THIRD QUARTER 2007, VOLUME 26, NUMBER 3

THERMOFORMING QUARTERLY®

A JOURNAL OF THE THERMOFORMING DIVISION OF THE SOCIETY OF PLASTICS ENGINEERS
"WINNER 2003, 2004 & 2005 AWARD OF EXCELLENCE"

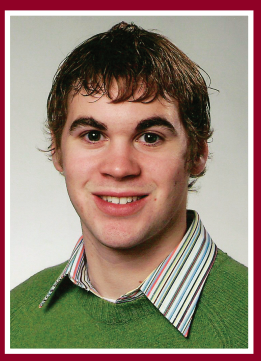
Special Conference Section

Cincinnati

2007 SCHOLARSHIP WINNERS ANNOUNCED ...

KEVIN E. DESOTELL
$1,000 DIRECTORS' SCHOLARSHIP
UNIVERSITY OF WISCONSIN

TIMOTHY D. McMASTER
$7,500 GRIEP MEMORIAL SCHOLARSHIP
PITTSBURG STATE UNIVERSITY



KORY R. SLYE
$7,500 SEGAN MEMORIAL SCHOLARSHIP
PENN STATE-ERIE

LUCAS D. STALLBAUMER
$7,500 DIVISION MEMORIAL SCHOLARSHIP
PITTSBURG STATE UNIVERSITY

➤ LEAD TECHNICAL ARTICLE

THERMOFORMING HDPE – PART ONE

"IF YOU CAN'T MEASURE IT, YOU CAN'T CONTROL IT"

BY BILL McCONNELL

..... *see page 11*

I'm Pumped!

➤ By Walt Walker, Chair

I just arrived home from our Spring board meeting in Las Vegas and I am definitely pumped! The range of new projects and leadership our division provides to the thermoforming industry is broad, forward-looking and – I must say – second-to-none. From the environment, to research, to communication, to education, to industry standards, we're committed to making our industry the best it can be. Here's a look at just some of the topics we're tackling:

Safeguarding the Environment

To help our members better participate in world and local environmental discussions, we formed a new committee to document the thermoforming industry's environmental stewardship and pro-active environmental initiatives. Chaired by Steve Hasselbach (CMI Plastics), a Past Chair of our division, our new "green" committee is made up of members from our Board of Directors, plus outside educators and business leaders. Their goal is help formulate national discussion and set the record straight about plastics, the environment, thermoforming and the growing issue of over-packaging. The group is developing relationships with organizations to research these issues, and provide facts and statistics to help all of us better support our industry during environmental discussions.

Enhancing Member Communication

To provide our readers with easier access to information, a team of board members – led by Division Chair-Elect Barry Shepherd (Shepherd Thermoforming & Packaging, Inc.) – is giving our award-winning "Thermoforming Quarterly" a facelift and upgrade. The new look is set for unveiling the first quarter 2008.

Establishing Centers of Excellence

To further research and grow the thermoforming industry, our division is donating $10,000 to help establish a new Plastics Manufacturing Center at the Pennsylvania College of Technology, a part of Penn State University. The Center will be located in a dedicated 18,000 sq. ft. facility. This could be at least the fourth thermoforming "Center of Excellence" in the USA. Others being developed are at the University of Wisconsin-Platteville, Pittsburg State College and San Diego State. Thanks to Past Board Chair Roger Kipp (McClarin Plastics) for spearheading this effort. These centers can also assist members in researching solutions to various thermoforming challenges.

Growing Our Annual Conference

To continue expanding the technical value of our own conference and the growth of our division, the board turned down the opportunity to open a Thermoforming Pavilion at NPE in 2009 – instead of hosting our annual conference & exposition. Although NPE offered our division the opportunity to try something a little different, the board felt we should focus on what our members want: a highly technical thermoforming conference. However, this does not mean we can't revisit the issue in the future. Special thanks to Board Treasurer Brian Ray (Ray Products) for researching the issue's pros and cons. Therefore, set time aside now for the 2009 Thermoforming Division Conference to be held in Milwaukee.

Developing Industry Certification

To assist SPI in upgrading the National Machine Operator Certification Program and to create a National Technician Certification for Thermoforming, the board voted to donate $20,000 to SPI. The updated Machine Operator Certification should be ready by late 2007. SPI and SPE are cooperating to foster the programs at a combined cost of $40,000.

Demonstrating New Thermoforming Techniques

To help us better understand the latest change-over techniques on today's new thermoformers, our annual conference will feature a live demonstration plus Q&A. While a crew is filming a close-up demo, attendees can watch and ask questions from a conference room. The demo is expected to be available on DVD later in the year.

Expanding Our Membership

To expand our membership and industry influence, please invite a colleague to become a member of our SPE thermoforming division. Additionally, I encourage YOU to consider becoming a board member and help us lead this industry forward. To learn more about what's involved, call any board member.

Enjoying a Visit from Stan Rosen

What a wonderful surprise. A distinguished guest dropped by our recent executive committee meeting to share his positive thoughts and concerns: Stan Rosen (Plastimach Corporation), recipient of the "1991 Thermoformer of the Year Award" and a longtime member of the division. You may also know him as the author of our highly read "History of Thermoforming" series in the *Quarterly*. It's always good to have past members stop by and share with us. Thank you, Stan.

Awarding High Value to Members

Last but not least, our thermoforming division was honored with a ***Pinnacle Gold Award*** – during the recent 2007 SPI ANTEC show and conference – for delivering high member value during the year, including organizational, technical programming, membership and communication value. It's wonderful to see our volunteers recognized for their outstanding contributions to the plastics industry. It's also nice to know our work does not go unnoticed!

It's a Great Day in Thermoforming! ➤

Walt Walker

THERMOFORMING QUARTERLY®

CONTENTS

➤ TECHNICAL SECTION

➤ DIVISION ACTIVITIES

A NOTE TO PROSPECTIVE AUTHORS

TFQ is an "equal opportunity" publisher! You will note that we have several categories of technical articles, ranging from the super-high tech (sometimes with equations!), to industry practice articles, to book reviews, how to articles, tutorial articles, and so on. Got an article that doesn't seem to fit in these categories? Send it to Barry Shepherd, Technical Editor, anyway. He'll fit it in! He promises. [By the way, if you are submitting an article, Barry would appreciate it on CD-ROM in DOC format. All graphs and photos should be black and white and of sufficient size and contrast to be scannable. Thanks.]

THERMOFORMING QUARTERLY®

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

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

Technical Editor
Barry Shepherd
Shepherd Thermoforming & Packaging, Inc.
5 Abacus Road
Brampton, Ontario L6T 5B7
CANADA
(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

Thermoforming Quarterly® is published four times annually as an informational and educational bulletin to the members of the Society of Plastics Engineers, Thermoforming Division, and the thermoforming industry. The name, "*Thermoforming Quarterly*®" and its logotype, are registered trademarks of the Thermoforming Division of the Society of Plastics Engineers, Inc.

Thermoforming Quarterly® is registered in the US Patent and Trademark Office (Registration no. 2,229,747).

Healthy Returns

➤ By Conor Carlin, Chair

For the first four months of 2007, we have seen steady growth in our membership ranks. As of April 1, we were only fifty-two (52) short of our historical high of 2,096 members in June 2006. With your help, we can continue the positive trend.

On the subject of numbers, the divisional growth (both D24 and D43) shows a combined increase of over 5% from 2005-2006 (the two lastest complete years). This is excellent news because increased membership means increased interest in thermoforming. When you examine the data more closely, it becomes apparent that there is a broad and diverse group of companies, individuals and industries represented. To give you an idea, here is a snapshot of the industries included in the most recent group of new members:

- Resin suppliers
- Food packing
- Consumer goods
- Primary metals
- Composites
- Chemicals

Like a well-balanced financial portfolio, our division reaps the benefits of diversification. And like a team of fund managers (without the bonuses!), the board of directors is constantly working to shuffle assets and find greater returns. As an example, we are strengthening ties with other thermoforming groups in Europe and Australia so that we can get first-rate papers on the latest technological developments including in-mold labeling and robotic trimming.

Still, we have a wealth of untapped reserves in the form of the undiscovered ideas in the minds of our members. I cannot stress enough how important it is for us to have your feedback. While the board is representative of the industry, we thrive on input from processors, suppliers and OEMs. This is especially true when we are canvassing for articles and presentations for the *Thermoforming Quarterly* and the Thermoforming Conference.

Dow Chemical chose an apt symbol for their latest advertising campaign: **Hu** (the Human Element). It underlines the importance of knowledge capital in the development and success of business today. Innovation, creativity and mastery of techniques are what drive us on in the pursuit of greater returns. Our industry and our board are no different – you are the human element that gives us competitive advantage.

Get involved! ➤

Questions? Comments?
Email me:
conorc@stopol.com

WELCOME, NEW MEMBERS!

Mohammad Ali
mohammad.ali@tateandlyle.com

Craig D. Bailey
CORVAC Composites
cbailey@corvaccomp.com

Beverly Benjamin
Benjamin Mfg.
akralac@aol.com

Gregory W. Burr
Bayside Plastic
baysidebaskets@hughes.net

Ruben Chevere
Organogenesis Inc
rchevere@organo.com

Keith W. Dirks
keith.dirks@insightbb.com

Alejandro Dyner
Sajiplast S a
sajiplas@racsa.co.cr

David F. Freund
Bostik Inc
david.freund@bostik.us.com

Gerardo E. Galvan
Ave Luis Donaldo Colosio
ggalvan@lear.com

Fernando Garciarce
Embotelladora AGA SA De CV
fergamu@prodigy.net.mx

Stephen J. Hawkins
shawkins@lear.com

Cory J. Hendricks
Corvac Composites
chendricks@corvaccomp.com

Viswanathan Kalyanaraman
GE Plastics Technology Center
Viswanathan.kalyanaraman@ge.co

Mark Kangas
Landscape Structures
mark_kangas@playlsi.com

Roland Karklin
karklin.r@frimo.com

Robert Z. Kitchen
Alcoa/Reynolds Food Packaging Division
robert.kitchen@alcoa.com

Jason Kreider
Chevron Phillips
kreidjjl@cpchem.com

David Lupardus
MR Germantown

Jerry Middleton
Sonoco
jerry.middleton@sconoco.com

Matthew A. Rhodes
A. Schulman
matt.rhodes@usaschulman.com

Ana Maria M. Rodriguez
Fragamex SA De CV
anapohis@fragamex.com.mx

Marco Smit
marco.smit@tno.nl

Michael A. Teslevich
Pactiv Corporation
mteslevi@hotmail.com

Stephen C. Tiefenthaler
Copper & Brass Sales
stephen.tiefenthaler@thyssenkrupp.

Sandra Vos
Azdel
svos@azdel.com

Stephen W. Wojcieszek
swoj@processsolutionsgroup.com

Why Join?

It has never been more important to be a member of your professional society than now, in the current climate of change and volatility in the plastics industry. Now, more than ever, the information you access and the personal networks you create can and wil directly impact your future and your career.

Active membership in SPE – keeps you current, keeps you informed, and keeps you connected.

The question really isn't "why join?" but …

Why Not?

THERMOFORMING DIVISION CONFERENCE BOARD MEETING SCHEDULE

September 13th - 16th, 2007
Millennium Hotel
Cincinnati, Ohio

FOR RESERVATIONS, CALL: 513-352-2110.

REQUEST SPE ROOM RATE OF $145.00.

Wednesday, September 12th, 2007
Executive Committee Arrives

Thursday, September 13th, 2007
7:30 – 8:30 am – Breakfast – Executive Committee, Queen Conference 464
8:30 am – 5:00 pm – Executive Committee Meeting, Queen Conference 464
2:00 – 3:00 pm – Finance Committee Meet Chair - Executive Committee QC 464
4:00 – 5:00 pm – Technical Chairs Meet Executive Committee, QC 464

Friday, September 14th, 2007
8:30 – 10:00 am – Materials Committee Breakfast Meeting, Pavilion A
8:30 – 10:00 am – Processing Committee Breakfast Meeting, Pavilion B
8:30 – 10:00 am – Machinery Committee Breakfast Meeting, Atrium
8:30 – 5:00 pm – OTHER COMMITTEES, Bronze A

JOIN THE BOARD ON THE DELTA QUEEN FOR DINNER CRUISE

• Bus departs Millennium Hotel at 5:30 pm – returns 9:00 pm •

Saturday, September 15th, 2007
7:30 – 8:30 am – Breakfast – Board of Directors, Bronze B
8:30 am – Noon – Board of Directors' Meeting, Bronze B
12:00 – 1:00 pm – Lunch – Board of Directors, Bronze B

Sunday, September 16th, 2007
Volunteers Assist Parts Competition

6:15 pm – 9:00 pm – Ribbon Cutting Opening Exhibits
Welcome Reception Exhibit Floor

Need help with your technical school or college expenses?

If you or someone you know is working towards a career in the plastic industry, let the SPE Thermoforming Division help support those education goals.

Our mission is to facilitate the advancement of thermoforming technologies through education, application, promotion, and research. Within this past year alone, our organization has awarded multiple scholarships! Get involved and take advantage of available support from your plastic industry!

Start by completing the application forms at www.thermoformingdivision.com or at www.4spe.com. The deadline for applications is January 15th, 2008. ■

Thermo Forming Division

➤ Thermoformer of the Year Criteria for 2008

Every year the SPE Thermoforming Division selects an individual who has made an outstanding contribution to our industry and names them "Thermoformer of the Year."

The award in the past has gone to industry pioneers like Bo Stratton and Sam Shapiro, who were among the first to found thermoforming companies and develop our industry. We have included machine designers and builders Gaylord Brown and Robert Butzko and toolmaker John Griep, individuals who helped develop the equipment and mold ideas we all use today. We have also honored engineers like Lew Blanchard and Stephen Sweig, who developed and patented new methods of thermoforming. Additionally, we have featured educators like Bill McConnell, Jim Throne and Herman R. Osmers, who have both spread the word and were key figures in founding the Thermoforming Division.

We're looking for more individuals like these and we're turning to the thermoforming community to find them. Requirements would include several of the following:

- Founder or owner of a thermoforming company
- Patents developed
- Is currently active in or recently retired from the thermoforming industry
- Is a processor – or capable of processing
- Someone who developed new markets for or started a new trend or style of thermoforming
- Significant contributions to the work of the Thermoforming Division Board of Directors
- Has made a significant educational contribution to the thermoforming industry.

If you would like to bring someone who meets some or all of these requirements to the attention of the Thermoforming Division, please fill out a nomination form and a one- to two-page biography and forward it to:

Thermoforming Division Awards Committee
% Productive Plastics, Inc.
Hal Gilham
103 West Park Drive
Mt. Laurel, NJ 08045
Tel: 856-778-4300
Fax: 856-234-3310
Email: halg@productiveplastics.com

You can also find the form and see all the past winners at www.thermoformingdivision.com in the Thermoformer of the Year section.

You can submit nominations and bios at any time but please keep in mind our deadline for submissions is no later than December 1st of each year, so nominations received after that time will go forward to the next year.

THERMOFORMER OF THE YEAR 2008

Presented at the September 2008 Thermoforming Conference in Minneapolis, MN

The Awards Committee is now accepting nominations for the 2008 THERMOFORMER OF THE YEAR. Please help us by identifying worthy candidates. This prestigious honor will be awarded to a member of our industry that has made a significant contribution in a technical, educational or managerial aspect of thermoforming. Nominees will be evaluated and voted on by the Thermoforming Board of Directors at the Winter 2008 meeting. The deadline for submitting nominations is December 1st, 2007. Please complete the form below and include all biographical information.

Person Nominated: _____ Title: _____

Firm or Institution: _____

Street Address: _____ City, State, Zip: _____

Telephone: _____ Fax: _____ E-mail: _____

Biographical Information:

- Nominee's experience in the thermoforming industry.
- Nominee's education (include degrees, year granted, name and location of university)
- Prior corporate or academic affiliations (include company and/or institutions, title, and approximate dates of affiliations)
- Professional society affiliations
- Professional honors and awards.
- Publications and patents (please attach list).
- Evaluation of the effect of this individual's achievement on technology and progress of the plastics industry. (To support nomination, attach substantial documentation of these achievements.)
- Other significant accomplishments in the field of plastics.
- Professional achievements in plastics (summarize specific achievements upon which this nomination is based on a separate sheet).

