



# Thermoforming Quarterly®

A JOURNAL OF THE THERMOFORMING DIVISION OF THE SOCIETY OF PLASTICS ENGINEERS

THIRD QUARTER 2015 ■ VOLUME 34 ■ NUMBER 3

**Special Extended Conference Edition**

## FORMING INSIGHTS WITH DATA



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- 2015 Thermoformer of the Year
- 2015 Conference Preview

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# Thermoforming Quarterly®

*A JOURNAL PUBLISHED EACH  
CALENDAR QUARTER BY THE  
THERMOFORMING DIVISION  
OF THE SOCIETY OF  
PLASTICS ENGINEERS*

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Cover Photo: *New thermoforming R&D laboratory, courtesy of Bosch Sprang BV*  
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# Welcome to the Conference Issue

Welcome to the Conference Issue of TQ! With our flagship event just about a month away, we offer a sneak peek at some of the show highlights in this edition. Our two keynote speakers will focus on the importance of design & manufacturing innovation and corporate leadership. While these topics are not groundbreaking in terms of novelty, they are central to running a healthy and profitable business. Sometimes, getting back to basics can produce unexpected results.

This year we will honor our newest Thermoformer of the Year, Barry Shepherd. Barry joined the SPE Thermoforming Division Board of Directors in 1997 and worked on several committees, including the Executive Committee, before retiring from the Board in 2010. His sons, Todd and Mark, continue to run Shepherd Thermoforming & Packaging ensuring that the family business continues for another generation. Barry's profile can be found on p. 30.

Our conference is also the time when we announce our annual scholarship winners. As we continue to stress in this magazine and through our work on the board, workforce development is critical to our industry's success. Four scholarships were awarded this year to students from Pittsburg State University, Michigan State and Penn State Erie. You can read the full bio of your next potential hire on p. 12.

In keeping with our tradition of publishing technical papers from students, this issue features a Lead Technical Article by Brian Robinson, a recent graduate of Penn College (Williamsport, PA) about new mold materials. We also feature the second in a 2-part series from Kettering University on their success in applying logic models to university-industry partnerships, something we have long advocated at SPE. On the industry side, toolmaker Bosch Sprang offers some insight into their approach to workforce development as they discuss their new R&D lab.

And from foreign shores, our editor reports from Feiplastic in Sao Paulo, Brazil where he interviewed the president of a commercial agency that specializes in plastics and packaging machinery (p. 34).

I look forward to seeing you all in Atlanta from August 31 to September 2. |

A handwritten signature in black ink, appearing to read 'Mark Strachan'. The signature is stylized and written over a light grey rectangular background.

# Thermoforming Quarterly®

## New Members

Peter Jones  
Skytec Plastics  
Seaford, VIC

John Gergely  
Acrylon Plastics Inc.  
Winnipeg, MB

Kyle Geroges  
Amut North America Inc.  
Vaughan, ON

Attila Nagy  
Pro-Form Kft.  
Budapest, HUNGARY

David R. Grice  
C&K Plastics  
Spring, TX

Rafael Quinones  
Mondelez International  
Atlanta, GA

Duncan Buhrmester  
Portage Plastics Corp  
Waukegan, IL

Samina Azad  
Dart Container Corp.  
Mason, MI

William Christopher Bravener  
Universal Protective Packaging  
Mechanicsburg, PA

David Alongi  
Maac Machinery Co. Inc.  
Carol Stream, IL

Matt Banach  
PTI Extruders  
Aurora, IL

Mauricio Eduardo Leano  
The Dow Chemical Company  
Lake Jackson, TX

Dennis Kelso  
SEKISUI SPI  
Bloomsburg, PA

Chase Camp  
Bilco Company  
New Haven, CT

Kristopher Eugene Dickinson  
Mid Michigan Community  
College  
Clare, MI

### Submission Guidelines

• We are a technical journal. We strive for objective, technical articles that help advance our readers' understanding of thermoforming (process, tooling, machinery, ancillary services); in other words, no commercials.

- Article length: 1,000 - 2,000 words. Look to past articles for guidance.
- Format: .doc or .docx
- Artwork: hi-res images are encouraged (300 dpi) with appropriate credits.

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## Jarden Buying Waddington for \$1.35 Billion

By Don Loepp, *Plastics News*

July 12, 2015 — Jarden Corp. announced July 13 that is buying Waddington Group Inc., a maker plastic food-service products, for \$1.35 billion.

The deal is scheduled to close in the third quarter.

Jarden Chairman Martin Franklin said Waddington is an attractive acquisition target for a variety of reasons, including its experienced management team, best-in-class technology and manufacturing capabilities.

He also cited Waddington's market-leading positions in premium and green food-service products.

Waddington is based in Covington, Ky., and is owned by private equity firm Olympus Partners of Stamford, Conn. Jarden is a publicly traded company based in Boca Raton, Fla.

Waddington does injection molding and thermoforming at plants in the United States, Canada and Europe. Its food-service products are used in catering, bakery, deli and chain restaurants, produce and confectionary markets.

Waddington has sales of about \$800 million and profit of \$150 million, according to Jarden. Waddington has about 3,700 customers, 2,900 employees, and 17 manufacturing facilities.

Waddington does thermoforming in Toronto; Montreal; Holley, N.Y.; Chattanooga, Tenn.; Houston; Arklow, Ireland; Milton Keynes, England; Bridgwater, England; and Buckinghamshire, England. It does injection molding in Montreal; Chelmsford, Mass.; City of Industry, Calif. (where it has two plants); and Lancaster, Texas.

It sells under the WNA, Polar Pack, Par-Pak, Waddington and Eco Products brand names, with Eco Products specializing in compostable materials, including compostable plastics.

Jarden had 2014 sales of \$8.29 billion.

Jarden makes a wide variety of consumer goods. It has an injection molding business, Jarden Plastic Solutions, which has plants in Greer, S.C.; Reedsville, Pa.; Springfield, Mo.; East Wilton, Maine; and Christchurch, England. Jarden's plastics business molds products including medical products and plastic cutlery.

*Plastics News* estimated Jarden Plastic Solutions' 2014 North American injection molding sales at \$175 million.

Mike Evans, Waddington's president and CEO, will remain with the company.

"Waddington's entrepreneurial growth culture is a strong cultural fit with Jarden, while offering a compelling financial and strategic value proposition," Franklin said in a news release.

## Sutton, MA Middle Schoolers Win \$5,000 for "AMP it up!" Video Challenge for Thermoforming Videos of Mayfield Plastics

Sutton, MA (PRWEB) July 20, 2015

Almost 40 middle school children from the Sutton Middle School visited custom thermoformer Mayfield Plastics last winter to participate in the AMP it up! Video challenge and their efforts paid off with two winning videos and \$5,000 in prize money for the school. The AMP it up! Challenge invited students to research the inner workings of an advanced manufacturing innovation and how it impacts the world around them. The Sutton Middle School won two awards for \$2500 each for the videos "A Guide to Thermoforming" and "An Amp it up! Special: Mayfield Plastics". There were a total of eleven winners and \$30,000 in prize money provided by the Manufacturing Futures Fund.

Students across the state visited manufacturers such as Mayfield Plastics, Bose, and Valentine Tool Company to learn how advanced manufacturing plays an important role in our daily lives. They learned about the process, the products and the people behind it all. Nearly 2,000 people voted in the contest.

"Mayfield Plastic is owned by Jay Kumar, who also owns Universal Plastics, a custom thermoformer based in Holyoke MA. Jay is a strong advocate of workforce development and embraced this opportunity to give students an inside view of advanced manufacturing processes", says Paul Davidson, Sales Engineer at Mayfield Plastics. "We have a strong legacy in local manufacturing and a commitment to engaging the younger generation in what we do – someday we hope that they will be part of our workforce."

"We welcomed the opportunity to work with the students from the Sutton Middle School. Their enthusiasm for the project and their interest in Mayfield and the products we make made for a rewarding experience. They learned a lot about manufacturing in a modern environment with state of the art equipment. I am sure most of the students had never had a firsthand experience in a facility like Mayfield Plastics. I thought they all did an outstanding job with the video presentations they put together. It was interesting to see how much they learned from their short visit. It is very rewarding to see that a couple of the videos of Mayfield Plastics won the grants," Davidson said. |

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### THERMOFORMED PACKAGING 2015 – Market Review & Outlook in North America

By *Plastics News Research*

*(Editor's Note: Thermoforming Quarterly would like to thank Plastics News for making excerpts of their in-depth report available to SPE Thermoforming Division members in this issue of TQ. The full report can be purchased online at [www.plasticsnews.com/tpreport](http://www.plasticsnews.com/tpreport).)*

#### **Thermoformed Packaging Grows Through Innovation**

Thermoformers serving the packaging industry continue to thrive in 2015, with innovation in packaging design options fueling growth and new opportunities. According to *Plastics News*' research, North American thermoforming sales totaled \$11.4 billion in 2014. Packaging comprised 85 percent of the total, or \$9.6 billion. Packaging sales grew an average of 7 percent among processors surveyed. Absent any unforeseen geopolitical factors, this upward trend is expected to continue. Thermoformed packaging is forecast to reach \$10.2 billion in 2015 and \$10.8 billion in 2016.

#### **Automation and Technology Making an Impact**

Evolving trends in the thermoformed packaging industry include robotics integration, inventory control optimization, extrusion, thermoforming and assembly equipment upgrades, improved tools in packaging design and graphics, lightweight packaging and sustainability issues. Jeff Mengel is Plante & Moran's national practice leader for plastics and the food processing/packaging industries. When it comes to current trends facing processors serving the thermoformed packaging market, he points to automation. "I know it sounds like a broken record, but advances in automation remains a primary trend," he said.

The thermoforming process may replace injection molding in many applications in packaging due to speed of production and lower tooling costs. According to Julie McAlindon, senior vice president, DSS for PolyOne Corp., there is a rise in the conversion of injection-molded packaging to thermoformed components, which reduces lead times and tooling costs so that customers can get to market faster with less risk and investment. Further, in-mold labeling (T-IML) has evolved over the past decade and is now becoming more common for the higher end of the thermoforming spectrum. The technology has improved and standards are being developed so that systems integration is easier.

#### **Light Weighting and Sustainability Gaining Ground**

As more consumers are seeking "green" products, sustainability is a key issue for processors serving the thermoformed packaging market. Lightweighting and downgauging are growing trends as weight reduction has impacts beyond the part itself (e.g., transportation and logistics). There is an increased focus on sustainability via thin-walling and the use of recycled and/or

bio-based materials. "We see an increase in demand for barrier properties in thin wall packaging as producers continue to seek lightweighting solutions," McAlindon said.

#### **Tamper-Evident Packaging**

Tamper-proof packaging is an effort by the brand owner to prevent any achievement in tampering or theft of an item. Most tamper-proof packaging is difficult to open without using a knife or scissors. Anchor's Packaging's Jeff Wolff noted that tamper evident packages in the market do not function well for the consumer and it may not be immediately obvious whether packages have been opened in the store. "Next-generation products will emerge that better satisfy consumer needs for opening and reclosing while providing increased protection for the retailer," he explained.

California-based PWP Industries recently developed a tamper-evident thermoformed package with a pull-open tab. Sara Lee has adopted the vacuum-formed PET package for various single-serve, "grab-and-go" foods, while Wal-Mart has approved the tamper-evident system for so-called "Dip-n-Go" packaging.

#### **Medical Packaging Security**

Security is a primary issue for thermoformed packaging options for the medical market. Medical packaging design has become increasingly important in helping to ensure medical part integrity and in preventing injury to patients and health professionals.

Quite often, it is up to hospital staff and those responsible for administering sterilized drugs to determine package integrity and evidence of tampering. The need for security and quality control of medical supplies has led to numerous innovations in medical packaging. Different methods of sealing, improved materials to ensure toughness, and different tamper-evident designs are employed to maintain package integrity throughout distribution and handling.

#### **Resin Pricing Favorable for Thermofomers**

According to Plante Moran's Mengel, resin prices have been an uncertainty for thermoformed packaging processors over the last several years. The tides are turning and positive gains made in 2014 are likely to continue in 2015. "Commodity resins have made life a lot easier for buyers," he said. "Companies still have to negotiate prices with suppliers and smaller companies are still buying materials in smaller quantities." There also are more and more companies of all sizes making a physical hedge on prices – buying in advance to take advantage of a lower price. "I think the prices have been relatively stable," Mengel added. "As a result of that stability, it has made life much easier for the processor to manage."



Even more important than lower resin prices for today's thermoformed packaging processors is predictability. Of course, that has not always been the case. In 2007 and 2008, it was the opposite. "Prices were going up by the week," Mengel said. "You had HDPE going up a nickel a week. Customers wanted processors to stick to the prices. The result was unpredictability and higher prices."

### **Aging Equipment Poses Challenges for Thermoformers**

In 2015, North American thermoformers are facing the challenge of older equipment, which can put them at a competitive disadvantage. A key challenge is unique processing variants that allow the thermoforming of non-typical part designs that traditionally are being made in other types of processing methods.

According to Steven Clark, president of Auburn, Mich.-based Monark Equipment Technologies Co., the industry probably already is pushing the limitations of the molding technology and conventional thermoforming equipment designs, including their associated automation. "The machinery designs won't change dramatically, or react with any revolutionary equipment designs, until the demand for these concepts is required to accommodate a new tooling and/or processing concept," he said.

As companies migrate into North America from Europe and South America today, they are bringing with them new state-of-the-art machinery. These companies, starting from scratch with new equipment, are able to run parts much more efficiently. As a result, even larger companies like Dart that had a majority of the market may be starting to lose market share. To counter that potential loss, Dart acquired Solo in 2012. While Dart was able to grow through acquisition, that isn't an option for most thermoformers. With new machinery, thermoformers can increase their productivity with machines that are wider, faster and more efficient. "I have seen some trends indicating there is some retirement of old presses going on and acquisition of new presses that addresses optimization and productivity issues," noted Plante Moran's Mengel.

### **Maximizing Efficiencies Is Key to Gain Competitive Edge**

Automation and lights-out machining are two areas where thermoformers and tool makers are continuing to invest in efficiency. In early 2015, there is evidence that to support that robotic improvements have helped companies to achieve efficiency gains and remain competitive. Robotic trimming has improved to the point that it is competitive with other methods of cutting parts in the cut-sheet area. But as SPI's Michael Taylor points out, efficiencies are not simply about increased automation and fewer workers. "Oftentimes, automation may alter your required

workforce but not actually result in fewer workers," he said. "Efficiencies can result from new technologies, energy savings, recycling, improved processes, better trained workers, etc."

Taylor further explains that automation is only one path to efficiency. "To maximize efficiency, automation solutions need to be integrated in operations and introduced in tandem with other efficiencies. In the 21st century, greater efficiency is key to gaining a competitive edge."

### **Overall Market**

The outlook for thermoformed packaging, and the plastics industry overall, is positive for 2015. "Given our significantly improved competitive position globally and the strength of our economy domestically, U.S. manufacturing and especially the plastics industry are poised for a renaissance, so the future looks very bright for the thermoformed plastics segment," noted SPI's Taylor. As an industry, thermoformers' customer base and supply base (i.e. resin producers) are big and getting bigger through ongoing consolidation. Many thermoformed packaging companies are sandwiched between giants with immense bargaining power. To survive and make an acceptable return, you must have the following qualifiers: quality, operational excellence, material optimization and high negotiating skills in selling and buying. Without these you cannot survive in this industry.

The future for thermoformed packaging is positive. Conor Carlin said "an honest analysis of the benefits of thermoformed packaging against other processes and materials indicates that it is clear the industry is providing a large amount of value to an impressive variety of end markets."

According to Lynn Dyer, president of the Foodservice Packaging Institute, the future is bright for thermoformed packaging. "We will see shifts, no doubt," she said. "I think there is still plenty of opportunity there. This industry is not going away. We will see new opportunities for food service, and this will lead to growth for thermoformed packaging companies."

Mengel is more cautious when looking to the future. He noted that more and more packaging is shifting to flexible options, which is eating away at thermoformed packaging. "You will continue to see more of that," he said. "It is easier to decorate and it is easier to pack. You get better density in the packing." At some point, processors are going to have to deal with consumer preferences and whether those preferences are with fiber containers, which are perceived to be more eco-friendly. "It could be that the stores that want better density in the shipping pack and better display on the shelves," Mengel said. |



**Did you know** the SPE Foundation offers numerous scholarships to students who have demonstrated or expressed an interest in the plastics industry?

### The Dawn of the Commercial Thermoforming Business

By Stanley R. Rosen

The end of World War II released the ambition within many of the discharged veterans to seek careers in the relatively new plastics industry. The U.S. Government's G.I. Bill of Rights paid for the veterans' education in technical, academic, or business fields. This program provided a foundation for many energetic plastics entrepreneurs.

In 1946, the first National Plastics Exposition was held in New York City and it was besieged by attendees. Critics complained that most of the visitors were **'not from the trade'** and they were classified as **'interested spectators'**. These amateurs were anxious to see firsthand how plastic was processed into commercial products. They needed to develop personal contacts with the plastics resin suppliers, mold makers and machine manufacturers. Unfortunately there was not any commercial vacuum forming equipment on exhibit and it took another six years for these machines to be developed and displayed.

