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Thermoforming[®] QUARTERLY

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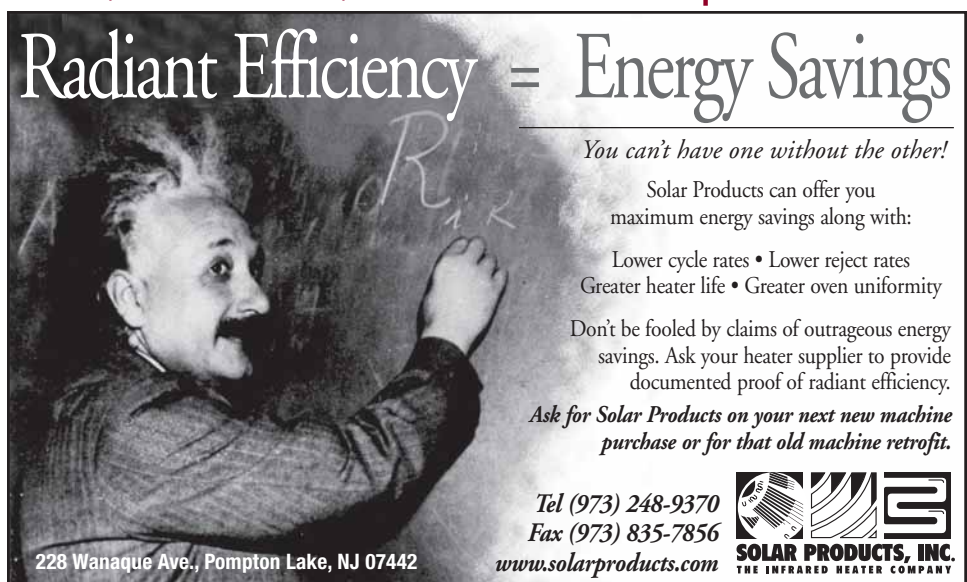
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A NOTE TO PROSPECTIVE AUTHORS

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 Jim Throne, Technical Editor, anyway. He'll fit it in! He promises. [By the way, if you are submitting an article, Jim 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.]

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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

Dr. James Throne

Sherwood Technologies, Inc.
1797 Santa Barbara Drive
Dunedin, FL 34698-3347
1-800-273-6370 • Fax (727) 734-5081
throne@foamandform.com
jthrone@tampabay.rr.com

Sponsorships

Laura Pichon

(815) 678-2131 Ext. 624
Fax (815) 678-4248

lpichon@extechplastics.com

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It's Conference Time Again!



BY MIKE SIROTNAK, MEMBERSHIP CHAIRMAN

The last time our conference was held in the beautiful city of Milwaukee, our country was still reeling from the devastating attacks of 9/11. I will never forget having to drive from New Jersey to Milwaukee, due to the massive airport closings, wondering what the future would hold. Now four years later, it's hard not to think back on that time and reflect on how much has changed and remarkably how much has stayed the same. I am very proud of our members for their continued support and I am confident that our division will achieve all of its goals.

Just a reminder! The reprints of our very first DVD "What is Thermoforming?" have arrived and are available. Please feel free to contact any of the Board members to request additional copies or visit our website, www.thermoformingdivision.com, for more information.

Recently the Thermoforming Division donated money to sup-

port a group of doctors and nurses to visit Sri Lanka to aid in the Tsunami relief. Make sure to read the article in this issue for complete details. It's another example of the good works your membership provides. Scholarships, educational equipment

gram will be cutting edge with a focus on new technology in our industry. Walt Walker and Ed Probst have searched high and low to bring you all that is new. The exhibit floor will be bigger and better than ever. Try to make a point of spending as much time as possible on the exhibit floor. The exhibitors are the backbone of these conferences. Joe Peters has put together a very diverse Parts Competition. Make sure to stop by and see what your competitors are up to. This year we are offering four plant tours including topnotch processors, Prent Corp. and Profile Plastics. You have to respect those business leaders that allow

the public to visit their facilities. Steve Murrill and Walt Walker are two examples of our industry's best. Four years ago, Milwaukee did not see our best. Let's make sure this conference changes that. See you on the exhibit floor.

God Bless America!



MEMBERSHIP REPORT as of 6/15/05

Primary Paid	1,229
Secondary Paid	447
Total Membership	1,726
Goal as of 6/30/2005	2,000

grants, disaster relief donations, educational DVD's, *Thermoforming Quarterly*, technical conference and the only industry specific trade show ... all possible because of your continued support. I urge you to continue to help recruit new members.

This year's conference should be very exciting. Hometown boy, Bob Porsche, has put together an exciting conference. The technical pro-



To Our New Members

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

WHY NOT?

THERMOFORMING QUARTERLY ... A WINNER!



At the recent Antec in Boston, the Thermoforming Quarterly again won First Place in the Division's Newsletter Contest. Roger Kipp, Division Chairman, is shown presenting the award to the Thermoforming Quarterly Editor Gwen Mathis.

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In Memory of James E. Gilham



On April 27, 2005, James E. Gilham of Marlton, New Jersey passed away at the age of 78. He was the beloved husband for 50 years to the late Doris E. (nee Homan). Loving father of Harold S. Gilham and his wife Lisa of Southampton, NJ; Deborah Cherico and her husband John of St. Louis Park, MN; Robin Zerillo and her husband John of Medford, NJ; Lorrie Fabrizio and her husband Joseph of West Chester, PA; and 14 grandchildren. Dear brother of Mimi Leisy, Betty Danley, Tom Gilham and Butch Gilham. A service honoring his life was held at St. Andrew's Methodist Church with interment in Locustwood Memorial Park, Cherry Hill, NJ. Contributions in his memory may be made to the Lupus Foundation of South Jersey, 1873 Rt. 70 East, Cherry Hill, NJ 08003. ■

PENN STATE-ERIE ROOMMATES RECEIVE 2005 THERMOFORMING SCHOLARSHIPS

Ken Griep, Chairman of Student Affairs, is pleased to announce the winners of the following scholarships. These scholarships will be presented during the annual Thermoforming Conference in Milwaukee.