Individual Submitting Nomination: _____ Title: _____

Firm or Institution: _____

Address: _____ City, State, Zip: _____

Phone: _____ Fax: _____ E-mail: _____

Signature: _____ Date: _____

(ALL NOMINATIONS MUST BE SIGNED)

Please submit all nominations to: Hal Gilham,
Productive Plastics, 103 West Park Drive
Mt. Laurel, New Jersey 08045

MARK YOUR CALENDAR!!!

The Thermoforming Board of Directors has taken your advice from your completed surveys and beginning in 2008 we will be going back to our old dates –

DATES:

Saturday, September 20th, 2008
thru
Tuesday, September 23rd, 2008

MINNEAPOLIS CONVENTION CENTER

HEADQUARTER HOTEL: MINNEAPOLIS HILTON & TOWERS

2008 Chairman:
Dennis Northrop
Avery Dennison
Performance Films

Cut Sheet Chairman:
Jim Armor
Armor & Associates

Roll Fed Chairman:
Phil Barhouse
Creative Forming

➤ 2007 Thermoforming Division Scholarship Award Winners

$1,000 DIRECTORS' SCHOLARSHIP

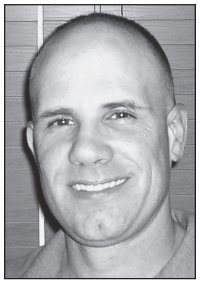
KEVIN E. DESOTELL
UNIVERSITY OF WISCONSIN-PLATTEVILLE

Kevin will be a senior at the University of Wisconsin – Platteville, where he is pursuing a B.S. in Industrial Technology Management, with minors in metals and plastics processing. A serious speed-skater, Kevin is a member of the United States Speedskating Association and the Badger Speedskating club. He is also an active member of the SPE Student Chapter at UWP.

Kevin is putting his classroom experience in thermoforming to good use. He is currently working on a package design to hold items to promote UWP's plastics program to area high schools. The mold is being made by a local company, and will run on the new roll-fed thermoformer the school obtained with help from the Thermoforming Division Equipment Grant.

$7,500 GRIEP MEMORIAL SCHOLARSHIP

TIMOTHY D. McMASTER
PITTSBURG STATE UNIVERSITY



Tim McMaster will be a junior at Pittsburg State this fall, working on his B.S. in Plastics Engineering Technology. Married and the father of two children, this scholarship will help ease the challenge of supporting a family and getting a degree.

Tim works at a custom fiberglass shop that manufactures corrosion resistant air handling equipment. He has also worked on projects for a thermoforming company in the area, designing molds and selecting materials for the production of various parts. He modified a planter tray that is used to hold soil and grow grass on the roofs of buildings in large inner city areas, and is currently working on a thermoformed LDPE all-weather enclosure for industrial wireless networking routers and switches used in warehouse inventory tracking. This replaces a thermoset product that failed, and provides a substantial savings to the customer. Working and attending school full time has required cooperation by Tim's family and employer – and his desire to succeed shows. He is maintaining a 4.0 gpa in his major!

$7,500 SEGAN MEMORIAL SCHOLARSHIP

KORY R. SLYE
PENN STATE UNIVERSITY-ERIE

Kory will be a senior at Penn State - Erie this fall, working on his B.S. in Plastics Engineering Technology. A Dean's List student, he maintains a 3.84 gpa. He was accepted into the Schreyer Honors College at Penn State, which allows him to research any aspect of the plastics industry he chooses.

Kory credits being an active member of SPE for the many opportunities he has had at Penn State. Last summer, he was selected to participate in a Research Experience for Undergraduates at the University of Southern Mississippi in the School of Polymers and High Performance Materials. While there, he researched a monomer that would provide a drug eluting coating for coronary artery stents, conducted various chemical experiments, and co-authored a paper that was presented at the ACS meeting earlier this year. He presently works for Beaumont Technologies in the R&D department, where he conducts studies on various aspects of runner and gating design.

$7,500 DIVISION MEMORIAL SCHOLARSHIP

LUCAS D. STALLBAUMER
PITTSBURG STATE UNIVERSITY

This is the second year Lucas has received a scholarship from the Thermoforming Division. He was also a recipient in 2006. He received his B.S. in Plastics Engineering Technology last May from Pittsburg State University and is a graduate student at Pittsburg State University, working on his MBA.

Lucas had an internship with Joe Peters at Universal Plastics in 2005, where he experienced all kinds of applications from thin gauge to thick gauge, and from drape forming to trap forming. Lucas said he learned all aspects of thermoforming that summer. He works as a plastics lab assistant at Pittsburg, and teaches new students how to use the thermoforming machine. He helped a few seniors with their senior thermoforming projects, and uses thermoforming to make simple prototypes in his part design classes. Lucas plans to get his MBA to make him a more well-rounded job candidate when he graduates in 2008. ◄

These sponsors enable us to publish
THERMOFORMING QUARTERLY

CONGRATULATIONS
2007
THERMOFORMER
OF THE YEAR

CURT ZAMEC

PRESIDENT & CEO
WILBERT INDUSTRIES, INC.

These sponsors enable us to publish THERMOFORMING QUARTERLY

Thermoforming HDPE – Part One

("If You Can't Measure It, You Can't Control It")

➤ By Bill McConnell

(Technical Editor's Note: One of our most respected members of the Thermoforming Division has written this complete lesson on extruding and thermoforming HDPE. Part One deals with the resin and extrusion process. Part Two, in the next issue of the Quarterly, will deal with the tooling and thermoforming process. This two-part article should answer all of your questions regarding one of the most difficult materials to thermoform.)

Extruding HDPE for the Thermoforming Process

I. Materials

A. Resin History

1. A breakthrough in 1955 by Phillips Chemical in Bartlesville, Oklahoma in the manufacture of HDPE resin enabled the industry to extrude the resin into sheet and then thermoform HDPE products for the first time. This was considered a remarkable development.

B. Specifications

1. Detailed specifications are essential on extruded sheet/film for thermoforming any material. A complete data sheet showing explanations, descriptions tests, etc., must be provided by the extruder both on the resin and the sheet, to the thermoformer. This should definitely include specific information such as, resin manufacturers, type, and grade; melt index, brand names and complete specifications on all additives such as heat stabilizers, talc, etc. It is essential to have a homogeneous and consistent exact specifications whether virgin, some regrind or 100% regrind. **Remember: if you can't measure it you can't control it!**

C. Extrusion

1. **HDPE should be run on extruders** with a length to diameter (L/D) ratio at least 24:1 to allow enough time for complete melting of the resin at high output rates. Proper horsepower should be available to operate at top capacity with the extra low melt index resins as because of the increased melt viscosity.
2. **Use only extruder screws designed for HDPE** and more finely tuned screws for the lower melt index polyethylene.
3. **Temperature control** of the roll stand requires one temperature control unit for each roll in the polishing stack capable of circulating a high volume of liquid up to 250° F (121° C) in a high turbulence, at least a Reynolds number around 7000 - 8000+. (see Definitions)
4. **Use a long cooling conveyor** inserted between the polishing roll

(continued on next page)

(continued from previous page)

unit and the rubber covered pull-rollers. This enables the sheet to cool longer and better. When HDPE sheet is rolled or stacked while still hot, as is common with short conveyors, the center material may not cool to room temperature for two weeks or longer.

6. **In either manual or automatic stacking**, the system must keep the sheet edges uniformly aligned because many thermoforming operations employ automatic sheet loading devices. They won't work if the sheet stack is uneven.
7. **Here is an extrusion tip**. Melt flow across the dies should be balanced before moving the polishing roll unit into position. The height of the die should be adjusted so that the web does not contact either of the first two rolls before it enters the nip between them. The polish roll speed should then be adjusted to allow very little, if any, bank of excess material. Large banks can produce sheet with excessive molded-in stress along with thick and thin areas in the formed part.
8. **Another tip on the use of all concentrates**. Use the same melt index as the base sheet resin for the carrier in the concentrates. LDPE concentrates may reduce shear thus lowering the blending efficiency of the screw, causing streaks of concentration to appear in the sheet and the LDPE will have a tendency to stick to the cooling/polishing rollers causing the ugly blemishes on the surface.

D. Regrind

1. **The use of quality regrind** in extruded sheet and film is a very common, viable an economical practice. As long as you have clean (uncontaminated) regrind with physical properties that fall into the processing parameters, there is no reason not to use it. For many companies the right amount of regrind to use is the same percentage that is generated in their thermoforming operation. You hope that is less than 50%.
2. **When using less than 50% regrind blend**, the "heat histories" of the regrind are always at a mathematical minimum. In a 60% virgin - 40% regrind blend after the 6th extrusion, only 6.4% has had 4 or more extrusion passes. In a blend of 30% virgin - 70% regrind, on the sixth pass, 34.3% of the resin will have had 4 or more extrusion passes.
3. **Be aware of heat histories**. Every time the resin or sheet is heated to its processing temperature it has encountered a heat history. When trim or rejected parts are granulated be sure the blades are sharp, otherwise they generate heat and degrade the regrind. When parts are trimmed too fast by saw blade or router, heat can be generated gumming-up the edges and sawdust. Heat stabilizer additives in the resin are reduced with each heat history, so they are not as effective in protecting the sheet from degradation on subsequent passes. Typical results of excessive heat history are grainy surface texture and possible reduction in physical properties of the thermoformed part. As a result the regrind level in thicknesses .250" (6.35 mm) or greater should be kept below 50%. As long as excessive stock temperatures are avoided during extrusion, thinner sheets can handle regrind greater than 50%. No scorched sheet in the regrind! Whenever satisfactory sheet quality is achieved, the regrind percent should be rigidly maintained throughout the run.

4. **Frequently check melt index of all regrind used**.

E. Sheet & Film Specifications for thermoforming.

1. **Thin gage 0.080" starting thickness & less**
   a) **Melt Index (viscosity)**: 0.25 to 0.70 (Tolerance: ± %) ASTM D1238, Condition 190/2.16, g/10 min
   b) **Orientation**: around 60 to 80% (depends on thickness and pounds per hour extruded) ± 5% all the way across the web. Not easy to hold!
   c) **Density**: 0.955, ASTM D1238, g/cc, (density is normally easily controlled)

2. **Cut-Sheet heavy gage**, usually above 0.080" (2.03mm)
   a) **Melt Index (viscosity)**: 0.25, (Tolerances: 0.20 to 0.30) ASTM D1238, Condition 190/2.16, g/10 min
   b) **Orientation**: around 50% ± 5% all the way across the sheet
   c) **Density**: 0.955, ASTM D 1238, Condition 190/2.16, g/10 min

3. **High and Extra High Molecular Weight Polyethylene**: In both thin gage (roll-fed) and heavy gage (cut-sheet) HDPE, improved environmental, stress crack features, cold weather impact, etc. can be achieved by specifying HMWPE (High Molecular Weight Polyethylene) or EHMWPE (Extra High Molecular Weight Polyethylene)

   These materials come from much higher molecular weight resins that are at the extrusion borderline because the viscosity at the processing temperature is so low that it is extremely difficult to push through into sheet form. However all of the physical properties improve, so it makes it worth the effort.

   a) HMWPE Melt Index: 10.0, ASTM D1238, **Condition F – HLMI* (190/21.60)**
   b) EHMWPE Melt Index: 5.0, ASTM D1238, **Condition F - HLMI* (190/21.60)**
   c) **For thin gage applications**, HMWPE nearly always thermoforms more easily than HDPE.

F. **Here is a tip for storage of sheet and film**. Both sheet and rolls should be "seasoned" for at least 72 hours at the same temperature that is around the thermoforming machines. Any difference in temperature from the last roll or sheet that has been thermoformed will cause great havoc!

Property	As Average Molecular Weight Increases	As Molecular Weight Distribution Broadens
Melt Viscosity	Increases	
Tensile Strength at Rupture	Increases	No Significant Change
Elongation at Rupture	Increases	No Significant Change
Resistance to Creep	Increases	Increases
Impact Strength	Increases	Increases
Resistance to Low Temperature Brittleness	Increases	Increases
Environmental Stress Cracking Resistance	Increases	Increases
Softening Temperature		Increases

(continued on next page)

(continued from previous page)

Definitions:

A molecule is a basic building block of a chemical compound; it is the smallest particle of a substance that is capable of independent existence while still retaining its chemical properties. Regardless of the process used to produce a resin it can be adequately described if its density, molecular weight and molecular weight distribution are known. Resin properties are determined by these three parameters. Some generalizations may also be made about the effect of molecular weight and molecular weight distribution on the properties of polyethylene.

Molecular Weight.

The total weight of all of the atoms in one molecule of plastic material – **relative molecular mass**! In other words, the number of repeated units within the basic molecule represents the degree of polymerization (chemical reaction). In effect the degree of polymerization, or the number of times a unit is repeated in the molecule, means long chains and greater opportunity for molecular entanglement and interactions resulting in better physical properties and a more viscous and tough material.

Molecular Weight Distribution.

The relative amounts of "component polymers" which go to make up a polymer. Components polymers, in this context, is a convenient term which recognizes the fact that all polymeric materials in fact comprise a mixture of different polymers of different molecular weights.

Melt Index.

The amount in grams of a thermoplastic resin which can be forced through a 0.0825 inch orifice when subjected to 2160 gms. force in 10 minutes at 190° C. [374° F]. Term used to measure viscosity of HDPE and HMWPE. ASTM D1238 Condition 190/2.16, g/10 min.

Reynolds Number

The nature of conduit flow (laminar or turbulent) is determined by the value of the

Reynolds number (Re): $R_e = \frac{pVd}{n}$

Where: p = fluid density

V = mean (average) flow velocity

d = diameter of channel

n = viscosity of fluid

The Reynolds number (R_e) represents the ratio of inertia forces (pVd) to viscous forces (n). In the movement of a fluid through a flow channel, turbulent flow will occur when turbulence is above the critical Reynolds number, which is about 2100. Below the critical number, laminar flow occurs: this is referred to as streamline flow. The higher the Reynolds number is above 2100 the more efficient is the cooling regardless of what mold temperature is maintained. Naturally, the colder the mold the faster the cooling cycle; however, as mold temperature drops, internal stress in the formed part increases. Increasing the flow rate from 2,000 Reynolds to 10,000 Reynolds increases the heat transfer coefficient by about nine times. In other words, the more turbulence, the better the cooling rate.

HLMI High Load Melt Index

A resin with a Melt Index of 5.0 HLMI (190/21.60) is so tough and viscous that the melt index tests had to change to a higher melt temperature and pressure to get results. This means that the melt index of VHMWPE is much less than the fractional melt index of regular HDPE, consequently a different scale had to be used. This scale is the High Load Melt Index.

In Memoriam

JOHN KELLY • 1952 – 2007

Chairman, SPE Thermoforming Division 1986-1988
Member of the Board 1980's - 1990's

John's even temperament and common sense aided the Board in formulating guidelines for projects that are now the basis of our yearly conferences. He was a production executive for some of the most successful pioneer thermoforming firms. Mr. Kelly assisted in the growth of Plastofilm Corp., Wheaton, Illinois, John Hopple Corp., Cincinnati, Ohio and Berkley Corp. San Marcos, California. John was President of Fabri-Kal Corp., Kalamazoo, Michigan, and later was a consultant to the thermoforming industry.

Early 1950s Vacuum Forming Tooling

➤ By Stanley R. Rosen, Plastimach Corporation, Las Vegas, Nevada

Thermoformed parts in the early 1950s were mainly produced on slow cycling vacuum forming equipment with only a few proprietary pressure forming machines in operation. The 1950's era vacuum formers first heated the sheet and later formed it which increased the total production time by the addition of this heating cycle. Later models of thermoformers, both thin gauge roll fed and sheet fed rotaries, preheated the plastic prior to the forming sequence so that the heating time was eliminated from the overall cycle.

Production orders for formed sheets from 1950 to 1955 were for small quantities, therefore inexpensive tooling (molds and dies) were a necessity for a sale to potential customers. Easily-fashioned and low cost mold cavity materials such as wood, plaster or aluminum-filled epoxy were fabricated in-house (Fig. 4-1).

