NEW TOPICS

Composites • TPOs • System Controls • New High-Tech Costing Software • Distortion Printing
Thermoforming Streamlined Images • Material Properties • Testing • Specifications

Sunday, March 4, 2007

Registration & Welcome Reception . . 6:00PM to 8:00PM

- With food and refreshments funded by our sponsors
- Plenty to eat and drink!
- Great networking atmosphere!

Come and introduce yourself to the other participants, speakers and sponsors in this informal setting.

Monday, March 5, 2007

Registration	7:00AM – 8:30AM
Symposium	8:30AM – 5:00PM
Reception	6:00PM – 8:00PM

Introduction to Thermoforming

8:30AM – 8:45AM

Speaker: **Bill McConnell**

Agenda for the week

Material Sheet Behavior and Testing for Processing Excellence and Quality Control in Thermoforming

8:45AM – 11:45AM

Speaker: **Don Hylton**, Associate, McConnell Company, Inc.

This three-part materials study is designed to provide:

1. A basic understanding of material behavior in thermoforming.
2. The variables that affect performance in every phase of the process from polymerization to end-use.
3. Sheet testing and specifications.

The sessions include discussions on material attributes such as morphology (shape and structure), rheology (flow properties), and blending, with emphasis on their effect on thermoforming behavior. There is information on why certain materials form better than others; thermoplastic elastomers and their behavior; crystalline materials and how they differ from amorphous materials; and why some materials have unique properties such as moisture retention. In addition, the attendee learns the importance of testing for forming consistency and excellence and how testing helps us understand and specify forming behavior.

The course provides a summary of ASTM and other relevant laboratory tests for thermoformability. It also explains how and why specific material properties should be tested and how to incorporate this understanding into quality management.

A. Polymers

1. Polymer Chemistry
   a. Effect on Processing
2. Polymer Morphology
   a. Why it's Important in Processing

B. Types of Thermoforming Materials

1. Amorphous Materials
2. Crystalline Materials
3. TPO Elastomer Materials
   a. How resin is manufactured
   b. TPO rheology
4. Other Elastomers TPE, TPU, etc.

Coffee break 10:00AM – 10:15AM

C. Rheology and Viscoelasticity

1. What is Viscoelasticity?
2. Role of Viscoelasticity
3. Effect on Processing

D. Polymer Processing

1. Principle of Accountability
2. Process Flow Diagram
3. Material Behavior in Processing
4. Bulk Properties
5. Heat Histories
   a. Extrusion
   b. Heating, Cooling
   c. Post Extrusion Converting
6. Part Performance

E. Material Testing

1. ASTM Methods and Standards
2. Tests for Formability
3. Applicability

F. Material Testing as a Quality Control Tool

1. Specifications
2. Laboratory QA/QC

G. Material Specifications That Should be Considered When Ordering Material

1. Specs for Cut-Sheet (heavy gage)
2. Specs for Thin Gage (roll-fed)

Special: Texstars' "Bird Strike Video" 11:45AM – 12:00 NOON

Lunch 12:00 NOON – 1:00PM

Thermoforming Optically Clear and Class A Finished Parts

1:00PM – 1:45PM

Speaker: **Jim Irion**, Vice President Engineering, Texstars, Inc

1. Material Types Processes
2. Forming Optically Canopies, windshields, etc.
3. Secondary Treatments
4. Inspection Methods

Thermoforming Methods

1:45PM – 5:00PM

Speaker: **Arthur Buckel**, Associate, McConnell Company, Inc.

A. Webbing

B. Vacuum Forming

1. Why Fast Vacuum Needed
2. Vacuum Pressure Measurements
3. Surge Tanks, Vacuum Line and Solenoid Sizes, 90° and Elbows, etc.