At the 1952 SPI National Plastics Exhibition in Philadelphia, PA, the first commercial vacuum forming machine was operating on site and it became the star of the show. What made this process so appealing was the equipment. Molds were quite inexpensive compared to injection molding or extrusion equipment. This meant that a whole universe of plastics parts could be produced in small quantities to develop many new markets.

The former chief of the Army Map Services, E. Bowman (Bow) Stratton, Jr., helped introduce "vacuum forming" to the plastics world. The Army Map Service labored for twenty years to find a way to produce topographic maps in three dimensions, testing various materials and settling on thermoplastics. At the end of WWII, Bow Stratton and some of the former Army Map Service employees worked for a number of years to develop a commercial vacuum former. Bow traveled throughout the U.S. and Canada to speak at plastics and packaging forums about the virtues of vacuum forming. He was the sales manager of the Industrial Radiant Heat Corp. of New Jersey which demonstrated the first vacuum former at the 1952 plastics show

A mix of vacuum forming startups concentrating in various fields - **packaging** (blister packs), **advertising and displays** (3-D beer signs), **paper box inserts** (cosmetics, toys), and **heavy gauge products** – quickly set up businesses. New ventures were evenly split between in-plant departments and commercial vacuum forming shops. All of these early machines were manually operated, using timers to control the

vacuum forming cycles. Pressure forming equipment was developed later and the word **thermoforming** (either pressure or vacuum forming) was not in common usage until 1962.

Vacuum formed multi-cavity plastics shots required that each cavity be perimeter trimmed for use by the customer. The paper industry cut out individual pieces from a sheet, using inexpensive steel rule dies mounted in large-area, powerful short-stroke presses. These die cutting presses did not provide the long stroke and clearance necessary for high-profile formed plastic parts. Shoe leather components are manually cut from a hide on a small area clicker press using similar knife edge dies. The clicker machine daylight opening could be adjusted and adapted easily for manual die-cutting of formed plastics shots. All kinds of punch and hydraulic presses were then mobilized and converted into service for steel rule die cutting. Very accurate cut parts were trimmed in metalworking punch presses using a punch and die. Thick gauge sheet thermoformed components were manually band-sawed or router-trimmed with their rough edges hand-finished. Large area heat-assisted presses were specifically designed for steel rule die cutting thermoformed sheets.

A mold is an essential tool used to form thermoformed parts. For short runs, molds should be inexpensive enough to be amortized over an initial small run in order to be competitive with injection molding. Mold cavities were often fabricated on site using a pattern maker's wooden master and reproducing multi-mold cavities in plaster or aluminum-filled epoxy. These cavities were mounted on a wooden vacuum box base with the finished shot cooled by fans. Early vacuum forming machines could only run at 1-3 cycles per minute on thin sheet, so the poor thermal efficiency of these non-metallic molds was sufficient for the small orders of the times.

Advertising and display firms were able to use distortion to copy artwork images on to plastic sheets. After vacuum forming, the distorted sheet returned to the features seen in the original artwork. Simple, loose reusable letters were used as molds for what were called 3-D advertising signs which were vacuum formed at very low cost. Theatrical and movie companies formed backdrop scenery for their productions. Ubiquitous Santa Claus and Elves were thermoformed for the Christmas holidays. Protective cases for instruments, home movie protectors, industrial tote boxes and machinery safety enclosures were vacuum formed from thicker gauge sheet.

Some independent vacuum forming firms were slow to upgrade or increase their capacity until forced to by growing product demand. Manual vacuum forming machines were being replaced by new professionally-designed machines which obsoleted the individual sheet-fed machines with roll-fed continuous equipment. The new roll-fed thermoformers required the efficient heat transfer from the mold to reduce the cooling cycle time. The use of water cooled aluminum cavities increased the tooling cost but raised the output significantly. The increased production of formed shots caused a backup of parts waiting to be manually steel rule die cut and this problem took some time to be resolved.

Thermoforming firms realized that integrated forming and trimming was a necessity for progress in processing the finished trimmed parts. Machinery builders needed firm orders to proceed with the design and development of this next step in the evolution of thermoforming. The go-ahead came from a large paper cup manufacturer who visualized plastic cups and lids as a viable profitable product. A collaboration between Dow Chemical and Gaylord Brown (Brown Machine) and Maryland Paper Cup in the early 1950s developed the first commercial inline forming and trimming systems. This roll-fed vacuum forming machine consisted of a tunnel oven, a vacuum forming station with an indexing system to transport the web through the machine. The moving thermoformed web was introduced into a self-indexing punch and die trim press and both machines were synchronized. The cups were punched through the die and packaged and the scrap was cut into small pieces and recycled. This system was practical for large volume components but the tooling was too costly for use for low and medium production.

A further thermoforming development was for an inline pressure former incorporated with a steel rule die cutting press. The equipment evolved after Jack Pregont (Prent Corp) convinced Gaylord Brown to build a simple inexpensive version of his inline thermoformer and trim press. This type of machine became the workhorse for custom thermoformers to this day for its moderate cost of tooling and high productivity.

All of the thermoforming machines previously described were heated using various forms of **radiant heat** emitters (tubular, quartz, ceramic, etc.) **Contact heating** of plastics requires that the plastic be in intimate contact with a heated metal surface. Contact heat thermoforming combines the forming and trimming in a single tool and it is mainly used for the forming of oriented polystyrene (OPS). Robert Butzko was the engineer-partner of Bow Stratton at AutoVac Corporation (an early thermoforming machine building company). Bob Butzko left AutoVac in the 1950s to establish Thermtrol Corporation to design and build roll-fed contact heat thermoformers. The machine and tooling was comparatively inexpensive and the machine was extremely easy to operate.

Prior to the 1950s thermoforming machines of some sophistication and merit were designed and built for the use of private firms. However the market during that period for thermoformed products was weak and demand for equipment was light.

Many of the early pioneering thermoforming family-owned companies are gone, sold or merged, except for some notable exceptions. Large financial corporations have heavily invested in this industry that was once crudely described as **“the poor man’s injection molding.”** |

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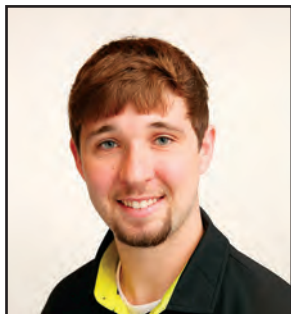
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## SPE Thermoforming Division 2015 Scholarship Winners

### The Segen Griep Memorial Scholarship

#### Zachary Travis, Pittsburg State University



Zach grew up in Fort Scott, Kansas, and graduated from Uniontown High School. He is heading into his senior year at Pittsburg State University in Pittsburg, Kansas. At Pittsburg State, Zach is pursuing a Bachelor of Science in Engineering Technology degree with an emphasis in Plastics Engineering Technology. He is currently the

Vice President of Pittsburg State University's Society of Plastics Engineers Chapter.

In the future, Zach plans on continuing to work hard in the plastics industry and to gain valuable knowledge that will help make him successful. Zach says that it is very important to him to continue to be involved with SPE so that he can be connected with other members and to continuously learn about new advancements in the industry.

### The Thermoforming Division Memorial Scholarship

#### Samuel Moore, Pittsburg State University



Sam grew up in Springfield, Missouri, and is currently a senior at Pittsburg State University, majoring in Plastics Engineering Technology. He is an active member of the SPE Student Chapter on campus and he enjoys working on projects for the group.

Sam chose to study plastics due to his interest in polymers and how things are made. He has worked at three companies in the plastics industry: at Buckhorn, Polyfab Plastics and currently at Becton, Dickinson and Company in Nebraska. Sam says that each job has taught him the skills he needs in order to be successful in the future. He gained valuable experience working with thermoforming equipment at Polyfab Plastics last summer and in the lab at Pittsburg State.

### The Thermoforming Division Memorial Scholarship

#### Charlotte Seeley, Michigan State University



Charlotte Seeley is originally from Suttons Bay, Michigan. Her experience with thermoforming started at Michigan State University, where she will be a senior this fall studying Packaging with a minor in Graphic Design. Charlotte has continued her education at Kimberly Clark, where she has been interning for the past

six months. While at KC, she has had the opportunity to work with a wide variety of materials including polyolefins and even helped support a trial involving thermoformed nitrogen flushed trays. In addition to interning at KC, she has also interned for Colgate-Palmolive.

In the future, Charlotte would like to develop sustainable packaging options that are cost-efficient enough to be utilized by giant global companies like Kimberly Clark and Colgate-Palmolive.

### The Bill Benjamin Memorial Scholarship

#### Samuel Heasley, Penn State Erie



Sam grew up in Oil City, Pennsylvania. He is an undergraduate Plastics Engineering Technology student at Penn State Behrend in Erie, Pennsylvania. Sam serves as secretary of the Plastics Engineering club at Behrend where he volunteers with events such as the Youth Explorers and GE STEM program. He has also

taken advantage of Behrend's cooperative education program with Husky Injection Molding Systems and Apple Inc., working with new product development and validation. Sam has also performed research focusing on thermoforming processing parameters effects on dullness and webbing in formed parts.

Upon graduation, Sam will be seeking a job as a tooling engineer where he hopes to design and optimize tools and processes for mass production. |

# Penn College's Plastics Resources to Be Touted at European Conference

April 29, 2015 — European visitors' recent first impression of Pennsylvania College of Technology's Plastics Innovation & Resource Center will lead to a second look when they promote the facility to a continental conference next year.

The four international guests and their American host talked with employees and students in labs featuring each of the college's five plastics processes (injection molding, extrusion, blow molding, rotational molding and thermoforming) during a March tour of the PIRC and its Thermoforming Center of Excellence.

The group also learned from Director C. Hank White about the PIRC's role in helping the industry remain competitive.

"We want to be the place to go in North America for training and research and development," White told the group.

The goal of the tour (sponsored by the National Society of Plastics Engineers Thermoforming Board Executive Committee) was to showcase the facilities to the mutual benefit of the PIRC and its potential international partners, and – judging from the response – it was an objective well-met.

"Our visit was indeed an eye-opener!" said Jeff Pitt, director of Plas-Logic Ltd. in the United Kingdom. "In Europe (and, in particular, the UK) there has been a lack of comprehensive 'ground roots' training for students and apprentices wanting to follow a specific practical plastics technology."

The norm for training in that sector has been basic, practical engineering courses," he explained, followed by more specific training "downstream" – more often than not the direct responsibility of employers.

"To have the facility on offer at Penn College would relieve the employer of that burden and would, in my view, be a great attraction," Pitt said. "To that end, we will promote (the PIRC) to the European audience that attends our 2016 European Thermoforming Conference in Barcelona."

Pitt was accompanied by Andy McGarry, managing director at Cox Wokingham Plastics, also in the UK; Lars Ravn Bering,

managing director at Gibo Plast, Denmark; and Francois Berry, president at Top Clean Packaging, France. Joining the contingent were Katharine Skopp, from the state Department of Community and Economic Development, and J.P. Tambourine, manager of economic development for FirstEnergy.

The visit was coordinated by Ed Probst, principal at Probst Plastics Consulting LLC in Wisconsin.

For more information about the PIRC, visit [www.pct.edu/pirc](http://www.pct.edu/pirc) or call 570-321-5533.

For more about the college – one of only five plastics programs in the nation offering degrees accredited by the Engineering Technology Accreditation Commission of ABET – visit [www.pct.edu](http://www.pct.edu), email [admissions@pct.edu](mailto:admissions@pct.edu) or call toll-free 800-367-9222. |



# Plastics Pioneers

*A trailblazing course and its modest professor gave life to entrepreneurial spirit and a thriving Wisconsin industry.*

By David J. Tenenbaum, MA '86

*TQ would like to thank Cindy Foss, Co-Editor, On Wisconsin, for giving us permission to reprint this article that originally appeared in the University of Wisconsin publication. Cindy is also the Assistant Director of University Communications.*

It's an unforgettable scene in Dustin Hoffman's 1967 breakout movie, *The Graduate*, when party guest Mr. McGuire pulls Hoffman's character, Benjamin Braddock, aside to advise the younger man about the future. "I just want to say one word to you.... Just one word.... Are you listening?" he says. When Braddock confirms that he's all ears, McGuire drops the magic word: Plastics.

That boost from Hollywood was an accurate prediction that shone a spotlight on the industry. But Tom Mohs '62 founder of Madison plastic manufacturer Placon, says he truly owes nothing to the film. "I was already buying my second thermoforming machine when the movie came out," says Mohs, referring to the equipment that softens and forms plastic. "No, I owe it to Ron Daggett."

Ronald Daggett '38, MS '39, brought plastics into the classroom, teaching the University of Wisconsin's—in fact, the world's—first course on the subject. After earning his two mechanical engineering degrees, Daggett engineered plastic for RCA Corporation during World War II. When he returned to Madison in 1946 and joined the university's faculty, "There was this new material, but nobody knew anything about it," says Tim Osswald, a professor of mechanical engineering who teaches the courses that Daggett originated. "So (Daggett) thought, 'I went through this learning process at RCA; there's got to be a course taught.' He wanted the course to focus on manufacturing, on strength and creep—all the strange things about plastic that people did not understand at the time. There was not even a textbook."

The elective course that Daggett devised has been offered every semester for the past six decades. In 1990, the course was split into two areas of emphasis—plastics design and plastics processes—and they are the most popular electives among mechanical engineering students.

"[Daggett's] course was perfect for what I was looking for," Mohs recalls. "It was not highly technical. It was a survey that talked about the fundamentals of various plastics-processing equipment and various kinds of plastics — the differences among polyethylene, polypropylene, ABS, polystyrene."

When Daggett first started teaching, Osswald says, plastics was a trial-and-error industry. Plastic parts were crude, ugly, and fragile. Today, however, plastic can be tough, resilient, and attractive.

Thanks to new formulas and processes, plastic has emerged from the shadows, encroaching on fabric, wood, and metal and becoming the material of choice. Many things — retail bags, computer keyboards, car dashboards, heart valves, and more— could not realistically be made from anything else.

In a significant made-at-the-UW collaboration, engineering professor Ronald Daggett and heart surgeon Vincent Gott invented an artificial heart valve that was smaller than earlier models. It was implanted into a patient for the first time at UW Hospital in 1963.

But Osswald notes that much of the credit for that stream of innovations in plastic belongs to the scientific approach begun by Daggett and his colleague, UW chemist John Ferry.

"Ferry was the father of polymer physics," Osswald says. "So, two hundred meters apart from each other (on campus), we had the moldmaker in mechanical engineering and this polymer physicist in chemistry who understood the molecular structure of the material. It wasn't until those two came together after 1955 that people in this industry could push their material to the limit." The plastics industry has continued to expand and innovate, Osswald says, noting that today, companies make products that did not exist even a decade ago. Although a primitive industry existed before Daggett started teaching, he was present for the plastics revolution. "He got it all going," Osswald says. "Wisconsin was the birthplace. The pioneers in understanding plastics were here, and that's why it's no coincidence that such a small state has such a huge plastics industry."

These days, Wisconsin plastics are thriving. By 2011, the field employed an estimated 35,000, making it the eighth-largest plastics employer in the nation, according to the Plastics Industry Trade Association. And a number of these flourishing companies owe their roots to Daggett. When students or former students shared ideas for new products, Daggett was the first to tell them to start their own companies.

When Mohs first came back to Madison in the 1960s with an idea for the blister pack—today used to hold a vast array of items ranging from allergy pills to batteries—he turned to his former engineering professor. "Ron was the first person I contacted," Mohs recalls. "I decided to do some design work, and Ron offered the use of equipment and machine tools in his basement. He was very kind and helpful, [and he] continued to teach me what I needed to know."

That idea grew into Placon, a company that today employs six hundred people based at a main plant in Fitchburg and additional manufacturing facilities in Indiana and Massachusetts. The firm makes packaging for the food, retail, and medical industries.

Another of Daggett's successful students was Robert Cervenka '58, whose wife, Debra, says that her husband landed his first job out of college at Modern Plastics directly because of Daggett's course. In 1964, Cervenka founded his own company, now called Phillips-Medisize, which focuses on pharmaceutical packaging and sophisticated medical devices such as insulin

pumps and surgical instruments. It employs more than 3,100 people at six locations in Wisconsin, and in California, Europe, Mexico, and China.

In 2010, to recognize UW-Madison's role in their success, the Cervenkas donated \$1.5 million to the university to fund advanced equipment in the undergraduate engineering teaching labs. "We both feel very connected to what it takes to run a successful company technologically," Debra Cervenka says. "Madison is one of the foremost schools of engineering in the country, and they're doing unbelievably good work on basically a shoestring."

Daggett himself was also drawn into entrepreneurship. After years of designing intricate molds and parts for other manufacturers in his basement, he decided that he needed to move to gain credibility with potential customers. In 1963, he started Engineering Industries in Verona, and Rayovac became a major customer.

Engineering Industries president, Dean VandeBerg '78, who began working at the company as an intern in the summer of 1978 and never left, recalls that Daggett specialized in the hard jobs. "Ron would not take just anything that came along," he says. "He liked to work on parts that required a little more engineering and development work. He loved helping the customer design. I would watch him work with customers, getting their thoughts, and he would be drawing the part as they talked."