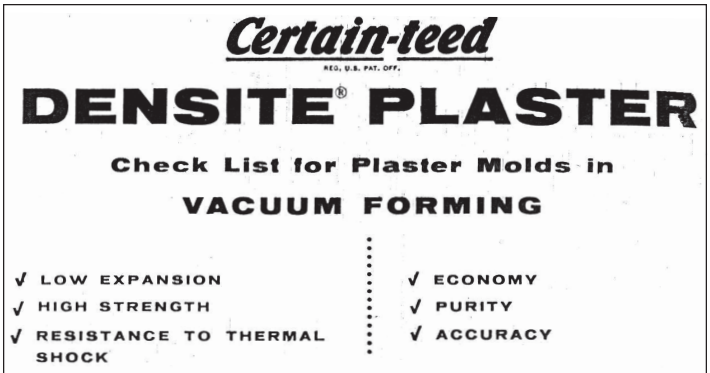


Figure 4-1. Ad for the use of an industrial plaster as a material for building vacuum forming molds. (1954)

These materials acted as thermal insulators and did little to conduct heat away from the formed shots. Cavities were often mounted directly on simple inexpensive plywood vacuum boxes further hindering cooling. Auxiliary cooling fans and water mist spray were employed as the major method to transmit heat away from the plastic into the air.

Thin gauge processors thought themselves fortunate to vacuum form 2 or 3 shots per minute during the morning startup. The cavities continued to build up heat as the day progressed and then the cooling cycle needed to be increased, reducing output. Summer heat and humidity created havoc as the cooling fans became even less efficient under these conditions. Heavy gauge sheet thermoformers had similar heat transfer problems but they had more flexibility as they sold each product for dollars not the pennies that thin gauge processors received. Fortunately, the plastic resins then available for thermoforming (HIPS and cellulose acetate or butyrate) were readily vacuum formed since they provided a wide temperature window for easy processing.

Vacuum forming molds did not require the durability or sophistication of an injection mold. This gave rise to some unique techniques to fabricate vacuum forming cavities.

Victory Mold & Die Co. N.Y. (Oct. 1953) offered cast metal shell (thin wall) vacuum forming molds. These molds were guaranteed (by the firm) to be unbreakable with optional cooling coils and clamp frames available (Fig. 4-2).

Vacuum Sales Co., Long Island, N.Y. (Mar. 1955) produced electro formed cavities built up by electroplating a master with a shell of copper and nickel. The master could be a model made of wood, plastic, plaster or metal or any material

(continued on next page)

(continued from previous page)

Figure 4-2. Shell (thin wall) cast cavities with optional attached clamp frames (1953).

that does not deteriorate in an electroplating solution. The thin plated shell was reinforced by casting on the reverse face of the cavity a low melting point backup metal. During this process, metal tubing could be placed within the backup metal to assist cavity cooling (Fig. 4-3).

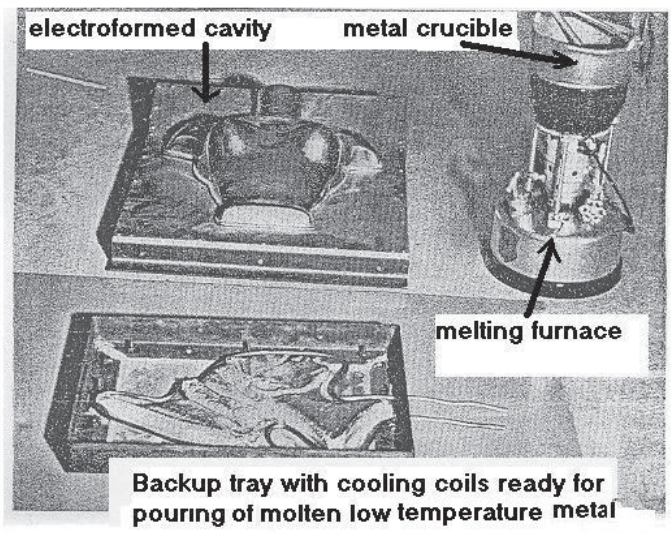


Figure 4-3. Vacuum Sales Co. L.I., N.Y. sold thin wall electroplated cavities shown being prepared for the metal backup. (1955)

Metalmold Forming Co., N.Y. (Sept. 1953) used a metalizing process to fabricate a cavity. The master which might be cloth, wood or even wax is evenly sprayed with atomized metal (a low metal point alloy). An alloy wire is drawn through a hot flame where it is melted and atomized by an air jet directed at the master (Fig. 4-4). The shell cavity is backed with plaster or epoxy to increase its durability. The owner of the firm was well known in New York City by his nickname "Sparky."

Figure 4-4. Sprayed metal mold ad. (1953)

These techniques were advertised as inexpensive alternative vacuum forming molds available with short delivery schedules and served portions of a then existing market. Electroformed and metalized spray techniques were useful for reproducing intricate details such as tooled leather, cloth, etc. in a mold (Fig. 4-5). Efficient

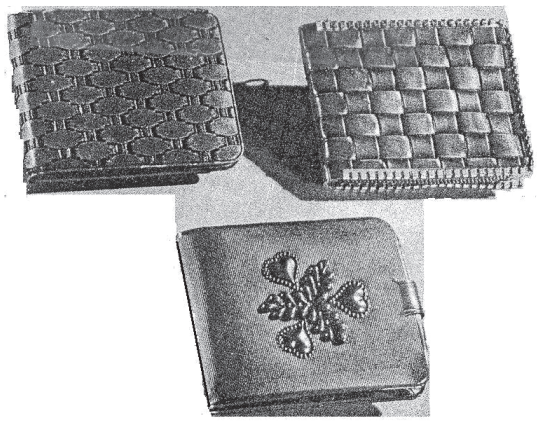


Figure 4-5. Electroformed or sprayed metalized molds can pick up extremely fine texture for these PVC heatsealed wallets. (1954)

cooling was not its strong point and those mold making methods were eventually abandoned.

Thermoformed and injection molds do not have much in common except that they both contain cavities which produce plastic parts. All injection molds require two components – a hardened steel cavity and a "force" that will create the wall thickness of the part. In the 1950's injection mold makers used several means to fabricate

cavities. They utilized various types of copying milling machines in which a tracer tracked over a pattern while the milling head cut the cavity followed the pattern contour (Fig.4-6). On

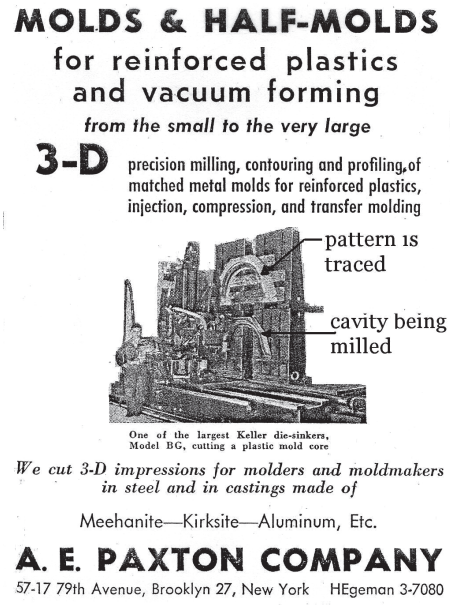


Figure 4-6. Copying milling machine traces a pattern to cut a cavity. (1953)

smaller cavities a Hobbing process was employed in which a hardened steel master was pressed into a soft steel cavity by a powerful hydraulic press. Pressure cast beryllium copper cavities are hard and tough enough to stand up to service in injection molding machines and were applied to certain injection molds. Beryllium copper is a nasty material, difficult to machine and may become a health hazard if improperly handled. None of these slow, expensive injection mold making processes were suitable for the emerging thermoforming industry. The computer revolutionized machine shop economics by introducing CNC (Computer Numerical Control) and EDM (Electrical Discharge Machining) in the 1960's. These new machining developments did unite thermoforming and injection mold fabricating techniques as they reduced costs and raised the quality for both kinds of molds.

Thermoforming mold makers were not often recruited from the injection mold industry; instead they were drawn from the ranks of pattern makers. Metal foundries rely on pattern makers to build wooden patterns which are used in the metal casting process. Their skills in accurately fashioning wood to specification made them ideal for building prototype and production thermoforming cavities. Wood can be fabricated many times faster than metal and is more quickly modified. Skilled pattern makers had the training and some added their artistic talents to build high quality and esthetically pleasing patterns which are cast into aluminum cavities. Round and regular polygons shapes are easily machined into aluminum cavities by a tool maker and may be substituted for cast aluminum cavities where appropriate. Pattern makers were asked to visit and provide consulting to thermoforming personnel after studying the details of the forming operations. This close association with the thermoforming process soon permitted them to improve their mold making skills.

A saleable thermoformed part relies on two interdependent tools – a **mold** and a **trimming** medium. Inexpensive knife-edged steel rule or forged dies were adapted to die cut thin gauge multi cavity shots (Fig. 4-7). Thicker heavy gauge parts were trimmed using existing woodworking saws and routers. Punch and dies were only occasionally employed because of cost considerations.

Figure 4-7. Ad directed to vacuum formers to employ knife-like die to trim parts in a punch press. (1953)

Steel rule dies require a high tonnage press with sufficient clearance for the formed parts to be passed through the open platens. The existing paper industry die cutting presses had adequate tonnage but their platen openings were small

(continued on next page)

(continued from previous page)

and designed as clearance for thin paper products. The early vacuum forming machine builders did not offer to sell trim presses, and their customers had to look elsewhere for die cutting equipment. Some processors converted long stroke metal working punch presses or four-post hydraulic presses into die cutters, which might be unsafe machines to operate. The inexpensive swing arm clicker die cutter used by the shoe, rubber and textile industries was quickly adopted by the majority of thermoformers (Fig. 4-8). These machines offered a variable opening platen height, sufficient tonnage, a soft anvil for the die to strike, and were relatively safe. Their cutting platen area was often smaller than the formed shot so multiple trim strokes might be needed to completely cut the whole part.

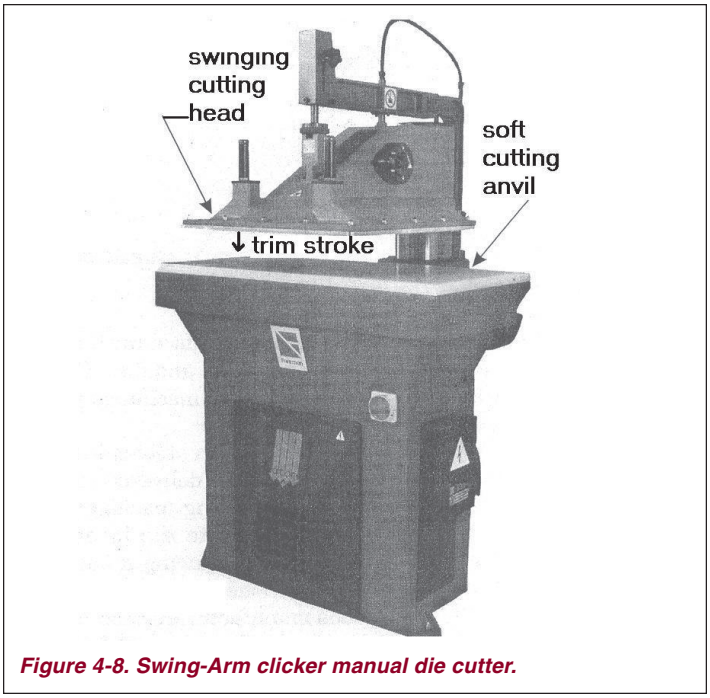


Figure 4-8. Swing-Arm clicker manual die cutter.

The first commercial steel rule die cutter introduced in 1955 specifically for the vacuum forming industry by the Tronomatic Corp. N.Y. was a four post heat-assisted press (Fig. 4-9). Its cutting platens were designed to trim a complete shot size of existing vacuum formers, with models available from 24x36 in. (61x91 cm.) to 48x96 in. (122x182 cm.) in area. A cutting force of 75,000 pounds (34,000 kg) and up was supplied by a patented self-contained air hydraulic intensifier and power cylinder designed by the author. Its cutting ability was further enhanced by an electrically-heated anvil

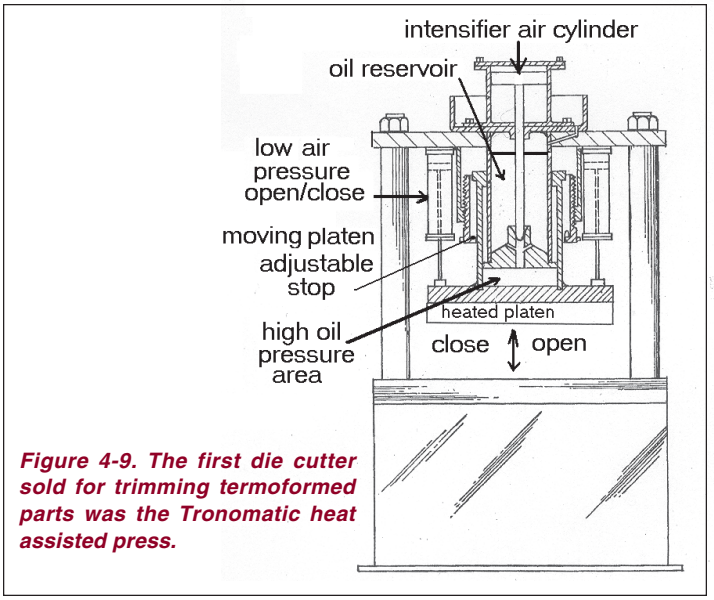


Figure 4-9. The first die cutter sold for trimming termoformed parts was the Tronomatic heat assisted press.

plate attached to the upper moving platen. The cutting force needed to cut through thicker plastics, i.e. .25in.(6.4 mm.) was considerably reduced by heating the knife cutting area before the full force of the press is exerted, resulting in a square, clean trimmed edge.

References

Fig. 4-1 – Certain-Teed Corp. Vacuum Forming cavities made of industrial plaster. Ad - Modern Plastics Encyclopedia 1953

Fig. 4-2 – Victory Molds & Die Co. New York, NY. Cast metal shell vacuum forming molds. Ad - Plastics World Magazine Oct. 1953

Fig. 4-3 – Vacuum Sales Co., Long Island, NY. Thin wall electroplated vacuum forming cavities. Ad - Modern Plastics Magazine Oct. 1955

Fig. 4-4 – Metalmold Forming Co., New York, NY. Sprayed metal cavities. Ad - Plastics World Magazine Sept.1953

Fig. 4-5 – Fine detail 3-D vacuum forming cavities. Article - Feb. 1955

Fig. 4-6 – A.E. Paxton Co., Brooklyn, NY. Copying milling machines cut vacuum forming cavities. Ad - Modern Plastics Magazine Dec.1953

Fig. 4-7 – Cutting Die Institute, Detroit, MI. Open steel cutting dies to trim vacuum formed. Article - 1953

Figs. 4-8, 4-13, 4-14, 4-15 – Illustrations from book Thermoforming: Improving Process Performance. Author, Stanley R. Rosen, published by Society of Manufacturing Engineers 2002

Fig. 4-9 – Patent #2,980,013 filed 4/29/59 by Stanley R. Rosen. First commercial vacuum formed part die cutter (1955)

The Impossible Draw Ratio

➤ By Barry Shepherd

(Technical Editor's Note: Looking back over the last 9 years at 36 Thermoforming 101 *articles, which are all presented in our annually updated booklet, it is the most comprehensive collection of basic technical information one could find on our process. For this issue I have chosen to talk about a subject that my predecessor Jim Throne wrote about in 2000 and 2001 – pre-stretching the sheet. But this time I want to discuss what type of pre-stretching should be used in a very difficult application.)*

Knowing It Can Be Done

The customer knows what he wants and you want to give him a part that will do what he wants but in the back of your mind you are thinking, "I should be telling him this is impossible." However, you know it is possible with the right tooling.

The main ingredient in getting hot plastic to form tight over a mold is vacuum. Air pressure and other various forms of assist tools make vacuum forming, thermoforming. The trick is to decide what tooling options to use to give the customer what he wants without creating problems for your production department, while staying within the customers tooling budget.

Back in the days when we used to say thermoforming is half art, half science we would make a mold, put it into the press and see what happens. Then start adding pieces of wood we called web stretchers and if we had a top press at that time we could build a pusher to assist the plastic into a problem area. OK, so maybe some of us still do this in prototyping but the ultimate aim for all of us is to build production tooling that will go into the machine and start forming good parts on the first shot.

