Innovation in Emerging Areas in Packaging

Dr. Narayan Ramesh
Packaging and Specialty Plastics R&D
The Dow Chemical Company
Freeport, Texas

ANTEC 2017
By 2030, the world’s population will reach 8.3 billion

The world will need...
50% more food
45% more energy
30% more water
Performance Plastics

Plastics play a major role in all segments today

Packaging
- Food and Specialty
- Industrial & Consumer

Hygiene & Medical
- Diaper
- Fem Care
- Adult Incontinence

Transportation
- Bumper and Fascia
- Interior Trim
- Hose and Tube
- Weather-strip

Infrastructure
- Roofing & Flooring
- Artificial Turf
- Telecommunications
- Power
- Pipe

Consumerism
- Hot Melt Adhesives
- Housewares
- Footwear

Benefits: Durability, Toughness, Haptics, Reliability, Appearance, Sustainability, Safety & Protection

Customer base requires a cost-performance balance & other benefits (Haptics, Sustainability etc)
The Growth of Polyolefins

1975 Prediction for 1995
- High Performance Engineering Thermoplastics e.g. PEEK, sulfones, PPS etc.
- Nylons, ABS, PS, SAN, etc.
- Polyolefins, PE, PP, LLDPE, EPDM etc.

1995 Reality
- 80%
- 19%
- 1%
The Growth of Polyolefins

1975 Prediction for 1995

- Customers will pick the cheapest solution that meets their performance criteria.
- You can give away extra performance, but customers won’t pay for it.

1995 Reality
Inter-material Substitution: Balancing Act

- High Cost
  - High Performance
- Low Cost
  - High Performance
- Low Cost
  - Moderate Performance
- High Cost
  - High Performance

Cost

Environmental impact

Performance
The Evolution of Polyethylene:

An Evolution of Catalysis!

**LDPE**
Radical mechanism (1933)
- High Temperature & Pressure
- Many reactions possible
- Kinetics complicated

Highly Branched:
- Excellent flow properties
- Fast extrusion rates
- Poor mechanical properties

**LLDPE**
Coordination catalysis (1950’s)
- Low Temperature & Pressure
- Multiple catalytic sites
- Nobel Prize Zielger & Natta 1963

Linear Backbone:
- PE homopolymer: crystalline
- Copolymers: flexible and tough
- Inhomogeneous

**mPE**
“Single Site” catalysts (1990’s)
- Molecular catalysts
- Kinetics the same for each site

Homogeneous Polymers:
- Narrow molecular weight distribution
- Narrow comonomer distribution
- New monomer combinations
- Long chain branching
Polymer Properties Determined by Catalysis

Composition of each chain determined by relative kinetic rates:

Molecular structure of polymer chains determines bulk structure:

- **Lamella**: long sequences of ethylene units fold into crystallites
- **Interfacial regions**: “defects” are excluded into amorphous regions
- **Tie molecule**: Bridge more than one lamellar crystallite

With “Perfect” Kinetics Properties are Correlated

More comonomer = lower density = less crystallinity = softer material = lower melting
Market-driven Innovation Model

An average of 40 new products are launched globally each quarter – driven by innovations in packaging.
Material Science: From Catalyst to the Supermarket Shelf

**Y - Market Trend**
- Up to 25% Down-gauging

**y - Product Functionality**
- Higher abuse at a given modulus
- Lower diffusivity/solubility of water vapor & oxygen
- Broad sealing window
- High hot tack strength

**x - Molecular Structure**
- Control of LCB & SCBD
- Crystal structure & orientation control
- Control of MWD
- Control of SCBD

- Improved barrier for increased shelf life
- High production rate for food packaging
- Lower defect rate
Resins to Structures → Deliver Functionality & Sustainability

ML Structures
3-11 Layers

Functionality
- Print/Appeal
- Bulk
- Tie
- Barrier
- Structural
- Processing
- Abuse
- Sealant

Sustainability
- Down-gage
- Recyclable
- Renewable Energy

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Superior Packaging Abuse Resistance

Collaborate
- Reduced Weight & Thickness

Innovate
- Superior Stiffness & Toughness

Accelerate
- Higher Performance

Up to 25% Down-gauging

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Breakthrough Compatibilization for Barrier Packaging

Collaborate
Improved Compatibilization of Polyethylene & EVOH / PA

Innovate
Advanced Compatibilization Solutions

Accelerate
Recyclable Barrier Package

- Cap Layer: PE
- Tie Layer: AMPLIFY™ TY
- Barrier Layer: EVOH, Polyamide
- Tie Layer: AMPLIFY™ TY
- Sealant Layer: PE

Non Recyclable Pouch
Recyclable Pouch By Dow

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Packaging Solutions by Design

Collaborate
- Reduced Weight

Innovate
- Package Design

Accelerate
- Efficient Packaging

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Comparison of Deformed Shape

The pouch deformation is decreasing with increase in the pouch length.
Procedure for shelf stability modeling

FE model for 100% filled pouch based on laminate properties

Actual pouch 100% filled with water

FE Deformed shape of pouch with Laminate material properties
Enhanced PE Functionality For Structure Simplification

Resins

Packaging Functionality

Solution

Sustainability = Combining Technologies + Full Value Chain Connectivity

AGILITY Performance Low Density Polyethylene (LDPE) by Dow Chemical Co. received the Market Disruptor-Products Bronze Award

Equipment (Bosh VFSS) - Material Change (Dow) - Consumer education (SPC How to Recycle label) – Retailer (Drop off location) - Brandowner (Scalability).
Delivering Sustainable Value

2025 Sustainability Goals

- Process Innovation
- Energy Efficiency
- Recyclable Solutions
- Energy Bag Pilot Program

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Resin Manufacturer

Converter

Brand Owner

Retailer & Consumer

Catalyst Breakthroughs

Dowgauging / Improved Impact

Recycle Compatibilizers

PacXpert™

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Thank You