That emphasis on solving hard challenges "remains a strong suit and laid the foundation for who we are as a company,"

VandeBerg says. Engineering Industries employs about eighty people, including four mechanical engineers educated at University of Wisconsin-Madison.

"I learned an awful lot from [Daggett]," VandeBerg says. "He was my mentor — that's not debatable. He was an even-keeled kind of guy, not a gregarious backslapper.... From looking [at him], you would not realize all that was going on there."

How might Daggett, who passed away in 2004, react if credited with the critical role he played in his former students' success? "If someone complimented him," VandeBerg says, "He would just smile and say, 'That's very kind of you.'"

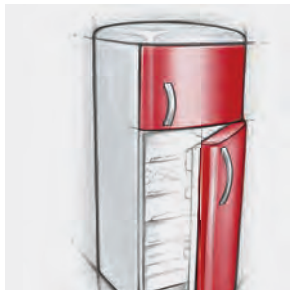
To focus exclusively on plastics would be to miss much that is fascinating about UW professor Ronald Daggett. In addition to teaching his engineering courses, he played violin, made furniture, painted an estimated six hundred beautiful—and structurally accurate—watercolors, lettered calligraphy, and photographed flowers.

And then there was his ability to fix things. "He could do anything," says his daughter, Karen Wertymmer '65. "People brought their broken goods to our basement. Whether it required metalwork, woodwork, or plastics fabrication, in short order, it would come back fixed."

John Wertymmer '65 says his father-in-law "embodied the Wisconsin Idea, that the university should not be an ivory tower, but should serve all the people of the state. There wasn't anything he wouldn't attempt. He would never turn away anyone who asked for help." |



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## Using Logic Models to Predict Efficacy in Industry-University Partnerships *How Kettering University is Making a Difference in Workforce Development*

By Eve A. Vitale, Director of Philanthropy - Corporate & Foundation Giving, Kettering University

### *Part 2 of a 2-part series*

In 2012 Mark Richardson, Lecturer in the Department of Industrial and Manufacturing Engineering, spent time at NPE and began many conversations about the needs of the plastics industry. He made connections with Kettering alumni who understood the value of a co-op education model in developing future workforce and began discussions around equipment needs for the University. In the first 18 months these discussions resulted in a number of donations or consignments of equipment and cash including the following items: a cold jet dry-ice blasting machine and ongoing support of dry ice; a cash donation for lab support from The Grainger Foundation; a water bath and pelletizer from Bay Plastics Machinery; a compressed air polymer dryer from UNA-DYN; a film die and profile die for a roll stack from Rebuilding and Fabricating, Inc; ongoing resin donation from Asahi Kasei; rolled ABS from PMC through alumnus Eric Short; grants from MAAC, the SPE Thermoforming Division and the Dart Foundation for a new MAAC ASP Thermoformer; and a donation from the GM Foundation to develop coursework in support of plastics curriculum for mechanical or industrial engineering students at the University.

The **activities**, as shown on the *Logic Model*, that contribute to desired outcomes include:

- meetings to discuss the details about the specific skills industry is looking for in graduating workforce;
- students using relevant and current donated equipment in coursework/labwork as well as research and development;
- alumni mentoring students and supporting them in SPE activities and networking; and
- co-op employers helping in the recruitment of students.

In the first 18 months, a few of the applied research projects at Kettering which utilized student and faculty talent included the following: the effect of dry ice blasting on plastic tooling materials with cold jet; the development of new mold materials utilizing an experimental thermoset ceramic material; and, material development in the use of industrial paint waste products as filler for olefins using a corporate partner's patented technology.

The acquired MAAC Thermoformer was used by an undergraduate and graduate student over the summer 2013 term to do an independent thermoforming study. The thermoformer

was set up, work instructions were developed for the introduction to manufacturing processes lab, and a curriculum was developed in thermoforming for advanced plastics processing. There was also a successful recruiting event at Dart Container in Mason, MI. Barely a week goes by without a visit to campus by someone in the plastics industry to "see what's going on at Kettering." These activities are moving us toward desired outputs.

The **outputs** due to inputs and activities include:

- coursework developed with industry input;
- a closer relationship between the University and its industry partners;
- students gaining confidence on relevant machinery and being eager to utilize it on application development and research;
- recruiting local students interested in engineering who do their co-op work rotations in plastics companies; and
- students getting involved in SPE, and creating relevant professional networks.

Kettering students have always been ahead of their contemporaries in engineering programs that don't require co-operative/experiential work. Students do real engineering, most beginning in their freshmen year. They work in plants, design parts, improve processes and learn to articulate their work in presentations. Many students have access to VP- level or higher Kettering alumni who mentor them during their work terms. As an example, when John Moyer, president of Asahi Kasei Plastics North America, and Kettering board of trustees' member, visits campus, he often spends time with his co-op students. Kettering has about 500 corporate partners who visit campus often, who employ its alumni, and who are interested in developing permanent STEM workforce. (<https://www.kettering.edu/co-op/co-op-employer-partners>)

With inputs and activities it is easy to envision **outcomes** that should follow in one to three years and beyond. There will be:

- engineers with specific knowledge which is important to the plastics industry;
- more students seeking careers in plastics;
- students who will be familiar with donated equipment and will recommend and/or acquire these pieces of equipment for their employers.



With regular recruiting events and by word-of-mouth promotion in local high schools, more students will choose an education at Kettering so they can work in or near their hometowns as part of their engineering education. This allows homegrown talent to help fill local workforce needs. Additionally, students-turned-engineers will continue their participation in SPE events and grow their professional networks.

These outcomes will create a lasting **impact** on the industry. More and better-prepared plastics engineers who look forward to innovating US manufacturing in support of the industry will help create stability in the plastics workforce. These engineers will want to use the equipment they were trained on, and will continue to support the plastics equipment industry either by joining those manufacturers or supporting them in their roles as customers. The network of professionals will be increased and will contribute to the growth of SPE and the industry at large.

We are seeing phenomenal outcomes and impacts with our program. The two most notable are an increase in students seeking and finding employment, both co-op and fulltime within the plastics industry and the second, unexpectedly, is the increased desire of our students to take an active role in educating middle and high school students about the plastics industry and its opportunities.

University/industry partnerships, with the proper championing and nurturing, are a key to fulfilling the workforce needs of the U.S. plastics industry.

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## Update

There are three important factors which have been instrumental in the exceptional growth of student interest in plastics in the last three years. First and foremost is Kettering's partnership with the Detroit Section of SPE and SPE International, and the initial help from SPI. Secondly is Kettering's extensive industry connections, and Mr. Richardson's willingness to aggressively engage at every opportunity to benefit the students and the program. Lastly is a high level of mentorship and engagement with the students.

Detroit SPE became very interested in what we were doing when they noticed an increase in student membership and involvement in SPE-sponsored activities. Kettering students are now regulars at galas, conferences, board meetings, and technical dinners. The students look forward to helping at these events and networking with industry professionals. Dr. Sassan Tarahomi of IAC, president of Detroit SPE was especially adamant about engaging Kettering's students and advisors. Very importantly, SPE "put their money where their mouth is" and have contributed much-needed dollars to the student programs. Without this funding, much of the engagement wouldn't be possible. The scholarship

support from SPE is also instrumental in the initial capture of student's interest. We promote the financial and career benefits of being actively involved. We currently have students attending most, if not all, Detroit-area events including board meetings, ANTEC and NPE. Our students are also working with SPE's NGAB (Next Generation Advisory Board).

Kettering has hundreds of co-op partners and successful alumni in every industry sector. The opportunity to leverage these relationships was the starting point for all of the work that Mr. Richardson is doing in his personal research and application development, in the work in which the students are now engaged, as well as in curriculum initiatives.

Early meetings facilitated by Autodesk brought GM, Ford and then Chrysler to the table to discuss industry needs for engineers who had a working knowledge of polymers and plastics processing. An early grant from the GM Foundation funded the development of two plastic processing courses. The American Chemistry Council's Automotive Plastics Division is supporting the value chain by sponsoring the development of a multidisciplinary *Plastics Engineering* course which we are planning to deliver in the Fall 2015.

Engagement with industry helps in many ways: projects, research opportunities, material, equipment and cash donations, relevant plant tours, technical presentations, career discussions and opportunities, and mentoring. Industry-based hands-on projects leading to the manufacture of parts, real application development and research keep Kettering students engaged.

A final, important factor in engaging students is a high level of mentorship. It is almost impossible to strongly influence and support students without spending a lot of time with them. Strong relationships within the context of educational, professional and extra-curricular activities are the hallmark of strong programs. We spend time with the students in meetings, in class, in the lab, at social events, at professional events and just engaged in conversation when they need it. They often are looking for guidance in their career path, their school path and with the assorted and sundry issues facing our young generation today. Being available can at times feel like a fulltime job as the number of students involved grows.

Although we have made great progress, our challenges remain. The administration at many universities won't support "industry-requested" program or curriculum changes unless industry comes to the table with significant dollars to ensure the sustainability of the changes. The way to ensure a plastics program which can continue to serve industry workforce needs is to have highly-ranked industry officials vocalize their need and give to the cause. It's insurance for a strong tomorrow. A widespread problem for SPE as a whole is that the percentage of student members who transition to professional memberships is far too low. We need to develop transitional programs to engage young professionals and create perceived ROI for their time and money. With the opportunity for exciting careers in the plastics industry and careful shepherding of young engineers, we can make a difference in our industry. |

# Thermoforming Technical Problems I Wish I Could Solve

## Forming Low-Density Foam

By Jim Throne, Dunedin, FL

### Prologue

A while back, I expounded (pontificated?) on methods of forming low-density foam. What I didn't explain at the time was that the ritual of "sneaking up" on a proper forming temperature before squeezing the heated foam sheet between two mold halves is best reserved for amorphous foams. Y'know - polystyrene, like the meat trays and clamshell take-aways.

But there are occasions when non-amorphous foams need to be shaped as well. Pipe wrap, for example. Trunk liners. Floor mats. And while forming PS foam can be tricky, it isn't rocket science. Forming polyolefin foam can often border on rocket science.

### So, why is that?

Remember our extended discussion about heating amorphous foam? As radiant energy is absorbed by the foam, the cellular structure softens and the internal foaming gas expands. There is a critical temperature where the foam has expanded in thickness to just about the point where cells begin to catastrophically rupture. The so-called 'lace curtain' effect is about to happen.

What about, say, polyethylene foam? Same thing? Nope. Crystalline (technically, semi-crystalline) plastics such as PE and PP are transformed from rubbery solids to viscous liquids at or around their specific melting temperatures. By now we've all seen these DSC scans. For low-density PE, 110C. For linear-low density PE, about 120C. For PP homopolymer, 170C. For PP copolymer, 155C. And so on.

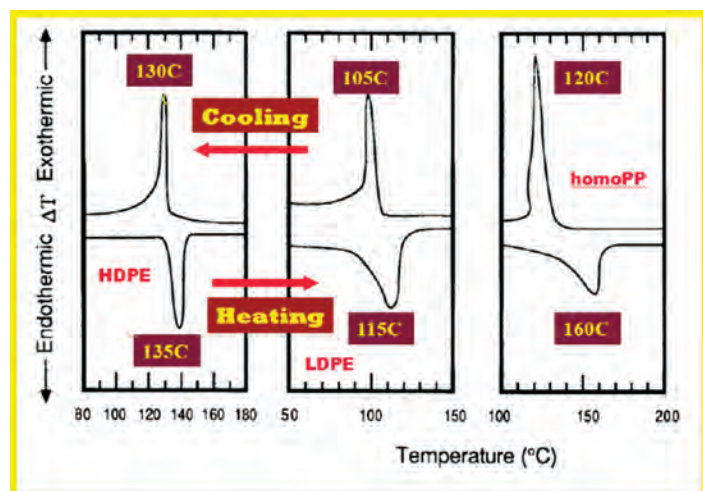


FIGURE 1: Differential Scanning Calorimetry (Heating and Cooling) of Certain Polyolefins

So our first concern is that overheating will not result in lace curtains; it will result in complete melting of the foam. Test it out. Heat some furniture wrap foam with a hot air gun.

### So there's nothing 'we' can do to form olefin foams?

We can form olefinic foams if, and only if, we grasp an additional detail: the level of crystallinity. We're gonna dip our toes into macromolecular science for just a moment. If the polymer backbone is linear without side branches, the molecule can twist into a regular form called a crystallite. On the other hand, if there are side branches, they can interfere with the twisting and can restrict the formation of a crystallite. Linear polyethylene, which we call high-density or HDPE, has very few side branches and so is quite crystalline, to more than 90%. Low-density polyethylene, LDPE, has many side branches, called long-chain branches or LCBs. As a result, LDPE is about 40% crystalline.

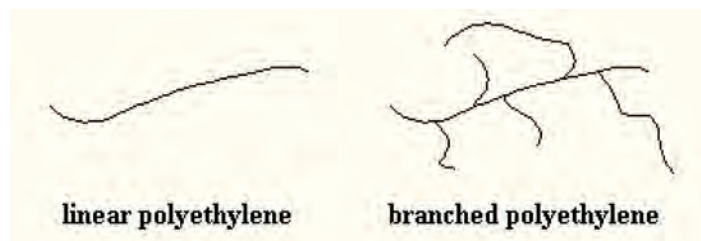


FIGURE 2: What one might imagine linear and branched polyethylene molecules to look like

Oh, and let's not forget linear low density polyethylene, LLDPE. It has short-chain branches or SCBs and crystallinity ranges between HDPE and LDPE. For many reasons, LLDPE is not normally produced as a low-density foam.

Polypropylene has large pendant methyl group spaced every other carbon along the backbone. It too is crystalline, to about 50-60%. But because of the bulky pendant group, crystallites form at a much slower rate than with HDPE. As an aside, that's why, in the figure above, PP recrystallizes from the melt at a temperature far below its melting point.

Before we leave the definition phase of this vignette, let's touch on TPOs or thermoplastic polyolefins. These are blends of polyethylenes, polypropylene and rubber. TPOs are difficult to foam to low densities. We may consider TPOs in another musing.

### Can we get back to the original thesis?

Okay, now that we've delved into polymer science, let us return to the question of formability of olefins. The solid structure of each of the olefins is comprised of crystallites that melt at a very specific temperature and a non-crystallite or amorphous region. Recall that amorphous plastics do not have melting temperatures. The glass transition is their only solid-to-rubbery-to-fluid transition. The glass transition temperature for PE is -125C. That for PP is -10C.

Consider first HDPE. Less than 10% of its solid structure is amorphous and is rubbery even at room temperature. So HDPE foam is very rigid even a few degrees below its melting temperature. This is a red flag to a thermoformer who has relatively little control of the actual sheet temperature. In short, let's not try to thermoform HDPE in conventional equipment.

What about LDPE? It has substantial amorphous regions around the crystallites. And while it doesn't exhibit the dramatic post-extrusion expansion of, say, amorphous PS foam, it does soften substantially just below its melting temperature. Solution? Careful heating to that point, then matched tool forming to achieve the final shape.

Polypropylene foam forming has some concerns. First, homopolymer PP is very difficult to produce as a foam. Typically a block copolymer of PE and PP produces a foamable low-density product. The amorphous level will dictate thermoformability. For typical commercial products, the PE level is less than 10% so that the molecular character of the copolymer is dictated by PP. In short, amorphous levels are 50% or less. However (and this is a big however), for decades thermoformers have formed unfoamed PP in the 'solid state,' being sheet that was just below its theoretical melting temperature. Why? Because PP does not usually form perfect crystallites. The imperfect crystallites are often infused with amorphous regions. As a result, PP ductility increases substantially as its theoretical melting temperature is reached.

### So why don't we thermoform foamed PP, say?

Oh we could. I'm convinced that copolymer PP can be successfully foamed to low densities and that foam can be successfully thermoformed into useful products. The question really is: Why don't we do it more often? I think it's because it requires a more thoughtful and certainly more technical approach to thermoforming foams. Again, the warning. Keep the foam temperature below the PP melting temperature. In short, form it in the 'solid state'. Overheating the foam can lead to serious calamities in the oven. And matched tooling is always the forming preference. Keep in mind, though, that unlike PS foam, there is no secondary or post-extrusion expansion during heating in the former.

In a subsequent vignette, I'll discuss a way of stabilizing polyolefins, thereby opening the now very narrow forming windows, albeit at added expense.

Keep in touch. |

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# Comparison Between Thermoforming Tooling Materials Aluminum and HYVAC-LCM

By Bryan T. Robinson, Pennsylvania College of Technology, Williamsport, PA

### Abstract

CMT Materials, Inc. hypothesizes that the heavy-gauge vacuum- and pressure-forming industry lacks an effective and affordable mold material that can be used on small-to-medium sized runs. (For the purposes of this paper, small-to-medium is defined as >500 parts and <5000 parts per year.) While some companies are willing to pay a premium for superior performance and results, the majority of processors continue to use low-cost, low-performance materials such as wood, Renshape and MDF board. Aluminum is most commonly used for longer- running projects and its price and performance is used as a reference by many in the industry. In this paper, we seek to validate the performance of HYVAC-LCM material against aluminum, the industry standard for thermoforming molds.

If HYVAC-LCM, a new alternative material, is usable for thermoforming molds, then it can produce parts at a lower cost.

