Thermoforming Quarterly®

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

THIRD QUARTER 2008 ■ VOLUME 27 ■ NUMBER 3

THERMOPLASTIC COMPOSITES REPLACE METAL

page 7

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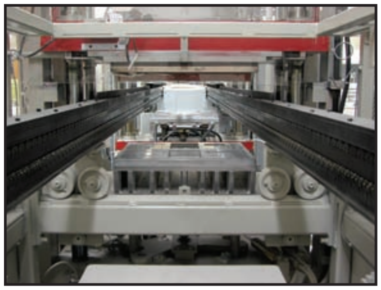

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Thermoforming Quarterly®

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

Editor
Conor Carlin
(216) 287-5375
cpcarlin@gmail.com

Technical Editor
Barry Shepherd
(905) 459-4545 Ext. 229
Fax (905) 459-6746
bshep@shepherd.ca

Sponsorships
Laura Pichon
(847) 829-8124
Fax (815) 678-4248
lpichon@extechplastics.com

Conference Coordinator
Gwen Mathis
(706) 235-9298
Fax (706) 295-4276
gmathis224@aol.com

Brian Ray

The beginning of a new two-year term as chairman has kept me very busy this summer. I have spent countless hours speaking with board members and executive committee members regarding goals and objectives for the coming term. It is amazing how many things our board has been able to accomplish through the unwavering support of its members. Without continued review, it is easy to lose track of all the fantastic things we have accomplished: educational and promotional events such as Antec and the annual Thermoforming Conference; the matching grant fund for equipment to be placed at universities and the matching grant for the PlastiVan Program. New opportunities include the Center of Excellence at Penn College and a Thermoforming Pavilion at NPE in June 2009. The opportunities are endless and as the industry continues to grow, we will find ourselves not looking for things to do, but rather looking for individuals to help us implement and execute our mission to advance thermoforming technology through education, application, promotion and research.

THANK YOU, WALT

Outgoing Chairman Walt Walker has done an excellent job positioning our Division and Board of Directors for continued growth. Through his leadership our Division has continued to stay true to our mission statement. Walt's dedication to the board of directors has allowed our division to move forward on several programs which will continue to advance our industry for years to come. Thank you, Walt, for all that you have done for this organization.

I am very excited to serve as your chairman for the next two years. The energy and enthusiasm that our board members put into this volunteer organization is encouraging. I intend to stay focused on the programs that continue to work well for us. I will also be exploring new avenues for growth and development which will take the board and this division to the next level. I am fortunate to be working with a disciplined and detail-oriented executive committee comprised of Ken Griep, James Alongi, Mike Sirotnak, Walt Walker, and Roger Kipp. This well-balanced group is poised for a very exciting two-year run, so stay tuned.

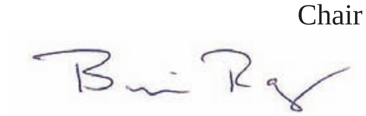
MINNESOTA CONFERENCE

In a few weeks we will all be descending on Minneapolis, Minnesota to discover our leading edge. The technical program will offer valuable insight and knowledge of what it takes to stay competitive in today's thriving thermoforming industry. As you may or may not know, it is the success of our annual conference that provides revenue which is used to fulfill our core objectives. This revenue would not be possible without the support of sponsors, exhibitors and suppliers. Each year a committee takes responsibility for the upcoming conference and this year Dennis Northrop, Jim Armor and Phil Barhouse have done an excellent job putting together an extremely relevant program compressed to just a few days.

GET INVOLVED

I welcome your opinions, suggestions and thoughts regarding the conference or the board of directors. It is with your feedback that we can make adjustments and improve. Without feedback, we risk stagnation and complacency. You can call me anytime at 800-423-7859 or email me at Brianr@rayplastics.com. We have an exciting two years ahead of us and I look forward to increasing our general membership as well as our board membership, increasing conference participation with new exhibitors and new attendees. Our division is the primary organization for all things thermoforming. I invite you all to be a part this successful and important division.

Brian Ray
Chair



New Members

Nicolae Abrudean
5 Barnett Street
Listowel, ON N4W 3V9
Canada

Sylvain Emery
Repaco Inc.
700 Cowie Street
Granby, QC J2G3X6
Canada

Gustavo Gomes De Amorim
PLM Plasticos SA
Est Ver Julio Ferreira Filho
441
Campina Grande So Sul,
Parana
83 430 000
Brazil

Jesus Gonzalez
Carvel Print Serigraph Inc.
Calle 2 No 117
Parque Industrial Jurica
Queretaro, Queretaro CP
72120
Mexico

Jeff Hammond
Covidien
5920 Lon Bor Drive
Boulder, Colorado 80301

Scott Irwin
Panoramic Inc.
1500 N. Parker Drive
Janesville, Wisconsin 53545

Luis German Joya Sanchez
Carvel Print Serigraph Inc.
Calle 2 No 117
Paque Industrial Jurica
Queretaro, Queretaro CP
72120
Mexico

John McKay
CertainTeed
200 Ronthor Road
Social Circle, Georgia 30025

Margaret Reeber
1505 Marymount Drive
Franklin, Tennessee 37067

Robert D. Roberts
NOVA Chemicals Inc.
18 Franklin Street
Millers Falls, Massachusetts
01349

Marco Roche
Plasticos Del Litoral S A
Km 11 5 Via a Daule
P O Box 09-01-1299
Guayaquil
Ecuador

Claudio Rogerio Rodrigues
PLM Plastics
Est Ver Julio Ferreira Filho
441
Campina Grande Do Sul, PR
83430-970
Brazil

Felix G. Silva
Valle De San Sebastian
129
Col Valle Residencial
Celaya 38020
Mexico

Steve Swain
Omnitool
3500 48th Avenue North
Minneapolis, Minnesota
55429

Thermoforming in the News

Packaging: Greiner, RPC bring clever new products to Interpack

Düsseldorf, Germany — Austrian packaging processor Greiner brought a number of innovative new rigid packaging options to the Interpack trade show, held April 23-30 in Düsseldorf, Germany. One package shown to **MPW** by Greiner's Kenneth Boldog, market product manager, includes a thermoformed top cup and an injection molded bottom cup, both of polypropylene but the bottom using clarified material. The top cup contains yogurt, and the bottom contains a small toy. Both cups are wrapped with a paper label. The first commercial customer is a European dairy.

Another new package from the firm involved a thermoformed cup that is entirely wrapped, to include the bottom, but a paper label. The paper is thick enough to fold across the bottom. This bottom, says Boldog, makes it very easy for bar coding, and therefore speeds food stores' logistics and checkout. He says Grenier is in talks with a number of large food packagers regarding this second package.

Competing rigid packaging processor **RPC** brought a number of new package solutions to Interpack, but probably the most novel was the Gizmo, a pressurized device incorporated into a closure of a container which, when opened, releases under pressure (so also mixes) the active ingredients into the beverage or other product. **MPW** opened one at the RPC stand, and can easily picture children enjoying the sudden surprise as the pressure is released. Unfortunately RPC would let the closure leave its stand, so its components remain a bit of a mystery. Shedding some light, Gizmo marketer, Gizmo Packaging Co., has a video that shows how the closure works at its website. |

Industry report offers harsh outlook, keys to survival

These and similar subject headers in a new report make it clear that the North American plastics processing industry is a difficult market in which to succeed, made more so in the past two years as energy costs and the price of resin have thrown a mean curve at many processors.

The complete downloadable report, titled "Prospering in Today's Plastics Industry: Making the Right Decisions in Turbulent Times," is available at the following website: www.principiaconsulting.com/publishing/getWhitePaper.cfm. The report also cites a poll conducted in the first half of 2008 of more than 150 plastics industry executives to evaluate the state of the industry, gather their views about the future, and let them elaborate on the ways they plan to navigate the current industry downturn and drive future profitable growth.

The poll and subsequent report were conducted by Principia Partners, an international strategy consulting firm in the plastics, specialty chemicals, and building products and materials industries, and Akin Bay, a middle-market investment bank. The report presents not only the polling results but also these two firms' observations and opinion about the implications for the future of the North American plastics industry. Though the difficulties faced by processors are not understated, the report's authors note that even in challenging market conditions opportunities remain for processors to grow their businesses.

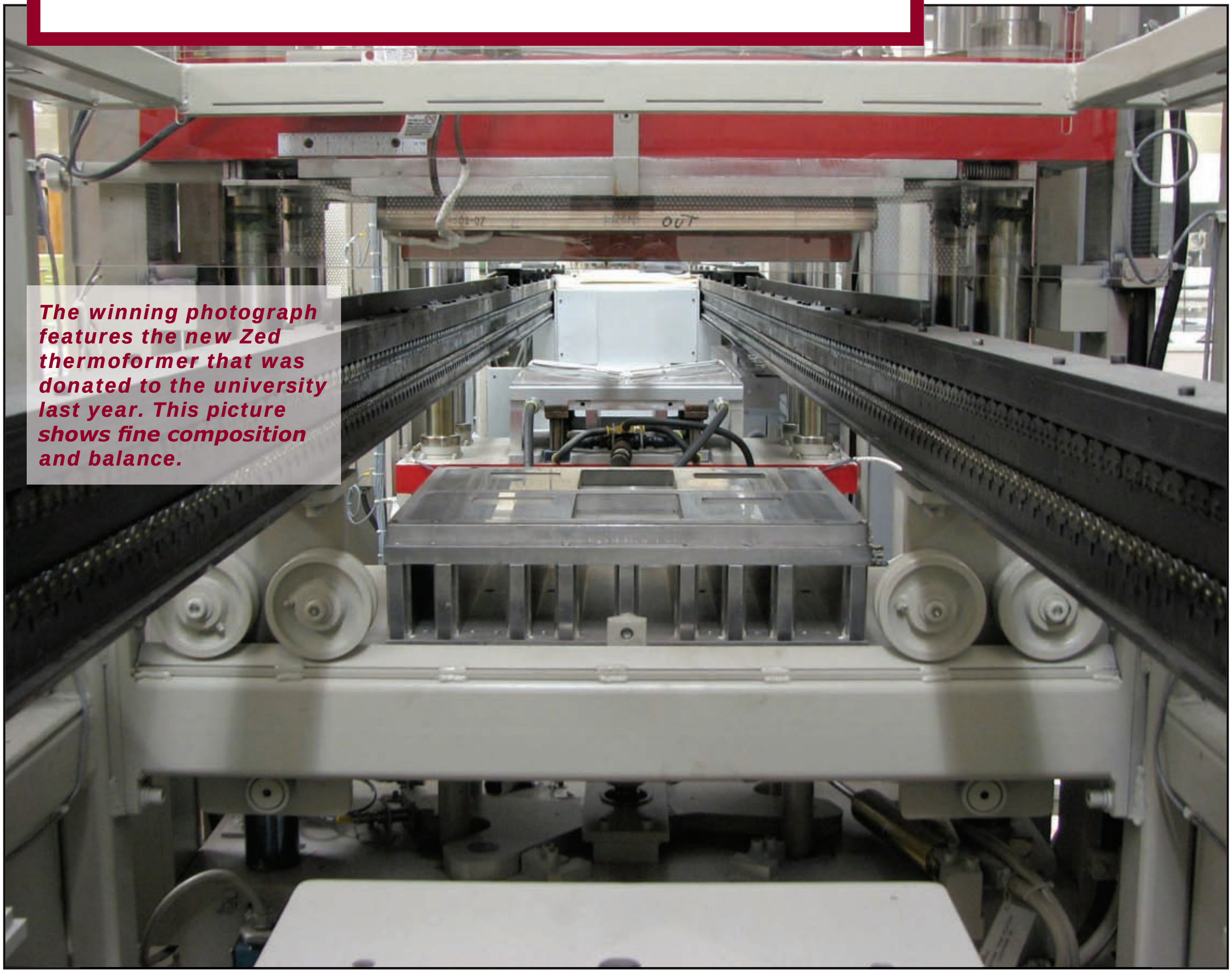
Among points cited in the report:

- Of the projected total demand increase for plastics, 75% of that will stem from increased demand in Asia. Another 15% will come from new demand in the Middle East, Latin America, and Central and Eastern Europe.
- The total value of plastic shipments in North America has increased by 22% since 2002, even as employment in the industry has dropped 20%, and the total number of plastics processors has shrunk 30%, a reflection of the growth in productivity.
- Multiples paid for plastics processors have dropped in the past few years from 8-10 times EBITDA to just 5-7 times EBITDA.
- Nearly 20% of the survey respondents anticipate a change in company ownership in the next five years, which would almost mirror the percentage of ownership changes that did take place during the past five years. |

These articles appeared in the May and July 2008 editions of Modern Plastics *and are reprinted with the kind permission of* Modern Plastics Worldwide.

PHOTO CONTEST WINNER

Photo Taken by Student
Dennis E. Haakenson, Jr. of the
University of Wisconsin - Platteville



The winning photograph features the new Zed thermoformer that was donated to the university last year. This picture shows fine composition and balance.

