
- Supports three business segments with strong, balanced product portfolios
- Leading positions in key markets with strong growth fundamentals
- Proprietary technology and service-driven business model
- Fundamentally strong margin and cash flow businesses
Global Presence

Research & Development
- Baton Rouge, La.
- Dayton, Ohio
- Tyrone, Penn.
- Pasadena, Texas
- Santa Cruz, Brazil
- Amsterdam, Netherlands
- Louvain-La-Neuve, Belgium
- Bergheim, Germany
- Nanjing, China
- Niihama, Japan

Sales/Tech Service
- Baton Rouge
- Houston
- Amersfoort, Netherlands
- Bergheim
- Dubai, UAE
- Louvain-La-Neuve
- Tokyo
- Beijing
- Guangzhou, China
- Nanjing
- Shanghai, China
- Seoul, Korea
- Singapore

Manufacturing
- 21 Manufacturing Sites

- 3,700 associates
- Sales in more than 100 countries
- 2007 Net Sales: 44% Americas, 38% EU-ME-A, 18% Asia Pacific
Albemarle Catalyst Overview
Leveraging Expertise Across All Catalyst Disciplines

• $1 billion in total catalyst revenue
• 250 employees in R&D
• Dedicated resources for polyolefin catalyst
• Manufacturing and R&D at same location
• A Global Leader in
  – Activator production and technology development
  – Metallocenes and single site catalysts
  – Organometallics for ZN catalysts

Our expertise makes us the preferred catalyst manufacturing partner
Market Dynamics Demand Innovation
Challenges for Catalyst Suppliers and Resin Producers

- Market recession weakens demand for PO resins
- Excess global capacity of PE and PP with new ME plants
- Need for Western producers to differentiate product line
- Need for global catalyst production expansion
  - Launched 2008 expansion and planned expansion in 2010
- Increased demand for development and scale-up
- New catalyst systems in commercialization stages

Resin producers need a reliable, value-added catalyst strategy for growing specialty Ziegler-Natta and metallocene catalyst systems
Albemarle Corporation – PO Catalysts
Our Value Offering to the Polyolefin Industry

• Commercial Supply
  – Catalyst and component manufacturing
  – Back integrated in aluminoxane and organoboron activators
  – Total supply management
    ▪ Procurement, production, hopper maintenance, testing, and shipping
  – Asset management (working capital and capacity management)
  – Safety and Product Stewardship

• Product Development
  – Speed to market
  – World class facilities

• Technology Innovation
  – Process Development
  – Activation Technology

Albemarle can make your life easier
Albemarle can make your company more money
Finished Catalyst Capability – PE/PP
Albemarle’s Expanding Role in Finished Catalyst Supply

Catalyst Systems

Albemarle Strategy

Metallocene SSC

Ziegler-Natta

Improve value to customer without compromise to resin performance / properties
Albemarle’s Role in Catalyst Development
Commercialization of Customer Catalysts is our Specialty

Concept
- Market Need
- Concept Review
- Feasibility Study

Catalyst and Resin Development
- Preliminary Design of Catalyst
- Final Design / Plant modifications
- Prototype PO Production
- Field Test

Resin Production
- Production Scale-up
- Marketing Review
- Product Launch

Albemarle Arena
- Need
- Concept
- Prototype
- Test
- Commercial
- Catalyst Development

Iterative Process
Technology Transfer

Bench
Kilo Lab
Pilot Plant
Scale-up
Commercial

Process Development
Catalyst Sales
Case Study One: SSC for slurry process

- **Objective**
  - Good morphology: right PSD, no fine particles
  - Higher productivity: lower cost in use
  - No reactor fouling

- **Experimental program**
  - Silica selection
  - Silica calcination T
  - MAO loading
  - Metallocene/MAO ratio
  - Impregnation conditions:
    - T, T profile, time, concentration
  - Bench polymerization testing
Case Study Two: Ziegler-Natta Catalyst

• Objective
  – Good morphology: right PSD
  – Lower manufacturing cost
    ▪ Shorter cycle time
    ▪ Higher slurry concentration

• Experimental program
  – Process conditions optimization
    ▪ T, T profile, time, concentration
  – Filtration vs decantation
  – Bench polymerization and polymer characterizations
Recent Catalyst System Improvements
Successful Collaboration with Albemarle

• Catalyst Reactor Fouling
• Productivity Improvement
• Catalyst Flowability
• Catalyst Agglomeration
• Resin Particle Size / Resin Flowability
• Halide-Free Activation
• Catalyst Sensitivity to Poisoning

Solutions through Albemarle innovation and process development
INTRODUCING

ActivCat™
Customer Supported Catalysts
Employing our
Next Generation Family of Activators
The Value of Our Activation Technology

• Extended I-P for your custom catalyst systems
  – Protect current market channels through I-P barriers

• Improved value for commercial catalyst systems

• Optimized cost-in-use and increased market penetration rate of newly commercialized catalyst systems

• Dedicated R&D for new activators

Customer value gained through lower cost-in-use and defended market position through intellectual property protection
ActivCat™ – What is it?
Lowering Cost-in-Use and Eliminating Perceived Cost Issues

• Based on aluminoxane co-catalyst

• Typical productivity at 200% of conventional MAO/silica type catalysts with metallocenes

• PE and PP resin production

• Resin properties equivalent to standard MAO/silica catalysts

• Tested with different types of metallocenes
  – About one dozen to date

• Albemarle I-P and available to our customers

• Working with our customers to commercialize finished catalysts

Customize YOUR catalyst systems with ActivCat™
ActivCat™ Productivity Improvements
Albemarle Activation Innovation

Transformational Productivity Improvement

![Graph showing productivity improvements between PE and PP using ActivCat catalysts](image-url)
Latest development

• China Aluminium Alkyls distribution site established in 2006, to serve the Chinese market

• Developing a strategy to address growth in the Middle East region

• Approved the new Catalyst Manufacturing Unit at the Process Development Center in the USA (under construction)

Market growth demands met through Albemarle expansion
Conclusions

• Albemarle adds value and reliability
  – Fully integrated catalyst supplier
  – Effective supply chain management
  – Capital expansions
  – Product and safety stewardship
  – Process development and innovation

• Albemarle is the leader in activation technology
  – Extends customer intellectual property
  – While driving improvements in catalyst cost-in-use

• Contact us to find out…
  … What two can do!