C. Pressure Forming (Use of Compressed Air)
1. Free Pressure Forming
2. Pressure Plate or Box Forming
3. Pressure Box Forming – Roll Fed Thin Gage

D. Mechanical Forming
1. Stretch Forming
2. Ridge Forming
3. Strip Heating

E. Modifications of Basic Forming Methods
1. Pre-stretching
2. Snap Back—Male Mold
   a. Billow Snap Back—Male Mold
   b. Billow Snap Back (with a pressure chamber)
3. Billow Snap—Female Mold (No Plug)
4. Plug Assist—Female Mold
   a. Billow Plug Assist—Female Mold
5. Twin Sheet Thermoforming
   a. Process
   b. Molds
   c. Twin Sheet Thermoforming Machines

F. Slip Forming
1. Loose Clamping Frame
2. Clamping Two Sides of Sheet
3. Use of Multiple Vacuum Zones

Forming of Composite Thermoplastic Sheet
4:30PM – 5:00PM
A special presentation from Art Buckel
1. Material Properties and Applications
2. Mold Designs
3. Sheet Heating and Forming Techniques
4. Trimming

Welcome Reception
6:00PM – 8:00PM
Crowne Plaza Hotel
- Funded by our Sponsors
- Plenty of Food and Drink!
- Great Networking Atmosphere

Tuesday, March 6, 2007
8:30AM – 5:30PM

Methods of Measurements in Thermoforming
8:30AM – 9:30AM
Speaker: Dennis Northrop, Technical Services Manager
Avery Dennison
1. Understanding Variation
2. Measurement Methodology
3. Measurement Used During the Thermoforming Process
4. Measuring Thermoformed Parts
5. Putting It Together, for Your Customer
6. Case Study

Plant Tours
9:45AM – 5:30AM
Depart hotel for plant tour 9:45AM
Skyline Career Development Center
One of the foremost vocational plastics high schools in the nation.
Return to hotel for lunch
Depart hotel for plant tours 12:45PM (approximately)
Spartech Plastics
Custom sheet extrusion plant
Kinro Composites (Better Bath Components)
A large custom thermoforming plant
Return to hotel by 5:30PM

Dinner at the Trail Dust Steak House
6:30PM – 9:00PM
- Dress in your best "cowduds"
- Funded by our sponsors
- Transportation is provided for the plant tours and dinner.

Wednesday, March 7, 2007
8:30AM – 5:15PM

Process Controls Workshop
8:30AM – 11:00AM
Improved Production Capacity of Your Equipment by Use of Modernized Controls
Speaker: Michelle Curenton, Sales Engineer, Facts, Inc.

A. Modernize Controls
1. Develop product codes for process variables
2. How to tune controls to automatically adjust set points for closed-loop control algorithms (including platen movement, gage/profile, temperatures & when vacuum &/or compressed air is applied)
3. How to improve quality & consistency with improved controls
4. Use of trend charts/graphs & also alarming
5. Data collection to assist in on-line troubleshooting/diagnostics

Coffee break 10:00AM – 10:15AM

Software for Real Time Production Control & Cost Analysis
11:00AM – 11:30AM
Speaker: Gregory Shteyngarts, Amros Industries, Inc.

A. Software That Allows Management, Scheduling Customers' Orders and Monitoring All, Utilizing PLC to Track in Progress
1. Simplify order scheduling process
2. Monitor productivity in Real Time Environment
3. Second job status info
4. Easily manage open orders portfolio
5. Collect production data for analysis
6. Ability to monitor any machine in your facilities on your laptop computer from **anywhere!**

Thermoforming HIPS Cups Lids at 55-60 Cycles/Minute

11:30AM – 12:00 NOON
Speaker: Mark Zelnick, President, Zed Industries, Inc.

A. Hurdles to Overcome When Thermoforming at 55-60 Cycles/Minute

1. Press movement
2. Press design
3. High speed film sheet/film indexing system
4. Control systems
5. Process air sequencing