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Thermoplastic Composites Replace Metal

By Dale Brosius, Contributing Writer, Gardner Publications

Editor's Note: This article first appeared in *Composites Technology* in February 2008. It is reprinted here with the kind permission of Gardner Publications. We offer this to our readers as an example of how the thermoforming process is gaining traction in other industries.

Low-pressure forming processes and low-density, long fiber-reinforced thermoplastic come together to cut weight of aluminum transit bus roof air conditioning door by 40 percent.

Composites material suppliers and molders have spent many years developing and producing lightweight components for automobiles and heavy trucks, aimed at improving fuel efficiency and cost. During this period, much less attention has been devoted to mass transit applications for composites. But that is changing, as transit equipment manufacturers and governments recognize the opportunities to reduce fuel consumption and road wear, particularly for buses. Transit authorities in New Jersey, for example, have requested bids for new buses that weigh 5,000 lb/2,270 kg less than current models in use, says Uday Vaidya, director of the Engineering Plastics and Composites Laboratory at the University of Alabama at Birmingham (UAB). Vaidya and his colleagues Sellvum Pillay and Haibin Ning, in collaboration with the National Composite Center (NCC, Kettering, Ohio) and other partners, have recently completed a five-year effort, funded by the U.S. Department of Transportation, to demonstrate how buses can be made lighter using composites.

A key entity in the contracted effort was North American Bus Industries Inc. (NABI, Anniston, Ala.), a major producer of heavy-duty diesel, compressed natural gas (CNG), liquefied natural gas (LNG) and hybrid electrically powered buses. NABI offers standard-floor and low-floor transit buses, including 60-ft/18.2m articulated versions. In 2001, NABI also offered the first bus with an all-composite body.

For this program, NABI provided the platforms from which the UAB/NCC team selected components for its series of demonstrations. In the program's first four years, composite bus seats, floor and frame sections, body panels, and a battery box door were produced. For the culminating project, an aluminum door/cover for the roof-mounted air conditioning system was selected for conversion. The net result is an innovative hybrid: an unreinforced thermoplastic outer skin made using low-cost thermoforming technology backed with a structural, low-density thermoplastic composite inner panel, produced by low-pressure compression molding. The finished product meets or exceeds all requirements for fit, form and function, exhibiting greater stiffness, improved vibration damping and a mass reduction of nearly 40 percent compared to the aluminum production part.

INITIAL TRIAL WITH UNREINFORCED TPO

The air conditioning cover doors on the NABI 60-BRT (see "Learn More") are part of a series of rooftop doors that give access to the heating, ventilation and air conditioning (HVAC) equipment. Other doors provide access to natural gas tanks and other systems. The existing production door is approximately 4 ft. wide and 6 ft. long (1.22m by 1.83m). Weighing 46.2 lb./21 kg, the door is assembled from a curved 0.125-inch/3-mm thick sheet of aluminum with a metallic stiffener rib. During service and maintenance of the bus, technicians prop the cover open using an extender arm on one end of the door. Under its own weight, the unsupported end deflects approximately 1.9 inches/48 mm, a target for improvement by switching to a lighter weight composite door. Other goals of the project included providing a ready-to-paint or molded-in color surface, better sound absorption/damping characteristics, and the use of simple, low-cost manufacturing technologies.

Initial finite element analysis conducted at UAB looked at a smooth outer skin with a ribbed inner panel, both produced via thermoforming, using an extruded unreinforced thermoplastic polyolefin (TPO) sheet material for both panels. The selected material was Sequel E3000, a modified polypropylene from Solvay Engineered Polymers Inc. (Auburn Hills, Mich.). With inner and outer panels each measuring 0.125 inch/3mm thick, this design offered a reduction in deflection but a weight savings of only 18.5 percent compared to the baseline. It was concluded that this design failed to offer enough weight savings to justify conversion; the parts would have to be significantly thinner or they would have to be thermoformed from material of lower density. This latter possibility would appear difficult to achieve given that the specific gravity of the TPO is already a low 1.07.

(continued on next page)

LOFTED THERMOPLASTIC HITS DEFLECTION/WEIGHT TARGET

The solution was found by replacing the unreinforced, ribbed inner panel with a lightweight, glass-reinforced thermoplastic composite material, SuperLite SL551400.109, supplied by Azdel Inc. (Lynchburg, Va.). The SuperLite material is a form of glass mat thermoplastic (GMT), but unlike traditional GMT, which requires compression molding at 1,500 psi to 2,000 psi (10 MPa to 13 MPa), it can be consolidated via low-cost methods such as vacuum thermoforming or low-pressure compression molding (less than 50 psi/0.3 MPa). This permitted forming in low-cost tooling on the same equipment used for the outer panel.

The Super Lite material is manufactured using a slurry process, similar to that used in papermaking. Chopped glass and polypropylene are combined in an aqueous slurry and captured by a moving belt that transports the material through a drying process. The material contains fibers oriented not only in the x/y plane but also a percentage oriented vertically or at angles in the z direction. During manufacture, the sheet is consolidated, causing fibers with z orientation to bend and remain so as the material solidifies. When the finished sheet is subsequently heated during part production, these fibers straighten and have a “springing” effect, causing the material to increase in thickness or “loft.” Although by weight the composite contains 55 percent glass and 45 percent resin, lofting introduces a substantial amount of air through the panel thickness, resulting in much lower densities than fully consolidated GMT of the same thickness. For example, the material used on the bus program, at 1,400 g/m^2 areal weight, has a specific gravity of only 0.56 when heated to melting point and compressed to 0.125-inch/3-mm thickness.

Analyses run on combinations of an unreinforced TPO outer sheet (still required to meet the surface appearance requirements) with the SuperLite inner predicted deflection of less than 1.2 inches/30 mm in the fully open position and a total weight of less than 33 lb./15 kg — a mass savings of more than 30 percent. This was considered sufficient to move forward with prototype manufacture.

MANUFACTURING PROCESSES OFFER HIGH-RATE POTENTIAL

Although earlier projects in the program had involved fully consolidated long fiber thermoplastic components, most of which could be manufactured at the National Composite Center, the team selected thermoforming to manufacture the composite AC door. Because the Center does not have thermoforming equipment, NCC helped UAB find a site for the manufacture of the components in the prototype production phase, notes Pritam Das, program manager for advanced composites at NCC. The work was done at Portage Casting & Mold Inc. (Portage, Wis.).

The first choice of the team for the AC door was twin-sheet thermoforming of the smooth TPO outer sheet with the SuperLite ribbed inner panel. However, this produced parts with uneven shrinkage and also resulted in significant print-through of the ribs due to differences in thermal expansion between the two materials. This necessitated manufacture of the components individually, followed by a secondary bonding process.

The tooling was fabricated by Portage Cast and Mold and consists of a curved, smooth mold for the outer TPO skin and a ribbed mold for the inner panel. Both were fabricated by casting 356 aluminum to near-net shape, with heating and cooling lines cast in place. The molds were finish machined and polished to a 100-grit sandpaper finish. It was decided to compression mold the inner panel to a thickness of 0.125 inch/3 mm, so Portage also fabricated a mating tool out of laminated tooling mahogany for this step.

The molding was done on a four-station rotary thermoforming machine supplied by Brown Machine LLC (Beaverton, Mich.). Capable of accommodating parts as large as 10 ft. by 12 ft. (3m by 3.65m), the machine also can generate forming pressures of up to 60 psi/0.4 MPa. Thermoforming of the outer skin involved loading the flat sheet of TPO onto a clamping frame and moving it through heating ovens until forming temperature was reached (360ºF to 400ºF/182ºC to 204ºC). The sheet then was transferred to the preheated vacuum forming tool, maintained at 150ºF to 160ºF (65ºC to 71ºC). After forming and cooling, the part was moved to the machine's loading/unloading station and removed. Due to the number of manual steps involved in prototype fabrication, total cycle time was 300 seconds, but Vaidya expects that in an automated situation parts could be produced every 100 seconds. While most of the outer panels produced used the paintable Sequel E3000, several trials were done using a multilayer co-extruded sheet of roughly the same thickness as the paintable sheet, which combined E3000 and a thin, weatherable, pigmented cap layer of Indure E1500 HG (high gloss), also from Solvay. Use of the E1500 HG part enabled successful production of parts with molded-in color and a Class A finish, eliminating the painting step. Although NABI prefers to paint the parts to match specific bus colors, Das emphasizes that both materials process identically in the thermoforming step and, thus, the program validated the no-paint option for other applications of the technology.

For the inner panel, the machine was set up for compression molding, using the aluminum male tool and the mahogany female tool. The low-density composite sheet, which has a delivered thickness of 0.25 inch/6 mm, was loaded into the clamping frame and heated to 400ºF/204ºC, which caused the material to loft to a thickness of approximately 0.35 inch/9 mm. The lofted sheet was transferred to the molding cell, where it was compressed to a thickness of 0.125 inch/3 mm under 40 psi to 50 psi (0.3 MPa to 0.35 MPa). The aluminum male tool was maintained at 125ºF/52ºC while the mahogany female tool was heated to less than 100ºF/38ºC. After cooling, the panel was transferred to the unloading station and removed. Total cycle time was about 240 seconds per inner panel. In production, the lower tool also would be aluminum and the cycle times with automation reportedly could be reduced to 80 to 100 seconds.

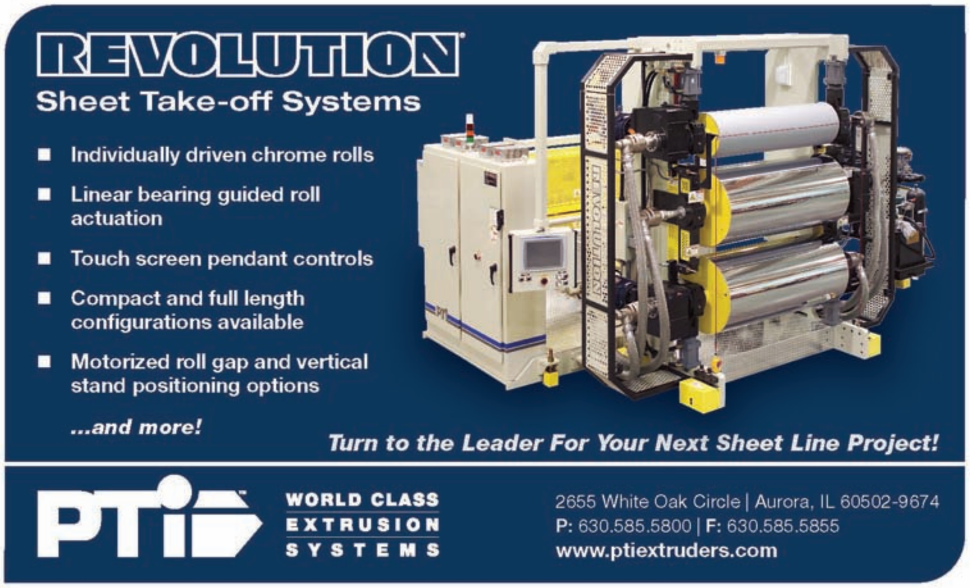
TECHNOLOGY BENEFITS FAR-REACHING

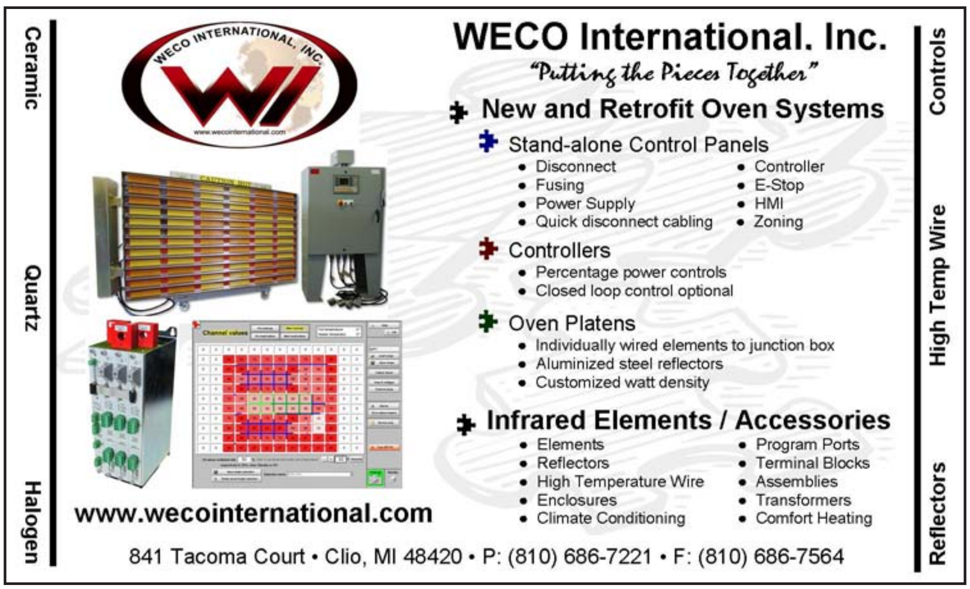
The two molded components were trimmed by hand and then assembled via adhesive bonding. First, 3M Tape Primer 94, a liquid, was rolled onto the mating surface of each part and allowed to dry. The primer provides additional bonding strength to the low-surface-energy polypropylene and TPO. Next, the mating surface of the SuperLite inner panel was covered with 3M VHB Tape 5952, an adhesive tape in a foam carrier. Both materials were supplied by 3M Industrial Adhesives and Tapes Div. (St. Paul, Minn.). The parts were assembled, placed in a press fitted with the upper tool used on the outer panel and the lower tool used to form the inner panel and compressed at 13 psi/0.9 MPa for several seconds to ensure contact before removal. The assembly then was placed in a fixture and trimmed to finished dimensions on a 5-axis CNC machine supplied by Parpas America Corp. (Bloomfield Hills, Mich.). After mounting hardware was attached, the part was ready for installation on the bus.