Part Design/Tool Design

You can't design a thermoformed part unless you have a full understanding of tool design and what capabilities you have in your equipment. This seems obvious but when the part has extreme draw ratios and wall thickness requirements that must be met, it is imperative.

Let's take a heavy gauge part that has towers that defy all principles of thermoforming, 8" high, only about 2" diameter at the top and only 6" between towers and it must be polyethylene which makes matters worse. The configuration of the part is such that the tall sections are at the perimeter. In other words, this is a job that would seem impossible. But the customer is faced with having to build these parts on a limited budget and other processes are too expensive. The designer must make a decision knowing that he has a number of tooling options available.

Pre-Stretch Tooling

The main problems that must be addressed in designing the tooling for this part is a) how to pre-stretch the material so that there is enough material in the areas around the towers and b) how to get the material down into the valleys between the towers without webbing or bridging.

Pre-stretching the material can be done by forming a seal on the material around the edge of a box and drawing a vacuum to pull the sheet into a bubble. This is called a pre-draw box and this is done on the opposite platen to the mold platen. So now we have stretched the material to give us enough surface area to cover the towers without

(continued on next page)

(continued from previous page)

getting too thin. Now how do we get all that material down to the bottom of the valleys?

Plugging or Pushing

This is where a newer technique of plug assist can be used effectively. Visualize the material in a bubble hanging below the mold in the clamp frames. It has been pulled down by the pre-draw box. With an independently acting air cylinder inside the pre-draw box, a plug or pusher tool can be mounted and used to push the pre-stretched material into the valleys. Obviously you must have this capability built into your machine and the timing must be such that the mold, vacuum and pusher are activated in the right sequence.

If the machine does not have the capability to have this third motion tool then it may be possible to mount a fixed pusher inside the pre-draw box. However this means the material must then drape around the pusher during the pre-stretching and this could mean that the material cools in these areas causing other forming problems. Pusher shape and heating then becomes critical.

Impossible No More

We see thermoformed parts now that once would be impossible to thermoform – especially in roll-fed, thin gauge applications. Third motion tooling, improved materials and plug assist design has made severe draw ratio's common place in the packaging and drinking cup sector. The same principals can be used in heavy gauge, sheet-fed thermoforming to form large heavy parts.

Cincinnati Council Meetings Summary

➤ By Lola Carere, Councilor

TO: THE COUNCIL

This summary is intended to help you review the highlights of the Council Meetings held in Cincinnati on May 6, 2007.

ANTEC

Registration at ANTEC was 3,546 (including registrants in the seminars). A total of 148 registrants attended 16 Society seminars.

Incoming President Vicki Flaris's SPE mantra is: "No Borders." The full text of her speech is available on the SPE Councilor intranet site at: http://extranet.4spe.org/council/index.php?dir=May%202007%20COUNCIL%20.

HIGHLIGHTS FROM THE COUNCIL FLOOR

Executive Director Report & Staff Update

Executive Director Oderwald provided an overview of her perspective of the key points required for a successful SPE in the future.

1) Increased Revenue: Needs to grow through Core and New Development offerings.
2) Member Value: Critical for success. This is a changing metric and the Society needs to be keeping in step with members.
3) Excellence in Staff: As volunteerism declines, SPE staff needs to be able to step up and fill in any gaps.
4) Excellence in Operations: Delivery of services is critical. SPE needs to keep up with the ever-changing communications technology.

Financial Update

Treasurer John Szymankiewicz provided an update summarizing the 2006 year-end audit as well as results so far for 2007. A key point is that 2007 income is behind expectation. On the positive side, ANTEC has already met budgeted income expectation.

SPE Foundation Update

Gail Bristol reported on the financial health of the Foundation. The total amount of scholarship funds distributed this year will be about $95,000.

SPE ONLINE ENCYCLOPEDIA

Tom Conklin updated Council on the progress in the development of the Online Plastics Encyclopedia. During his presentation he provided a guided tour of the beta site and highlights for each page. The link to the test homepage is: www.4spe.org/encyclopedia/index_test.php.

SPE MEMBERSHIP SURVEY

Tobi Gebauer, SPE staff, and Andrea Pellegrino of Maia Marketing presented the results of a Membership marketing survey, which was emailed to all SPE members with email addresses (17,278 members); 3,871 responded. The purpose of the survey was to better understand what members value, how they see SPE, where the Society is going, what they are looking to gain most from their SPE membership and why they remain SPE members. The information will be used to benchmark key membership drivers and serve as the databased foundation for needs evaluation and subsequent research efforts. SPE leaders can read the survey report on the extranet: <http:/extranet.4spe.org/council/index.php>.

COMMITTEE REPORTS

Sections: Roger Corneliussen summarized some of the highlights from the 2006-07 Sections Committee meeting. These included sharing of success stories, discussion and actions relating to the reorganization task force, as well as Sections' finances.

- The Composites Europe Special Interest Group petition was approved by Council
- The Extrusion Europe Special Interest Group petition was approved by Council
- The Rio Grande Section was abandoned by Council
- The Hudson-Mohawk Section was abandoned by Council
- The TN-VA-Holston Valley Section was abandoned by Council

(continued on next page)

(continued from previous page)

- The Kentuckiana Section was made provisional by Council

Divisions: William Arendt reviewed the activities of the Divisions Committee. These include the approval of two new SIGs, Extrusion Europe, and Composites Europe, the discussion of several additional technical areas for new SIGs, Nanocomposites, Biopolymers, and Building and Construction.

International: John Ratzlaff provided an overview of the current status of the International Sections and Divisions activities and an update on International Committee objectives.

ANTEC Operating: Sal Monte updated the status of the ANTEC Operating Committee meeting, including an update on ANTEC 2007, the WRITE NOW document, and future site selection. He noted that there were more technical presentations at ANTEC 2007 than at ANTEC 2006.

NEW CHARTERS

A Student Chapter was established at Humber College in Toronto, Canada.

AWARDS & RECOGNITIONS

In addition to the recognition of the retiring administration, the Michael Cappelletti Excellence Award was given to Ken Braney. The James Toner Service Excellence Award was awarded to SPE staff member Tricia McKnight.

Outgoing President Tim Womer thanked his Executive Committee for their hard work. Incoming President Vicki Flaris introduced her Executive Committee. New Executive Committee Vice Presidents are: Vijay Boolani from India Section; Vassilios Galiatsatos from the Polymer Analysis Division; and James Griffing from the Composites Division. Russell Broome is the 2007-2008 Secretary and Ken Braney is the 2007-2008 Treasurer.

CONTRIBUTIONS AND DONATIONS

It is with grateful appreciation that the Society acknowledges the following contributions and donations by its Sections and Divisions:

a. Ken Kerouac, Mid-Michigan Section, presented $500 to the Foundation for the Robert Cramer Scholarship.

b. Tom Powers, Detroit Section, presented $2,500 to support the Annual Award for Education, $5,000 as the final payment on a $50,000 endowment for the Robert Dailey Scholarship, and $2,000 to support the 2007 Wonders of Plastics Essay Contest.

c. Amod Ogale, Electrical and Electronic Division, presented two rebate checks totaling $901.42 to the Foundation (they have been credited to the Match Your Members program).

d. Fred Steil, Mold Making and Mold Design, presented $2,500 toward the Student Activity Fund for Student Night at ANTEC. Mold Making and Mold Design also contributed $1,000 for the Student Travel fund for travel to and from ANTEC.

e. Don Witenhafer, EPS Division, presented a check of $2,500 to support the International Award.

f. Bill Diecks, South Texas Section, presented a check for $40,750.68 to SPE as proceeds from the 2007 Polyolefins Conference.

g. Nippani Rao, Automotive Division, presented a check of $2,500 to support the Annual Award for Education.

NEXT COUNCIL MEETING

The next meeting of the Council is scheduled for September 29, 2007 in Irvine, California.

PLEASE NOTE:

All presentations and updated reports mentioned in this summary are available via the following link: http://extranet.4spe.org/council/index.php?dir=May%202007%20COUNCIL%20.

From The Editor

Thermoforming Quarterly welcomes letters from its readers. All letters are subject to editing for clarity and space and must be signed. Send to: Mail Bag, Thermoforming Quarterly, P. O. Box 471, Lindale, Georgia 30147-1027, fax 706/295-4276 or e-mail to: gmathis224@aol.com.

These sponsors enable us to publish
THERMOFORMING QUARTERLY

These sponsors enable us to publish THERMOFORMING QUARTERLY

MARK YOUR CALENDAR!

2007 THERMOFORMING CONFERENCE
September 16th - 19th, 2007
Duke Energy Center & Millennium Hotel
Cincinnati, Ohio

CINCINNATI 2007
ThermoForming
"ADAPTING TO FORM THE FUTURE"

THERMOFORMERS, HAVE YOU DISCOVERED A FORMING TIP THAT YOU ARE WILLING TO SHARE WITH YOUR FELLOW FORMERS?

A TIME SAVER?

OR A COST SAVER?

OR SOMETHING THAT WILL SAVE WEAR AND TEAR ON YOUR MACHINE?

OR YOUR EMPLOYEES?

THEN THE

Forming TIPS

COLUMN IS FOR YOU!

Just email Barry Shepherd at bshep@shepherd.ca outlining your tip in two hundred words or less. You may include drawings, sketches, etc.

6th European Thermoforming Conference 2008 in Berlin

The Society of Plastics Engineers - European Thermoforming Division invites you to the 6th European Thermoforming Conference to be held in Berlin from 03 to 05 April 2008 at Maritim Hotel Berlin.

The conference agenda will include, as in previous conferences, presentations from experts in the thermoforming industry and lively debates in workshops about technical and commercial innovations. Moreover, the event provides the unique opportunity to meet colleagues and customers from the industry around the world. More details are available soon at www.e-t-d.org.

EUROPEAN THERMOFORMING PARTS COMPETITION

Again on the occasion of this next ETD conference, thermoformers are invited to participate in the European Thermoforming Parts Competition. Originality, creativity, mould complexity and technical ability will be the judging criteria in order to promote advanced design and developments from a structural innovation perspective.

Entries with thick gauge parts will be possible in the categories Vehicle/ Automotive, Industrial and Point of Purchase/Displays. Thin gauge parts will be judged in the categories Food Applications, Medical Applications and General Packaging.

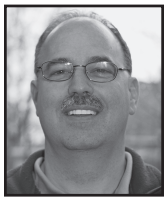
The conference is to be complimented by an informative and comprehensive exhibition (table top displays) of relevant latest product developments and services offered by a variety of leading suppliers to the thermoforming industry. This will also create a discussion platform for exhibitors and conference participants.

Social events enabling you and your accompanying partner to experience the dynamic, cosmopolitan and creative metropolis and gain memorable impressions of Berlin.

Come to Berlin ...
you'll be most welcome!

SOCIETY OF PLASTICS ENGINEERS EUROPE
EUROPEAN THERMOFORMING DIVISION
Eric Sasselaan 51 ~ BE-2020 Antwerpen ~ Belgium
Tel. +32 3 541 77 55 ~ Fax +32 3 541 84 25
spe.europe@skynet.be ~ www.e-t-d.org

MONDAY, SEPTEMBER 17, 2007
ROLL-FED MORNING SESSIONS



Frank Karai

ODC Tooling & Molds is a global supplier of thermoforming molds and trim tooling. Project experience supplying a wide range of thermoformers from small custom shops to large proprietary formers gives ODC unique insights into the demands facing thermofomers today. Frank is a graduate of the University of Waterloo (Economics) and is a third generation employee of ODC. He has worked for ODC for 22 years in a variety of capacities including quotations, plant operations and he is currently VP of Sales and Marketing. Frank is particularly interested in the effects, challenges and opportunities globalization has created for well established business such as ODC.

ABSTRACT: Title - *Speed Matters*. Increased competition, globalization and margin pressures are common challenges faced by every modern business. The solution to many of these issues is speed hence, "Speed Matters." In this presentation, Frank will present current opportunities being pursued by thermoformers in co-operation with their tooling vendors to address the need for speed. Faster solid model designs, speed to market of new products, rapid prototyping systems, quick change mold bases, third motion plug assist forming, pre-heaters, in-line extrusion/forming lines, automated part picking etc., are a small number of the topics to be presented as "speed" opportunities. This fast-paced presentation is intended to be thought-provoking and will provide a glimpse of the many opportunities available to thermoformers/tool vendors interested in remaining successful and competitive in today's demanding environment.

Hossam Metwally

Dr. Metwally has been working at Fluent Inc. since June 2001. He has been involved in multiple consulting projects using computer simulation in different areas of polymers processing including extrusion, thermoforming and blow molding. Before joining Fluent Inc., he attended the University of Cincinnati where he obtained his Ph.D. in mechanical engineering in the subject of compact heat exchanger for non-Newtonian liquids.

Dr. Metwally is a regular attendee and presenter at the ANTEC (Annual Technical Conference for polymer science and polymer processing sponsored by the Society of Plastics Engineers) and other polymer processing meetings. Dr. Metwally was awarded best paper award in the extrusion division at ANTEC 2006.

ABSTRACT: Title - *Numerical Modeling of Medical Tray Thermoforming, Sealing and Post Thermoforming Shrinkage*

Authors: H. M. Metwally, A. Dozolme, J. Kulkarni, and T. Marchal

The production of a sterile medical tray by thermoforming is considered in this work. To maintain the required shelf life, certain sealing properties have to be maintained. These translate to required thickness distribution of the tray material itself as well as a minimum thickness threshold for the sealant layer in the tray cover, which may be multi-layer.

In the current work, the use of numerical simulation is used to obtain the thickness distribution of the thermoformed tray. Two processes will be simulated: drape forming over a male mold and slip ring forming. The resulting final material distribution will be compared. Then, the analysis is extended to examine possible warpage/shrinkage of the tray in the post-thermoforming stage to ensure that the final dimensions of the cooled tray will allow the proper packaging of the medical instruments.

Finally, to examine the integrity of the three layer seal cover, a detailed analysis for the transient hot ironing process is carried out to examine the minimum thickness of the barrier (middle) layer around one of the tray corners.

Brian Golden

Brian began his career in the plastics industry beginning in 1983 as an electrical assembler at Packaging Industries in Hyannis, MA. He soon became a service technician and traveled worldwide for machine repairs, installations and operator training.

In 1989, Brian joined TMCI, an Italian based machinery manufacturer of form-fill-seal equipment focusing on the food industry. As the Service Manager for TMCI, Brian was directly responsible for the installation and support of all equipment in the USA.

In 1993, Brian joined Crystal Thermoplastics, a custom thermoformer in Cumberland, RI as the Manufacturing Manager. The focus quickly turned from customer support to machine maintenance and operational efficiency. Utilizing machines from several suppliers such as Sencorp, Lyle and Brown, he implemented quick change tool hardware and other practices that reduced changeover time by 50%.

Crystal decided to expand operations by entering into a partnership with a company in Puerto Rico to produce thermoformed parts for the medical Industry. Brian was responsible for relocation of several machines from RI to Puerto Rico as well as complete overhaul of remaining lines in RI. This increased overall capacity as well as enhancing product quality.

Brian returned to MA in 1997 as a Project Manager for the thermoforming division of Sencorp, Inc. He currently serves as Director of Customer Satisfaction responsible for all aftermarket activity. Recent innovations include the introduction of an industry-first Predictive Maintenance Inspection. This program entails a complete 175-point inspection measuring machine deficiencies against factory standards. This critical report allows the customer to identify areas of the machine that need immediate attention while also drawing attention to those areas that are within factory specifications. This can

(continued on next page)

(continued from previous page)

be used as an important management tool for capital budgets as well as determining machine value.

Brian lives in Cape Cod, MA with his wife and two children.

ABSTRACT: Title - *Maintaining Your Edge: The High Cost of Low Maintenance*. Does investing in machine maintenance really pay off? Should you adopt a "if it's not broke, don't fix it" mentality? Why invest time and money in machinery that seems to be continually producing? How do I get management to understand the need for preventive maintenance?