### Individual Performance Objectives

While planning and accomplishing this experiment, multiple objectives had to be met. These objectives are listed throughout the paper and will be explained in each step. The objectives were:

- Comparison between HYVAC-LCM and aluminum in terms of:
  - Overall performance: tool durability, tool cost, tool lead time, tool weight, forming cycle time, and tool temperature
  - Material distribution
  - Part shrinkage
  - Visual inspection – part finish
  - Manufacturing techniques/challenges for syntactic foam for a washing machine door
- Ease of use
- Issues
- Ideas for lay-up
- Time required to make tool
- Tool mounting suggestions

### Equipment Used

- MAAC Thermoforming System 9000 Single Station 36" x 48" Model #43SPT
- Shel Lab Oven dryer
- Magna Mike Model 8000
- Strainoptics, Inc. Birefringence Strain Viewer PS 100 SF
- 12 inch digital calipers

### Material

The material used on the HYVAC-LCM consisted of two different layers to create a composite mold. The outer shell of

the tool is syntactic foam while the inner core is constructed of composite spheres. Syntactic foam gets its name from the ordered structure of the spheres (syntactic) and the cellular structure of the material (foam).

Syntactic foam contains preformed hollow spheres that are held together in a binder. The binder typically is an epoxy, urethane, thermoplastic, glass, ceramic or metal. The hollow spheres can be made of thermoplastic, ceramic, or glass. Glass spheres held together with an epoxy binder are the most commonly found in syntactic foam. Figure 1 is a cross-section of the material zoomed in 100 times to allow for a view of the hollow areas (the hollow spheres) and the material around them (the binder).

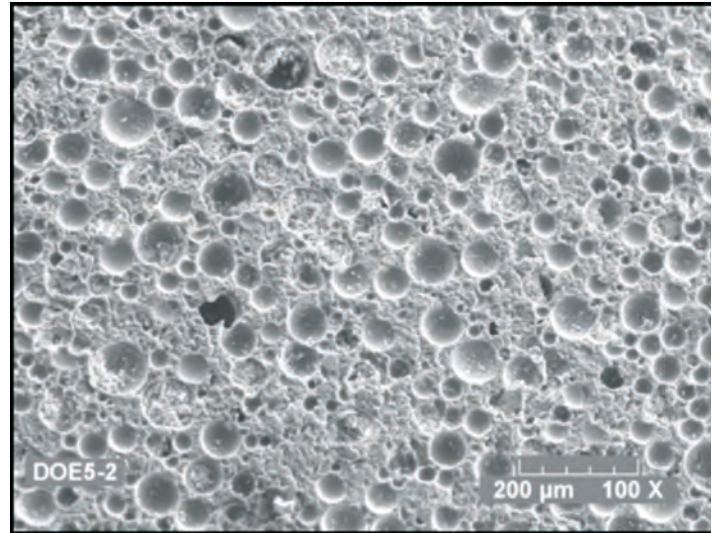


FIGURE 1: Syntactic Foam

Five different types of polymer sheet were used: High Impact Polystyrene (HIPS) 0.080" thick; Polyethylene Terephthalate glycol-modified (PETG) 0.080" thick; KYDEX T (Acrylic PVC) 0.125" thick; Acrylonitrile Butadiene Styrene (ABS) 0.125" thick; and High Density Polyethylene (HDPE) 0.093" thick.

### Machine Set-up

The physical set-up of the machine was the same for both molds used in this study. All timers and delays were the same except for the forming time. Changes to the forming time were necessary to meet the part ejection temperature ranges recommended by the manufacturers of each polymer tested. A common oven heating profile was used to eliminate variables, show in Figure 2. The oven on the MAAC Thermoformer has 56 heating zones, 30 quartz heaters on top and 26 glassed-faced ceramic heaters on the bottom. The vacuum box for the HYVAC-LCM was built to match the vacuum box for the aluminum mold to eliminate

any variation and for ease of set-up. While processing, the goal was to maintain at least 25in/Hg vacuum. The change over time between molds was 5-10 minutes total. Speed of the change-over minimized oven temperature spikes. All settings remained the same except for the encoders (platen travel) as the vacuum box heights were slightly different.



FIGURE 2: Oven Profile

The polymer sheets were all cut with matching orientation to a size of 10" x 18.5". For example, all the orientation in the HIPS sheet prior to forming is the same for each the HYVAC-LCM and aluminum tool; the same approach was used for the other four polymer sheets used in this experiment. Consistent orientation eliminated the possibility of shrinkage or material distribution variation between the two molds.

### Tool Durability

In order to test the durability of the syntactic foam, a small part was made into a saucer about 7 inches in diameter and one half-inch thick. This part was gelled and cured. After curing and annealing the part back down to match the mold characteristics, the sample piece was dropped from 4 feet and did not crack or dent. Further tests would be to drop the HYVAC-LCM and observe the results.

### Tool Cost

The aluminum tool (donated to PCT by Bayer MaterialScience) was machined from 6061 aluminum that is easily polished for processing clear polymers. The estimated cost for this mold is \$2500. The estimated cost to produce a duplicate mold using HYVAC-LCM is calculated using the material cost and the labor necessary to make the tool. The actual raw material cost came to \$51.10: \$31.54 for the putty and \$19.56 for the beads, resin and hardener. This product will eventually be sold in kit form, and the total cost will depend on the size of the mold being built. The necessary labor time is about 10 hours at a rate of \$50 per hour. For our purposes, the total cost for the tool ran approximately

\$550. In this evaluation, a negative cavity was available and was used to create the mold. No cost was calculated for making a negative cavity. HYVAC-LCM can be machined to shape as a built-up mold or packed in to a negative cavity with no machining required.

### Tool Construction

The following tool construction is based on building a tool for a front-load washing machine door. This door was used to further study building techniques and a glass door was used so voids could be seen in the syntactic foam lay-up process. Tool construction required two, eight-hour days to complete. The first step was to wax the mold and lay the putty (syntactic foam) along the walls in a 0.5"-thick wall. Next, a batch of beads was mixed and coated in an epoxy with catalyst to attach all the beads together so they could be packed into the mold (about 2 hours.) The mold was placed in a 170 degree Fahrenheit oven and gelled overnight. The mold was then slowly cooled to room temperature by lowering the heat in the oven and allowing the part to anneal (about 12 hours of heat and 4 hours to reach room temperature.) After reaching room temperature the voids in the mold surface were filled with the putty again (about one hour) and the mold was placed back in the oven to gel again (12 hours to heat, approximately 4 hours to cool.) Sanding then took place to eliminate all the spots that were filled (about 3 hours). After sanding was complete, the mold was put back in the oven for a final cure at 280 degrees Fahrenheit for 6 hours. The heat was then turned off to allow the mold to anneal back at room temperature (about 6 hours of heating and 4 hours to anneal.) Next the inserts were interpolated by first drilling holes and vacuuming all loose debris out of the area. Some of the holes were filled with Gorilla Glue. The shell of the metal inserts were also coated with Gorilla Glue and the inserts were then placed in the holes (about one hour) allowing the glue to cure and expand. The glued areas were then retouched to fill any extra gaps. Once the glue dried the mold was mounted to a mounting plate with specific holes cut out under the tool to allow vacuum to travel into the beads. It is estimated that it would take about 3 days to create this tool.

### Tool Weight

The tool weight is very significant, as the HYVAC-LCM is much lighter and easier to handle than the aluminum tool. The HYVAC-LCM mold and mounting plate weigh only 3.5 pounds. The tool, vacuum box and mounting fixtures combined weigh only 21.5 pounds. The aluminum tool weight including the vacuum box is 38.5 pounds – a total difference of 17 pounds (44% more). The use of a lighter tool has a great possibility to reduce machine wear and allow for machine sustainability. The lighter tool will also increase the safety of workers involved with machine set-up.

### Forming Cycle Time

The forming cycle differs from polymer to polymer due to differences in starting material thickness and ejection temperatures. Samples produced from the HYVAC-LCM were formed using two cooling cycles to document the rate of change in temperature over a 10-cycle run and to achieve the ejection temperature suggested by the manufacturer. Using High Impact

Polystyrene (HIPS) as an example, the forming (cooling) time for the HYVAC-LCM was set for 40 and 80 seconds. For the aluminum tool, the forming (cooling) time was set at 60 seconds. The same approach was taken with the other polymers with forming times and ejection temperatures.

### Tool Temperature

The tool temperature was measured before and after forming. The data of importance is that of after forming to see how hot the tool became. As mentioned above, samples were processed in sets of ten, documenting the rise in temperature. The data shown in Figure 3 represents mold temperatures (when processing HIPS material) after forming each of the ten samples, both with a 40 and 80 second forming (cooling) cycle. Temperatures were taken at two points on the tool, illustrated in Figure 4. The tool was measured immediately upon the ejection cycle. The LCM mold can only be cooled by heat dissipation due to its low thermal conductivity. Syntactic foam is approximately 50% air by volume which virtually eliminates thermal conductivity to prevent the sheet from instantly “freezing” upon contact with the mold. Initial tests showed the mold maintaining a stable temperature after a few shots. In the event the mold continues to rise in temperature, it is possible to regulate the temperature by use of external cooling fans.

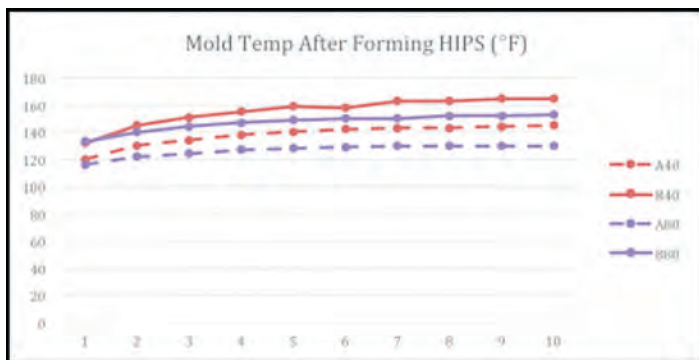


FIGURE 3: Mold Temperature After Forming of HIPS

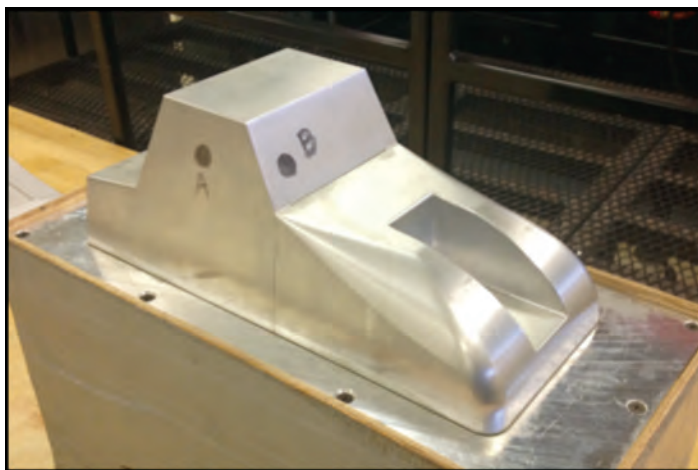


FIGURE 4: Aluminum Tool showing points “A” and “B”

### Material Thickness Profile

Material distribution is a main contributor to the overall efficiency of using HYVAC-LCM. When comparing the average

thickness by position for each type of polymer, illustrated in figure 5, the HYVAC-LCM had a more uniform wall thickness. HYVAC-LCM allows the polymer to “slide” over the tool instead of freezing and stretching as observed on samples produced from the aluminum mold. In addition, it appears that the HYVAC-LCM allowed for distributing material from the perimeter flange or skeleton of the part, resulting in improved material distribution. Figures 6 and 7 show the different measuring points used. These points are the same points used for industry project studies conducted by the Plastics Innovation and Resource Center (PIRC), with the addition of points I and J.

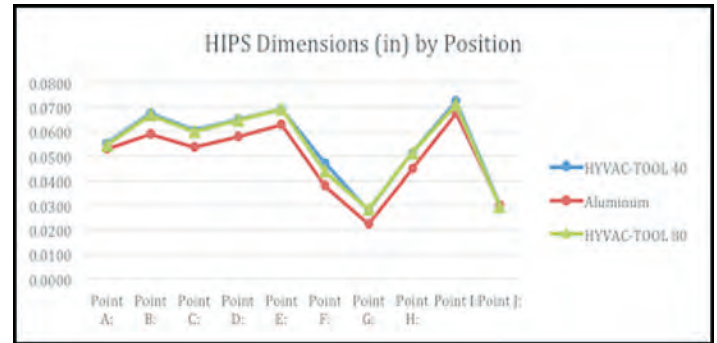


FIGURE 5: Material Thickness By Position on HIPS



FIGURE 6: Top View of Molded Part

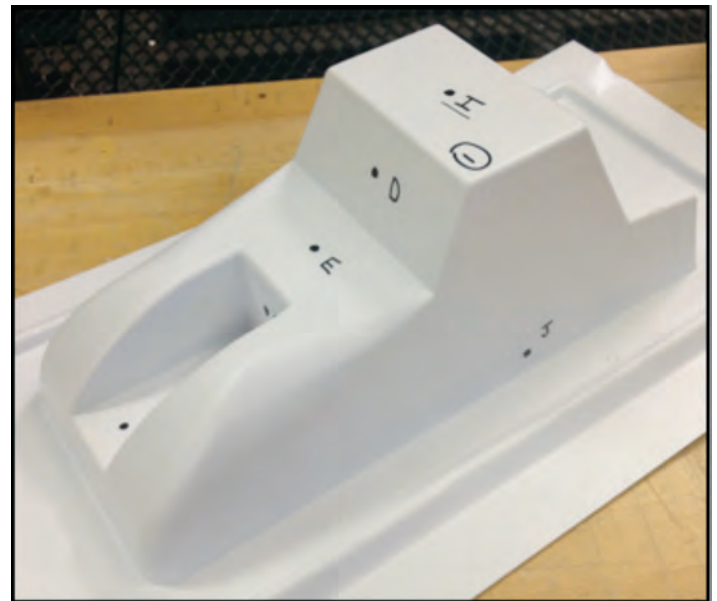


FIGURE 7: Front Left View of Molded part

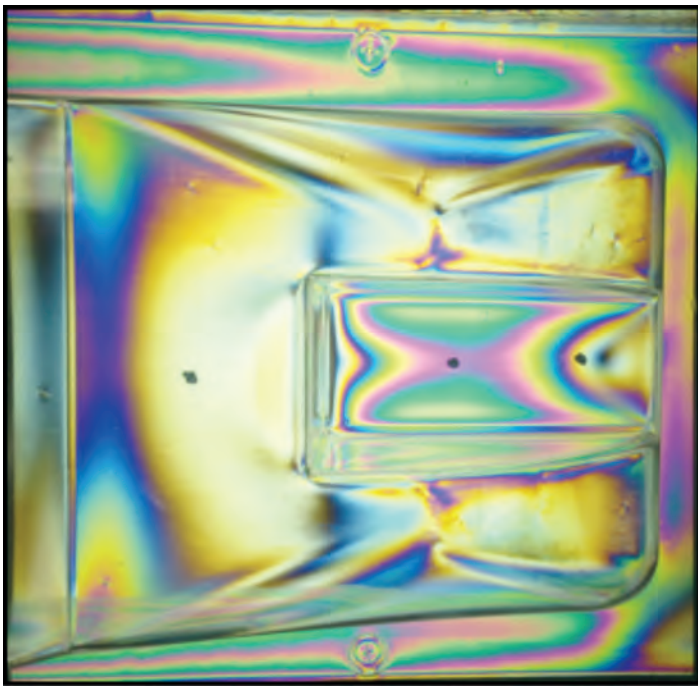


FIGURE 8: Birefringence View of the Aluminum Tool Molded PETG

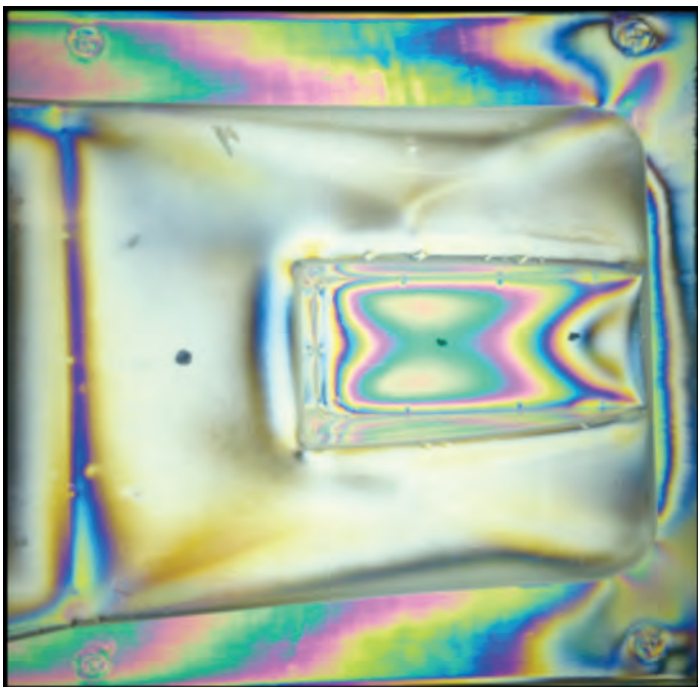


FIGURE 9: Birefringence View of HYVAC-LCM Molded PETG

### Part Shrinkage

After comparing the two tools, the HYVAC-LCM showed less shrinkage in both the length and width. On all the polymers, the shrinkage was greater when using the aluminum tool, however the data could be skewed slightly due to part warpage, particularly in the length axis. The part tends to curl away from the mold, which in turn, artificially increases the overall length. As seen in Figure 10, the length axis is warped creating a longer distance.