Validation of the design objectives included deflection testing, vibration testing, mass verification and installation on the test bus at NABI. The composite door showed significant improvement in freestanding deflection at 1.1 inch/27 mm — almost half that of the aluminum production door. In vibration testing of the materials used in the door, the TPO/SuperLite combination showed the highest damping ratio of any individual material and more than tenfold the ratio of the aluminum it replaced. The high damping capacity of the thermoplastic door is expected to result in excellent noise abatement.

The actual weight of the composite door is 27.1 lb./12.3 kg, 39 percent lighter than the aluminum door. Vaidya estimates that if all rooftop doors on the bus were replaced with composites, total weight savings per vehicle would be 500 lb./227 kg. In the weight reduction schema for an entire bus, using this method and these materials for all the rooftop doors could, for example, satisfy 10 percent of the New Jersey Transit authority's weight reduction request and would do so without sacrificing part durability: Although the AC doors are designed with a "no step" requirement, when mounted on the bus, they demonstrated the ability to support the weight of two people, notes Das.

The doors are currently undergoing field trials and durability testing at NABI. Vaidya does not know if this particular design will enter full production for NABI, but he says it is being considered for use as a replacement door. He points out, however, that when lifecycle costs are considered (up to 500,000 miles/800,000 km or 12 years), the composite door offers significant economic benefits. He also notes that the UAB/NCC team is already in discussions with manufacturers in other transit categories, such as light and heavy rail, about possible applications of the material. NCC's Das also sees widespread opportunities outside mass transit, including golf carts, agriculture equipment, heavy truck and medium-volume automotive parts as well as the home appliance industry. |





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In addition to giving customers more product and price options for a broad range of applications, both products offer significant benefits, including:

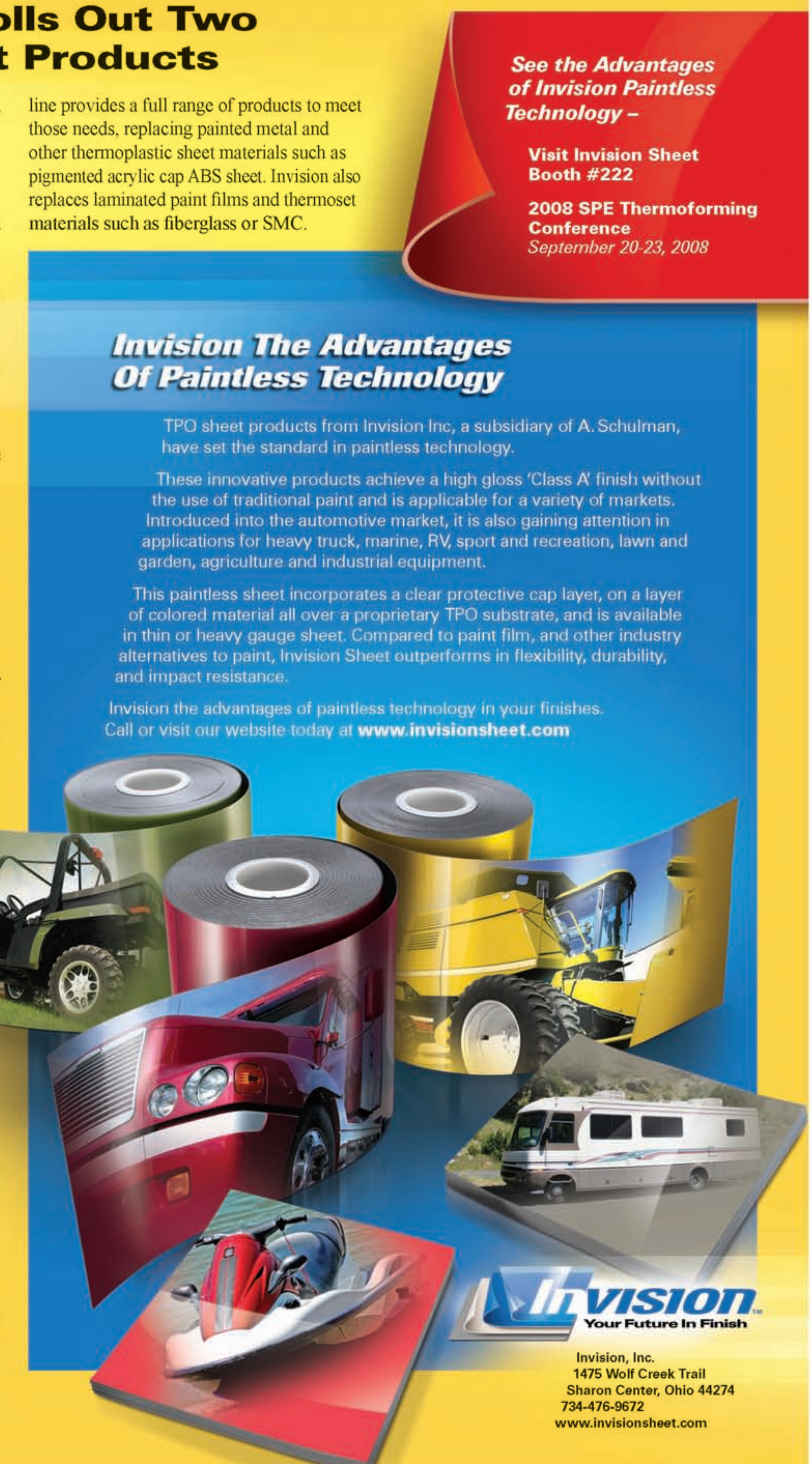
- High melt strength allowing for a larger process window, added processing flexibility and fewer rejects
- A 33% greater stiffness than competitive TPO sheet products, which enables processors to down-gauge and lower costs by using less material, while achieving lighter-weight parts, quicker cycle times and reduced trim scrap

Invision's innovative line includes mono- and multi-layered, extruded sheet products that are cost-competitive and simplify manufacturing. They also provide a higher-performance and more environmentally friendly alternative to existing plastic sheet and film materials that are pigmented or painted.

"The TPO used in the production of Invision sheet is a proprietary TPO that A. Schulman designed to provide exceptional forming characteristics beyond the typical market offerings," said Dennis Smith, General Manager and Director of Technology. "It possesses the highest stiffness-to-ductility ratio available in a TPO material, which puts its performance on par with higher-cost engineered resins."

As the only provider with dedicated TPO sheet production lines, Invision offers customers the shortest industry lead times. Its in-house color design team operates around the clock, whereas other sheet providers outsource the color analysis and design capabilities, adding to cost and product delivery time.

Processors in sectors such as agriculture, recreational vehicles, heavy trucks, aquatic sports and boating have a variety of performance needs. This expansion of the Invision line provides a full range of products to meet those needs, replacing painted metal and other thermoplastic sheet materials such as pigmented acrylic cap ABS sheet. Invision also replaces laminated paint films and thermoset materials such as fiberglass or SMC.



Keeping America Competitive: The Manufacturing Challenge

Established in 1895, The National Association of Manufacturers continues to advocate on behalf of its members to enhance the competitiveness of manufacturers by shaping a legislative and regulatory environment conducive to U.S. economic growth and to increase understanding among policymakers, the media and the general public about the vital role of manufacturing in America's economic and national security for today and in the future. The following Executive Summary outlines the challenges facing manufacturing today. For more information or to read the complete report including footnotes, visit www.nam.org.

Manufacturers in the United States are innovative, productive and efficient. For decades the manufacturing sector has been the center of strength of the American economy and its prospects for future growth. Nonetheless, manufacturing faces several forces that have sparked a period of transformation:

- **Global pressures** are squeezing U.S. manufacturers as they face brutal competition from around the world. To continue to succeed, U.S. manufacturers must compete less on cost than on product design, productivity, flexibility, quality and responsiveness to customer needs. These competitive mandates put a high premium on the skills, morale and commitment of workers.

- **Relentless advances in technology** have infused every aspect of manufacturing — from design and production to inventory management, delivery and service. Today's manufacturing jobs are technology jobs, and employees at all levels must have the wide range of skills required to respond to the demands of an increasingly complex environment.

- **Demographic shifts** portend great change ahead. The "Baby Boom generation" of skilled workers will be retired within the next 15 to 20 years. Currently, the only source of new skilled workers is from immigration. The result is a projected need for 10 million new skilled workers by 2020.

In addition, a long-term manufacturing employment and skills crisis is developing, one with ominous implications for the economy and national security. The loss of more than 2 million manufacturing jobs during the recent recession and anemic recovery masks a looming shortage of highly skilled, technically competent employees who can fully exploit the potential of new technologies and support increased product complexity.

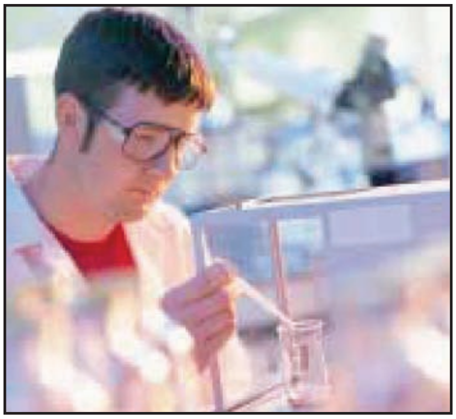
A study of workforce issues in manufacturing was conducted by the National Association of Manufacturers at the onset of the recent recession and published in its *The Skills Gap: Manufacturers Confront Persistent Skills Shortages in an Uncertain Economy* report. The study revealed that more than 80 percent of the surveyed manufacturers reported a "moderate to serious" shortage of qualified job applicants — even though manufacturing was suffering serious layoffs. In sum, what manufacturing is facing is not a lack of employees, but a shortfall of highly qualified employees with specific educational backgrounds and skills.

AMERICAN YOUTH ARE "TURNED OFF" BY MODERN MANUFACTURING

To uncover the reasons behind the talent shortfall and identify why fewer young people appear to be entering careers in this sector, the National Association of Manufacturers, The Manufacturing Institute and Deloitte & Touche recently conducted two major research studies.The findings reveal a troubling picture. Among a geographically, ethnically and socioeconomically diverse set of respondents — ranging from students in middle-school through college, parents and teachers to policy analysts, public officials, union leaders and manufacturing employees and executives — the sector's image was found to be heavily loaded with negative connotations and universally tied to an old stereotype of the "assembly line," as well as perceived to be in a state of decline.

When asked to describe the images associated with a career in manufacturing, student respondents offered phrases such as "serving a life sentence," being "on a chain gang" or "slave to the line," or even being a "robot." Even more telling, most adult respondents said that people "just have no idea" of manufacturing's contribution to the American economy.

The research also explored what today's young people are looking for in their careers, how they make career choices and how well today's educational programs support successful preparation for careers in manufacturing. With near unanimity, respondents across the country saw manufacturing opportunities to be in stark conflict with the characteristics they



desire in their careers — and as a result, they do not plan to pursue careers in manufacturing.

OUR EDUCATION SYSTEM IS A WEAK LINK

The research also emphatically showed that the United States' educational system exacerbates the negative perception of manufacturing, because it is largely out of step with the career opportunities emerging for young people in today's economy, including those in manufacturing. The United States sends more than two-thirds of its high-school graduates to college, but half of them drop out. The educational system fails to engage these students and help them enter alternative post-secondary programs. For those who do graduate, one-third fail to find employment requiring a four-year degree. Meanwhile, many well-paid and rapidly increasing manufacturing jobs remain unfilled, including those requiring two-and four-year technical degrees or short-term skill certificates.

THE GOOD NEWS

The reality of manufacturing is vastly different from its image. Today's manufacturing company is a major source of high-tech innovation, wealth creation and exciting, varied careers. Manufacturing contributes more than one-quarter of the nation's total economic output. It grew at an annual rate of 4.6 percent in the 1990s, compared to the economy-wide average of 3.6 percent. In fact, every $1 million in manufacturing sales supports eight jobs in manufacturing and six in other, allied sectors. Manufacturing's varied jobs and careers averaged $54,000 in total compensation in 2000 — 20 percent higher than the average compensation for all American workers — while 83.7 percent of manufacturing employees receive health benefits from their employers, more than any other sector except government.