These are common questions that every facility faces from the CEO in the corner office to the mechanic lubricating the press. What is obvious to some may not be so clear to others. In this workshop we will discuss effective ways to communicate to different levels of personnel the need to adopt necessary maintenance programs to protect the company's assets that are producing shippable product. The focus will be on inline thermoformers including common areas that require periodic maintenance to help boost productivity, increase reliability and most importantly maintain safety. If your organization has recognized the need for a planned maintenance program but lacks the ability to implement one, this workshop will provide you with some of the necessary tools to help justify the expense and most importantly start out with achievable expectations.

Using real life examples of previously implemented inspection programs, we will discuss results that can be acknowledged by all levels, from quality control to the production manager. Understanding the current condition of your equipment and its market value is one of the first steps to consider when justifying the need for planned maintenance. If your machinery is aged and in desperate need of technological enhancements, spending dollars on a preventive maintenance program may not be a wise decision. We will explore using simple "rule of thumb" formulas that can help you make that critical decision to either retrofit your aged machine to increase performance, trade it in for a new one or sell the machine outright.

MONDAY, SEPTEMBER 17, 2007
ROLL-FED AFTERNOON SESSIONS

Jo Theunissen

Jo Theunissen is the Managing Director of PfP Consulting, an international consultancy for packaging professionals. A Belgian national, Jo has extensive global experience in extrusion and thermoforming. He has worked in the U.S., Europe and S.E. Asia and is fluent in five languages.

Jo began his career at ANL Plastics, one of Europe's premier custom thermoformers with locations in Belgium and France. Over a period of 20 years, ANL set the standard in thermoformed packaging for the chocolate and confectionary business in Europe. Throughout this time, Jo worked in various capacities including R&D, sales and marketing.
He was the sales manager for France and Germany before expanding the territory to include all of Northern & Central Europe.

In 2000, Jo became the Business Unit Manager for ANL Techniforms, a division created to serve the needs of the growing medical and electronics packaging sectors. During this period, Jo traveled frequently to work with suppliers, processors and end-users in

the U.S. and Asia. He developed and promoted engineered LDPE thermoformed parts for protective packaging in the semi-conductor and disk drive markets.

A member of the SPE Thermoforming Division for many years, Jo is also on the board of several industry groups and chambers of commerce in Limburg, Belgium. He has degrees in Latin, Economics & Mathematics.

ABSTRACT: Title - *Developments in Thermo-formable Bio-Materials*. The presentation will cover the following topics:

1. What is to be understood as being "biodegradable"
2. What is a biodegradable polymer vs. traditional polymers?
3. Eco-taxes and eco-tax related materials
   a. Ecolean
   b. Talc-filled materials
4. Corn- and starch-based: pros and cons
   a. PLA
   b. Plantic
   c. Biotec
5. Soja/soy-based materials
6. Cost comparison among the different materials
7. Wal-Mart scorecard

Markus Zlotosch

Markus Zlotosch is currently General Sales Manager for Kiefel Technologies, Inc. He started his career 16 years ago as a technical apprentice for a printing press manufacturer before joining Kiefel in 1997. He has held several positions at Kiefel, starting with technical service and now serving as the sales manager for North America. His many years working together with customers, engineering and development provide him with extensive knowledge of thermo-forming equipment and processes.

ABSTRACT: Title - Precision Cutting with Steel Rule for Packaging Applications. Steel rule cutting remains a challenge for many thermoformers. Machine, tool and material variables affect the quality of cutting, tool life and your overall cost of operation. This presentation identifies the variables and discuss solutions with the intention of improving your cutting process and delivering predictable results. Kiefel has extensively studied tool and material influence on cutting force, looking at variables such as knife and striker temperature, knife wear, material thickness and composition. This data was used to improve our cutting press design and performance in order to achieve a consistent trim and long tool life time.

In this presentation we will look at the importance of machine factors such as table stiffness and parallelism in maintaining exact table control during the cutting process. The use of servo drives to control table positioning, use of tension rods to prevent uncontrolled table motion and the control of knife penetration will also be looked at in this presentation.

Noel J Tessier

Mr. Tessier is a Materials Engineer and has over 30 years of experience in the Research and Development of composite materials. He is one of the founding directors of CMT Materials, Inc (1998), the first company to be dedicated to thermoform tooling materials. He holds a Master of Science in Plastics Engineering from the University of Lowell and a Bachelor of Science in Chemical Engineering from Northeastern University. Mr. Tessier is responsible for the development of new materials for plug assist thermoforming at CMT Materials, Inc. Prior to CMT, he was employed with Quadrax

(continued on next page)

(continued from previous page)

Corporation having responsibilities for production, development and quality improvement for all thermoplastic matrix continuous fiber tape products. He has extensive experience in composite materials including syntactic foams, fiber reinforced materials and highly filled plastics having held research and development positions at WR Grace and the Army Materials & Mechanics Research Center.

ABSTRACT: Title - *Plug Materials Influence on Final Part Quality in Thermoforming Process – Plug In.* This co-operative research project is funded by the Commission of the European Communities Research Directorate-General under the Sixth Framework Program. This project brings together 2 thermoformers, 2 materials suppliers, 1 software developer and 2 research institutes. The common goal is the need to understand the influence of plug design in final part quality in the thermoforming process. This presentation will present the project and its objectives, work plans and expected outcomes.

When a new product is being developed, the process parameters and plug properties are determined through a mixture of trial and error and experience. These methods are highly inefficient, stifle innovation and reduce the overall competitiveness of thermoforming companies. The aim of the project will be to use a more scientific approach which will enable products to be manufactured with a faster time to market, optimal properties and with reduced material and energy costs. The work will gather the current knowledge base, use experimentation to understand the physical phenomena that govern the effects of the plug and observe the actual plug behavior and verify these results through extensive thermoforming trials.

The overall strategy of this proposal is to substantially improve the productivity and competitiveness of the vitally important, but largely underdeveloped, European thermoforming industry. Specifically the major strategic objectives are to:

1. Understand the friction and interaction behavior of a plug during the thermoforming process.

2. Encapsulate and distill the knowledge and expertise of the consortium, and blend this with the

results of the major scientific investigation to create a powerful user-friendly software tool.

3. Develop test methods and procedures for the measurement of the frictional and heat transfer of plug and sheet materials.

4. Increase the use of simulation software in the industry through demonstrative improvements in the predictive capabilities of the software.

5. Enable manufacturers to gain better understanding and control over their process allowing them to produce products of uniform wall thickness and with a 5% reduction in weight.

6. Reduce energy costs and cycle times due to weight reductions in parts.

7. Reduce new product lead times by 25% by the end of the project.

8. Create a web-based interface that will disseminate the results of the program to the wider thermoforming community.

TUESDAY, SEPTEMBER 18, 2007
ROLL-FED MORNING SESSIONS

Nick Mebberson

Nick is a mechanical engineer with 20 years in plastics. For the last 17 years he has been the Managing Director of Scope Machinery (Australia).

Scope specializes in roll fed, cut in place pressure forming machines. These include both contact and radiant heat machines.

Nick's function at Scope is very hands-on with design (of machines, tooling, automation, commissioning / training and troubleshooting) as well as worldwide sales.

Nick is the inventor of the "Automatic Foil" which is a revolutionary air- and time-saving invention for contact heat machines.

He is married with three children his pastimes include flying, sailing and mountain biking.

ABSTRACT: Title - *Contact Heat Pressure Forming for Thin-Walled Parts*. The contact heat method is ideal for the thermoforming of shallow trays such as biscuits, chocolates and bakery items as well as a huge variety of other thin walled packaging.

The process is suited for a range of materials up to (generally) 0.030"/ 0.75mm.

This presentation covers topics from basic theories to advanced concepts and is intended to give the delegates a good understanding of the process.

Topics include:

- How does contact heat pressure forming work?
- A brief history
- Applications, allowable part dimensions and configuration
- Advantages and limitations
- Materials, settings, hints and applications
- Economics: scrap rates, cycle times, tooling costs, machine costs
- Where contact heat fits in with other thermoforming processes
- Advanced concepts in tooling, process tricks, undercuts and ejection
- Mold types and options
- Equipment options and availability
- Machine features, various configurations
- Stacking and automation
- Troubleshooting and hints
- Future directions

Sven Engelmann

Sven Engelmann, Dipl. – Ing. (FH) born: 1972. Studied Polymer Technology at University of Applied Sciences of Aalen, Germany

Diploma Thesis: Thermoforming of Reinforced Thermoplastics

From 2000-2004 he worked for the thermoforming machine manufacturer Illig (Heilbronn, Germany) in the Development Department responsible for Application Technology and Polymer Materials.

Since 2004 he has been Managing Director of Polymer Technology at Schubert, producer of packaging machines. Sven is in charge of the development of Schubert's new thermoforming branch.

He is a lecturer for "Basics of Thermoforming" at University of Stuttgart, Germany and also the author of several articles concerning thermoforming.

ABSTRACT: Title - *New Technologies for Robotic Pick and Place in Thermoforming*. Schubert is a producer of packaging machines and plays a major role when it comes to pick and place robots (F44). Some of these pick and place robots are linked with thermoforming, filling and sealing machines.

In the past, when Schubert picker lines were interlinked inline with thermoforming and sealing stations, these combinations never permitted the F44 robots to develop their full efficiency potential. The intermittent operating cycle of the thermoforming unit and the sealing station prevented the packaging film web and the trays formed into it from running continuously.

The inline link-up of machine components for forming, filling and sealing applications from different manufacturers is bound to result in the creation of interfaces. These interfaces can in some cases represent a substantial hurdle for the planning, design, commissioning, operation and servicing of the overall plant. A cohesive, standardized system can offer substantial simplification for the user with all the associated benefits.
It means that the machine operator only has to communicate with one contact partner and the responsible electrical engineers enjoy the benefit of a systematic approach to the complete line.

The newly developed thermoforming machine works with running and repeating form and sealing/punching modules. The reciprocating modules facilitate continuous running of the packaging film and thus the efficiency of the picker line increases.

Continuous running of the film web is not the only remarkable feature of the machine. Sealing and punching take place using the ultrasound technique. The sealing station is used at the same time as a punching station.

Steve Sclimenti

Steve Sclimenti is the owner/operator of Pro-Tek Vacuum Form Mold in Upland, CA. For almost 30 years, Steve has worked a machinist, engine builder and tool maker for several industries in the greater Los Angeles region.

Steve began his career as a race engine tuner for Weber Carburetor where he tuned engines for the likes of Rick Mears, Ivan Stewart and Shelby American. He moved into the plastics industry as a die cast mold maker for injection molding. During this period, Steve designed and built molds for many industries including automotive (turbo wash), medical/dental and consumer goods.

(continued on next page)

(continued from previous page)

In 1986, Steve joined House of Packaging in the mold making division. It was here that Steve worked on many different aspects of thermoform tooling and package design: pattern making, prototype molds, production tools, plug assist tooling, striker plates and master tooling for inline machines.

Steve opened his own business in 1999 when he established Pro-Tek Vacuum Form Mold. Pro-Tek is known as a premier mold making company and CNC job shop. They offer a broad array of services for the thermoforming industry including design and build of prototype molds, production forming molds, matched metal trim dies, RF sealing dies, steel-rule dies, striker plates and master tooling for Sencorp, Brown, Lyle, Irwin and others.

ABSTRACT: Title - *Good Tools Aren't Cheap and Cheap Tools Aren't Good*! The difference between a good tool and a cheap tool is one that is built with detail in mind. Most cheap tools are made without care taken to details. A good tool will generally cost 20-30% more than a cheap tool. But if you look at the production bottom line, and I emphasize production bottom line, a good tool at a 30% premium will more than pay for itself in a short time. A cheap tool will eventually cost more due to the fact that it will have to be modified in some way. Generally the product doesn't fit correctly, snaps are not in the right place or don't work correctly, the tool runs hot and so on.

So, when you consider the loss of production time, machine down time, shipping to and from the tool maker, employees standing around waiting, upsetting your customer, etc. it becomes clear that when you add up all of these elements, it will certainly cost more than the 30% higher cost of a good tool!

TUESDAY, SEPTEMBER 18, 2007 ROLL-FED AFTERNOON SESSIONS

Mark Strachan

ABSTRACT: Title - *Conditions for Optimal Thermoforming*. The thermoforming process has many variables including material, machinery and tooling. Problems with one can lead to problems with another. The goal for processors is to establish control over these variables, reduce errors and ultimately produce quality products with little or no rejects.

In addition, there are also some known elements that are common to the process. Many of these elements are considered "givens" and therefore don't always receive the necessary attention they deserve when it comes to optimal thermoforming conditions.

During my in-plant visits in many companies and countries around the world over approximately 18 years, I have noticed that poor final product quality and excessive downtime is a direct result of the following:

- Services supplied to the thermoforming machinery such as compressed air, cooling water and vacuum
- Environmental conditions – location of machinery, ambient temperature and humidity
- The quality of the plastic roll stock
- Poor tooling design and maintenance
- Poorly maintained machinery

In this presentation, I will address these concerns and discuss how to identify, qualify and rectify negative consequences associated with such causes.

Timothy H. Bohrer

Tim Bohrer earned BS and MS degrees in Chemical Engineering from Michigan Tech and Purdue, respectively. He began a 30 year career in flexible and rigid packaging structures of plastic, paper and composites with American Can Company at their Neenah, WI packaging R&D center. He was given increased leadership opportunities, becoming VP Technology for James River's $2 billion packaging business in the early 90's, where he built, equipped and staffed a major packaging research facility. He also served as VP Product Development and Technology for Ivex Packaging from 2000 through their sale to Alcoa in late 2002. He started his consulting practice, Pac Advantage Consulting, LLC in early 2003 and helps clients build sustainable packaging advantages by providing his skill and insights to companies ranging from raw material suppliers through package users.

In addition to his industrial R&D responsibility, Tim has led functional groups in Marketing and Business Development, Intellectual Property, and Quality and Environmental Engineering and Compliance; he led the acquisition of a specialty packaging entity and then assumed P&L responsibility for its rejuvenation and growth. He serves on the Advisory Board for Clemson's Packaging Science Department and is a past Trustee of a State of Ohio Technology Transfer Institute.

ABSTRACT: Title - *Superior Sheet Consistency Leads to Superior Thermoforming and Part Performance*. Thermoformers know intuitively that many of the difficulties they experience running their hardware and shortcomings their customers may experience in formed part quality relate to sheet inadequacies. Where gross sheet deficiencies are the cause, problem solving efforts often identify specific sheet quality issues. Less obvious, but more prevalent, is forming inefficiency resulting from sheet inconsistency, "normal" variation in sheet properties, and roll configuration and other workmanship defects.

Formers cope with this variation in a variety of ways, including over-designing parts to ensure minimum wall thickness and part performance, slowing down thermoforming equipment to minimize poorly formed parts, and accepting the waste and spoilage levels that historically have been "standard" for the industry.

A new APET sheet is available which represents a significant improvement in consistency and which is resulting in improved forming performance and greater yield of good parts per pound of sheet. From raw material and equipment selection through operating process control, production of this sheet has been designed to optimize performance for the thermoformer, and thus, the end user. This presentation will provide data showing this new level of consistency and examples of the improvements that have been realized by thermoforming operations using this new sheet.

Paul D. Tatarka

Paul D. Tatarka is in Market Development for TOPAS® Advanced Polymers, Inc., based in Florence, Kentucky. In this role, he is responsible for promoting TOPAS® cyclic olefin copolymers in flexible packaging applications. In his 20-year career in the polymer material and packaging industries, he has developed and commercialized graft copolymeric materials, food and medical packaging

films. He holds nine US patents covering impact modified propylene graft copolymers; biodegradable starch ester thermoplastics and puncture resistant heat shrinkable meat packaging films. He holds a Master of Science in Plastics Engineering and Bachelor of Science in Chemical Engineering, both from the University of Lowell and MBA from Farleigh Dickinson University.

ABSTRACT: Title - *Improved Properties and Cost Efficiencies of Cyclic Olefin Copolymer Enhanced Forming Films*. Cyclic olefin copolymers (COC) can provide film producers and packaging converters with an opportunity to create new forming films or to modify existing ones. COCs are amorphous thermoplastics with excellent moisture barrier, glass-like optical properties, high temperature stability and stiffness. Mono- and multi-layer examples of LLDPE-based forming films, compared against commercially available ones, clearly demonstrate how well the addition of COC improves physical properties, thermoforming and package performance, all at lower material cost. COC significantly improves material distribution of LLDPE in formed trays. These improvements enable the formed trays to withstand higher crushing force. Enhanced performance permits possible down gauging and this can further reduce material costs.