FIGURE 10: HIPS Part Warpage

### Visual Inspection

On the top of the vertical wall of each part, there is an area where the material freezes off and is forced to stretch. This mark is called a chill mark, or flow line. Chill marks are very noticeable with the PETG and KYDEX T parts formed on the aluminum tool shown in Figure 11. This is because the aluminum draws out the heat from the polymer and freezes it to the top of the mold, forcing the remainder of the sheet to stretch and form the part. On the HYVAC-LCM the chill mark is smaller because the tool does not draw the heat out as quickly as the aluminum tool does (see Figure 12). This allows the polymer to adhere to the syntactic foam and evenly cool the entire part to reduce the freezing and stretching of material.



FIGURE 11: Chill Mark on KYDEX T Sheet on Aluminum mold



FIGURE 12: Chill Mark on KYDEX T Sheet on HYVAC- LCM

### Part Finish

The part finishes on the aluminum tool are suitable minus the noticeable chill marks. The HYVAC-LCM part finishes are less than ideal because the mold has a significantly lower surface quality. One issue with the HYVAC-LCM product is the inability to completely eliminate voids when laying up the putty initially. It is possible to miss a few of the microscopic voids, which are not easily seen. This requires reapplication of the putty, sanding and curing at least one other time to achieve a suitable finish. A possibility to obtain a higher surface quality part would be to form the similar mold but extra material around the tool to later be CNC machined. Syntactic foam machines nicely and can save a lot of time and do a better job than filling voids and hand-sanding the mold.

### HYVAC-LCM Techniques / Challenges

The HYVAC-LCM was easy to use while working with the putty (syntactic foam). In order to create fewer voids and have an easier piece of putty to work with, the putty must be kneaded to allow heat to enter and make it more pliable. Once the putty is pliable, it must be flattened out to a half-inch thickness. The putty is then cut with a knife into two-inch wide strips, shown in Figure 13. This was the easiest way to lay up the mold instead of just arbitrarily arranging the putty around the mold. Without using a uniform lay up process there will be many voids in the putty. Using the strips creates fewer voids and makes the material easier to work with. Taking just a ball of putty and pressing it onto the glass door created many voids. The strips eliminated many voids, although still left a fair amount.



FIGURE 13: Syntactic Foam Lay-up Strips

### Time Required Making The Tool

The time it took to create the tool for the front load washing machine door was approximately two hours of lay up time, including time to mix up the epoxy and beads and pack the beads (Figure 14). The part that took the longest was time in the oven, which was about eight hours of consistent heat and then left off overnight to anneal to room temperature. After the mold was cooled to room temperature the voids could be filled. Half the mold was fixed using the putty to fill any voids while the other half mold used Loctite 495 with ground up syntactic foam dust to create a liquid composite. After filling the voids on each half, the mold was set back in the oven for another eight hours plus overnight to anneal to room temperature. The syntactic foam side was fairly easy to sand using 800 grit sandpaper, while the side with the Loctite 495 was rock hard. Using a Dremel sander, the tool was spot sanded for a couple of hours with 180 grit sandpaper. The Loctite was tearing through the 180 grit after just a couple of minutes. After most of the sanding was done, the mold had to be set in the oven for a final cure. Time was limited to do a perfect job sanding and almost all the time was used to sand the Loctite 495 side. On average it took over nine hours to sand the mold. (CMT has since developed a putty format that may be applied to a finished mold for easy patch/polish).

### Tool Mounting Suggestions

In mounting the HYVAC-LCM to the mounting plate, there was not enough time to do multiple tests with mounting techniques.



FIGURE 14: Mixed Composite beads Coated in Epoxy



FIGURE 15: Washing Machine Door Filling Comparison

Holes were drilled and threaded aluminum inserts installed into the bead area of the mold as recommended by CMT Materials for use in solid syntactic foam products. What was encountered was the Loctite 495 adhesive did not hold the inserts properly in the HYVAC-LCM porous core. Instead, an alternative method of using Gorilla Glue was used. The Gorilla Glue is more effective as the holes were not perfect and were larger due to the epoxy beads chipping away during the drilling process. The Gorilla Glue expands while drying to fully secure the inserts into the beads, creating an extremely strong bond.

### Conclusion

In conclusion, the HYVAC-LCM is a feasible mold material depending on the desired applications. If the application requires tight-tolerance products to be produced without flaws, then the HYVAC-LCM is probably not the best option at this point. With further testing and development this tool is capable of producing



parts with high clarity and minimal imperfections. For the cost of the mold and the properties received off of the tool, the HYVAC-LCM could be a big development for the thermoforming industry to use syntactic foam as a mold and not just as a plug.

### Acknowledgements

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6. Bayer MaterialScience
7. Patrick Castrechini - Curbell Plastics – HDPE
8. Matt Vandivier - Primex Plastics – PETG, HIPS
9. Sekisui-SPI – KYDEX T (Acrylic PVC)

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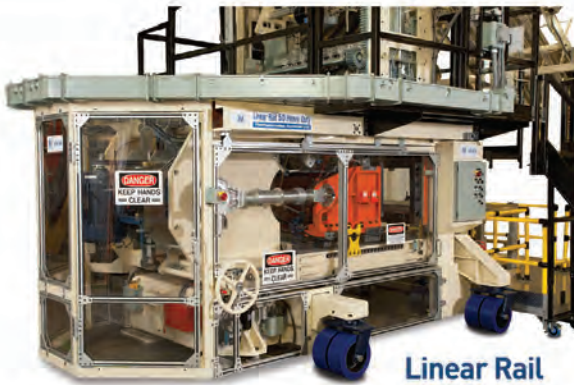
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# Improvements in Color Technology: Impact on Cost and Efficiency

By Jeff Smink, President, Carolina Color Corporation, Salisbury, NC

The thermoformed plastics product business has grown dramatically in the past decade due to improved materials, processing and the ability to mold in color. With such growth, the market has become very competitive and molders are constantly looking for ways to reduce costs while delivering products that are esthetically pleasing while meeting higher performance expectations. Producing colored parts may seem simple but can present molders with some difficult challenges.

Color is often one of the first things that customers notice. Even if the color is just a little off, it can cause the product to be rejected. This is why proper specification is critical during the design phase. The first question that needs to be addressed during the design phase is whether to choose between masterbatch or pre-colored resins. Both have advantages and disadvantages. Today, masterbatches are chosen more often because they help reduce overall molding costs. Adding masterbatch to virgin resin is typically cheaper than using pre-colored compounds. The savings only multiply when the processor is molding the same part in several colors.

Four additional critical questions that should be asked during the design phase:

1. What is the application of the final part and what is the environment in which it will be used?
2. Are there any regulatory requirements?
3. Are functional additives like UV, slip, anti-oxidants, etc. necessary?
4. What are the color tolerance needs for the application?

Color can be a deal breaker if it does not meet the customer's specifications. Color tolerance is the agreement between buyer and supplier as to how closely colored parts have to match their respective master standards. This can be challenging for both sides, especially if parts molded from different resin systems have to match. A good example of this kind of application is an automotive interior.

Color tolerances are usually established using a spectrophotometer. This device allows for the numerical representation of any color space. It can be used to take the human element out of the equation when evaluating colors. A DE tolerance of 1.00 is a standard in the industry for opaque colors but critical applications require much closer tolerances.

Once all of this critical information is gathered, the color process then moves to development of the masterbatch. Masterbatch is typically a concentrated mixture of pigments and/or additives. The masterbatch is then added to the carrier resin. The carrier resin matches the primary molding resin for ease in blending during the molding process.

During the sampling phase, the customer decides if any changes are required. Once all parties are in agreement on the color specification, the color receives final approval and the process moves forward to final masterbatch production.

Repeatability in the production of masterbatch is critical. Certain suppliers have earned a reputation for consistent color and innovative technologies. These companies have been able to develop products that far exceed the characteristics of those that came before them, specifically as it relates to loadings of additives and pigments.

Many molders have found that using highly-loaded colorants can reduce costs. The fundamental idea is to add smaller quantities of more concentrated colorant to virgin resin in order to achieve the same end result as obtained by using larger amounts of a weaker conventional colorant. There are numerous benefits to doing so, not least of which are improved physical properties.

The idea of a highly-loaded "super concentrate" has circulated in the industry for some time, but has fallen short of performance expectations. There is now a new pellet technology on the market that is able to deliver real cost-saving possibilities. Furthermore, the pellets are also exceptionally well-dispersed and effectively distributed in both large and small parts. The following examples outline various ways in which thermoformed product manufacturers have been able to benefit from this new pellet technology.

Large part sheet extruders and thermoformers see reduced material needs, improved extruder efficiencies, more consistent sag rates, reduced scrap, improved cycle times along with increasing UV protection and improving gloss.

As an example, Port-A-Potty customers are largely concerned with the bottom line price point, so manufacturers must be extremely cost-conscious and look for ways to reduce production costs. In thermoforming Port-A Potty panels, for instance, manufacturers must focus on the sag across their entire color palette in order to maximize cycle time efficiencies and minimize

scrap when going from color to color. They also need to ensure that parts will remain strong and will not be damaged due to UV degradation or other external thermal sources. While this can usually cause an increase in cost during manufacturing, new pellet technology can achieve more consistent sag than traditional color concentrate without increasing cost.

Moving up the supply chain, sheet extruders that sell into the Port-A-Potty market report that they have been able to reduce production cost by switching to this new pellet technology for a number of reasons. Quantifiable improvements in extruder efficiencies have led to improvements in extruder throughput. Sheet made using the technology allows for panels with reduced warp, enabling the molder to produce parts quicker and of higher quality.

Sheet extruders and thermoformers that sell into the markets listed below can also benefit from the switch to this new pellet technology:

- Tractor hoods and Interior parts
- Earth moving equipment panels and interior parts
- Semi-truck panels
- Snowplow blades
- Golf cart and ATV panels
- Seating
- Medical equipment

For more information about Carolina Color G2 and G3 color pellet technology visit: [www.carolinacolor.com](http://www.carolinacolor.com).



Figure 1: Medical equipment thermoforming manufacturers can reduce production cost by switching to new higher performing pellets. (Istockphoto.com)

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Throughout the 1960s, Barry Shepherd worked for several different packaging companies in sample making and design. He joined Kodak in 1970 and began designing packaging for cameras, film and related products. One of Barry's first plastic projects was to develop packaging for Kodachrome slides, an early groundbreaking use of thin wall injection molding.

During the mid 70s and early 80s, Barry worked for several corrugated packaging companies in positions ranging from sales to president of a small box company, but he always stayed involved in his passion: the design and development side of the business. In 1984, Barry was introduced to the Alloyd Company, which specialized in thermoforming medical and consumer packaging as well as sealing equipment, and was intrigued by plastics and blister packaging.

In 1985, Barry launched Shepherd Packaging, selling plastic blisters, trays, clamshells, sealing equipment and other packaging

materials. Shepherd Packaging expanded its manufacturing business. In 1997, Shepherd entered the heavy gauge thermoforming market by developing a custom thermoformed plastic pallet for Lear, which they use to transport automobile seats to the assembly lines. Under Barry's leadership in 2006, Shepherd Thermoforming & Packaging, Inc. opened its 43,000 square foot custom thermoforming facility near Toronto, Canada, where the company operates seven thermoforming and two CNC milling machines. Now retired, Barry remains active in development projects at his company.

Barry joined the SPE Thermoforming Division Board of Directors in 1997 and worked on several committees, including the Executive Committee, before retiring from the Board in 2010. During his tenure, Barry also served as technical editor of the Thermoforming Division's award-winning publication, *SPE Thermoforming Quarterly®* magazine. |

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### An Interview with Berry Smeulders, Chief Innovation Officer of Bosch Sprang BV

By Conor Carlin, Editor, *Thermoforming Quarterly*

*Berry Smeulders is current Chief Innovation Officer (CIO) of Bosch Sprang, a thermoform toolmaker based in the Netherlands. The company specializes in the development, production and implementation of thermoform tools for cups, trays, lids and other items for a wide array of end-use markets.*

*TQ conducted an interview via email with Bosch after learning about their recent investments in a state-of-the-art thermoforming lab at their newly redeveloped facility*

**Carlin:** Can you give us a brief history of Bosch Sprang and your role in the company?

**Smeulders:** Bosch Sprang originally started as a steel-rule knife factory to supply the local shoe-making industry. Since the shift of the shoe industry to low-wage countries, the company has focused on the market of thermoform tools for the plastics industry (there are lots of flowerpots in the Netherlands!) We now have over 40 years of experience in the development and manufacturing of thermoform tools. I now hold the role of Chief Innovation Officer where I can get involved with both new market developments and how we respond to customer needs.

**Carlin:** What are some of the biggest challenges and innovations in thermoform tooling today?

**Smeulders:** Thermoform challenges from our perspective include making quality tools that perform well in environments that require high cycle speeds. To achieve high cycle times, tools and machines are much more integrated than they used to be. For example, a partially-adjustable cooling system combined with the choice of materials with the right heat conduction offers better cooling. And a tailor-made airflow system for every specific tool makes higher cycle times possible.

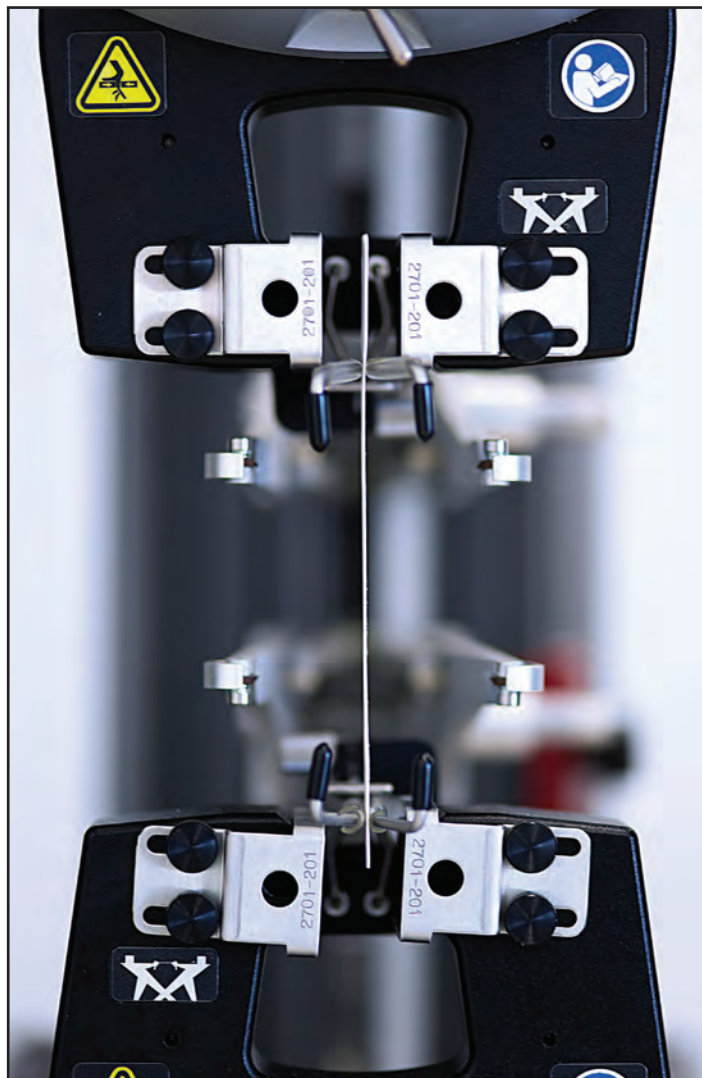
The production of high quality parts within very narrow tolerance fields creates challenges for the thermoformer and toolmaker. Product specifications and tolerances are critical for the downstream processing such as automatic filling. To achieve such narrow tolerances, e.g. coffee capsules, all aspects of the process, material, product design and tooling must be under control. Bosch Sprang has worked closely with customers and partners to address this phenomena and built-up the necessary knowledge.

Price is always a challenge. The prices for end-use thermoformed products are highly dependent on the base material price. The aim is to make a high-quality product within specifications, with minimum possible weight and material costs. So before starting with the design of a tool, together with our customers we concentrate on choice of material. We look at which material is most suitable for the end product, the possibility for use of fillers

such as CaCO<sub>3</sub>, use of multilayers, use of additives, and for example the necessary IV value in case of PET or crystallinity in case of C-PET.

Another challenge is that customers are looking for an affordable investment and lower maintenance costs. When constructing a tool, our engineers focus on ways to reduce maintenance costs as well while ensuring the best possible performance. We have moved to an integrated, paperless shop floor control system to become more efficient.

**Carlin:** You have just completed a major renovation and expansion of your facility, including the addition of a new research and development lab. What were the main drivers for this expansion?





**Smeulders:** In our long-term vision, we wanted to set up a laboratory to increase the overall knowledge level in the company. The expansion of the facility with construction of a new building for main offices and a thermoforming test center provided the perfect opportunity to include a dedicated lab space.