THE CHALLENGE

To remain strong and continue to thrive in a highly competitive environment, U.S. manufacturing must surmount many challenges. High on that list is a need to attract a new generation of manufacturing employees prepared for 21st-century jobs. Our research results were clear: Manufacturing is severely challenged by an old, negative image; an education and training system that does not understand or promote careers in manufacturing; and public policies that are not supportive of a robust manufacturing sector.

Unless the industry finds a compelling way to communicate a positive image and address education and training issues effectively, manufacturing could experience a shift from merely having a talent shortage to facing a serious labor crisis. This could foreshadow a significant decrease in manufacturing's competitiveness and accelerate the movement of American productive capacity and well-paid manufacturing jobs overseas. These events could deliver a decisive blow to an already fragile economy and even undermine national security.

Manufacturing industries must quickly address these problems. Other industries and sectors such as health care are organizing to address similar skills issues. Manufacturing must do likewise. To this end, the National Association of Manufacturers (NAM) has committed "to make manufacturing careers a preferred career option by the end of this decade" through an integrated awareness, career-planning and public education campaign. The NAM also will energetically advocate for education, training, taxation, regulation, trade and monetary policies that will enable manufacturing to maintain its position at the core of a productive U.S. economy.

The urgent goal is to energize and focus the sector's many resources to solve its common problem. To that end, the NAM has issued four challenges:

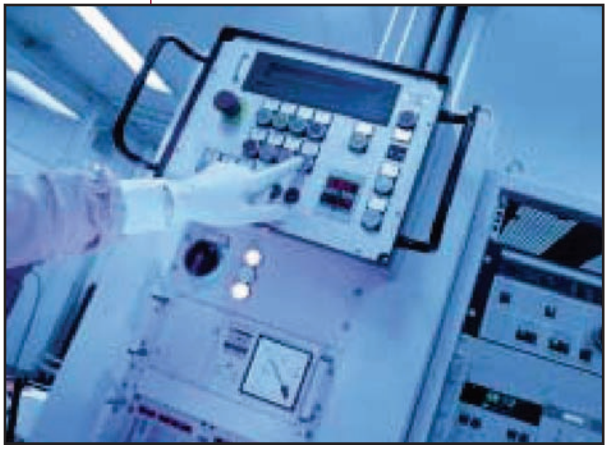
- **To the President of the United States:** Declare U.S. manufacturing a national priority.
- **To the United States Congress:** Establish "National Manufacturing Day" to recognize this priority.
- **To manufacturers in the United States:** Open your plants and facilities to young people, teachers and parents on National Manufacturing Day.
- **To educators in the United States:** Bring your students and guidance counselors to a modern manufacturing facility on National Manufacturing Day.

U.S. manufacturing can emerge from this period of transition stronger and better equipped to compete on a global basis and maintain its core contributions to the American economy. The NAM invites all interested parties to join in this effort.

In addition to the services and advocacy provided by the National Association of Manufacturers, thermoforming companies can find resources for workforce development and training via grants and government programs.

The National Institute of Standards and Technology offers a Manufacturing Extension Partnership. This program provides a range of services to enable manufacturing companies to achieve measurable results. Visit www.mep.nist.gov for more information.

For manufacturing companies affected by competition from imports, the U.S. Department of Commerce offers Trade Adjustment Assistance for Firms (TAA). More information can be found at: www.taacenters.org.



Processes Used to Make Thermoforming Sheet

Adolf Illig

Technical Editor's Note: Regardless of which thermoforming process is used or the type of polymer used to form the products, processors must have flat sheet. The sheet can be rolled on cores in thicknesses from .005" to .080" or supplied flat on skids up to 1/2" thick or more. Extrusion is the most common method of producing sheet; however, thermoplastic resin can be cast, calendered or even injection or blow molded into sheet for thermoforming. Much of this article was edited from Adolf Illig's book "Thermoforming, A Practical Guide."

PREPARATION OF THERMOPLASTIC RESINS, RECYCLED CONTENT AND ADDITIVES

There are essential steps in the production of thermoplastic forming materials prior to the final process to make it into sheet. Obviously the base polymer must be produced by one of the many resin manufacturers.

Additives such as pigments, fillers, lubricants, processing aids, plasticizers, anti-aging, anti-static and light stabilizing agents and flame retardants are all blended together into a cohesive mixture. This process is called compounding. As recycling of plastics becomes more prevalent, the addition of quantities of flake (recycled plastic products ground into small particles) of the same polymer is becoming more common. Compounding is very important in getting the desired properties for the thermoformed product.

EXTRUSION

Thermoforming sheet is most commonly made via extrusion. Thicknesses from less than .010" (0.25mm) to over ½" (15mm) and extrusion lines up to 80" (2000mm) wide are common; however, much bigger lines are being built to accommodate the increasing size of the heavy gauge thermoforming lines. The extruder heats, mixes, and if necessary, de-gasses the material to be processed (granulate, powder blend, polymer resin or regrind). As this mixture travels through a barrel by way of a screw, it is forced through a slit die under pressure (Figure 1). The die can be finely adjusted to provide the right thickness across the sheet. Subject to sheet specifications, the material is hauled off and calibrated by way of temperature controlled chill rolls. The sheet is transported through a cooling section, edge trimmed and slit into widths specified by the customer.

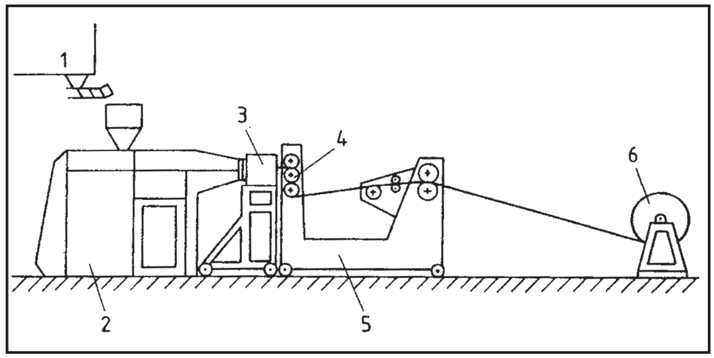


Figure 1.

Thickness up to .080" (2mm) can be rolled onto fiber cores (usually 3" or 6" in diameter) for running on roll-fed, thin-gauge thermoforming lines. Thicker gauges must be guillotined into sheets in a final operation at the end of the extruder and loaded on pallets. Amorphous materials are wrapped to reduce the effects of humidity prior to thermoforming.

CO-EXTRUSION

Where the thermoformed product specifications call for a barrier or special surface requirement, two or more screws extruding different materials simultaneously can be used to combine those materials at the die or shortly after the die. This is called co-extrusion and is used to produce the more sophisticated sheet materials for automotive, medical and other markets.

EXTRUSION PITFALLS

Thermoformers should be aware of the problems that may occur in our process as a result of a lack of quality control at the extrusion process. Strict specifications should be provided and agreed to by the extruder.

- Thickness Tolerances: normal thickness tolerances allowed by the extruders have typically been +/- 5% which has been generally acceptable. High volume runs can and should be extruded at a tighter tolerance to improve wall thickness variation in the final part. This can help to avoid forming difficulties and it can also mitigate the added cost resulting from the material being at the high end of the tolerance. Material is usually purchased by weight and thicker material yields fewer parts and consequently results in a higher part material cost. However, new technologies and improved uniformity have resulted in a “next generation” of sheet extrusion resulting in +/- 1% tolerances. This new technology has significant implications for thermoformers.

- Melt Temperature Differences: Variation in melt temperatures caused by irregular extrusion temperatures can cause significant problems in the forming process.
- Orientation: Extruded sheet always has a molecular orientation which is demonstrated by the shrinkage of heated sheet in the extrusion machine direction compared to the transverse direction (across the machine). These shrinkage factors and orientation should be specified. It is especially important to know the orientation of heavy gauge sheet since the extrusion machine direction is not readily observed as it is in rolls. Inherent stresses during extrusion causing poor orientation will result in sag problems and creasing in the formed part.
- Melt-Bead: Too large a melt-bead at the polishing stack rolls can result in transverse streaks in the sheet.
- Die Contamination: This will show imperfections in the sheet.

CALENDER SHEET PRODUCTION

Figure 2 shows a calender sheet line which is predominantly used to produce PVC sheet from .005" (0.13mm) to .035" (0.89mm) although polypropylene and ABS sheet production is also possible. Modern calenders can hold thickness tolerances to plus or minus 0.002" (.05mm).

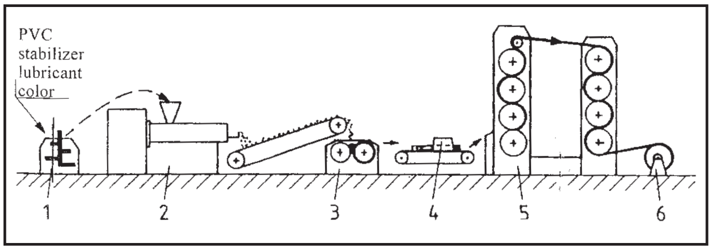


Figure 2.

Essentially, a calender line is a series of highly polished rolls that take molten material that has been extruded and kneaded while still hot and squeezes it out to finally become a rigid film. The irregular globs of material progressively flatten while being cooled until it exits the last series of rollers at the specified thickness.

The differences between extrusion and calendering are:

- high quality clear PVC films are easier to produce by calendering and thickness tolerances can be held tighter than with extrusion.
- reduced stresses during calendering, resulting in less sag is an advantage to the thermoformer.
- only single layer materials can be calendered and generally calendered material is more expensive than extruded material.

CAST SHEET

Casting (cell cast or continuous cast) is a process used for producing high quality acrylic (PMMA) and acetate materials. Acrylic can also be extruded and the thermoformer will experience quite different forming characteristics between the two types of processes. Continuous cast acrylic is softer, can scratch easily and can contain impurities. Cell cast acrylic can exhibit up to 20% variation in the target thickness which creates big problems when forming but has a very high impact resistance and is very clear.

Cell casting is done using the water bath technique. Acrylic syrup is poured into a mold typically constructed from two tempered glass sheets separated to produce the desired thickness of the sheet and sealed with a gasket at the edge. The mold is submerged in a bath which maintains/controls a curing temperature and efficiently removes heat generated in the process when the monomer is converted to polymer.

Continuous casting is also a mass production form for manufacturing acrylic sheet. The process involves the pouring of partially polymerized acrylic (somewhat less viscous than syrup) between two highly polished stainless steel belts. The belts are separated by a space equal to the thickness of the sheet and the “syrup” is retained by gaskets at the edge of the belts. The belts move through a series of cooling and heating units to regulate the curing and are cut “on the fly” to size at the end of the production line.

OTHER PROCESSES USED TO MAKE SHEET

Small quantities of very high grade thermoforming sheet are sometimes injection molded. An example is polyurethane sheet for the thermoforming of artificial heart components. When it is not possible to co-extrude the two polymers, two or more layers can be laminated by flame treating or by the use of adhesives like polyurethane bonding agents.

ADDITIONAL TREATMENTS FOR THERMOFORMING SHEET

Texturing is done immediately after the extrusion process. As the sheet is still warm the surface is embossed with

(continued on next page)

a heated embossing roll. Surface engraving produced in too cold a state regresses again, when the material is being heated in the thermoforming machine and it becomes smooth again.

Sealing layers on a sheet are external covers usually produced by co-extrusion while still inside the slit die or just after discharge of the melt from the die.

If the thermoform material is to be printed, heat sealed or painted a coating can be applied to allow these other materials to bond properly. Special pigments are available to allow printing directly onto some polymer sheets as is the case with preprinted PVC or PET packaging.

Flocking is an enhancing process where fibers are applied to the material surface using special flocking adhesive. It provides a soft velvet feel to the surface which is ideal for retail packaging. Flocking is available in several colors. Care must be taken to keep the flocked side away from tooling to prevent the transfer of the fibers to the tool.

Metallizing is done by applying an aluminum vapor coating onto one side of the material. PVC, PET, PP and PS are materials which can be metallized. Thermoforming of this treated material can be tricky and usually the metallized side should not be exposed to the heat source, consequently the cycle time is a little longer.

Electroplated sheet known as a reflector sheet can be applied to thermoform materials but the shape of the part must be limited to shallow draws and large radii. Like the metallized material, the heat source must not be adjacent to the coated side.

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Sponsoring companies nurture the development of their future workforce by opening children's minds to careers in sciences, engineering and the plastics industry. In addition, PlastiVan benefits the sponsoring company by increasing the company's visibility in the community and often garnering local media coverage, changing the public's perception of the industry, and positively affecting the lives and minds of young people. Plus, sponsorship of a PlastiVan visit is a tax-deductible donation to the school.

For more information about the PlastiVan™ Program, please contact Betty Coleman, Outreach Director at (781) 337-7127.