MONDAY, SEPTEMBER 17, 2007 CUT-SHEET MORNING SESSIONS

Charles Buehler

Charles Buehler is a Technical Integration Engineer (TIE) at General Motors Corporation with more than 20 years of experience in thermoplastics, polymerization, compounding and applications to the vehicle. He is the author of several publications and patents in the area of thermoplastics. He holds a BS in Chemistry from Elmhurst College in Elmhurst, Illinois and an MBA from Illinois Benedictine College in Lisle, Illinois.

ABSTRACT: Title - *A Client's Perspective: What Do We Expect From You the Thermoformer?* General Motors Corporation (GM) is still actively engaged in the development and implementation of thermoforming automotive class "A" parts onto its vehicles. Currently, we have a number of part types in production amounting to multiple 100,000 individual parts being sourced into GM.

As we continue to identify new applications, part types, and subsequent sourcing of the business, GM, and the automotive industry will need more thermoformers qualified to step up to meet the demand. In this paper we would like to provide some basic information, on what you the thermo former could expect from an OEM. This information would include:

- The process to become a supplier.
- How you get the business?
- What is needed to support the business?
- What certification systems would be needed?
- Support after launch?

And, finally, we would like to share some future opportunity.

Mat Cappel

Mat has a background in Mechanical Engineering Technology from University of Cincinnati as well as in Elementary Education at the College of Mount St. Joseph in Cincinnati. He started working with Berding Surveying as one of the first employees in 1993 and worked his way to a lead project management position as the company grew to over 20 employees by 2000. In 2001 Berding Surveying purchased their first long-range 3D laser scanner for capturing buildings and bridges. By late 2003 Berding Surveying announced the launch of its new sister company Berding 3D Scanning. At this time Mat was charged with heading the new company up and leading it to success by finding employees and new markets to service. Since this Time Berding 3D Scanning has purchased 3 new scanners and physically relocated it's operations to a new office in the Cincinnati area and growing faster than ever.

ABSTRACT: Title - *The Scanning Advantage*. Laser Scanning has evolved much in accuracy, availability and affordability. With the employment of 3D scanning techniques, vacuum formed part, molds and prototypes can be analyzed in great detail. Molds and first run parts can be verified to be made to specs. Prototypes can be scanned and modeled to a solid or surface for verification reverse engineering and rapid prototyping. Software can be used to compare and generate detailed graphical reports of a 3D design model versus the scan of actual component.

The digitizing, capture and modeling procedure can play a crucial roll in the thermal forming process. First, a part is scanned to a point cloud from multiple positions (depending on the complexity of the part). Next, the point clouds are registered together and extraneous data is filtered out. The point cloud can then be modeled or surfaced to create a CAD object or even compared to an existing CAD model. This can be used for archiving, validating, rapid prototyping, initial inspection or aiding the construction process.

3D Laser Scanning is quickly becoming an invaluable tool for the mold making industry. Scanning or digitizing a part or mold can be an important time and money saving step for initial CAD-CAM design and alteration of prototype parts, validation of first run or actual mold even rapid prototyping and qualification. With current technology advancements for software and scanners, the process has become more affordable, accurate and readily available.

The presentation will include a slide display introducing the technology, an overview of the process and several examples of actual cost savings and implementations of the process. There will be time for questions and open floor discussion.

The presentation will be specifically tailored to the vacuum forming industry. Specific case studies and vacuum forming examples will be provided. We hope that all audiences will be able to gain awareness of benefits associated with the use of scanners and 3D digitizing equipment. The audience will be made aware of the many different applications and situations for scanning including inspection of parts and validation of molds and first run.

Peter M. Byra

With 40 years of experience in the Plastics Industry, I serve as Business Manager of the Korad Acrylic Film Business for Spartech Corporation located in Newark, New Jersey. For the past 18 years, I have been

(continued on next page)

(continued from previous page)

involved in the Design and Manufacture of Acrylic Compounds and Films for the Heavy Gauge Cut Sheet Industry.

My affiliations include the following: Uniroyal Chemical, United States Steel Chemicals, Wilson Color Company, M.A. Hanna Color, Polymer Extruded Products Inc., and Spartech Corporation.

ABSTRACT: Title - *Acrylic Film's Place in the Cut Sheet Thermoforming Market*. One of the most effective methods of protecting and decorating heavy gauge thermoformed cut sheet is to use a clear, pigmented or printed acrylic film as the surface of the sheet. This presentation will discuss acrylic films, their chemistry, manufacturing processes, as well as their protective and decorative characteristics.

MONDAY, SEPTEMBER 17, 2007 CUT-SHEET AFTERNOON SESSIONS

Kedzie Fernholz

Kedzie Fernholz is a Research Engineer in Materials Research and Advanced Engineering at Ford Motor Company. Her primary responsibilities are identifying opportunities for cost effective implementation of film laminates and validation of advanced plastic joining techniques. Her areas of research include the relationship between process conditions and part appearance, thermoforming process robustness, and development of appearance metrics. Ms. Fernholz received her received her B.S. in Aerospace Engineering from the University of Illinois at Urbana-Champaign and her M.S. in Materials Science and Engineering from Virginia Polytechnic Institute and State University. She currently serves as the Joining Working Group Chair in the Automotive Composites Consortium, part of USCAR.

ABSTRACT: Title - *Impact of Cooling Method and Incoming Sheet Quality on Final Part Surface Quality in Thick Sheet Paint Film Thermoformed Parts*

Authors: Kedzie Fernholz, Rick Wykoff, Brandon Papazian, Stan Staniszewski, Materials Research and Advanced Engineering, Ford Motor Company

Thick sheet, paint film parts were thermoformed using different cooling methods to determine whether the cooling method used when forming parts had a direct effect on the surface quality of the part. In the first experiment, the effect of cooling type on surface appearance was evaluated. Parts were formed using no external cooling, high flow rate fans, and two different "pressure boxes." In this experiment, pressure boxes were supplied with air from an air conditioner. The incoming air was approximately 50°F. One of these "pressure boxes" was built with standard pressure fittings. The second box was a design developed by Ford Materials Research and Advanced Engineering (R&A). This experiment was a full factorial experiment with three replicates. Parts were formed using a top sheet temperature of 310°F, 315°F, 320°F, 325°F, and 330°F.

Subsequent confirmation experiments were completed. In the first, parts were formed using the Ford R&A-designed pressure box. The sheet top temperature was 320°F. Five replicates were formed with "plant air" and five were formed using 12°F air supplied from outside in February. In the second, parts were again formed using the Ford R&A-designed pressure box and a sheet top temperature of 320°F, but various parts of the "pressure box" cooling system were turned on and off. In the third, cooling was provided by high flow rate fans pointed either directly at the part or at the window plate clamp frame.

While claims have been made that applying chilled air after forming "dry paint" film parts improves the gloss of the parts, the data from this study showed that application of chilled air did not have an effect on either initial gloss or on time-dependent hazing. The critical factor in maintaining surface quality in these parts was the maximum temperature reached by the "dry paint" film during heating.

Analysis comparing the data taken prior to forming the sheet with that after forming demonstrated the critical importance of incoming sheet quality to the surface quality of the formed part. A difference of as little as four points on the Wavescan W_b scale on the incoming sheet can result in a 20-point difference after forming. Furthermore, a difference of as little as one point on this scale prior to forming can result in a four to six point difference after forming. While a four to six point difference in W_b score is not necessarily visible, this change was large enough to confound conclusions from the process optimization trials. Consequently, validating the consistency of the incoming sheet surface appearance is a critical step in conducting meaningful process vs. appearance experiments.

Paul Schuch

Paul Schuch is Routing Systems Sales Manager at KMT Robotic Solutions, Inc. (formerly Robotic Production Technology, Inc.). KMT Robotic Solutions, Inc., based in Auburn Hills, Michigan, is a turnkey robotic systems supplier for plastics, appliance, automotive, aerospace, bath/shower, consumer goods, and marine industries. Since 1985 KMT Robotic Solutions has been a leading manufacturer of flexible manufacturing systems utilizing five and six axis robots, with an installed base of over 2,500 units. Paul has more than 20 years of experience working with automation in the plastics industry. He has held positions ranging from installation/field service to Product Management for CNC automation companies. In his current position he is responsible for robotic router trimming systems sales for KMT Robotic Solutions in the Americas.

ABSTRACT: Title - *Robotic Trimming and Technology Helps Thermoformers Improve Quality and Save Time and Money*. Thermoformers using flexible router trimming systems gain a competitive advantage by meeting the demands of their customers for higher quality and productivity.

This multi-media presentation will incorporate the benefits of using robotic automation in thermoforming applications and showcase real world case studies of companies implementing and using the systems. Specific case study examples will be shared to show how manufacturers are benefiting from the use of flexible trimming robotic methods to help increase production, save money and improve quality of the end product.

By automating these processes, thermoformers lower the cost of their labor-intensive operation and improve the working environment for their employees. Manufacturers benefit from improved quality of their parts by reducing the reject rate and making the

trimming more repeatable and consistent. In addition, manufacturers see increased throughput due to the automation of the process.

Session participants will learn about the benefits of implementing this technology. In addition, information will be shared about key software technologies and improved hardware that were recently introduced to make automated trimming of plastics precise and accurate.

Eric Short

Eric Short is the Global Manager of the Thermoforming Business Unit at Solvay Engineered Polymers, Inc. The company is the leading supplier of custom-designed thermoplastic polyolefin materials to the North American automotive industry. Short began his association with the company while he was an undergraduate at GMI (now Kettering University). After receiving his degree, Short joined the company, then known as D&S Plastics International.

Short has had responsibilities for the marketing and development for most of the company's portfolio of engineered polyolefins. When the extrusion and thermoforming products were organized as a specific initiative in 1996, Short began to concentrate on these specialized materials. He has headed the Thermoforming Business Unit since its inception in 2002. In 2006, Eric was named Manager of the company's Thermoplastic Elastomers Business Unit as well.

In addition to his bachelor's degree in mechanical engineering, Short holds an MBA from Oakland University.

ABSTRACT: Title - *In-Line Extrusion Bonding of Acrylic Films to TPO*. This presentation will introduce a new, extrudable tie layer material that allows the in-line extrusion bonding of acrylic films to TPO. This technology will marry the desirable surface performance of industry-proven amorphous films with the impact toughness of TPO without the need of offline lamination. Topics reviewed will be the physical properties of the three layer system including impact, weathering, and adhesion along with the necessary extrusion & thermoforming parameters for success.

TUESDAY, SEPTEMBER 18, 2007 CUT-SHEET MORNING SESSIONS

Steve Kerber

Born in Rock Falls, Illinois and having been raised in the shop (his father was a tool & die maker), Steve had an interest in tooling and machinery from a very young age. Introduced to cryogenics in the spring of 1985, there was a great deal of misunderstanding to the possibilities and the theory of cryogenics. Being constantly reminded that "tooling just wasn't lasting" by his father, Steve began testing the cryo process.

Steve was a Process Engineer and Mechanical Engineer with employers such as Wahl Clipper and Northwestern Steel & Wire. There were several possibilities to enhance tooling performance everywhere he went. In the spring of 1997 Steve received his Associates Degree in Electronics Engineering and went to work for Motorola. During this time there were always applications that would benefit from cryogenic processing and Steve began testing on some of these operations. The results were very encouraging. In the fall of 2004 Results Cryo was born in Sterling, Illinois. Since that time Steve has been able to "specialize" processes for many different types of tooling. Testing continues to this day, "I'm constantly striving for continued improvement of my processes."

ABSTRACT: Title - *Frozen Tooling Performance – Cryogenics, Not Just for NASA Anymore*. This seminar will include the science of Cryogenics and what actually happens during this process and how long it takes. You will gain a complete understanding of what takes place in the structure of metals and why longer lasting, better cutting tools are the result. We will show the advances made in Cryogenics during the last several years and how Results Cryo performs this process to get the most out of your tooling dollar; the why, how and what of Cryogenics. We will also discuss the several different types of applications that benefit from cryogenics. The Thermoforming industry has seen huge benefits from our specialized cryogenic processing. We are constantly striving for continued improvement of our processes and your tooling results.

TUESDAY, SEPTEMBER 18, 2007 CUT-SHEET AFTERNOON SESSIONS

Christopher D. Willis

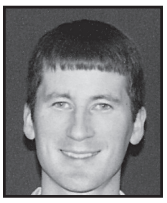
Chris Willis is the Global Director of Sales and Marketing for the Non-Automotive team at Azdel, Inc. He has worked in the plastics industry for 27 years, and has been with Azdel, Inc. since January 2007. Prior to coming to Azdel, he was with GE Plastics for Seven years, during which time he led market, product and application development for thermoplastic extruded sheet materials in large thermoforming applications. In his role at Azdel he has focused on driving growth in Non-Automotive markets by educating customers about the unique benefits of Azdel's product technologies, examples of these markets include Recreational Vehicles, Aircraft, Agriculture and Heavy Truck.

Chris holds a BS in Business from the Massachusetts College of Liberal Arts, is known for creating new markets for thermoplastics composites and has been recognized by the plastics industry for developing large parts for extrusion and thermoforming applications.

Rick Hemstreet

Rick Hemstreet is the Application Development Specialist for the Non-Automotive team at Azdel, Inc. He has worked in the composites industry for 7 years, and has been with Azdel, Inc. for 5 years. In his role at Azdel he has been instrumental in identifying new business opportunities, driving customer awareness and promoting the unique benefits of Azdel's product technologies for Non-Automotive markets. Examples of these markets include Recreational Vehicles, Agriculture and Heavy Truck.

Rick holds a BS in Industrial Design from Michigan State University. He is known for introducing thermoplastic composites to the recreational vehicle market.



Brian Hynes

Brian Hynes is the GMT Application Development Engineer for the Non-Automotive

(continued on next page)

(continued from previous page)

team at Azdel, Inc. He has worked in the composites industry for 11 years, and has been with Azdel, Inc. since November 2002. Prior to coming to Azdel, he was with Corning, Inc. for six years, during which time he held leadership roles in Engineering, Quality, and Operations. In his role at Azdel he has focused on driving growth in the GMT segment of Non-Automotive markets by educating customers about the unique benefits of the Azdel's product technologies. Examples of these markets include Recreational Vehicles, Agriculture, and Heavy Truck.

Brian holds a MS from the School of Chemical Engineering Practice at the Massachusetts Institute of Technology and a BE in Chemical Engineering from the Stevens Institute of Technology. He is known for solving challenging technical problems.

ABSTRACT: Title - *Azdel, Inc.'s Thermoplastic Composite Technologies*. The subject matter on our presentation will focus on Azdel's SuperLite* and GMT (Glass Mat Thermoplastic) thermoplastic composite sheet technologies, relating to these product's design space, applications, processing and assembly considerations. Azdel's product technologies have supported Automotive applications for over 30 years. Most notably Azdel's GMT used for Bumper Beams and SuperLite* for Headliners. However, Azdel's presence in Non-Automotive Markets has been somewhat limited until 2007. The focus of the presentation will highlight Azdel's technologies for Non-Automotive markets and introduce the thermoforming community to new materials to consider for a broad range of customer applications.

Giles Gaskell

A graduate in Mechanical Engineering from Aston University in Birmingham, England, Giles Gaskell has been working in the field of Reverse Engineering and Design re-use since 1993.

Having worked for PTC amongst other design software vendors, he was involved in the formation of Professional Engineering Support Services Ltd and 3D Scanners UK Ltd in England and 3D Scanners Italia Srl. in Italy dedicated to the provision of non-contact reverse engineering hardware, software and expertise. In that time Giles has worked with many of Europe's most prestigious design, engineering and manufacturing companies on reverse engineering and non-contact projects.

In 2004 Giles joined NVision Inc, North America's leading company in these fields as Director of Business Development and is particularly active in the dissemination of good practice developed in the Automotive and Aerospace industries into wider industrial markets.

ABSTRACT: Title - *Reverse Engineering – Much More Than Copying*. The tools to speed up the design to manufacturing process are well developed and adopted. However, in cases where products are to be designed to be manufactured by different processes and in different materials these tools alone are not enough to maximize fully the design to manufacture productivity gains possible with today's technology.