The lab allows us to conduct applied polymer research. We want to create added value through deeper knowledge of all elements of thermoforming. This includes advising our customers and helping them to select the right material for the manufacturing of their end products. To select the most suitable material, you should know exactly what the characteristics of different types of polymers are and be able to predict how they behave in the thermoforming process.

We want to offer customers the knowledge and data that allows them to create an end product with the best price-quality ratio. We do this by thinking about potential material savings, optimal material compositions and the geometry of the product.

**Carlin:** How do changes in materials (polymers) affect Bosch's approach to tooling? Do you see changing demands from customers?

**Smeulders:** We see that when companies decide to change materials, they don't always realize the impact on the quality and wear of the tool. By doing research, we want to have better insight into the possible wear on tooling. The new lab gives us the ability to analyze and check materials before we start engineering the tool. We know which problems to expect so we can discuss them with our customers at the beginning of the process. The data and test results mean we can decide either to adjust the material or design a tool specific for those material properties.

**Carlin:** Do you see clear differences in various markets around the world where Bosch is active? Give us some examples.

**Smeulders:** Yes. In Asia there is a lot of mass production and the range of different products and materials is limited. For example

in Indonesia, which has the biggest water cup industry in the world, 160 million cups for drinking water are produced every day!

In Europe we see that the market is more fragmented with many different products, produced in smaller volumes. The US has a combination of both mass produced items and special packaging applications. Here we often see that a wide range of products is produced with a standard tool.

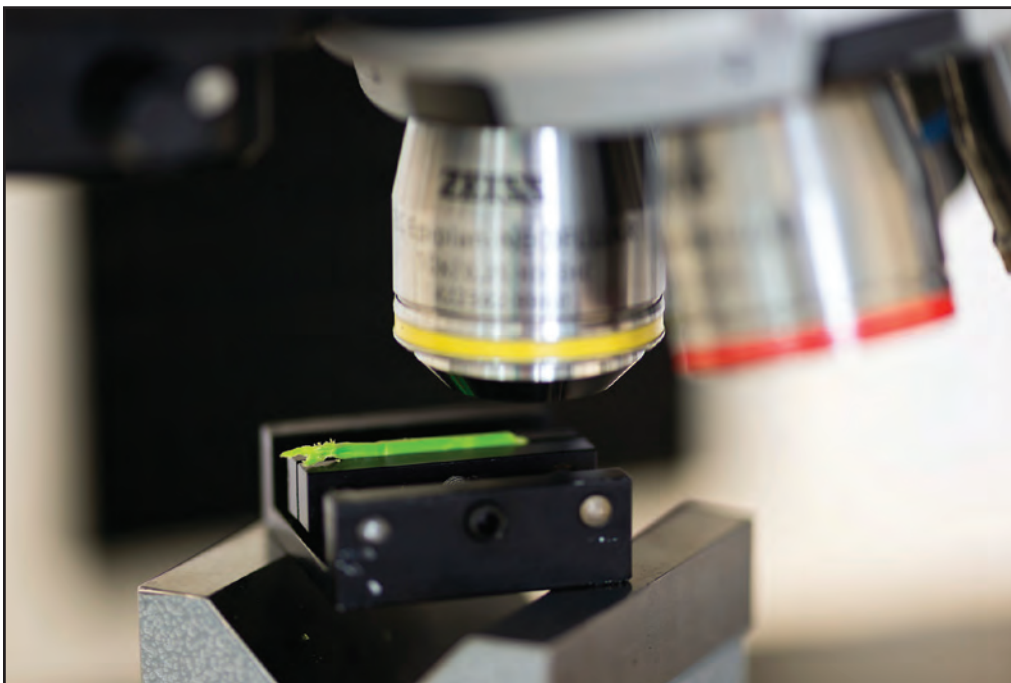
**Carlin:** Here in the US, workforce development is an important subject as companies seek to retain talent and train the next generation of workers. How does the Dutch model compare to US and other European countries?

**Smeulders:** In our company, we have a system where recently retired employees come back to the business to help train new workers. This is how we protect our institutional knowledge. Our younger workers are trained on older, non-digital equipment so they get a true feel for how the machines work. Then they are introduced to and trained on newer CNC machines.

We have agreements with 3 major universities in our region and we work closely with them to design courses that align with industry needs. In both theoretical concepts and hands-on work, we set benchmarks to determine if the students meet or exceed the criteria we have established. We offer internships and paths to full employment.

**Carlin:** What will the next 3-5 years look like from Bosch's perspective?

**Smeulders:** Our expectation is that the application of biomaterials and heat-resistant materials will continue to develop further. In terms of end products, we think that the production of portion packs will increase, to reduce transportation costs and to contribute to a better environment. Thermoform tools and technology will be tailored for the specific properties of these products and materials. |



# Interview with Harold Weil, President of EMATEC

Feiplastic 2015, Sao Paulo, Brazil

*Equipamentos e Materiais Técnicos Ltda, (EMATEC) is a Brazilian company that represents major European and American OEMs to the plastics and packaging industries. With principals from sheet extrusion lines to feedblocks and dies to plug assist materials, EMATEC is well-positioned to comment on the state of the thermoforming industry in Brazil, a country of 200MM people. TQ editor Conor Carlin spoke with Harold Weil at the Feiplastic 2015 tradeshow in Sao Paulo.*

**Carlin:** Tell me about the origins of Ematec.

**Weil:** My father, Leo Weil, started the company in 1972. He was born in Germany and moved to Brazil in 1951. He began as a representative for foreign packaging-related equipment companies. At this time in the early 1970s, Brazil was beginning to open up to global trade. Brazilian companies started to travel to international tradeshow such as K in Germany. These entrepreneurs and engineers started to learn about plastics processing to develop the local market. Leo started working with both US and European companies such as Davis-Standard (sheet extrusion, wire & cable and blown film lines), Van Dam (printing), Kautex (extrusion blow molding), Rambaldi (milling machines), Innocenti (boring & milling machines) before bringing on HPM and Starlinger as other principals.

In 1991, I started with the company as my father started to withdraw from the daily business of running the company. I began as a representative for OMV before doing some projects with Greiner when they were building smaller tilt-mold thermoforming equipment - the model KTR4. [Note: Kiefel purchased the Greiner KTR line in 2003.] Because Kiefel already had an agent in Brazil, Gabler invited us to become the exclusive agent for Brazil. SML (an Austrian extrusion machinery company) was already part of the group since 2000 and then we started with CMT and their line of HYTAC® plug assist materials in 2010 after another K show.

Today we have 5 principals: Van Dam, SML, Gabler, Cloeren and CMT Materials as well as consumable materials such as UV lamps and printing blankets. We are very much focused on rigid and flexible plastic packaging (only cast concept), both upstream extrusion and downstream thermoforming.

**Carlin:** What do you think has changed most in thermoforming in Brazil over the past 10 years?

**Weil:** I would say that the market has slowly changed over the past 10 years to the point where we now can see 3 distinct market segments. The first is what we call disposables: high volume, low value parts such as thin PP and PS drinking cups. In this area, Brazilian machinery makers and toolmakers dominate. The second segment is what we call food service: again, high-volume parts that are used by major brands such as McDonalds, Burger King, and other fast food restaurants. In this segment, quality printing is required so we see the use of Van Dam printers and some European thermoforming technologies. Because the local machinery suppliers build cut-in-place machines with blow-off systems, the end-customer can use 90+ cavity tools and achieve the necessary quality. The third segment is what we call industrial packaging: this is where you find very high-quality dairy parts (yogurt, margarine) that require tight tolerances for downstream processing such as filling and sealing. This segment uses European technology almost exclusively.

**Carlin:** You work with both US and European technology companies. What are similarities / differences that you see?

**Weil:** In packaging, it seems to me that the Brazilian market prefers the European platform. This is true for injection, blow molding and thermoforming processes. The European OEMs have been exporting outside their (smaller) domestic markets for many years. The US OEMs still have a very broad and deep market at home. Their machines are usually much larger and don't always fit the standard that we now have here.

I think the customers perceive the European machines as more advanced than others. This is perhaps because the Europeans are more aggressive when it comes to investing in and introducing new technologies.

That said, in foam (EPS trays and cups), the market is supplied mostly by Asian and American machinery such as TSL/Sunwell Global. The cups are all injection molded and trays are typically thermoformed. We do not operate in this market.

**Carlin:** Do you think Brazilian companies are able to compete in world markets?

**Weil:** It depends on what sector of the market. Some of our customers who use large SML extrusion lines for shrink film are doing very well both domestically and internationally. In fact, some of them are selling into Germany to be distributed in Europe and directly exported to the US, Latin America and Central America. Another one has recently purchased a facility in the US to distribute and soon produce there as well. In thermoforming, Brazilian companies do not sell too much, only small quantities in Latin America and Central America.

We are seeing some movements of Brazilian companies that are installing new facilities abroad to be more international and to compete beyond our shores as the internal costs and taxes are too high and we lose our competitiveness.

**Carlin:** How does this Feiplastic show compare to the last one in 2013?

**Weil:** It is very different than the last one. While the traffic has generally increased over the course of the week, the overall attendance is down. You can see several unsold booths here. This is due mainly to some negative changes in the economy. That said, the quality of meetings is quite high as we know many of the players in our market.

**Carlin:** What does your crystal ball tell you about the next few years in Brazil?

**Weil:** [Smiles.] When you ask me that about Brazil, I can only say that it is very difficult to predict the future. Almost impossible. We have seen an incredible drop in business in just the past year. The automotive sector is down more than 20%. Volkswagen gave forced vacation to 8000 employees. Political instability has increased and now interest rates have climbed to 13.25%. Energy costs are also increasing. At the moment, people have lost confidence so investments have declined and people are postponing large purchases. |

## From the Editor

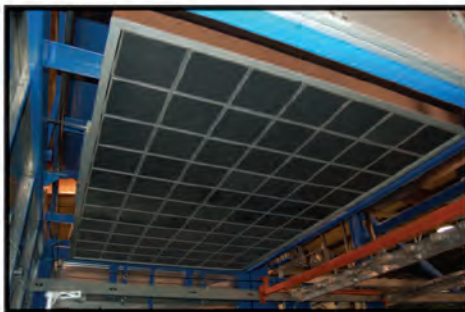
If you are an educator, student or advisor in a college or university with a plastics program, we want to hear from you! The SPE Thermoforming Division has a long and rich tradition of working with academic partners. From scholarships and grants to workforce development programs, the division seeks to promote a stronger bond between industry and academia.

**Thermoforming Quarterly** is proud to publish news and stories related to the science and business of thermoforming:

- New materials development
- New applications
- Innovative technologies
- Industry partnerships
- New or expanding laboratory facilities
- Endowments

We are also interested in hearing from our members and colleagues around the world. If your school or institution has an international partner, please invite them to submit relevant content. We publish press releases, student essays, photos and technical papers. If you would like to arrange an interview, please contact Conor Carlin, Editor, at [cpcarlin@gmail.com](mailto:cpcarlin@gmail.com) or 617-771-3321.

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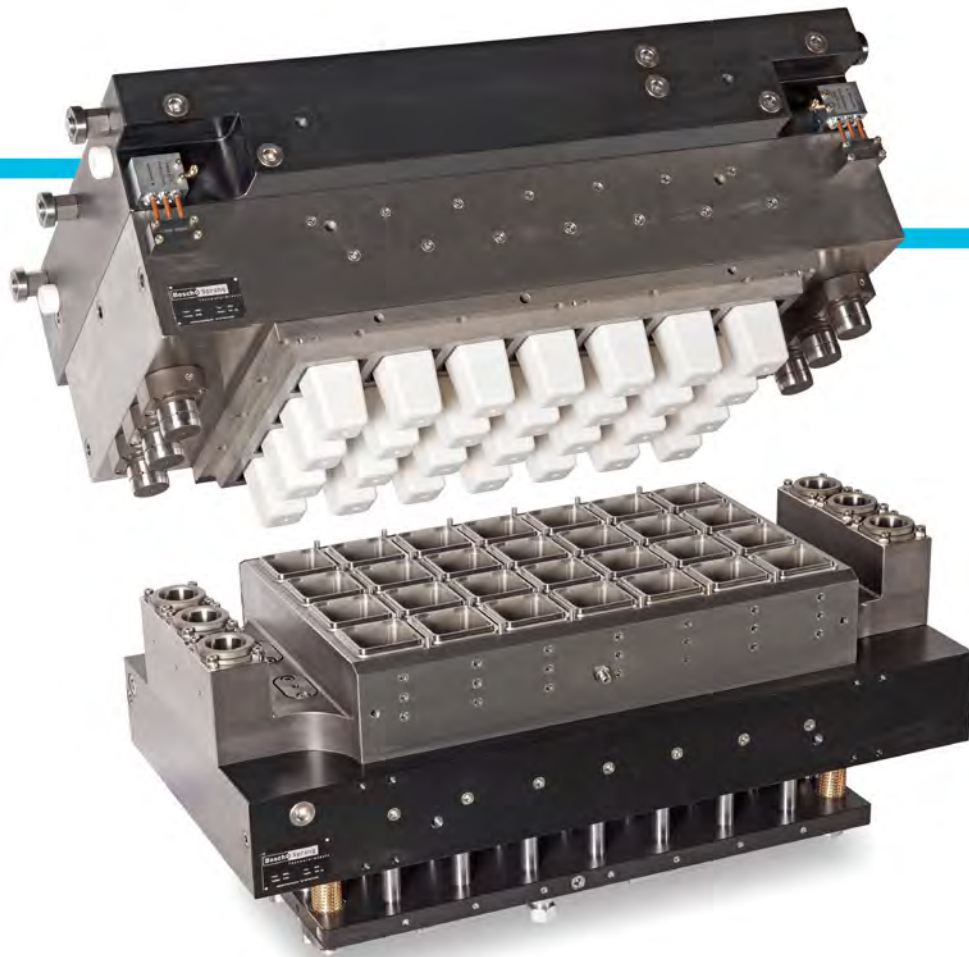
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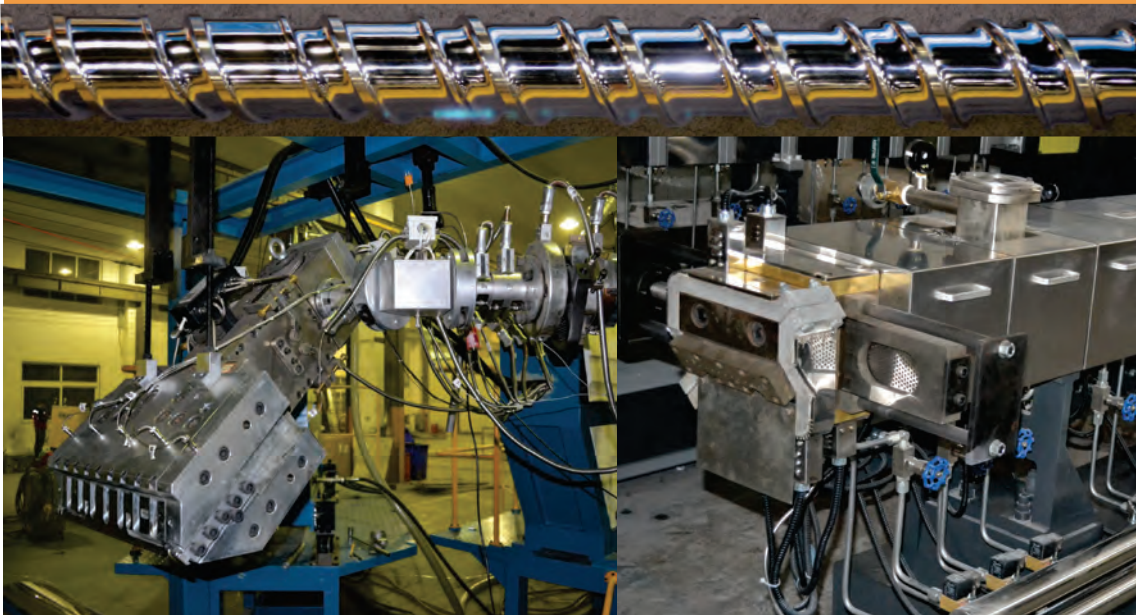
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# CONFERENCE KEYNOTE SPEAKERS TO ADDRESS DESIGN INNOVATION AND CORPORATE LEADERSHIP

The keynote speakers for the 24<sup>th</sup> annual Society of Plastics Engineers (SPE) Thermoforming Conference® will focus on the importance of design and manufacturing innovation and corporate leadership.

***From Square Wheels to Not Quite Rocket Science!  
A Presentation on Speciality Fabrication Using a Variety of  
Plastics Related Medias.***  
**Tuesday, September 1**

Mark Harrington, owner of Storyland Studios, a custom fabrication company that creates sculptures for films, amusement parks and corporations, will describe how his company employs a wide range of techniques (including vacuum forming) to build movie props and sets, exhibits, trade show booths, theme park and architectural elements and retail merchandising displays.



***Chick-fil-A's Leadership Model: SERVE.***  
**Wednesday, September 2**

Michael Garrison, Senior Director, Sustainability & Packaging, on the Menu Strategy & Development team of Chick-fil-A, Inc., will reveal Chick-fil-A's Leadership Model, using the acronym "SERVE." Takeaways will include the "Servant Leadership" principles that are taught and celebrated at Chick-fil-A. The audience will reflect on and write an outline of an action plan to utilize such leadership principles in their businesses.