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Expect the Unexpected: Thermoforming Pushes the Boundaries

Technical Editor's Note: "Thermoforming could be set to challenge blow molding in the bottle market." This from Illig, who introduced their new line in Germany this year. The machine and tooling demonstrated certainly goes beyond what we normally consider acceptable draw ratios. The cost savings mentioned here are surprising to say the least, especially given the heavy starting gauge and what I expect would be high tooling costs. For me it is a wait and see situation but I welcome the response to this article from our North American machine manufacturers.

Thermoforming is widely accepted as a cost-effective way of producing and manufacturing larger sized plastics parts and packaging such as food trays and clamshells but it could now be set to challenge blow molding in the 50ml (1.7oz.) to 200ml (6.7 oz.) bottle range.

Until now, blow molding technology has been the only option for producing bottles such as those currently used for nutraceutical and wellness drinks. The methods used include extrusion blow molding or stretch blow molding. In the former, an extruder presses a continuous plasticized material stream through a tube-head, before a tool closes around the tube and a knife cuts it. The bottle, which features a seam in the middle, is formed in the blow molding tool. In stretch blow molding, a preform is produced and then formed into a bottle under high temperature and pressure forming. It is a process whereby uniform sidewall thickness is challenging.

German company Illig Maschinenbau believes that it has now transformed the cost advantages of thermoforming into a method for deep-forming small bottles in-line. Launched last August and introduced at the Interpack exhibition in Germany during April, the Bottleformer BF 70 is based on the company's FFS lines and thermoforming machines and was one and a half years in development.

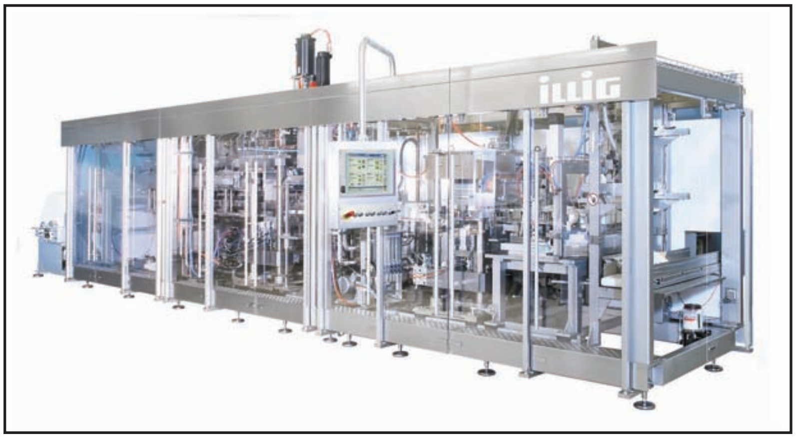

Figure 1. New Illig Bottleformer BF70.

Reiner Albrecht, sales director of Illig, explained at the recent European Thermoforming Conference in Berlin that the company's development was initially based on the forming methods. "Bottles featuring such pronounced undercuts (a benefit in the design of items such as jam containers and fruit yogurts) can only be produced with movable tool parts. In addition, there was a requirement to find a forming sequence which would allow a uniform wall thickness distribution in spite of small initial area and high depth of draw (maximum 120mm or 4.7")."

The thermoformed bottles formed on the BF 70 are, at first glance, extremely similar to conventional bottles However, the thermoformed bottle weighs only half of the conventional blow molded bottle, while remaining in-line with market demands for stability.

THE THERMOFORMING PROCESS

The bottle is thermoformed, as usual, out of sheet material. By using special

Figure 2. Rendering of thermoformed bottle options.

tools in combination with a servo driven pre-stretcher and control of forming air, it is possible to draw bottles with a top-load stability suitable for the market out of a basic material of only 1.4mm (0.055"). It can withstand a top load of 90N (20.2 lbs. – force) with just 2mm (0.078") deformation, and experiences deformation of 6mm at a top load (sidewall) of 7N (1.57 lbs. – force). During the forming process, plug-assists are critical. The plug material depends to the shape of the bottle, the used material, the required depth of draw, film thickness and the required material distribution in the bottle. It can be different for each different bottle.

After bottle punching there is a single-material skeletal which can be reground and recycled, further reducing material costs. The bottles are then sealed with circular aluminum blanks featuring a slightly bigger diameter than the opening on the bottle. However, because of the outer sealing rim, it is also possible to use snap-on lids or similar closures.

The bottle can be decorated with a sleeve and potentially can be done within the free track between the forming and punching station. At the moment it is done after filling.

“According to the design of the bottle, also a roll-fed label can be used instead of a sleeve,” explains Albrecht. “This is cheaper, but because of the lower shrinkage, it is not suitable for bottles with pronounced negative drafts.”
A typical thermoforming bottle line incorporating the BF 70 could produce 20 bottles per cycle and 25 cycles per minute, which is equivalent to 30,000 cups per hour. This is more than adequate to compete with existing blowing lines, according to Wolfgang Riess, sales manager FFS-Lines, at Illig. “30,000 bottles of 200ml (6.7 oz.) is the required standard output of the mid-sized filling and sealing machines. Most of the dairies are using it.”

Meanwhile, Single-blow PET bottles, made from pre-forms, are mainly used in the beverage industry for 500ml bottles and above. Does this mean that Illig’s thermoformed bottles will centre on the use of HDPE?

“At the moment we do not have PP or PET bottles in this market segment up to 200ml (6.7 oz.), but we are preparing to be able to use these materials,” says Riess. “We have already formed PP in a multilayer bottle, such as a PP/EVOH/PP structure, which will be used for beverages that are sensitive to light and oxygen. PET bottles are for larger volumes and there is no demand for small bottles thus far. But we have made trials with PET with reliable success although the forming process needs further development”

The forming machine uses what the company refers to as the ‘open mould’ process. Here, normal sheets coming from roll stock up to 2mm (0.078") thick (depending on the bottle) are heated and formed in several steps: contact heating; formation in the forming station and punching the formed bottles out of the web in a separate punching station. For form, fill seal lines the bottles are discharged and transferred with the BO TRANS (bottle transfer system) to the filling and sealing machines. The transfer system was built by Maier Packaging.

Punching is performed on the system using a kind of steel rule cutting (at a punching force of 30T) in a separate station. “The open mould process describes the kind of de-forming we use to get the bottles out of the mould. Two halves of the lower part of the forming tool ‘open’ in the feed direction and release the formed part.” Although it is not detailed by Illig, the trim tooling must quite sophisticated given the bottle contour which overhangs the trim line.

So, what about the cost differential of thermoforming bottles? Does it retain the traditional cost-effectiveness of this forming process? According to Albrecht, it does: “The weight difference can be up to 4g (0.14 oz.) for a thermoformed bottle when compared with a blow molded one, especially a shaped bottle. Without a sleeve, a blow molded drinking bottle could cost €0.028 ($0.043) whereas a deep drawn bottle could cost €0.008 ($0.012).”

In fact, 4.5g (0.16 oz.) is the starting weight for a standard 200ml thermoformed bottle and this rises to 6-7g (0.2 – 0.247 oz.) for a high resistant, multilayer or thicker version.

(continued on next page)

NEW TECHNOLOGY?

Those familiar with the thermoforming sector might remember a launch in 2002 by machine maker Erca-Formseal of France that bears striking similarities to those bottles produced by Illig.
The company's EFB 200 prototype machine could produce 150ml to 1L thermoformed bottles called La Bouteille. This system, however, disappeared without a trace no sooner had it been launched.

Erca-Formseal's process, which was based on pressure forming due to the company's expertise in form-fill-seal (FFS) technology, started with a disc and involved the production of zero wastage-scrap. According to several industry sources, the reason La Bouteille failed was that nobody other than Erca-Formseal could make such discs economically and so the expensive raw material, in conjunction with the same handling efforts and logistic costs as in the case of prefabricated bottles, meant that the process wasn't cost-effective enough, especially as the output wasn't high enough.

According to Hubert Kittelmann, president of Germany-based Marbach Tool and Die Manufacturing, thermoforming is more reliable than pressure forming in terms of temperature and heat consistency. Thermoforming also makes it possible for multilayer bottle forming through a wall in a dairy.

"It is less complicated than blowing bottles and the scrap can be reground in the cycle," he says. "On paper it looks like a good challenge for blow molders but is it sufficiently better for dairies to want to replace blow molding with thermoforming?"

"Plastics materials such as PE and PS and others on rolls are available worldwide, so you do not require a specific supplier," explains Illig's Riess. "Furthermore, the scrap material is raw material, meaning that it is clean, not contaminated, and can go back into the process immediately." According to several material suppliers, the following calculation could be made by the customer: if he pays €1.52/kg ($2.34) for PS film, he gets €1.10/kg ($1.68) refund for the granulated material if he returns it to the supplier. Only on the basis of this and other cost savings in terms of handling, logistics, energy, and space for additional sorting and cleaning machines, can we calculate the bottle on a price of €0.019 ($0.02) per piece. This includes energy costs, labor, capital investment and material.

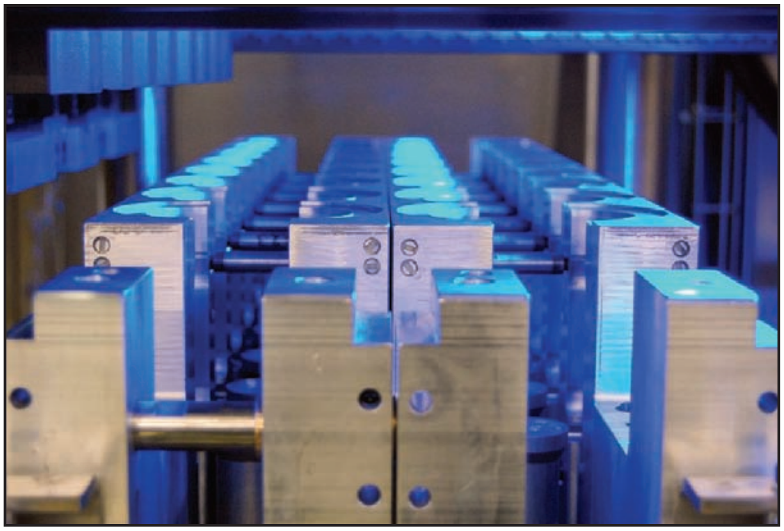

Figure 3. Detail of new tooling technology used in Illig BP70.

Illig got a patent for the forming process itself and the rest is state-of-the-art in thermoforming.

FORWARD THINKING

One of the primary barriers to entry for this technology will come from convincing those companies with blow molding equipment already installed. But Illig says it has several trials operating and has interest even from the pharmaceutical and cosmetics industries.

The big selling point for the thermoforming of bottles is the cost. Bottle weight savings are impressive but the process also uses less pressure (only 6-bar) than blowing and the energy consumption (approximately 50KVA) and even the cooling water (at 0.8m3/hr.) are cheaper. It is also cleaner because users can form with sterile air.

"We hope we can manage to take a lot of market share away from blown bottles in the dairy sector," says Riess.

As for in-mould labeling (IML), Riess answers the question of whether it can be applied to thermoformed bottles with the kind of response that echoes the company's stance with this new technology: "Let me say it with an advertising phrase — expect the unexpected." |

This article first appeared in the June 2008 issue of Plastics in Packaging and has been edited for publication in Thermoforming Quarterly. It is reprinted here with the kind permission of Sayers Publishing, UK. The editors would also like to thank and acknowledge the contribution of Illig Maschinenbau GmbH as the primary source of technical information provided herein.

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COUNCIL SUMMARY

Roger Kipp
Councilor

Council Communications

The spring council meeting was held in Milwaukee on May 4, 2008 followed by ANTEC. The following are highlights of the council meeting and committee meetings I attended while representing the Thermoforming Division.

Executive Directors Report

- An agreement with Wiley Publishing for Plastics Engineering magazine has been concluded. Wiley will manage publication while SPE will maintain responsibility for the technical content. Ad sales to date have been strong and tracking well to budget.
- SPE and SPI are in final negotiations on a contract to hold ANTEC at NPE 2009. Both organizations are extremely pleased with the potential mutual positive value of this alliance.
- Membership continues to be a concern as we enter a slow down in economic activity.
- Conferencing revenues are moving along to plan; however, seminar programs are a little behind plan. Seminars are more time intensive and expensive to attend then conferences resulting in a general slowdown in attendance the first half of the year.
- SPE is continuing with a complete re-design project for the website that is nearing completion.

Financial Update

Treasurer Ken Braney provided an update summarizing the 2007 year-end audit as well as results so far for 2008. On the positive side, ANTEC had already met budgeted income expectation by May.

Overall there are material increases in revenues for advertising, online presentations and seminars. Membership revenues are down slightly compared to the same period last year. On balance, the trends to date have been better than expected given the current economic climate.

It is still too early in the year to tell precisely what the overall down economy and other factors will mean for SPE's finances, but to date, the indicators are optimistic that SPE will fare better than last year.

SPE Foundation Update

Gail Bristol reported on the financial health of the SPE Foundation. The SPE Foundation awarded $120,000 in scholarships to 32 students in 2007. The Foundation expects to exceed that amount in 2008. New scholarships for the coming year include the Western Plastics Pioneers Scholarship, which will be available to students attending school in Arizona, California, Oregon, or Washington, and the Detroit Section Legacy Scholarship, which will be a general scholarship within the Foundation.