In the real world the total process of new product development involves the incorporation of existing design data, bought-in parts, legacy components and design improvements.

The tools to enable design information to be routed back up the process from physical items to CAD are not nearly so well developed understood or adopted.

Without the means of feeding information back up the process from physical parts to CAD, the full potential of modern design systems for rapid product development cannot be realized.

The tools that enable this process are Reverse Engineering tools and it is a mistake to think that the purpose of these tools is simply to copy existing designs.

Robert L. Browning

Robert Browning, of Atlanta, Georgia, has 25 years experience in the design and engineering of single sheet, twin-sheet, and pressure thermoformed products, tooling and processes. During this time he has had the opportunity to develop, refine and patent new processes in thermoforming, and in the design of thermoforming tooling. For fifteen years, he was with one of the largest twin-sheet thermoforming companies in the U.S., as Director of Research, Development and Engineering. Currently, an Associate/Partner consultant with the McConnell Co. Inc., Robert has also had his own consulting firm, Isosceles, Inc., since 1984. With degrees in Business Management and Industrial Design, he has successfully worked with companies such as BMW, Ford, Honda, Boeing, and John Deere, to define problems, develop alternatives, and implement solutions. At the present, he is an active member of the Industrial Design Society of America and is a Senior Member of the Society of Plastic Engineers.

Brett Jarriel

Brett Jarriel is an industrial design consultant based in Aiken, SC. After graduating from Georgia Tech in 1982, Brett joined Jan Lorenc Design in Atlanta, GA. With JLD, he helped design many highly successful signage programs, including the award winning Wildwood Office Park. In 1985, he joined Diversified Products in Opelika, AL, then the world's largest manufacturer of consumer fitness equipment. Within DP's 85 member R&D department, Brett developed numerous rowers, treadmills, exercise bikes, skiers, basketball backboard systems & free weight strength equipment. In 1994, Brett left DP to found The Design Source, an industrial design consulting firm focusing on consumer products. Since then, he has developed a long list of satisfied clients, including Reebok, Roadmaster, American Yard Products, PolyPortables, Ducane, Char-Broil & Aqualair. Brett's inventions have resulted in twelve design & utility patents to date. His goal is to deliver the highest level of design to each client on a uniquely personal level.

ABSTRACT: Title - *From Concept to Production – Thermoforming Case Study – "What it takes to make it work."* According to Wikipedia, the relationship between design and production is one of planning and executing. In theory, the plan should anticipate and compensate for potential problems in the execution process. Design involves problem-solving and creativity. In contrast, production involves a routine or pre-planned

process. Design and production are intertwined in many creative professional careers, meaning problem-solving is part of execution and the reverse. This is not to say that production never involves problem-solving or creativity, nor design always involves creativity. Designs are rarely perfect and are sometimes repetitive. The imperfection of a design may task a production position with utilizing creativity or problem-solving skills to compensate for what was overlooked in the design process. Robert Browning (the McConnell Company) and Brett Jarriel (The Design Source) will co-present an indepth case study of a successful thermoforming project - "The Development of Two Thermoformed, High End Personal Steam/Sauna Spas". Starting with the initial verbal concepts and napkin sketches, the complete design and engineering process is laid out in detail. Every step along the way, including the pitfalls, is highlighted as the two spa systems are simultaneously developed for a major trade show introduction. Using a diverse development team (industrial design, engineering, spa design/manufacturing, thermoforming, manufacturing and materials suppliers), each spa system is successfully prototyped within the extremely tight time frame. This is a unique opportunity to see first hand how the design process, creativity, problem solving and the thermoforming process can work hand-in-hand to create successful products.

SUNDAY, SEPTEMBER 16, 2007 CUT-SHEET WORKSHOP

William K. "Bill" McConnell

William K. "Bill" McConnell is president of McConnell Co., Inc., consultants to the thermoforming industry, in manufacturing analysis, assistance in product development, process troubleshooting, in-house training seminars, and development of processing specifications. He is asked regularly to be an expert witness and consultant to the legal field on plastics-related projects. Mr. McConnell's pioneering contributions to the plastics industry are well recognized. Bill has been in thermoforming since 1948 and was awarded the first annual "Thermoformer of the Year" award from the Thermoforming Division of the Society of Plastics Engineers. He is also one of the 136 Fellows of the Society, out of 36,000 members. Bill was honored with a "Lifetime Achievement Award" at the 1997 Thermoforming Conference. He was inducted into the Plastics Pioneers Association in 1997.

Bill has been a member of SPE since 1953 and has served as an International Membership Chairman, Education Chairman and also President of the North Texas Section. He is currently on the Board of Directors of the Thermoforming Division of the SPE.

After attending Texas A & M University with a major in Aeronautical Engineering. Bill worked as a General Manager of Texstar Plastics, a custom thermoformer, injection & blow molder, and thermoplastic sheet laminator, concentrating on the aircraft, aerospace, and industrial markets. In 1964 Bill founded AAA Plastic Equipment, Inc Advisory Board of the Polymer Science and Engineering Technology Advisory Committee at Pittsburg State University in Pittsburg, Kansas, and also a member of the Industrial Advisory Board of the Polymer Technology Consortium of Texas A & M University.

Arthur Buckel

Arthur Buckel has spent 36 years overall in the job shop world of manufacturing. Twenty-eight years were spent operating his own companies in technical management with twenty years of that time in a custom thermoforming plant. Art served a 4-year apprenticeship in San Diego, he worked with U.S. Rubber in 1961-1962 in flexible vinyls and went into business for himself in 1963. He directed sales toward many industries preparing and presenting proposals, working with sales personnel, and directing costing and sales estimating procedures. Art founded Specialty Manufacturing Inc. in San Diego, California, in 1972. By the mid 1980's SMI had become one of the country's most sophisticated thermoforming and fabrication companies. As Vice President of Engineering at Specialty Mfg., Art has organized, written, promoted, and presented numerous seminars on thermoforming technology and production procedures. He has lectured at San Diego State University, Industrial Technologies Dept., University of California at San Diego Adult Continuing Studies Dept. and at present is a board member, and International Representative for the Thermoforming Division of the Society of Plastics Engineers. He has been active many years on the Board of the Thermoforming Division of the Society of Plastics Engineers. He also advises on legal cases in research and expert witness for plaintiff and defendant positions. Cases have been material failures, product failures, including loss of life, and patent infringements. He has given depositions and in-court testimony. In 1996 Art was awarded the "Outstanding Achievement" award from SPE and in 1999 was named "Thermoformer of the Year."

SUNDAY, SEPTEMBER 16, 2007 ROLL-FED WORKSHOP

Mark Strachan

Mark Strachan's career in the packaging industry started in 1982 while working as a trainee electronics engineer for Metal Box South Africa. His first project involving the rewiring and programming of a thermoforming machine which sparked his interest in the plastics processing industry.

He started his own plastics manufacturing business (PacMark) in the garage of his home which quickly grew into a successful plastics thick gage and thin gage thermoforming company producing a range of products for the cosmetic and catering markets

Over the next decade, Mark worked as Engineering Manager, Production Manager, R&D Manager and Technical Consultant for several international companies in Europe and the USA where he gained valuable experience in both thin and thick gauge thermoforming and extrusion technologies.

After moving to the USA, Mark continued to travel extensively to assist and advise companies both big and small to perfect their technology and products. In addition, he set up and commissioned plants at some of the biggest name companies in the rigid plastics, foam and packaging industries. His hands-on practical experience in both Europe and the Americas has enabled him to develop an intimate working knowledge of both

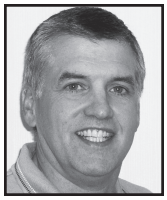
(continued on next page)

(continued from previous page)

U.S. and European machinery. His most recent project was the turnkey planning, installation and commissioning of a yogurt and ice cream cup manufacturing plant in Miami, Florida (extrusion, thermoforming and paper sleeve wrapping).

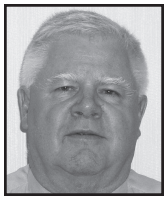
Mark has always enjoyed training and this desire to share his knowledge and experience has led to the formation of Global Thermoforming Technologies Inc. and Global Thermoforming Training Inc.

WEDESDAY, SEPTEMBER 19, 2007 WORKSHOPS



Jim Robbins

In his current role of Vice President Marketing of Brown Machine, Jim Robbins is responsible for all marketing activities at Brown as well as the sale of new equipment and upgrades systems within the United States. Jim spends considerable time within customers' facilities understanding their current and future needs leading to equipment configurations and the advancement of technology. He joined Brown in 1981 and has been involved in customer related roles for over 20 years. He has been a member of Brown's management staff since 1990 and has held previous positions of Director of Tooling, Manager of Spare Parts & Kits, as well as the Vice President of Manufacturing from 1995 -1999. Jim has an MBA from Central Michigan University and a BA in Accounting from Saginaw Valley State University.



William F. Kent

Bill Kent joined Brown Machine LLC in 1961 and has over 45 years of broad-based experience in the thermoforming industry, both in equipment and tooling. Prior to his current position as Vice President Sales and Business Development world wide he has held several management positions within Brown Machine. Bill attended Western Michigan University and is currently a board member of the Thermoforming Division of SPE.

ABSTRACT: Title - *Advances in Thin and Heavy Gauge Thermoforming Equipment Configurations for Faster Cycle Times, Consistent High Quality Product, Integration and Quick Changeover Time.*

Authors: Bill Kent and Jim Robbins

With the advancement of various materials, processes and product requirements, thermoformed products continue to be utilized in more cost effective and demanding applications than at any point in time. These requirements have forced the manufacturers of thermoforming equipment to provide innovative solutions to meet the specific needs of their customers.

In both thin gauge inline equipment to heavy gauge cut sheet equipment this presentation will focus on machine designs and features allowing processors to successfully produce products with application requirements of: (a) materials as polystyrene-to-polypropylene-to-PLA-to-barrier-to-TPO, (b) speeds of less than one cycle per minute to in excess of 40 cycles per minute, (c) product sizes of an inch in diameter to 14' x 22', (d) material thicknesses of .006" up to 1.00", and (e) pressure requirements of up to 100 PSI in both thin and heavy gauge applications.

Added into the mix is integration directly with extrusion for inline or hot sheet applications, lip rolling, product handling, automatic sheet loading, insertions, and material handling.

With the demand on inventory reduction and just-in-time production, changeover time reductions are an increasing requirement within the equipment. Various features can be implemented into the equipment that significantly speeds up this process.

This presentation will allow the participants to gain insight through slide show material, group discussion and video. Topics from thin gauge thermoforming with steel rule/forged high die or match metal post trim, and heavy gauge shuttle or rotary equipment in vacuum, pressure and twin sheet applications will be discussed.

Michelle Curenton

Michelle Curenton currently serves as Products Manager for WECO International. Holding a Bachelor of Science in Electrical Engineering degree, she has spent the past thirteen years working within the rubber and plastics extrusion and thermoforming industries as a process controls expert for both Engineering and Sales. She has managed many projects and custom installations, and routinely helps clients with trouble-shooting process controls issues. She holds a position on the Board of Directors for the Extrusion Division of the Society of Plastics Engineers (SPE) and is often called upon to support the industry with technical presentations at conferences and SPE sponsored events.

ABSTRACT: Title - *Process Controls Workshop – Improved Production Capacity of Your Equipment.* Thermoformer life can be extended and better-quality product can be produced with updated control systems. Manual only controls, PC, PLC, and PAC based systems will be discussed. Learn how to effectively implement up-to-date controls regardless of budget. All aspects of the process are covered from temperature, gauge, speed, pressures, vacuum, position and more. All variables can be set up based ona product code, with adjustments made automatically based on set points and closed-loop control algorithms. Your firm can reduce scrap, boost throughput, improve quality and consistency with improved controls. Identify changes on-line with trend charts/graphs and alarming. Data collection is useful for troubleshooting/ diagnostics. The second half of the seminar will focus on basic components for each control loop and how to troubleshoot when things just aren't working right.

WEDESDAY, SEPTEMBER 19, 2007 BIO-BASED MATERIALS WORKSHOP

Edward L. Steward

Ed is the co-founder of American Kuhne and is the Director of Process Technology. Prior to that he was employed at the Davis Standard Corporation for 24 years as Chief Process Engineer. His responsibilities include screw design and application along with processing related tasks that insure extrusion systems will meet the designated performance goals.

Educational experience includes a Bachelor of Science degree in Mechanical Engineering from the University of Connecticut and he is a Fellow of SPE. He has written numerous papers on screw design and related topics including general screw performance, data acquisition, screw wear, co-extrusion, vented, and grooved feed extrusion. Ed also

received the SPE Bruce Maddock award in recognition of contributions in single screw extrusion. He is a co-founder of American Kuhne.

David Citron

David is a managing partner in American Kuhne and is the Director of Sales and Marketing. Prior to that he was employed at Davis-Standard Corporation where he held positions in various markets including: sheet, blown film, cast film, fiber, blow molding, pipe, profile, and tubing. Educational experience includes a Bachelors degree with honors, from George Washington University.

Louis G. Reifschneider

Dr. Reifschneider teaches in the manufacturing technology program at Illinois State University in Normal, IL. His focus area is product design and processing related to plastics technology. He received his doctorate in mechanical engineering from Ohio State University in 1990. Upon graduating OSU he worked as a software development engineer charged with developing commercial software for injection and compression molding simulation. Prior to joining Illinois State University, Dr. Reifschneider worked as a numerical analyst optimizing the design of injection molded products and molds.

Dr. Reifschneider's interest in analysis is matched with an equal interest in experimental work. While at ISU, he has conducted numerous prototype projects using the facilities in the department to design products and molds, build molds, and process materials with the molds.

Carol Casarino

Carol Casarino, Technology Manager, Sustainable Packaging, DuPont Packaging and Industrial Polymers, is a native of Kalamazoo, Michigan. She earned a BA in Chemistry at Carleton College and a PhD in Physical Chemistry at the Massachusetts Institute of Technology. Carol began her DuPont career in the Imaging business, where she led the development and commercialization of the Cyrel® Digital Imaging System. Carol has held a variety of technical and business management roles at DuPont and joined DuPont Packaging & Industrial Polymers in 2003.

K-SHOW TOUR ARRANGEMENTS ANNOUNCED. MARK YOUR CALENDAR!!

Once again, a tour to the German Plastics Fair has been organized to encourage plastics people to go and experience this really big show in Dusseldorf, Germany, this coming October.

There are three options available.

1. The full two weeks, with 3 days at the K-Show

2. The second week, with 3 days at the K-Show

3. Only the three days at the K-Show

The tour will begin on October 14th, in Madrid. Spain. Tour through Spain, France, and Germany, ending on October 28th, 2007. Visits to thermoforming plants are included along the way.

The tour includes pickup at Madrid airport, 14 nights at 3 & 4 star hotels with bath and breakfast, 3 special dinners, driver and modern bus and English speaking guide for entire trip, with local English speaking guides for the 5 city tours.

Also transportation to and from the fairgrounds three days, with optional sightseeing for those who do not attend the fair.
Bus transportation to Frankfurt Airport at tour conclusion is included.

The full trip price is U.S. $2,760.00 p/p double per room.
Single in a room is U.S. $3,958.00 p/p. Airfare is not included.

The half trip begins on October 21st in Lyon, France, and includes 7 nights hotel with bath and breakfast, 2 special dinners, the K-Show transportation, and bus to Frankfurt Airport.

The half tour price is U.S. $1,380.00 p/p double in a room.
Single in a room is U.S. $2,040.00 p/p. Airfare is not included.

The 4 day K-Show only begins on October 24th in Bonn, Germany and includes 4 nights hotel with bath and breakfast, the farewell dinner, 3 day Show transportation, and bus to Frankfurt Airport.

K-Show only price is U.S. $698.00 p/p double and U.S. $1,178.00 single.

For more information, contact Arthur Buckel for a four page color brochure sent by postage or E-Mail.