Chick-fil-A is a privately held quick-dining restaurant chain with 2014 revenues of over \$5.5 billion. After working as an intern with Chick-fil-A while attending Auburn University, Michael Garrison joined the organization full-time in 1993 as an Information Technology Analyst. He moved on to the Marketing department in June 2011 to begin Chick-fil-A's sustainability efforts. Today he serves on the organization's Menu Strategy Leadership team and is responsible for Sustainability and Packaging.

**SPE THERMOFORMING CONFERENCE  
INNOVATION BRIEFS**  
**Tuesday, September 1**

**2:30 p.m. – Keynote Stage (back of exhibit hall)**  
**Terrence Woldorf, CMT Materials**

***Alternative Mold Materials for Heavy Gauge Thermoforming***  
As a result of more stringent quality requirements in the cut sheet segment, CMT Materials, Inc. engineers have developed a new materials and process that offers dramatic savings in mold making and provides results on par or better than aluminum for low-to-medium run projects.

The new syntactic foam material, released as HYVAC-LCM, utilizes a porous core covered by a layer of syntactic foam. Due to its low thermal conductivity, syntactic foam does not impart stress to the plastic as occurs with aluminum molds. No temperature control is required for the mold. When forming a part, the approach offers improved materials distribution in the same cycle time, while offering much longer tool life than wood, MDF or other toolboard materials.

**3:00 p.m. – Keynote Stage (back of exhibit hall)**  
**Sushant Jain, Processing Technologies International**

***Advanced Roll Stand Technologies***  
Features and benefits of PTi's all new configurable G Series Roll Stand will be presented. The Roll Stand features patented vertical nip height positioning and linear bearing roll stand traverse with digital positioning control. It includes servo motorized gap positioning and transfer roll coater. There is a compact inline or full length telescoping conveyor with low friction precision idler rollers. Included is a Roll Stand safety lock-out mechanism, light curtain safety exit at pull roll and LED task lighting for work area illumination. These and additional technologically advanced and operator friendly features of the configurable G Series Roll Stand will be discussed.

**Wednesday, September 2**

**2:30 p.m. – Keynote Stage (back of exhibit hall)**  
**Kirk Morrow, Dynamic Robotic Solutions**

***Advanced Trimming Techniques for Thermoformed Parts***  
The talk will discuss traditional trimming methods and their limitations. It will then detail advanced techniques, including CO2 laser for high speed accurate trimming. A case study will then be given on a hybrid system that handles router trims and laser cuts on a large thermoformed part.

## TECHNICAL PRESENTATION ABSTRACTS AND PRESENTER BIOS – ROLL FED

Tuesday, September 1 and Wednesday, September 2

Tuesday, September 1

10 a.m.-10:45 a.m.

Ryan Hunt, Algix

### *Understanding Bioplastic Technologies*

The landscape for using renewable materials to produce polymers has been rapidly expanding over the past 10 years. This presentation will review the types of bioplastic technologies on the market and discuss their strengths and weaknesses, their origins and their applications. The presentation will discuss the environmental advantages of bioplastics and its qualification using life cycle assessments. Providing clear definitions of commonly used terms and jargon will help thermoforming companies better understand the product offerings to make decisions for incorporating bioplastics in commercial applications.

### About Ryan Hunt

Chief Technology Officer of ALGIX, LLC, Ryan holds a B.S. in Physics and a M.S. in Biological and Agricultural Engineering from the University of Georgia.

Mr. Hunt was involved with research in the UGA, Biorefining and Carbon Cycling Program since 2006. He has over four years of research experience investigating algae cultivation for renewable biomass and bioplastic production. During this time, he has published six research papers on various aspects related to algae biotechnology and has filed for five patents related to algae production and product conversion. Mr. Hunt helped develop the first algal bioplastic prototypes at UGA with Dr. Suraj Sharma in 2009.

Mr. Hunt co-founded ALGIX with the CEO, Mr. Mike Van Drunen, in 2010 with a focus towards custom compounding algae plastics for the sustainable packaging market. Mr. Van Drunen brings significant experience and commercial visibility from the packaging machinery industry that has helped grow the business from lab bench to commercial production.

1 p.m.-2 p.m.

Mathieu Fourcade, Dassault Systemes SOLIDWORKS

### *Optimizing the Design of Thermoformed Parts*

If you are involved in the design or manufacture of thermoformed parts, attend this session to see how CAD software can be used to ensure that your parts meet form, fit and function requirements. Learn how you can use those tools to maintain best design practices and optimize part quality.

### About Mathieu Fourcade

Matt Fourcade is Product Manager at Dassault Systemes in charge of SOLIDWORKS CAD and new initiatives. Matt is a Certified SolidWorks Expert (CSWE). He previously worked as a Technical Support Engineer and Product Marketing Manager for SOLIDWORKS Simulation, Plastics, and Electrical.

2 p.m.-2:45 p.m.

Scott Weaver, ACS Group

### *Temperature Control For The Thermoforming Process*

A review of the needs for mold temperature control for the thermoforming process including reasons why required, equipment most commonly used to provide it and considerations for selecting the proper equipment.

### About Scott Weaver

Scott has 30+ years of experience in the sales of cooling and temperature control equipment to the plastics industry.

3:30 p.m.-4:15 p.m.

Holly Hansen, Heritage Plastics

### *Minerals in Rigid Packaging - What's New and Exciting*

The use of talcs, and to a greater extent calcium carbonates, in polyolefin packaging has steadily increased over the past several years. This presentation will look at some of the aspects driving these changes – product design, performance properties, material savings, processability and environmental advantages.

### About Holly Hansen

Currently Holly is VP Technical Services for Heritage Plastics, a company specializing in mineral concentrates. She has been with Heritage for 15 years and is responsible for managing the tech service team, which supports sales and manufacturing, and is instrumental in identifying product development opportunities for not only thermoforming, but also film, blow molding and fiber.

Wednesday, September 2

10 A.M.-10:45 A.M.

Evan Gilham, Productive Plastics

### *Using Another Processors Tools - A Look into Tooling Comparison and Spec Sheets*

This presentation will take you through an example that custom processors rarely get to see their products being made on tools that do not use modern molding technologies and techniques versus modern suggested methods. This presentation will touch on managing customer expectations, planning and project management, dealing with an existing production line to fulfill while building new tooling, potential savings areas to watch along the way and compare suggested tooling specs against the example provided.

### About Evan Gilham

Evan has been involved in the heavy gauge thermoforming industry for over 10 years and is a member of SPI. Evan attended Lehigh University and earned a BS in Finance. His responsibilities range from sales, program management, CAD design, production and fabrication, spray coating and quality. His employer, Productive Plastics, is involved primarily in rail, bus, medical device, aircraft and industrial markets.

**1 p.m.-2 p.m.**

**Jeremy Bivins, Ingersoll Rand**

### ***Energy Efficiency***

Do you know how much you spend to run your compressed air? This is a question that should be asked when companies want to save money on energy. Compressed air is like a fourth utility and we should look at it as such. There are many ways for companies to make their compressed air systems more energy efficient. By understanding how compressed air is used in a plant, companies can start to reduce their Kw usage by having the right size compressor and operating them correctly as well as a drying system that goes along with it. Compressed air storage can also help how a system operates if sized correctly and leaks in systems can hurt what you are trying to accomplish if not kept up.

### **About Jeremy Bivins**

Jeremy has been in the compressed air industry for 17 years servicing, designing and selling compressed air systems.

**2 p.m.-2:45 p.m.**

**Sushant Jain, PTi**

### ***Inline vs. Offline Thermoforming***

A technology comparison of sheet fed inline versus offline thermoforming process will be presented. Major components of each process will be discussed. For inline thermoforming, core of the sheet going into the thermoforming oven is at higher temperature. That results in more uniform sheet temperature going into the thermoformer. The energy and finished part quality implications of hotter sheet core temperature will be reviewed. The equipment and operating cost comparison for the two processes for different system throughput rates will be presented. Inline thermoforming offers advantages in areas of safety, elimination of roll stock handling and inventory, and elimination of winding and edge trim equipment. These and other benefits of inline thermoforming will be reviewed.

### **About Sushant Jain**

Sushant Jain is Senior Scientist, Applications and Technology, with PTi. He has 30 years of extensive experience in the plastics industry. He has held leadership roles focused on R&D, product development, process development and lean manufacturing with leading packaging companies including Pactiv, American National Can, Amoco Foam Products and Continental Can. He has successfully developed and commercialized containers for food/nutritional products. Mr. Jain earned his M.S. in chemical engineering from Cornell University.

**3:30 p.m.-4:15 p.m.**

**Marcia Kurcz and David Thompson, Sr.  
Polyscope Polymers B.V.**

### ***High Heat Polystyrene for Sheet Extrusion Applications***

The work presented proves the feasibility to create a high heat polystyrene-based product for extrusion applications. The sheet is used alone or thermoformed into products requiring higher temperature resistance, printability, and good rigidity/flexibility balance. The blends investigated are combinations of various grades of (high impact) polystyrene with styrene-maleic anhydride copolymers. The goal is to offer FDA compliant, cost-effective, easier to process and fully recyclable alternatives to the market.

### **About Marcia Kurcz**

Marcia Kurcz is presently the NA Business Manager for Polyscope Polymers B.V., a position she has held since 2008. Polyscope Polymers is the global leader for production of styrene maleic anhydride copolymers. Polyscope produces a comprehensive product line of neat and compounded resins for various markets.

Marcia has 35 years of experience in product and market development; having held key positions with GE Plastics, Quadrant, Solvay, Elix Polymers. She has supported applications for the automotive, consumer, recreational vehicle and specialty chemical fields. She had also served on the SPE Automotive Board.

Ms. Kurcz holds a Bachelor of Science degree from Michigan State University and a Masters in Finance from Walsh College.

### **About David Thompson, Sr.**

Dave Thompson is currently a Senior Technical Service and Development (TS&D) Leader for AmSty, a position he's held since the founding of AmSty in 2008. AmSty was formed as a joint venture of Chevron Phillips Chemical Company LP (CPCHEM) and the Dow Chemical Company (which transferred its interests to Styron LLC, now Trinseo LLC). AmSty is a leading polystyrene producer with plants in North and South America.

Dave has retained roles in Quality, Product Development, Applications Development, and Technical Service functions during the last 30 years in the plastics industry. He has working knowledge of laboratory test methods, extrusion, thermoforming, injection molding, and polymer printing processes primarily for polystyrene.

Mr. Thompson is a 1983 graduate of Pennsylvania State University. He holds a Bachelor of Science degree in Polymer Science.

## **TECHNICAL PRESENTATION ABSTRACTS AND PRESENTER BIOS – SHEET FED**

**Tuesday, September 1 and Wednesday, September 2**

**Tuesday, September 1**

**10 a.m.-10:45 a.m., Mauro Fae, Self s.r.l.**

### ***Solving Process Challenges with an Engineering Approach to Tooling Innovation***

Two different cases will be analyzed with resulting innovative tooling solutions. Machine dimension limitations and chilling marks in high esthetic products are the common issues. A challenging de-molding problem is also an issue in the first study.

The adopted solution utilizes multiple air circuits with flux regulators and valves for an easy set up and no electronic controls. Vacuum forming simulation with retrofitted electric heating in an open box tool (no vacuum box) is the combination of solutions used for the second tool example.



### **About Mauro Fae**

University degree from Engineering University of Padova (Italy). Mechanical and Automation Engineering degree. Member of the SPE European Thermoforming Division Board since 2009.

Since 2004, at Self s.r.l. as a technical manager. Currently, R&D and customer support manager/operations manager. Self s.r.l. specializes in the development and production of medium and large size aluminum moulds, especially for the thermoforming industry. Together with Ones, single and multisingle rapid prototyping, and Castalia, aluminum foundry is part of the SelfGroup.

Previously at SIPA S.p.A. Zoppas Industries (Italy) in charge of Research and Development Engineering in the PET containers blow moulding process. Sipa develops and produces machines and moulds for container blow moulding and injection moulds for the production of preforms.

**1 p.m.-2 p.m.**

### **Mathieu Fourcade, Dassault Systemes SOLIDWORKS**

#### ***Optimizing the Design of Thermoformed Parts***

If you are involved in the design or manufacture of thermoformed parts, attend this session to see how CAD software can be used to ensure that your parts meet form, fit and function requirements. Learn how you can use those tools to maintain best design practices and optimize part quality.

### **About Mathieu Fourcade**

Matt Fourcade is Product Manager at Dassault Systemes in charge of SOLIDWORKS CAD and new initiatives. Matt is a Certified SolidWorks Expert (CSWE). He previously worked as a Technical Support Engineer and Product Marketing Manager for SOLIDWORKS Simulation, Plastics, and Electrical.

**2 p.m.-2:45 p.m.**

### **John Price, Sukano Polymers Corporation**

#### ***Functional Additives of Current and New Advances in Technologies for Sheet Extrusion and Thermoforming***

This presentation will focus on functional additives of current and new advances in technologies for sheet extrusion and thermoforming. These products include melt enhancers, impact modifiers, slip/antiblock, nucleators, alternatives to silicone, and color enhancements. Several of Sukano's products have been developed to enhance the properties of biopolymers, expand the use of recycled polyesters and improve performance in use of other polymers. Sukano Polymers Corporation has over 20 years of expertise in providing functional additives for the sheet extrusion and thermoforming markets. Sukano has core technologies for resin platforms including polyesters, nylons, biopolymers, and polyolefins.

### **About John Price**

John Price has been with Sukano Polymers Corporation for almost two years as the technology and development engineer for North and South America. His responsibilities at Sukano Polymers include new product development, development to commercialization scale-up, conducting customer trials and technical support for the sales team. Previously John was employed

with Milliken for 18 years, filling roles as process engineer in manufacturing, development engineer in colorants, senior application engineer in sheet extrusion, thermoforming and blow molding as well as new product development for polypropylene and polyethylene. He holds a BS in Chemical Engineering from the University of South Carolina.

**3:30 p.m.-4:15 p.m.**

### **Roger Jean, PMC, and Jon Larson, Allied Plastics**

#### ***Transforming a Powder Coated Metal Enclosure to Mold In Color TPO for a Portable Light Generator***

Advantages of making the change to thermo plastic. Challenges faced in making the material transformation and how they were overcome including structural integrity, heat deflection, stress whitening, weathering, chemical resistance and scratch/mar surface performance. Tool design and processing challenges for the application will also be reviewed.

### **About Roger Jean**

Roger Jean is Vice President of Sales and Technology for Premier Material Concepts, a custom sheet extruder located in Findlay, OH, where he has worked since 2009. He has 28 years of Plastics Industry experience serving in mostly sales leadership and market development roles during his career at companies including Coachmen Industries, Fabwel, Wilbert Plastic Services and Solvay Engineered Polymers. He has a BS degree from Purdue University and an MBA from Indiana University. Roger has served on the Board of Directors for the SPE Thermoforming Division since 2010.

### **About Jon Larson**

Jon Larson is the Sales and Marketing Manager for Allied Plastics, a custom vacuum former located in Twin Lakes, WI. Working at Allied since 1997, Jon has over 18 years of experience in the vacuum forming industry, with job duties including CNC programming, CAD design, engineering manager and key accounts manager. Jon has an AS degree from the College of Lake County.

## **WEDNESDAY, SEPTEMBER 2**

**10 a.m.-10:45 a.m.**

### **Robert Porsche and Patrick Cain. General Plastics**

#### ***Reverse Engineering to Injection Molded Parts***

A discussion on how we solved a customer's problem when a mold became unable to produce product. Should he replace an expensive mold toward the end of its product life or find another solution – vacuum forming!

### **About Robert Porsche**

Bob Porsche is the President and Owner of General Plastics, a custom Heavy Gauge Thermoformer located in Milwaukee, Wisconsin. Bob has owned and operated General Plastics for 27 years with the prior 13 years spent as Sales Manager of an Illinois-based thermoformer. Bob has been involved with the SPE Thermoforming Board over the last 15 years, holding Chairman positions on all (3) technical committees. He now serves on the Finance Committee. He was also Chairman of the 2005 Conference and Technical Chair of the 2001 Milwaukee Conference.

### **About Patrick Cain**

Patrick Cain is the Plant Manager for General Plastics, a heavy gauge thermoformer located in Milwaukee, WI, where he has worked since 2009. He has 19 years of Plastics Industry experience serving in mostly engineering and operations leadership roles during his career at companies including KAMA, IVEX, Alcoa, and Reynolds Packaging. He has a BS degree from Illinois State University and an MBA from Wilkes University in Pennsylvania.

**1 p.m.-2 p.m.**

**Jeremy Bivins, Ingersoll Rand**

### ***Energy Efficiency***

Do you know how much you spend to run your compressed air? This is a question that should be asked when companies want to save money on energy. Compressed air is like a fourth utility and we should look at it as such. There are many ways for companies to make their compressed air systems more energy efficient. By understanding how compressed air is used in a plant, companies can start to reduce their Kw usage by having the right size compressor and operating them correctly as well as a drying system that goes along with it. Compressed air storage can also help how a system operates if sized correctly and leaks in systems can hurt what you are trying to accomplish if not kept up.