The Thermoset Division, which already had a memorial scholarship, has added a second scholarship in honor of Jim Cunningham (a former Councilor for Piedmont Coastal). Both Thermoset Division scholarships are in the amount of $1,500 each. The Thermoplastic Materials and Foams Division has chosen to increase the amount of their scholarship to $2,500 this year.

Plans for the merger of The SPE Foundation and SPE continue on schedule. At their ANTEC meeting, the Foundation Executive Committee reviewed and approved an Asset Transfer Agreement, which outlines the terms and conditions related to the transfer and delivery to SPE of the Foundation's assets, properties, rights, contracts and claims, and SPE's acceptance of those obligations. The SPE Executive Committee will review this document at their June meeting.

Bylaws & Policies

- There were three first readings of Bylaw Amendments:
  - Bylaw 7.4.3 - enabling the election of SPE Officers at a meeting other than the first meeting of a calendar year
  - Bylaw 14.7.11 - to include the structure of The SPE Foundation in the SPE bylaws
  - Bylaw 17.6 - procedures for temporarily suspending a bylaw
- Four Bylaw Amendments were approved by Council:
  - 7.3.4, 14.7.4, 14.7.5, and 14.7.6 - all related to the removal of the SPE International Committee as a standing committee of SPE
- Policy 014 regarding the process of establishing a Division of SPE was approved.

The full text of these Bylaws and the Policy can be found on the SPE Council meeting extranet.

Incoming President William O'Connell introduced his Executive Committee. New Executive Committee Vice Presidents are: Brian Grady from the University of Oklahoma, Austin Reid from DuPont, Jon Ratzlaff from Chevron Phillips Chemical, and Scott Owens, from Chemtrusion. James Griffing is the 2008-2009 Secretary and Barbara Arnold-Feret is the 2008-2009 Treasurer.

In addition to council meetings I attended the Division committee, Foundation committee, Strategic Growth Committee and Chaired the Communications Committee on behalf of the Thermoforming Division.

- The Divisions Committee
  - Goal to develop one new SIG or Division annually.
  - Develop a section collaboration program.
  - Maintain best practice documentation for Divisions with Divisions providing best practice procedure to the Committee.
  - I suggested that Divisions could collaborate with Sections to present a Mini-Tech (one day event) with Divisions providing Technical Program and Sections providing promotion. This could be done at multiple Sections geographically. This should be discussed for interest and further feedback to the Division Committee.
- The Strategic Growth Committee is a new Committee that picks up where the International Committee left off. It was felt that the Society has been successful in becoming International. The International Society should now focus on strategic International growth.
  - While membership in the Society has been stable, just short of 20,000 members, the North American membership

decline has been offset by growth in Europe, India, China, and Australia - New Zealand.
  - The topic of an Australian Thermoforming Division development effort communicated by Art Buckel resulted in a separate meeting attended by Ken Braney, Kitty Beijer, Vijay Boolani, Jon Ratzlaff, Lex Edmond, and me. It was agreed that there would be further evaluation both in India and Australia for consideration of a Thermoforming Technical Conference likely in 2010. Assignments were made and the group will report back to the Strategic Growth Committee. There is no need for the Thermoforming Division to provide support at this time.
- The Communications Committee's purpose is to oversee SPE's Communications Strategically from an international perspective and coordinate the communications effort to assure consistency.
  - The focus for membership growth is:
    1. Increase member value
    2. Communications
    3. Global growth support
  - One added value to communicate to the membership is that all SPE members are entitled to 5 free SPE downloads from Wiley Publishing
  - There is an ongoing web site design up grade in process with Phase 1 up in the third quarter
- The student reception at ANTEC was attended by about 80 students and this year the Committee provided a Casino Night Party. The event ran from 3:00-6:00 pm. The Thermoforming Division, Mold Making and Milwaukee Section were sponsors of this event. The challenge put forward by our Division to other Divisions and Sections to help finance the Stretch Award was accepted by the Automotive Electronics Division and the Kansas City Section with each providing contributions to support us in supporting Stretch.

The next council meeting will be held October 18th, 2008 in Southbury, Connecticut.

"Crossing Frontiers – Knowledge: The Key to Your Success"

Maritim Hotel – Berlin, Germany – April 2008

The 6th European Thermoforming Conference was an outstanding success. Held at the Maritim Hotel in Berlin from April 3-5 2008, 250 delegates attended from 23 countries. The high standard of presentations continued from the 2006 conference. Highlights included the presentation from Jim Griffing of Boeing Corporation. He spoke on the subject of thermoforming in the aircraft industry and the safety standards that are required. This aspect of the aircraft is vital to ensure the highest levels of safety and with the advent of new materials such as composites, as shown in the new Dreamliner©. This new development is a major step forward as planes' lighter weight helps to reduce fuel costs and in today's high energy priced market, it is a major consideration in the airlines' overall strategy.

Another presentation that was well-received was by Reiner Albrecht of Illig who spoke on the forming of bottles. His point of reference was wellness drinks (bioactive yogurts) and the history which up to now had been by manufactured via blow moulding. He gave examples of how bottles can now be thermoformed using new technology. The thermoformed bottle is only half the weight of the blow moulded bottle but it has the stability to meet the standards set in the industry.

Rik Hillaert of Samsonite presented the current range being developed by his company. He explained that the corporation's philosophy had been to move all production to cheaper parts of the world to ensure they stayed competitive in the market place. However, with the advent of new material it became obvious that they could not find the expertise in lower costs countries to manufacture their new luggage range in a difficult but rewarding new material. Therefore they invested in the development in the European plant. Here they designed the new range of luggage called "Travel Lite" from a new polypropylene material called Curv©. This is a combination of sheet and polypropylene fibre web that makes it very strong and it has the ability to withstand major damage. This is vital as luggage is subject to a great deal of rough handling during its use. The forming of the material is also a challenge as it has restrictions in the depth of form you can achieve by standard vacuum methods and pressure has to be applied to achieve the perfect shape.

These are just a few of the many presentations, workshops and discussions that took place in Berlin 2008. If you were among the 250 delegates you can go to www.e-t-d.org and read all of the presentations that were made. If you did not go to the conference, you missed a great opportunity to hear excellent speakers on major topics and to meet all of your fellow thermoformers in the industry.

One of the new innovations at this year's conference was the commercial presentations. These were twenty minute sessions when each company was allowed to introduce a new product or service. This was a very well received group of presentations. Everyone was aware that they were commercial and the information obtained was welcomed by all delegates. We at ETD will be in favour of continuing this type of presentation at the 2010 conference.

In Memoriam

****

GLENN GEORGE BLACKBURN

Glenn George Blackburn passed away April 13, 2008. He was born in Freemont, WI on September 28, 1923. Glenn will be deeply missed by Eunice, his loving wife of 63 years. Glenn was a World War II Veteran in the First Calvary Division, U.S. Army. Glenn was a pioneer in thermoforming in light-gage packaging and heavy-gage forming. He got his start at Portage Plastics in Portage, WI as plant manager. He had several successful thermoforming and compression molding companies in the Winter Haven, FL area since 1966. Glenn was predeceased by 2 sisters and 1 brother. Glenn has 4 surviving sisters and 5 surviving brothers all living in Wisconsin and Florida. Glenn and Eunice have three children: Dennis of Winter Haven, FL; Wanda Buchanan of Orlando, FL, and Wendy Booth of Auburndale, FL. Glenn and Eunice have 9 grandchildren and 27 great- grandchildren.

Some of Glenn Blackburn's accom-plishments:

1. Developed a process for vacuum packaging and sealing of cartons of stacked food products.
2. Worked with development of packaging films for Dow Chemicals (Saran Wrap), Dow Beckman (Cellophane), and B.F. Goodrich (Polyfilm).
3. Developed tooling and procedures for manufacturing a 5g plastic pail liner using .060" HDPE on a four cavity female mold with plug assist.
4. After other companies failed, Mr. Blackburn developed tooling and process to thermoform the 18" X 18" X 32" McDonald's waste receptacle using a female mold.
5. Developed a method for impregnating anti-static solution onto HDPE extruded sheet prior to vacuum forming. This material was used to form several million trays for Johnson & Johnson and surpassed the required static decay factors.
6. Mr. Blackburn developed several thermoforming companies: Portage Plastics, Haines Industries, Winter Haven Plastics, Artec Plastics, Rebel Plastics, Blackburn Industries and Progress Plastics.

2008 Thermoforming Division Scholarship Recipients

Marcus Gardner

Edward Segan Memorial Scholarship ($7,500)

Marcus is a junior at Grand Rapids Community College where he is working on an Associates Degree in Plastics Technology.

After working for 12 years as a thermoforming set-up technician, Marcus realized that it was difficult to advance without a formal education and chose to return to school to seek a degree in Plastics Technology. He and his wife, a public school teacher, felt that going back to school was his best option to further his career – and a great example for their two children. After obtaining his Associates Degree next year, Marcus plans to transfer to Ferris State University to obtain his B.S. in Plastics Engineering/Technology.

Marcus worked as a thermoforming technician for Leisure Life LTD and Display Pack, Inc., both in Grand Rapids, MI.

Katie Lieg

John Griep Memorial Scholarship ($7,500)

Katie is a graduate student in Mechanical Engineering at the University of Wisconsin-Madison. She is a member of SPE, ASME, and SAE, and was an active member of the Wisconsin Hybrid Baja SAE team while an undergraduate student.

Katie's focus in Mechanical Engineering has been in the area of polymeric fluids. She worked as an undergraduate researcher for the Multiphase Flow Visualization and Analysis Laboratory on campus, working on small engine carburetors. That experience led to a co-op at Mercury Marine, where all of the Mercury outboard boat engines are produced. Her work there in the propulsion integration group included designing engine components for new engines.

According to her senior thesis professor, Katie decided that the mechanics of thermoforming has been sorely neglected, so she identified, set up and solved the central problem in her field. Her paper on that work, Thermoforming Troughs, was presented at the 2008 ANTEC, and has been submitted for possible inclusion in SPE's premier journal, *Polymer Engineering & Science*.

Timothy McMaster

PTI Extruders /Director Select Scholarship ($3,000)

Tim is a senior at Pittsburg State University working on his B.S. in Plastics Engineering Technology. He was a Thermoforming Scholarship recipient last year. The continued support of this scholarship will help ease the burden of supporting a family (wife and two children) and getting a degree.

Tim works at a custom fiberglass shop that manufactures corrosion resistant air handling equipment. Last spring, his employer mentioned to a customer that Tim had been awarded the John Griep Memorial Scholarship. This prompted the customer, who was trying to fabricate the product from fiberglass, to consider using thermoformed ABS instead. "Having received the scholarship gave my company and me enough credibility to be chosen as the tool and pattern fabricator for this customer, and resulted in a tool-building job for our company for years to come," said Tim.

A USMC veteran who served in the first Gulf War, Tim hopes to go on to graduate school and one day realize his dream of owning his own successful thermoforming manufacturing business.

Jared Spaniol

Thermoforming Memorial Scholarship ($7,500)

Jared is a senior at Penn State - Erie (The Behrend College) studying for his B.S. in Plastics Engineering Technology. After serving for four years in the U.S. Air Force, including tours to Korea and Germany, Jared returned home to pursue a degree in plastics engineering at PSE.

Jared's senior research project entails the development of a tool to test the thermoformability of plastics materials. His research will focus on what properties make one sheet more thermoformable than another. The properties that will undergo testing are the ability to be deep drawn, webbing propensity, and maximum draw ratio. The tool developed will hopefully then be used to distinguish between easily-formable materials and materials that resist thermoforming.

After graduation from PS-E, Jared hopes to go to graduate school at Lehigh University or the University of Massachusetts - Lowell. A hands-on person, he wants to be involved in many stages of a product, including development, design, processing and production.

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Disney's Coronado Springs Resort

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*****NEW THIS YEAR*****

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GPEC® 2009 kicks off with the Connections Reception on Wednesday evening with the balance of GPEC® 2009 on Thursday and Friday.

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The Greening of Lean Manufacturing

Jeff Geiman, VP Operations, McClarin Plastics
Mary Anne Piccirillo, North Star Marketing

Merging green ideals with lean principles can have an impact far beyond raw materials, water and renewable energy. Forging sustainable relationships within a supply chain, along with the conservation of established partnerships, can produce a positive impact on a bottom line as well. One result of this marriage of theory and practice is a cooperative lean certification session for employees, customers and suppliers in the thermoforming industry.

According to a study commissioned by the U.S. Environmental Protection Agency, suppliers in lean supply chains which deliver a component in the right quantity at the right time share the benefits of reduced cost and waste reduction as well as a higher quality part. Furthermore, James P. Womack, Daniel T. Jones and Daniel Roos report in their book, *The Machine that Changed the World*, that many companies can only "lean" their operation by 25-30% if suppliers and customer firms are not similarly "leaned."