Telephone: 858-273-9620 or artbuckel@thermoforming.com

Society of Plastics Engineers
P.O. Box 403, Brookfield, CT 06804-0403 USA
Tel: +1.203.740.5403 Fax: +1.203.775.8490 www.4spe.org

MEMBERSHIP APPLICATION

Applicant Information

Name:

first last mi

Company Name and Business Address (or College):

company/college:

job title:

address:

address:

city: **state:**

zip: **country:**

Phone/Fax Format: USA & Canada: (xxx) xxx-xxxx All Others: +xx(xx) x xxx xxxx

Work Phone: **Fax:**

Email: *used for society business only*

Home Address:

address:

city: **state:**

zip: **country:**

Home Phone:

(✓) Preferred Mailing Address: ❑ **Home** ❑ **Business**

Gender: ❑ Male ❑ Female

Birth Date: (mm/dd/yyyy)

Demographics

Job Function *(choose only one)*

- ❑ Consulting
- ❑ Design
- ❑ Education (Faculty)
- ❑ Engineer
- ❑ General Management
- ❑ Manufacturing
- ❑ Marketing/Sales
- ❑ Other
- ❑ Purchasing
- ❑ Quality Control
- ❑ R & D
- ❑ Retired
- ❑ Self-Employed
- ❑ Student
- ❑ Tech Support

Materials *(choose all that apply)*

- ❑ Composites
- ❑ Film
- ❑ General Interest
- ❑ Nylon
- ❑ PET
- ❑ Foam/Thermoplastics
- ❑ Polyolefins
- ❑ Polystyrene
- ❑ TPEs
- ❑ Thermoset
- ❑ Vinyls
- ❑ No Interest

Process *(choose all that apply)*

- ❑ Blow Molding
- ❑ Compression
- ❑ Compounding
- ❑ Engineering Properties
- ❑ Extrusion
- ❑ Fabrication
- ❑ Foam
- ❑ Injection Molding
- ❑ Mold Making
- ❑ Product Design
- ❑ Rotational Molding
- ❑ Thermoforming
- ❑ General Interest
- ❑ No Interest

The SPE Online Membership Directory is included with membership. Your information will automatically be included.

- ❑ Exclude my email from the Online Member Directory
- ❑ Exclude all my information from the Online Member Directory
- ❑ Exclude my email from 3rd party mailings

Payment Information

New Member 1 Year	New Member 2 Years *	Student Member
❑ US ($122.00)	❑ US ($212.00)	❑ US ($28.00)
❑ Canada ($162.75)	❑ Canada ($282.00)	❑ Canada ($37.50)
❑ Euro (€125.00)	❑ Euro (€219.00)	❑ Euro (€25.00)

My Primary Division is (choose from below) _____

Additional Divisions are available for a fee. Check below to select Additional Divisions.

- ❑ Additives & Color Europe (D45)
- ❑ Automotive (D31)
- ❑ Blow Molding (D30)
- ❑ Color & Appearance (D21)
- ❑ Composites (D39)
- ❑ Decorating & Assembly (D34)
- ❑ Electrical & Electronic (D24)
- ❑ Engineering Properties & Structure (D26)
- ❑ Extrusion (D22)
- ❑ Flexible Packaging (D44)
- ❑ Injection Molding (D23)
- ❑ Marketing & Management (D37)
- ❑ Medical Plastics (D36)
- ❑ Mold Making & Mold Design (D35)
- ❑ Plastics Environmental (D40)
- ❑ Polymer Analysis (D33)
- ❑ Polymer Modifiers & Additives (D38)
- ❑ Product Design & Development (D41)
- ❑ Rotational Molding (D42)
- ❑ Thermoforming (D25)
- ❑ Thermoforming, European (D43)
- ❑ Thermoplastic Materials & Foams (D29)
- ❑ Thermoset (D28)
- ❑ Vinyl Plastics (D27)

Students must supply graduation date: _____

Membership Amount _____

Primary Division FREE

Additional Division(s)
costs for each Additional Division

	1yr.	2 yrs.
US	$6.00	$12.00
Canada	$8.00	$16.00
Euros	€5.00	€10.00

_____

TOTAL _____

❑ CHECK ❑ VISA ❑ AMEX ❑ MASTERCARD

_____
card number

_____
expiration date (mm/yyyy)

PAYMENT MUST ACCOMPANY APPLICATION
Sorry, No Purchase Orders Accepted

Checks must be drawn on US or Canadian banks in US or Canadian funds.

Dues include a 1-year subscription to *Plastics Engineering* magazine.
SPE membership is valid for twelve months from the month your application is processed.
*save over 10%

By signing below I agree to be governed by the Constitution and Bylaws of the Society and to promote the objectives of the Society. I certify that the statements made in the application are correct and I authorize SPE and its affiliates to use my phone, fax, address and email to contact me.

_____
signature date

_____
recommended by member (optional) Id #

D

These sponsors enable us to publish
THERMOFORMING QUARTERLY

These sponsors enable us to publish THERMOFORMING QUARTERLY

Visiting Cincinnati USA

The Duke Energy Center and conference hotels are convenient to downtown shopping, fine dining establishments, and the riverfront and popular attractions. The Cincinnati/Northern Kentucky International Airport is only 12 miles away.

Cincinnati events scheduled during TF2007 include performances at the Cincinnati Symphony Orchestra concert Music Hall, Disney's Lion King at the Aronoff Center, and Sherlock Holmes: The Final Adventure at the Cincinnati Playhouse in the Park, Marx Theater.

The city has invested more than $2 billion in new attractions and facilities over the past seven years. Among the most notable are:

• Duke Energy Center – featuring state-of-the-art technology and excellent pedestrian flow, the center promises an outstanding convention experience.

• Newport Aquarium – across the Purple Pedestrian Bridge are found fascinating underwater exhibits, including the popular "Surrounded by Sharks."

• Great American Ball Park – home of the Cincinnati Reds, professional baseball's oldest team.

• BB Riverboats – dinner and sightseeing aboard a riverboat on the Ohio River, an ideal way to view the city's skyline.

• Contemporary Arts Center – in the heart of downtown, the CAC offers varied exhibits, a gift shop, and the "unMuseum" for children.

• Cincinnati Art Museum – home of the Cincinnati Wing, known for its celebration of art, artists, and collectors who are a part of the city's history.

• Paramount's Kings Island – popular amusement park with breathtaking roller coasters and other rides and attractions.

• Zoo & Botanical Garden – featuring outstanding floral and animal exhibits, with manatees, polar bears, gorillas, elephants, and much more.

• Beach Waterpark – featuring water slides, a lazy river, and a wave pool, in Northern Cincinnati, to keep the family entertained and cool.

• Cincinnati Museum Center – three museums and an Omnimax Theater are located in the art deco Union Terminal just outside downtown. ◄

Details of attractions and special events are available at the Cincinnati USA Convention & Visitor's Bureau website, www.cincyusa.com, or by calling the bureau at +1 513-621-2142.

View of Cincinnati from Riverside Drive, Kentucky

These sponsors enable us to publish
Thermoforming QUARTERLY

These sponsors enable us to publish Thermoforming QUARTERLY

THERMOFORMING DIVISION BOARD OF DIRECTORS

James A. Alongi - 2009
MAAC Machinery
590 Tower Boulevard
Carol Stream, IL 60188-9426
TEL (630) 665-1700
FAX (630) 665-7799
jalongi@maacmachinery.com
Machinery Committee

Jim Armor - 2008
Armor & Associates
16181 Santa Barbara Lane
Huntington Beach, CA 92649
TEL (714) 846-7000
FAX (714) 846-7001
jimarmor@aol.com
Materials Committee

Phil S. Barhouse - 2009
Creative Forming
100 Creative Way
P.O. Box 128
Ripon, WI 54971
TEL (920) 748-1119
FAX (920) 748-9466
phil.barhouse@creativeforming.com
Materials Committee

Arthur Buckel - 2008
McConnell Co., Inc.
3452 Bayonne Drive
San Diego, CA 92109
TEL (858) 273-9620
FAX (858) 273-6837
artbuckel@thermoforming.com
Processing Committee

Conor Carlin - 2008
Stopol, Inc.
31875 Solon Road
Solon, OH 44139
TEL (440) 498-4000
FAX (440) 498-4001
conorc@stopol.com
Machinery Committee

Haydn Forward - 2009
Specialty Mfg., Inc.
6790 Nancy Ridge Drive
San Diego, CA 92121
TEL (858) 450-1591
FAX (858) 450-0400
hforward@smi-mfg.com
Processing Committee

Roger Fox - 2010
The Foxmor Group
373 South County Farm Road
Suite 202
Wheaton, IL 60187
TEL (630) 653-2200
FAX (630) 653-1474
rfox@foxmor.com
Marketing Committee

Richard Freeman - 2009
Freetech Plastics
2211 Warm Springs Court
Fremont, CA 94539
TEL (510) 651-9996
FAX (510) 651-9917
rfree@freetechplastics.com
Processing Committee

Hal Gilham - 2010
Productive Plastics, Inc.
103 West Park Drive
Mt. Laurel, NJ 08045
TEL (856) 778-4300
FAX (856) 234-3310
halg@productiveplastics.com
Processing Committee

Ken Griep - 2008
Portage Casting & Mold, Inc.
2901 Portage Road
Portage, WI 53901
TEL (608) 742-7137
FAX (608) 742-2199
ken@pcmwi.com
Machinery Committee

Steve Hasselbach - 2008
CMI Plastics
P.O. Box 369
Cranbury, NJ 08512-0369
TEL (609) 395-1920
FAX (609) 395-0981
steve@cmiplastics.com

Donald C. Hylton - 2010
646 Holyfield Highway
Fairburn, GA 30213
TEL (678) 772-5008
don@thermoforming.com
Materials Committee

Bill Kent - 2008
Brown Machine
330 North Ross Street
Beaverton, MI 48612-0434
TEL (989) 435-7741
FAX (989) 435-2821
bill.kent@brown-machine.com
Machinery Committee

Don Kruschke - 2010
Stopol, Inc.
31875 Solon Road
Solon, OH 44139
TEL (440) 498-4000
FAX (440) 498-4001
donk@Stopol.com
Machinery Committee

Wm. K. McConnell, Jr. - 2008
McConnell Co., Inc.
3030 Sandage St.
P.O. Box 11512
Fort Worth, TX 76110
TEL (817) 926-8287
FAX (817) 926-8298
billmc@thermoforming.com
Materials Committee

Vin McElhone - 2010
Stand-Up Plastics
5 Fordham Trail
Old Saybrook, CT 06475
TEL (860) 395-5699
FAX (860) 395-4732
vin@standupplastics.com
Materials Committee

Stephen R. Murrill - 2009
Profile Plastics Corp.
65 S. Waukegan
Lake Bluff, IL 60044
TEL (847) 604-5100 EXT. 29
FAX (847) 604-8030
SMurrill@thermoform.com
Processing Committee

Dennis Northrop - 2009
Avery Dennison
Automotive Division
650 W. 67th Avenue
Schererville, IN 46375-1390
TEL (219) 322-5030
FAX (219) 322-2623
Dennis.Northrop@averydennison.com
Materials Committee

Joe Peters - 2010
Universal Plastics
75 Whiting Farms Road
Holyoke, MA 01040
TEL (413) 592-4791
FAX (413) 592-6876
petersj@universalplastics.com
Processing Committee

Laura Pichon - 2008
Ex-Tech Plastics
P.O. Box 576
11413 Burlington Road
Richmond, IL 60071
TEL (847) 829-8124
FAX (815) 678-4248
lpichon@extechplastics.com
Materials Committee

Robert G. Porsche - 2009
General Plastics, Inc.
2609 West Mill Road
Milwaukee, WI 53209
TEL (414) 351-1000
FAX (414) 351-1284
bob@genplas.com
Processing Committee

Walt Speck - 2010
Speck Plastics, Inc.
P. O. Box 421
Nazareth, PA 18064
TEL (610) 759-1807
FAX (610) 759-3916
wspeck@speckplastics.com
Processing Committee

Clarissa M. Schorn - 2009
Invista S.A.R.L.
1551 Sha Lane
Spartanburg, SC 29307
TEL (864) 579-5047
FAX (864) 579-5288
clarissa.schorn@invista.com
Materials Committee

Jay Waddell - 2008
Plastic Concepts & Innovations, LLC
1127 Queensborough Blvd.
Suite 102
Mt. Pleasant, SC 29464
TEL (843) 971-7833
FAX (843) 216-6151
jwaddell@plasticoncepts.com
Processing Committee

Brian Winton - 2010
Modern Machinery
P. O. Box 423
Beaverton, MI 48612-0423
TEL (989) 435-9071
FAX (989) 435-3940
bwinton@modernmachineinc.com
Machinery Committee

➤ Index of Sponsors

These sponsors enable us to publish **THERMOFORMING QUARTERLY**

THERMOFORMING® QUARTERLY™

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

P. O. Box 471
Lindale, Georgia 30147

CHANGE SERVICE REQUESTED

Non-Profit Org.
U.S. POSTAGE
PAID
SOCIETY OF
PLASTICS
ENGINEERS, INC

ThermoForming Division

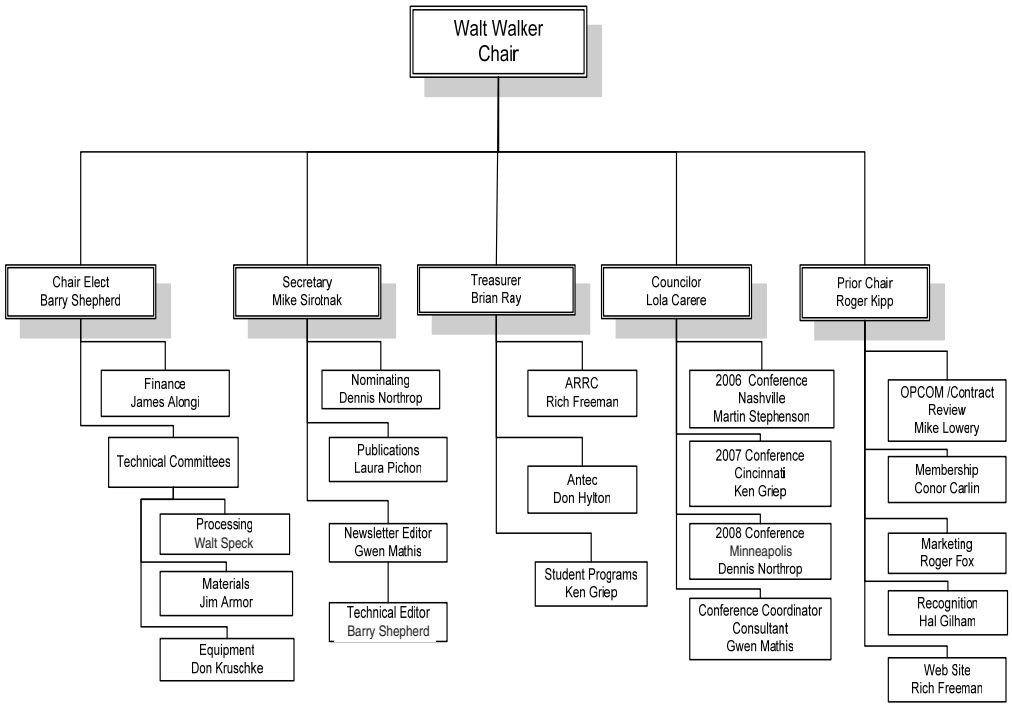
Our mission is to facilitate the advancement of thermoforming technologies through education, application, promotion and research.

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

Conference Coordinator
Gwen Mathis
124 Avenue D, SE
Lindale, Georgia 30147-1027
706/235-9298 • Fax: 706/295-4276
email: gmathis224@aol.com

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

2007 - 2009 THERMOFORMING DIVISION ORGANIZATIONAL CHART



THERMOFORMING DIVISION HOTLINE 800-608-7542 Walt Walker, Chairman, Extension 4401# at Prent Corporation

Executive Committee
2007 - 2009

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

CHAIR ELECT
Barry Shepherd
Shepherd Thermoforming & Packaging, Inc.
5 Abacus Road
Brampton, Ontario L6T 5B7 Canada
(905) 459-4545 x229 • Fax (905) 459-6746
bshep@shepherd.ca

TREASURER
Brian Ray
Ray Products
1700 Chablis Avenue
Ontario, CA 91761
(909) 390-9906 • Fax (909) 390-9984
brianr@rayplastics.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
Lola Carere
Thermopro, Inc.
2860 Preston Ridge Lane
Dacula, GA 30019
(770) 339-8744 • Fax (770) 339-4181
lcarere@bellsouth.net

PRIOR CHAIR
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