### **About Jeremy Bivins**

Jeremy has been in the compressed air industry for 17 years servicing, designing and selling compressed air systems.

**2 p.m.-2:45 p.m.**

**Edward Malloy, POLIFILM America**

### ***Protective Film for the Thermoform Industry***

Technical advances in the manufacturing of coextruded cast protective film as it applies to the thermoforming industry.

### **About Edward Malloy**

Ed Malloy is the Coex Cast Specialist for POLIFILM America covering all of North America. In addition, Ed runs the Northeast Region Converting and Distribution Center located just outside Philadelphia, PA. The majority of his time is dedicated to working with some of the largest extruders in North America with their protective film requirements.

**3:30 p.m.-4:15 p.m.**

**Mark Murrill, Profile Plastics**

### ***Back to the Future: A Look at an Early Pressure Forming Process Win***

This session will examine the complexities of one of the first successful highly engineered pressure formed parts (and a Parts Competition winner). Launched in 1986, the product design challenges overcome in the early stages of this processing technique were significant. The part is still in production with the original 30-year-old tool and is the main component of an intricate assembly with ten other thermoformed and purchased parts for the end customer.

Topics covered will include: pressure forming as compared to alternative techniques, iterative tool design, and early supplier involvement to create the most cost-effective final assembly: all relevant and applicable today.

### **About Mark Murrill**

Mark Murrill is currently the director of marketing for Profile Plastics in Lake Bluff, IL. In this role he works closely with customers and prospects to match design intent with Profile's capabilities, and leads the overall marketing approach for the company.

Founded in 1960, Profile Plastics is a leading heavy gauge thermoformer primarily supplying housings, covers and enclosures to OEM's in the medical, food/beverage, material handling, and transportation industries. Profile specializes in highly detailed, close tolerance production via the vacuum, pressure and twin-sheet thermoforming processes and was one of the early innovators of heavy gauge pressure forming. As early as 1985, parts were being engineered to bring the benefits of this process to the world of cosmetic plastic parts.

Before coming to Profile, Mark managed a new product development team at Emerson Network Power to develop leading-edge DC power systems for global telecom and datacenter applications. Mark holds a BS in mechanical engineering from Purdue University, West Lafayette, IN, and an MBA from Northwestern University's Kellogg School of Management, Evanston, IL. |

## ***Submission Guidelines***

**We are a technical journal. We strive for objective, technical articles that help advance our readers' understanding of thermoforming (process, tooling, machinery, ancillary services); in other words, no commercials.**

- **Article length: 1,000 - 2,000 words. Look to past articles for guidance.**
- **Format: .doc or .docx**
- **Artwork: hi-res images are encouraged (300 dpi) with appropriate credits.**

**Send all submissions to  
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### Too Valuable to Waste: Rethinking Plastics

*Realizing the full value of plastics with “the 4 Rs”*

By Steve Russell, Vice President Plastics Division, American Chemistry Council (ACC), Washington, D.C., USA

*TQ would like to thank the American Chemistry Council (ACC) and Plastics Engineering magazine for allowing us to reprint the following article.*

*An event called Plasticity Forum gathers leaders who can learn and collaborate on sustainability issues surrounding plastics. During the most recent Plasticity event in New York, I had the opportunity to share ACC’s views on the roles plastics play in the global drive toward sustainability. Here’s a synopsis of that presentation.*

In a relatively short period of time, plastics have become the “go to” material in many applications, for readily apparent reasons: they’re durable, adaptable, easy to produce, and in many cases more cost effective. That’s why today our shampoo bottles

don’t shatter in the shower, our cars and trucks are made with lightweight materials to burn less fuel, our new homes are well insulated to save energy, and we can ship more goods with less packaging than ever before.

Plus, we’re in a time of incredible innovation. Our industry’s experts are working with their customers to:

- transform medicine with nano-scale devices and lifelike prostheses;
- deliver “smart packaging” that keeps food fresh longer and warns us when it’s spoiling;
- create lightweight polymer composites for aircrafts and cars; and
- even spice up world championship soccer games with a NASA-tested ball made from specialty plastics.

And while most plastics are made from energy sources, lifecycle data and analyses show that in most applications plastics actually save energy, when compared to available alternatives. A world without plastics would not just be less pleasant but also more wasteful.

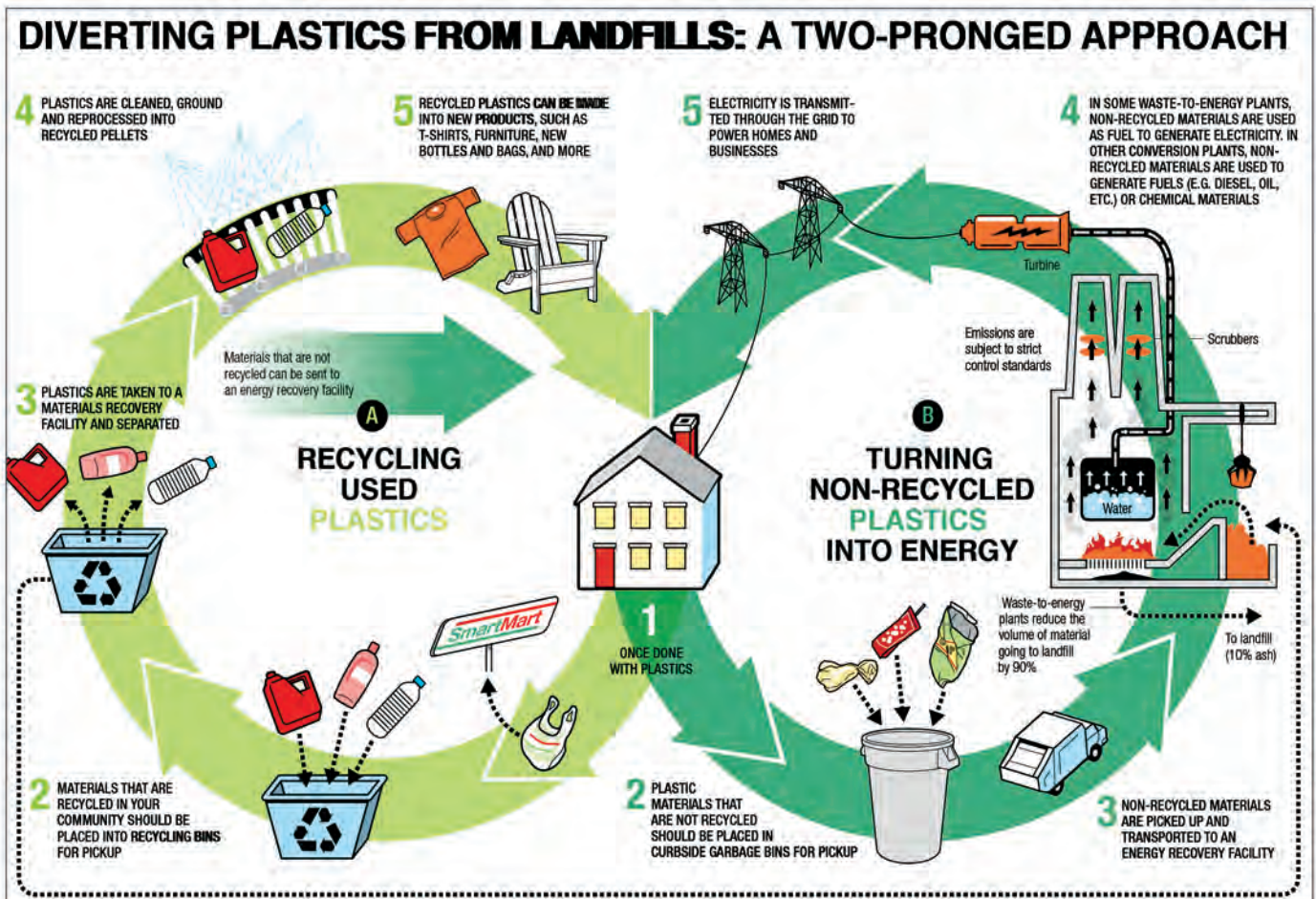


Diagram courtesy of ACC.

But nobody wants a world where plastics fill up landfills or become litter. As a society, we need comprehensive, integrated approaches to manage our waste that allow us to benefit from incredible innovations in plastics without trashing our planet in the process. That's why ACC and plastics makers are focused on "the 4 Rs": reduce, reuse, recycle, and recover.

### **The First R: Reduce**

Plastics are all about source reduction, since they allow us to do more with less. Let's look at packaging. Recent lifecycle studies in Europe and the USA have shown that replacing plastic packaging with alternatives would:

- require four and a half times as much material by weight and increase the amount of packaging used by nearly one 110 billion pounds (50 billion kg);
- increase overall waste generation by 22%, equal to the weight of 169,000 Boeing 747 jumbo jets;
- increase energy use by 80%, equivalent to the energy from nearly 91 oil supertankers; plus
- result in 130% more global warming potential, similar to adding 15.7 million more cars to our roads.

These are really striking findings. Because of favorable strength-to-weight ratios, we can package *more goods* in plastics using *less material*. And consumer product companies are continually striving to make bottles and packaging lighter and thinner and finding innovative ways to reduce the amount of packaging for shipping and selling food and other goods.

This is not happening only in packaging. Automakers are increasingly turning to lightweight, tough plastics to help them reduce the weight of cars to improve fuel efficiency and meet CAFE standards. And the next big move will be to replace even more traditional materials with plastics reinforced with carbon fiber, as in the Boeing Dreamliner.

And in our homes and buildings, plastic building materials such as foam insulation are helping us save tremendous amounts of energy by providing superior insulation properties and by sealing the building "envelope." through a combination of options, including passive energy (such as solar) and modern plastic insulation, the next goal is "net zero" and "net positive" energy homes—homes where on-site energy production equals or exceeds on-site energy consumption. That is going to be a game-changer for energy use and greenhouse gas emission reductions.

### **The Second R: Reuse**

Reuse is largely driven by how consumers use plastics, but companies are increasingly making plastics designed to be reused. Many brand owners are moving toward refillable products and concentrates that allow consumers to buy more product with less package, and consumers today have more opportunities to choose reusable packaging such as grocery bags, food containers, and beverage bottles.

### **The Third R: Recycle**

Plastics are relatively new materials, and plastic recycling is even newer. So while we're playing catch up, we're catching up

quickly, and there has been steady, year-over-year growth. Some examples:

- nearly all Americans today can recycle plastic bottles.
- there are more than 18,000 places across the USA to recycle plastic bags and wraps.
- nearly 31% of plastic bottles are recycled, not far behind glass containers at 34%.
- And more than one billion pounds of non-bottle plastic containers were recycled in 2013, which is triple the amount since just 2007.

To help increase these numbers, ACC works with coalitions of government, non-governmental organizations, brand companies, large retailers, and the recycling community to help consumers better understand how and what to recycle.

But the truth is we may never get to 100% recycling for plastics or any material. What do we do with those plastics that are not recycled? One of the truly counterproductive things our country has been doing for way too many years is treating used materials as garbage and burying them in landfills, which is a huge waste of valuable resources. This brings us to...

### **The Fourth R: Recover**

The molecules that make up plastic products are a powerful source of energy. Non-recycled plastics can supply more than 15,000 Btu/pound (35,000 kJ/kg) in a facility that converts waste to energy. That's more energy per pound than coal. Scientists at Columbia University found that converting all non-recycled plastics to energy could power 5.7 million homes.

Diverting all non-recycled municipal solid waste from landfills to waste-to-energy facilities could produce enough electricity to power nearly 14 million homes. That's 12% of American households, powered solely from garbage. So as a nation we have a domestic source of energy that could power nearly 14 million homes every year. And we're burying it.

While some U.S. communities are recovering energy from waste, other countries are far ahead of the USA. For example, there are more than four times as many waste-to-energy facilities in Europe than in the USA. And through aggressive recycling and recovery, Germany landfills only 1% of its waste.

But traditional waste-to-energy technology is only one way to recover the energy inherent in plastics. There also are promising new technologies that can turn plastics into fuels and other valuable materials, which can provide a source of readily available domestic energy. ACC is working with related industries across the country to jumpstart three emerging technologies:

- Plastics-to-oil technologies use pyrolysis to convert non-recycled plastics into oil that can be refined and used as fuel for cars and other vehicles. These technologies hold enormous promise: if all the non-recycled plastics in the USA were converted this way, we could create enough oil to fuel nine million cars for an entire year.

- Plastics also can be converted into a gas fuel that can be used to produce electricity or turned into liquid fuels and even raw materials such as chemicals for manufacturing. These technologies—called gasification— have not yet been fully commercialized in the USA but are under development.
- Other technologies turns non-recycled plastics into engineered solid fuels that someday could be used just like coal at facilities that make steel and cement.

So the technology either exists or is in the works to recover the energy potential of non-recycled plastics from America’s waste stream.

**Summing Up**

Can we stop treating used plastics and other materials as waste and tap into their energy potential—instead of burying them in landfills? It will require changing how we as a nation think about and treat “waste,” as well as changing public policy so that energy recovery can play an integral role in our nation’s energy portfolio.

Plastics are inextricably tied to the global drive toward sustainability. As uses and applications of plastics expand, they enable energy savings and reductions in waste in our food packaging, our automobiles, our homes and buildings, and more. And once they reach their “end of life,” they become a large, untapped source of energy. it’s time to recognize and celebrate that. |



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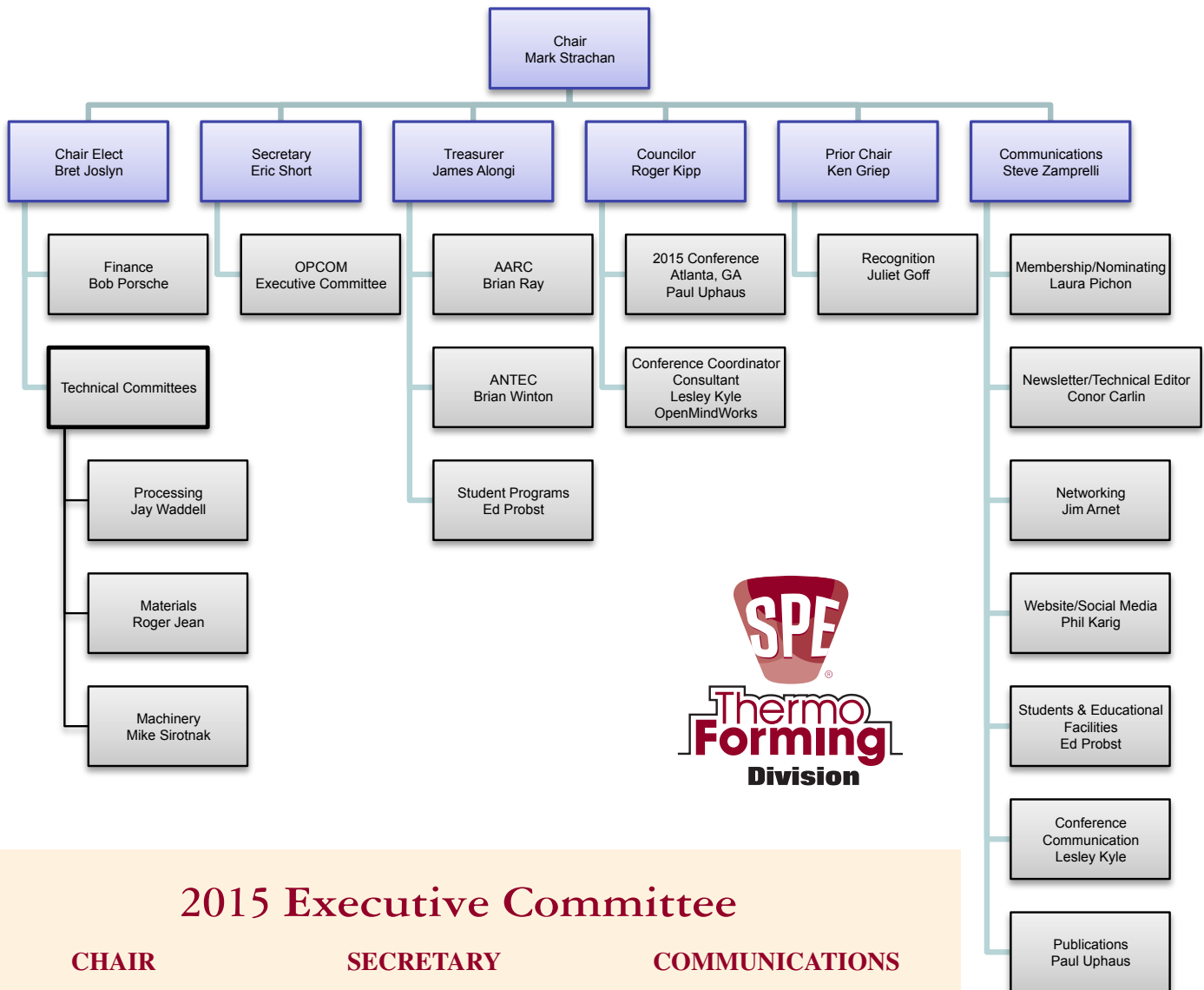
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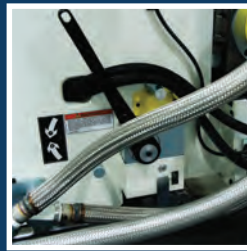
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