"Each segment of the supply chain must understand the others' needs. One kink in the chain can throw off the entire process causing waste and expense as well as excessive use of energy and raw materials," said Roger Kipp, vice president of marketing and engineering for McClarin Plastics in Hanover, PA. "This will bring everyone involved in a related supply chain together to learn how their performance affects others. The positive bottom line impact from the resulting relationships and understanding could be huge."

McClarin Plastics formally adopted lean manufacturing methodology in 2000 and has continually realized green benefits, in the form of space allocation, waste reduction, energy conservation and increased cash flow.

Lean facility management has produced some of the most impressive results. This is due in part to the Lean Continuous Flow Work Cell concept wherein the complete production of a component occurs. This has resulted in 30,000 square feet of warehouse space freed and reallocated as production space because raw materials are delivered just-in-time directly to the work cell. This has reduced the need to expand or build a new facility, thereby conserving land and resources. Additional resources include reduced man-hours and energy that would have been needed to transport the component from one station to another.

The U.S. EPA study also found that consistent product quality is a basic aspect of competitiveness, which affects cost and customer loyalty. When all members of a supply chain are operating under the same lean guidelines, the end product presented to the buyer is of a higher quality with timelier delivery and in some instances, lower costs. When the suppliers are not operating as a team, product defects escalate and costs compound due to added time, labor and space for rework and repair, material waste and disposal. This impacts both the environmental and fiscal bottom line as recurring defects and delivery delays can mean the loss of lucrative contracts and a more substantial eco-footprint.

McClarin Plastics, for one, has seen increased product quality and expects to see even greater quality once their entire supply chain is practicing lean. This translates to reduced waste from defects, overspray and scrap being sent to landfills.

Energy is another area where lean manufacturing has produced green benefits. By leveling production activity to meet customer demand, companies can lower spikes in energy demand. In addition, the manufacturers can manage machinery starts and stops around non-energy spike times.

"We are anxious to share what we've learned about eco-responsibility through using lean principles. Our hope is to get everyone in a supply chain operating on the same page so they too can realize the benefits," continued Kipp. "We've lowered overhead and increased cash flow which we've re-invested back into the company."

The cooperative lean certification session is the first of its kind in Pennsylvania and has multiple goals, including contributing to eco-friendly initiatives by reducing raw material consumption, energy and inventory. However, the main goal is to encourage the use of lean principles by all segments of a supply chain. This will reduce waste, human effort, manufacturing space and time which in turn will reduce supplier turnover and the costs – fiscal and human – associated with locating and training new suppliers.

Understanding Sustainability: Keeping It Simple

Tim Ritter, Universal Protective Packaging, Inc.

Sustainability is a broad, encompassing concept ultimately aimed at minimizing human impact on the environment and maximizing the outcome for future generations. As it relates to the packaging industry, sustainability is mostly about optimizing a package's life-cycle impact (i.e., minimizing environmental impact). Thermoformed packaging is at the forefront of the sustainability discussion because it is plastic and it is disposable. As thermoformers, you can take some simple steps to make your business and products more sustainable.

1) Recycling 100% of internal plastic scrap. All of the raw material waste generated in thermoforming operations can be easily reprocessed and returned into clean raw material supply. By doing this, you can keep manufacturing waste from going into landfills and reduce the amount of virgin raw material required for your operations.

2) Using post-consumer-recycled plastic. Plenty of post-consumer-recycled (PCR) plastic is available to be converted into film and used to manufacture your thermoformed packages. This material has already been through at least one consumer life-cycle as a drink bottle or some other package and would have otherwise been destined for a landfill.

3) Using bio-polymers and low-impact hybrid materials. Many advances have been made in a variety of alternative "plastics" for thermoforming like the corn-based film PLA. PLA is a clear packaging film that is well suited for a variety of thermoformed packages but it requires careful and unique manufacturing and handling processes. You can also thermoform other materials that are partially or entirely derived from non-petroleum sources. In addition to being made from sustainable resources, many of these materials are biodegradable, industrial compostable, or even water-soluble.

4) Designing packages for minimal impact. You can create thermoform designs that minimize package volume without affecting usability. By reducing package components and light-weighting you can minimize environmental impact and reduce packaging cost at the same time.

All plastic processors including thermoformers should participate in industry forums on sustainability and material life-cycle studies. Involve your technical personnel in the most current education the plastics industry has to offer and invest in technology to keep pace with emerging materials. The movement toward more sustainable packaging solutions is happening now. There is an important place for thermoformers in this movement but you must take the initiative to be a part of it.

ATTENTION!

ALL AMATEUR PHOTOGRAPHERS!

PHOTO CONTEST

Deadline:

The deadline for each contest will be announced in each new Quarterly. The deadline for the contest is October 31st, 2008.

The **Thermoforming Quarterly** is sponsoring a digital photo contest to highlight one or more aspects of the thermoforming industry. One winner will be chosen to receive a new Canon digital camera (value $250). The winning submission will also be featured in the following quarter's issue.

Criteria:

- We are looking for striking digital photos that feature some aspect of thermoforming: the process, tooling, machinery or parts.
- All photographs should accurately reflect the subject matter and the scene as it appeared. Photos that have been digitally altered beyond standard optimization (removal of dust, cropping, adjustments to color and contrast, etc.) will be disqualified.
- Entries should be submitted with the highest graphic quality in mind. JPEG format is preferred with resolution of 300 dpi.
- Entries must include a brief description of the photo including photographer name, company name and address.
- Images will be judged on originality, technical excellence, composition, overall impact and artistic merit.
- The judges will be a panel of editors and SPE board members.
- Only one winner will be chosen. Based on the number of eligible entries, the criteria may be modified in the future to award multiple prizes.
- All decisions made by the judges are final.

SUBMISSION:

ALL ENTRIES SHOULD BE SUBMITTED ELECTRONICALLY TO:
conorc@stopol.com

GOOD LUCK!!

~ THE EDITORS

TQ

PARTS COMPETITION GUIDELINES

Thermo 2008 FORMING

Minneapolis, MN

"Discover Your Leading Edge"
The Competitive Advantage

September 20 - 23, 2008

Once again this year we are excited to welcome all thermoforming businesses to our prestigious competition. The SPE Thermoforming Division is proud to showcase the advances and innovations in thermoforming design and applications.

1. All submissions must be final thermoformed components produced from production tooling.
2. All images and descriptions must be e-mailed to the Parts Competition Chairman two (2) weeks prior to the conference. Images to be in JPEG format and not to exceed 1MB.
   The description should follow the criteria as stated on the entry form. The company name and contact information may only be stated at the bottom of the description.
3. The representative who is present during the Technical Review must be affiliated with the design, tooling or production of the component and the submitting company.
4. The judging committee reserves the right to re-categorize a submitted product and merge categories that do not have at least six (6) entries.
   a. No electrical power hookups are permitted.
   b. All parts must be production units and not "one-off" samples.
5. All shipments must be identified on the outside of box as "Parts Competition."
6. Submitters and individual category winners may receive publicity in trade journals or other publications. Therefore, submission of entry constitutes agreement for publicity and guarantees that necessary approvals have been received from the submitter or other interested parties.

PRODUCT ENTRY APPLICATION FORM

Submit by Email

Discover Your Leading Edge - 18th annual Thermoforming Conference
September 20th - 23rd 2008
Minneapolis Convention Center - Minneapolis, MN

Company Information

Submitting Company Description

Designer

OEM

Processor

Moldmaker

Address1

Address2

City, State Zip

Email

Official Representative

Name

Telephone

Fax

Press release approval signature

Date

Entry Deadline

September 10th, 2008

Product Category

Roll-Fed	Heavy Gauge
☐ Industrial	☐ Vacuum Form
☐ Medical	☐ Pressure Form
☐ Multi-Part	☐ Twin Sheet
	☐ Multi-Part

Check one category only.

Commercial products must be produced from production tools.

Single award for multi-part category.

Application Form Attachments

Mail the following to hforward@smi-mfg.com:

√ This entry form.

√ Product image in JPEG format, 1MB or smaller.

√ Product Description in MS-Word.

Suggested content:
√ Critical elements of design
√ Intended use √ Innovative aspects
√ Materials used √Outstanding benefits

Both the image and the description must be publication-ready.
For blind judging purposes, company identification may only be entered at the bottom of the page. Each product entered must be accompanied by a separate hard copy of the entry form, description and image.

Shipping Information

For shipments up to 30 days in advance of show, please ship to:

Roadway Express
c/o RPM Completexpo Parts Competition
2950 Loan Oak Cr.
Egan, MN 55121

All shipments must arrive in a container suitable for return with return label and bill-of-lading paperwork. Return carrier will be at the shows discretion.

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BENEFITS

As part of the technology and specialty pavilions at NPE2009, SPE Thermoforming World will be in "Technology Central" in the West Hall and co-located with the NPE Educational Program that will feature ANTEC@NPE2009 and the SPI Business of Plastics conference.

The SPE Thermoforming World pavilion will be the hub of activity at NPE2009 for thermoforming process information and capabilities. On display will be thermoformed parts and assemblies, winners from prior Thermoforming Conference Parts Competitions. Also, process educational opportunities and real thermoforming practitioners (both in-line and cut-sheet) will be there to discuss thermoforming issues with NPE attendees, within the pavilion. You may want to exhibit in Thermoforming World either as your company's main set-up at NPE2009, as a satellite display to refer attendees to your full display elsewhere, or to highlight a thermoforming specific specialty of your company.

FEATURES

West Hall, area of Booth #119025

4,000 square foot total area for sixteen 10x10 exhibit booths or combinations.

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SPI Members: 10x10 booth package, $2,710

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** The full program is under development and subject to change.*

Produced by spi the plastics industry trade association

ROGER C. KIPP
VICE PRESIDENT OF MARKETING & ENGINEERING
McCLARIN PLASTICS, INC.
HANOVER, PA

An Innovator and Visionary Helping to Expand an Industry

Roger C. Kipp is Vice President of Marketing & Engineering at McClarin Plastics, Inc., located in Hanover, PA. His contributions to the plastics industry include hands-on development of processes and procedures, furthering education initiatives, and developing successful business models.

Roger C. Kipp's passion, contributions and innovations for the plastics industry began in 1967 during his first job out of college as the assistant plant manager of a small non-ferrous foundry in Cincinnati, OH. During this time, he saw an opportunity to become a one-stop source for plastic process tooling by combining pattern making with foundry skills. In 1968, he developed the first cast to form an aluminum injection mold for a major Cincinnati toy manufacturer. This venture was soon expanded to include tooling for heavy gauge sheet thermoforming and rotational molding.

From 1967 to 1983 Kipp partnered with his father and brother to grow their pattern and foundry business in Cincinnati. As Operations Manager and Treasurer, he focused on business development with expansion of a permanent mold division and creation of the plastics tooling division.

In 1983, Kipp spun off the plastics tooling division from the family foundry.

For over 25 years, Kipp devoted his attention to the construction of aluminum tooling, developing innovative processes which improved heat transfer, created new techniques for forming undercuts, part ejection, molding inserts and improving overall cast tooling quality.

As the industry evolved, so did Kipp's focus. After many years of working with captive forming and molding operations, he developed an interest in developing new plastic components, an interest that extended beyond tooling. Kipp's knowledge of the values and limitations of metals, along with tooling engineering expertise, provided a technical advantage to allow him to expand into large part thermoforming applications and markets.

In 1987, Kipp directed the start-up of a vacuum forming and rotational molding facility in Sidney, OH. While he continued to oversee tooling construction, this position was Kipp's first foray into the sales and marketing aspects of the industry. He subsequently developed millions of dollars of new applications by introducing plastics innovation to various industries, including waste management, agricultural and construction equipment, sound systems, air handling, and playground equipment.

In 1994, Kipp joined McClarin Plastics in Hanover, Pennsylvania as Vice President of Marketing & Engineering. In this position, he has made it a priority to be involved in strategic and functional initiatives to further the company as well as to promote the plastics industry through affiliation with various professional organizations.

Kipp has been a member of the Society of Plastics Engineers' Thermoforming Division Board since 1992. During his tenure on the Board, he has served as Conference Chairman (1996), Conference Treasurer, Division Treasurer and Chairman. As a member of the Society, he has served as the Communications Committee Chair and on the Foundation Executive Committee. The Society has honored Kipp with the 2002 Outstanding Achievement Award and a Lifetime Achievement Award in 2003.

With an interest toward the future of the plastics industry, Kipp has always had an affinity for education. He is Associate Professor teaching manufacturing processes part time at his alma mater, Miami University in Oxford, OH. Since then, he has assisted in the development of numerous industry-wide educational programs as well as a comprehensive in-house program at McClarin Plastics. The McClarin program offers its 200 employees about 40 classes that cover such topics as blueprint reading, lean certification, metrology and economics.

Kipp is also instrumental in supporting McClarin's aggressive programs focused on local high school students. These programs, which include job fairs, internships and hands-on projects are designed to spark interest in the industry and expose students to opportunities in the field of plastics manufacturing and engineering.