Lunch 12:00 NOON – 1:00PM

Heating

1:00PM – 1:30PM
Speaker: Bill McConnell

A. Introduction
Thermoforming Sheet/Film Processing
Temperatures Environment

B. Types of Heating

1. Convection
   a. Preheat Oven for Roll Fed Machines
   b. Cell Cast Acrylic Ovens
   c. Heating of Heavy Gauge Solid and Foam Sheet
   d. Prototype Forming
   e. Drying of Hydroscopic Sheet Such as ABS, PC, Etc.
2. Conduction
   a. Conduction Heating Plates
   b. Form-Fill-Seal Thermoforming Machines
   c. Heat-Form-Trim in Same Station Machines (GN, Kirkoff, Etc.)
3. Radiation
   a. Electromagnetic Radiation Introduction
   b. Types of Radiant Heat
      1) Coiled Resistance Wire
      2) Metal Tubular Heaters
      3) Flat Panel Heaters
         a) Ceramic
         b) Flat Aluminum
         c) Flat Steel
         d) Flat Quartz
         e) Glass (Such as Pyrex, etc.)
         f) Woven Quartz Cloth
4. Quartz Tubes
5. Gas Heaters
   a. Catalytic Heater Panels
   b. Open Flame Heaters
6. Halogen

Infrared Radiation Heat Imaging Systems

1:30PM – 3:00PM
"Hands-On" Demonstrations

Demonstration Leader: Rich Shannon, Product Mgr.
Ametek Land, Inc.

Teammates: Jim Bonkowski, Ametek Land, Inc.
Paul Ross, VP, Solar Products, Inc.

This session will discuss the applied theory and recommended practice for making temperature measurements using infrared thermometers. Attendees will divide into three groups for "hands-on" demonstrations with selected instruments. Participants may bring their own infrared thermometers for use during this session. A free calibration check, <1000°F, on a certified blackbody calibration source will be made available for participants' infrared thermometers. Avoiding the common pitfalls associated with high temperature reflections from heaters, transmitted radiation through thin sheet, and the challenge of measuring shiny metal molds will be among the topics demonstrated.

Coffee Break 3:00PM – 3:15PM

New Cooling Plate Technology

3:15PM - 3:30PM
Speaker: Bill McConnell

New technology on cast cooling plates designed for thin and heavy gage tooling with manifolds for good, uniform temperature control and embedded thermocouples.

Troubleshooting

3:30PM – 5:00PM
Speaker: Bill McConnell

1. Pilot Error
2. Mechanical
3. Material
4. Heating
5. Pressure (Vacuum & Compressed Air)
6. Controls
7. Question and answers

Thursday, March 8, 2007

THE HEAVY GAGE AND THIN GAGE SESSIONS ARE HELD CONCURRENTLY ON THURSDAY

Session 1 – Cut Sheet (Heavy Gage) Thermoformers

8:30AM – 5:00PM

Tooling

8:30AM – 10:15AM

Speaker: Robert Browning, Associate, McConnell Company, Inc.

1. Male versus Female
2. Construction
3. Vacuum Holes, Races, Slots
4. Vacuum Zones & Moats
5. Break-Aways & Undercuts
6. Temperature Control
7. Mechanical Helpers
8. Spec Check List for Mold Design

Coffee Break 10:15AM – 10:30AM

Changes in Design & Mold Manufacturing

10:30AM – 11:50AM

Speaker: Ken Griep, Vice President, Portage Casting & Mold, Inc.

1. An Initial Request for Quote
2. Quotation
3. Design and Prototype Part
4. Mold Tryout
5. Production

Lunch 12:00 NOON – 1:00PM

Trimming Thin and Heavy Gage

1:00PM – 2:00PM

Speaker: Robert Browning, Associate, McConnell Co., Inc.

A. Safety in Trimming

B. Trimming Tools

C. Route and Drill

D. Saw

E. Die Cut, Shear, Punch

1. Steel Rule Dies
2. Matched Punch Dies
3. In-mold Dies
4. Heated Dies

F. Robotics

1. Routing
2. High Pressure Waterjet
3. Laser

G. Deburring

Rigidizing

2:00PM – 2:30PM

Speaker: Bill McConnell

1. Bonded Doublers
2. Fiber Glass Spray-ups
3. Twin Sheet
4. Foam-in-Place
5. Spray-foam-up

New Thermoforming Machines "Break-Through"

2:30PM – 3:00PM

Speaker: Al Pedersen, President, AVT

Coffee Break 3:00PM – 3:15PM

Modernized Technology in Heavy Gage Equipment

3:15PM – 3:45PM

Speaker: Jim Robbins, VP Marketing, Brown Machine, LLC

1. Quick change clamp frames
2. Open architecture machine control systems
3. Faster mold changes
4. Pre-heat stations
5. Oven zoning techniques
6. Servo valves for vacuum and air pressure control
7. Precision high speed platens
8. Oven tracking systems and construction methods