Kipp serves as a member of the Advisory Board of the Plastics Manufacturing Center at the Pennsylvania College of Technology, an affiliate of Penn State University. Through them, he is active with the Pennsylvania Plastics Initiative.

He and his wife Sandy now reside in Hanover, PA. They have three children and five grandchildren. Mr. Kipp is an alumnus of Miami University and is active with their Alumni Recruiter Organization.

Thermo Forming Division

Our mission is to facilitate the advancement of thermoforming technologies through education, application, promotion and research.

SPE National Executive Director

Susan Oderwald
Direct Line: 203/740-5471
Fax: 203/775-8490
email: Seoderwald@4spe.org

Conference Coordinator

Gwen Mathis
6 S. Second Street, SE
Lindale, Georgia 30147
706/235-9298
Fax: 706/295-4276
email: gmathis224@aol.com

Website:

http://www.4spe.org/communities/divisions/d25.php
or
www.thermoformingdivision.com

SUNDAY, SEPTEMBER 21, 2008: JOINT SESSION

"Infrared Temperature Measurement Applications" - Jimmy Earle, Raytek
"Accelerated Package Development & Testing" - Hossam Metwally, Ansys
"Real Time Shop Floor Data Collection" - Brian Lynch, Dunsirn Industries

"Thermoforming Tooling" - Martin Haex, Bosch-Sprang
"The Latest in Thermoforming Equipment" - Bill Kent, Brown Machine

"A Brief History of Sheet Co-Extrusion" - Frank Nissel, Welex
"Achieving Optimum Production Results Through Sophisticated Control Systems" - Dana Hanson & Tom Limbrunner, PTi

"Thermoforming of Polypropylene – The Effect of Stabilization on Regrind and Part Performance"
Ronald Becker & Lyondell Basell
"Bio Materials" - Paul Uphaus, Primex Plastics
"Expanding Your Portfolio with PLA Materials" - Nicole Whiteman, Natureworks

MONDAY, SEPTEMBER 22, 2008: HEAVY GAUGE SESSIONS

"Engineering Resins – Options and Opportunitites for Extrusion Market" - Roger Petit, Sabic Innovative Plastics
"Low Gloss Flexible Thermoplastic Polyolefins" – Laura Weaver, Dow Chemical
"The Next Generation of TPOs" - Todd Hogan, Dow Chemical
"TPO Innovation in Design" - Brad Rickle, Premier Materials

"Designing Parts Using Bayblend (PC/ABS)" – Prakash Vizzeswarapu, Bayer Material Science
"Improved Rigid TPO Sheet Products for Large Part Forming Applications"
Michael Mahan & Steve Campbell, Spartech Plastics
"It's a Game of Inches" - Bob Marshall, ZMD

"Thermoformable CFR Composite Sheet: A Viable Alternative to Metal" - Peter Lindenfelser, Lingol Corporation
"Forming CFR Composite Sheet" - Art Buckel, McConnell Company

"Fluorex Bright Film – The Chrome" - Jeff Bailey, Soliant LLC
"The Latest in TPO & Ionomer: How They Can Help You" - Dennis Smith, Invision
"Next Generation of 5 Axis Trimming & Modeling" - Jim Bullis, Thermwood Corporation
"Robotic Trimming – Improve Your Competitive Advantage" - Paul Schuch, KMT Robotics
"Color Control for Extruded Sheet" - Axel Kronewitter & Larry DeBow, Senoplast
"Application Specific Equipment is Your Best Competitive Advantage" - Paul Ryan Alongi, Maac Machinery
"Halogen Heaters are Your Competitive Advantage" - Michael Roche, Geiss Thermoforming USA

MONDAY, SEPTEMBER 22, 2008: ROLL FED SESSION

"Novel High Performance PP Products for Thermoforming: Stiffness, Toughness and Clarity"
Tim Pope & Jason Brodil, Dow Chemical
"High Stiffness High Clarity PP" - Tom Gallagher, Sonoco
"The Challenges of Closing the Loop with Thermoformed Plastic Packaging" - Michael Brown, Packaging 2.0

"Providing Value with Thin Gauge Applications" - Jonathan Cage, Spartech Packaging Technologies
"Your Leading Edge – Today's Weakness May Be Tomorrow's Competitive Edge" - Mark Zelnick, Zed Industries
"Using Tools, Machines & Materials to Optimize Your Process and Maximize Profits" - Lars Ekendahl, Frimo

"Optimization of Thermoformed Products" - Thomas Stahl, Illig
"PVC and the Environment" - Allen Blakey, The Vinyl Institute
"Dynamics of the PET Market" - Clarissa Schroeder, Invista
"Steel Rule Dies – Are You Building Them Properly?" - Julie Griswold, W.R. Sharples Co.
"Advances in OPS for Thermoforming" - Jeff Pristera, Reynolds Packaging Kama
"PLA & Pin Chains – From Problem to Possibility" - Charles Hildebrand, Kiefel Technologies

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BOOK SPACE IN 2008!

Thermoforming Division Board Meeting Schedule 2008 - 2009

September 17 - 20 – Minneapolis, MN

February 17 - 22, 2009 – Indian Wells, CA

June 18 - 21, 2009 – NPE & ANTEC, Chicago, IL

Board meetings are open to members of the thermoforming industry.

If you would like to attend as a guest of the board, please notify Division Secretary, Mike Sirotnak, at msirotnak@solarproducts.com.

UPCOMING CONFERENCES

2010 - MICHIGAN

2011 - ILLINOIS

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15-MAR Spring	15-OCT Fall

DEADLINE FOR AD COPY

15-DEC Winter	15-JUL Summer
31-MAR Spring	31-OCT Fall

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2008 - 2010

CHAIR

Brian Ray
Ray Products
1700 Chablis Avenue
Ontario, CA 91761
(909) 390-9906, Ext. 216
Fax (909) 390-9984
brianr@rayplastics.com

CHAIR ELECT

Ken Griep
Portage Casting & Mold
2901 Portage Road
Portage, WI 53901
(608) 742-7137
Fax (608) 742-2199
ken@pcmwi.com

TREASURER

James Alongi
Maac Machinery
590 Tower Blvd.
Carol Stream, IL 60188
(630) 665-1700
Fax (630) 665-7799
jalongi@maacmachinery.com

SECRETARY

Mike Sirotnak
Solar Products
228 Wanaque Avenue
Pompton Lakes, NJ 07442
(973) 248-9370
Fax (973) 835-7856
msirotnak@solarproducts.com

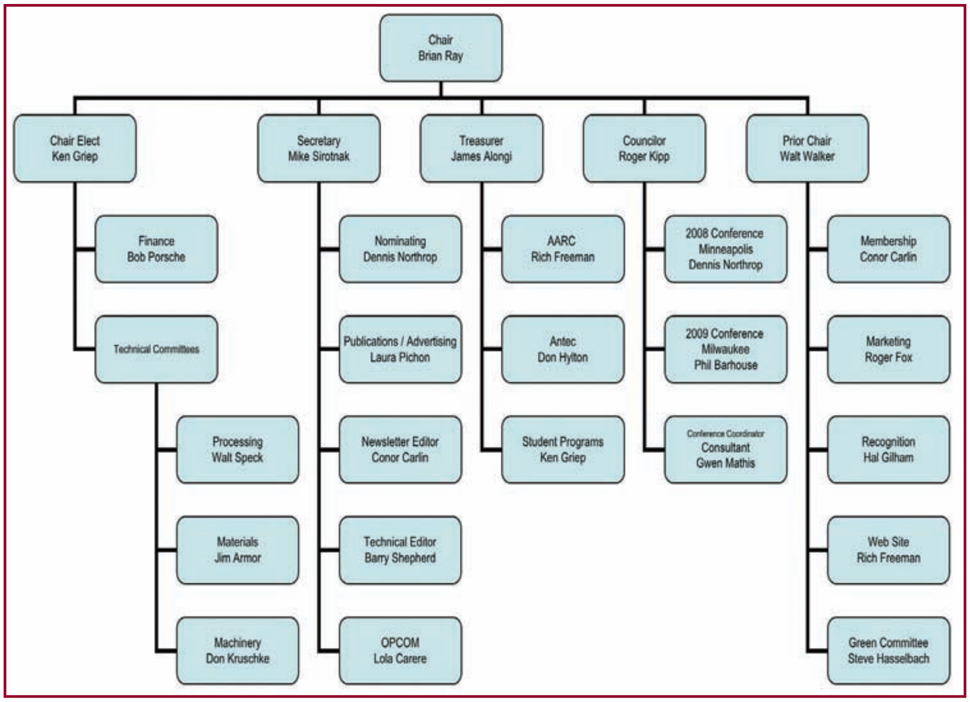
COUNCILOR WITH TERM ENDING ANTEC 2009

Roger Kipp
McClarin Plastics
P. O. Box 486, 15 Industrial Drive
Hanover, PA 17331
(717) 637-2241 x4003
Fax (717) 637-4811
rkipp@mcclarinplastics.com

PRIOR CHAIR

Walt Walker
Prent Corporation
P. O. Box 471, 2225 Kennedy Road
Janesville, WI 53547-0471
(608) 754-0276 x4410
Fax (608) 754-2410
wwalker@prent.com

2008 - 2010 THERMOFORMING DIVISION ORGANIZATIONAL CHART



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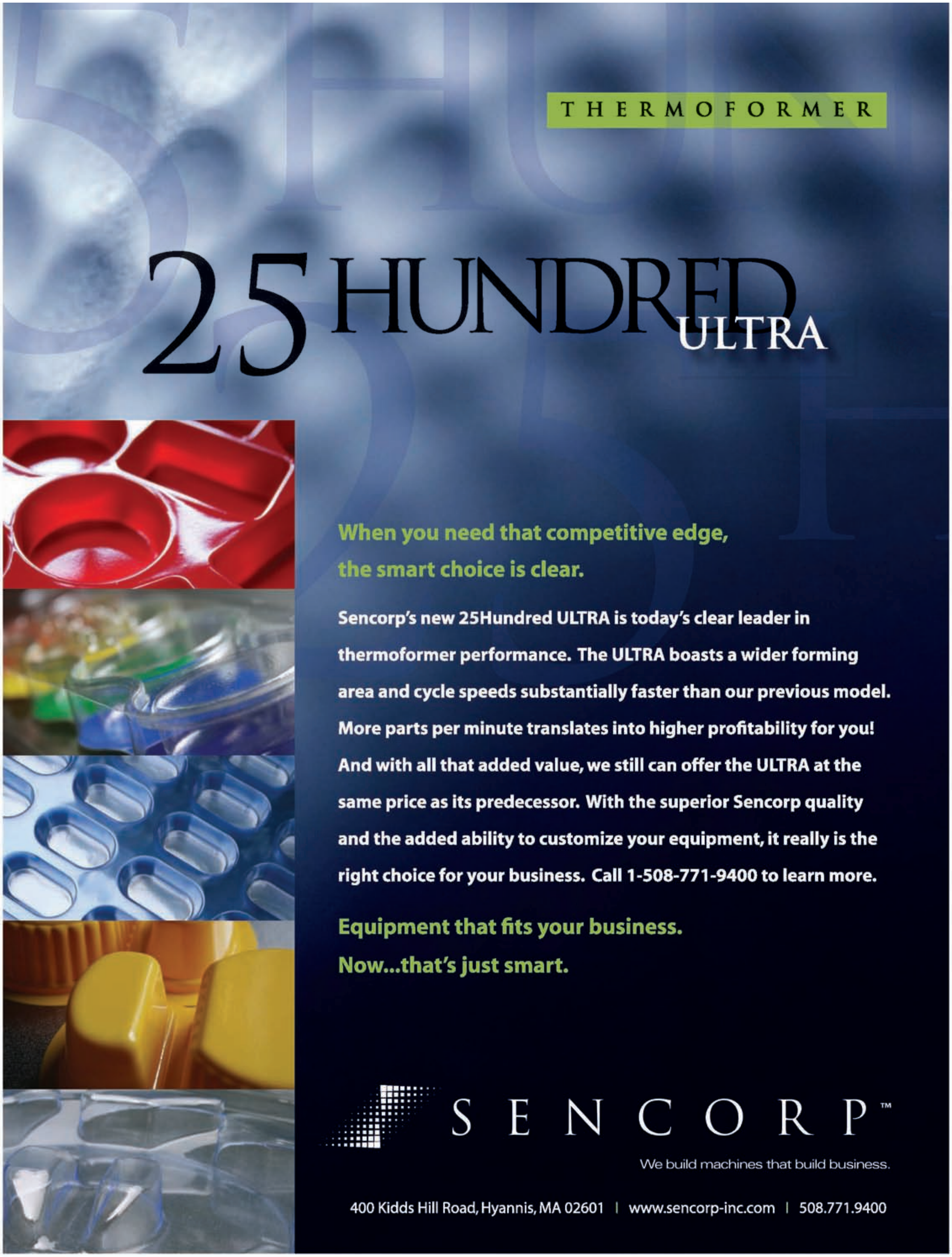
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