Sheet & Film for Thermoforming

3:45PM – 5:00PM

Speaker: Bill McConnell

1. Extrusion
2. Extrusion Laminating
3. Coextrusion
4. Biax
5. Calendering
6. Casting
7. Press Laminating/Compression Molding
8. Use of Regrind
9. Questions and Answers

Session 2 – Thin Gage Thermoformers

Lunch will be at 12:00 NOON – 1:00PM

Roll–Fed Thermoforming – Choosing the Right Machine & Tooling Options

Speakers:
Barry Shepherd, President, Shepherd Thermoforming & Packaging
Rita Webb, Sales Engineer, ODC Tooling & Molds.

A. Roll-fed machine alternatives

1. In-line steel rule die
2. Off-line matched metal trim
3. Cut-in-place
4. Inexpensive models
5. Extrusion in-line

B. Pushing the limits of roll-fed equipment

1. Materials being run today
2. Size limitations
3. Optional equipment
4. Cycle time limit

C. Tooling Options - How to select the right one!

1. Form &Trim In-place vs. Form & Trim In-line
2. Forged Kisscut trim vs. Matched Metal trim
3. Male vs. Female molds
4. Interchangeability
5. Quick-Change

D. Specialty Tooling Applications

1. CPET Food Trays
2. 3rd Motion Plug Assist Forming
3. Large Bed - Family Molds
4. Berry Baskets - Sidewall vented containers
5. Deep-draw Polyolefins
6. Contour / Automotive applications

E. Trouble Shooting

Friday, March 9, 2007

8:00AM – 1:00PM

Thermoforming Design for Designers of Thin and Heavy Gage Products

Speaker: Robert Browning, Associate, McConnell Co., Inc.

This is a comprehensive one-day seminar on thermoforming product design, and the development of plastic products using thermoforming, pressure forming and twin-sheet thermoforming. This intensive, fast paced seminar will help to provide a better understanding of thermoforming design, its limitations and advantages. Both designers and non-designers will appreciate this straightforward, hands-on course, in expanding their knowledge and insight into today's fast-paced and competitive design world.

The program is presented by an industrial designer, with lecture, slides, videos, sketches, samples, real-world case studies and questions and answers. Attendees are encouraged to bring questions and their design problems for discussion.

Additional topics include forming polycarbonates on composite molds; TPO materials and forming techniques; distortion printing & thermoforming; forming parts for the automotive and airline industry; all topics explained with case studies.

A. Brief Background and History of Thermoforming

B. Process Review – Pros & Cons of the Different Forming Methods

1. Materials and Properties
   a. Thermoset vs. Thermoplastics
   b. Molding & Trimming
2. Tooling/Mold Design and Considerations
   a. Undercuts
   b. Male or Female Molds
   c. Articulating Molds
   d. Plug Assist
3. Tooling Checklist Review
4. Prototypes & Samples
   a. Methods
   b. Pros & Cons
5. Creative Design Alternatives
   a. Thermoforming
   b. Pressure Forming
   c. Twin-sheet Forming
6. Mechanical Considerations
   a. How is the Part Used
   b. Ribs
   c. Gussets
   d. Tolerances
   e. Material Thinning & Control
   f. Molded-in Inserts & Hardware
7. Environmental Considerations
   a. Environment Exposure to UV & Weather
8. Appearances, Finishes and Decorating
   a. Style
   b. Shape
   c. Color
   d. Texturing
   e. Surface Finish
   f. Molded-in Details
9. Design Limitations in Thermoforming
10. Do's and Don'ts in Design
11. When to Look at Other Processes
12. Product Development Management
    a. From Design Concept to Production
    b. Case Studies
13. Distortion Printing & Thermoforming
14. Troubleshooting

Special Case Study Presentations

- **Registration Forming of Distortion Printed Sheet**
- **Thermoforming TPO Materials**
- **Development of a High-End Spa/Sauna**

Adjourn— 1:00PM