JOHN GRIEP MEMORIAL \$5,000.00 SCHOLARSHIP

TRAVIS HUNTER
PENN STATE - ERIE



Travis Hunter is a Senior at Penn State-Erie majoring in Plastics Engineering Technology. He has had extensive experience with the thermoforming process and is currently completing a project that tests the thermoformability of four different polymers (HDPE, LDPE, PP and PET) with additives. In an earlier project, he used an epoxy compound to form a mold of a product that is already on the market and tested the permeability properties of the thermoformed polymer. Travis had an internship at Emerson Appliance Controls where he was able to design a new mold. The Manager of Engineering at Emerson indicated that Travis and his partner, Joshua Sindlinger, were the best interns he'd worked with in his 35 years with the company. ■

SEGEN MEMORIAL \$5,000.00 SCHOLARSHIP

JOSHUA SINDLINGER
PENN STATE - ERIE



Joshua Sindlinger is a Senior at Penn State-Erie majoring in Plastics Engineering Technology. He has had extensive experience with the thermoforming process and is currently completing a project that tests the thermoformability of four different polymers (HDPE, LDPE, PP and PET) with additives. Josh partnered with his PS-E roommate Travis Hunter at Emerson Appliance Controls. Josh also worked for Holbrook Tool as an injection molding machine operator in the summer of 2000. Upon graduation, he hopes to become a process engineer and then work his way up the corporate ladder. ■

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THERMOFORMER OF THE YEAR

CRITERIA FOR 2006

Every year The SPE Thermoforming Division selects a individual who has made a outstanding contribution to our industry and awards them the Thermoformer of the Year award.

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 Greip, 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. Osmer, 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

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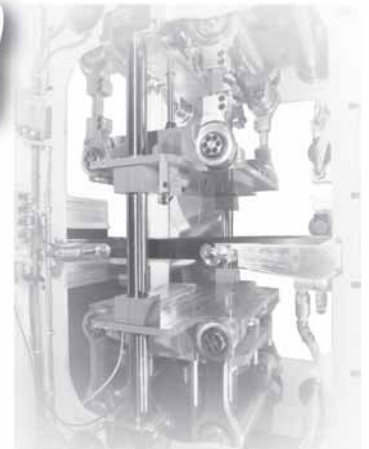
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You can also find the form and see all the past winners at www.thermoformingdivision.com in the Thermoformer of the Year section.

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.

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1986

George Wiss
Plastofilm Industries

1987

Dr. Herman R. Osmers
Educator & Consultant

1988

Robert Kittridge
Fabri-Kal Corporation

1989

Jack Pregont
Prent Corporation

1990

Ripley W. Gage
Gage Industries

1991

Stanley Rosen
Mold Systems Corp.

1992

Samuel Shapiro
Maryland Cup
Sweetheart Plastics

1993

John Grundy
Profile Plastics

1994

R. Lewis Blanchard
Dow Chemical

1995

James L. Blin
Triangle Plastics

1996

John Griep
Portage Casting & Mold

1997

John S. Hopple, Hopple Plastics

1998

Lyle Shuert, Shuert Industries

1999

Art Buckel
McConnell Company

2000

Dr. James Throne
Sherwood Technologies

2001

Joseph Pregont, Prent Corp.

2002

Stephen Sweig, Profile Plastics

2003

William Benjamin,
Benjamin Mfg.

2004

Steve Hasselbach, CMI Plastics

THERMOFORMER OF THE YEAR 2006

Presented at the September 2006 Thermoforming Conference in Nashville, Tennessee

The Awards Committee is now accepting nominations for the 2006 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 to the Thermoforming Industry in a Technical, Educational, or Management aspect of Thermoforming. Nominees will be evaluated and voted on by the Thermoforming Board of Directors at the Winter 2006 meeting. The deadline for submitting nominations is December 1st, 2005. 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

**THERMOFORMING
DIVISION
BOARD MEETING
SCHEDULE**

**Hilton Milwaukee
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Milwaukee, Wisconsin**

Wednesday, September 21, 2005

Executive Committee Arrive

Thursday, September 22, 2005

7:30 a.m. - 8:00 a.m. - Breakfast

8:00 a.m. - 5:00 p.m. - Executive Committee Meeting, Presidential Suite 2432

12:00 noon - 1:00 p.m. - Lunch

1:00 p.m. - 2:00 p.m. - James Alongi, Finance Chair, meets with Executive Committee

2:30 p.m. - 4:00 p.m. - Technical Chairs meet with Executive Committee, Room 2432

6:00 p.m. - 8:00 p.m. - Board Reception, Presidential Suite 2432

Friday, September 23, 2005

HILTON HOTEL

7:30 a.m. - 8:00 a.m. - Breakfast, Kilbourn Room

8:00 a.m. - 10:00 a.m. - Materials Committee, Miller Room

8:00 a.m. - 10:00 a.m. - Processing Committee, Walker Room

8:00 a.m. - 10:00 a.m. - Machinery Committee, Oak Room

10:00 a.m. - 12:00 noon - ALL OTHER COMMITTEES, OAK ROOM

12:00 noon - 1:00 p.m. - Lunch, Kilbourn Room

1:00 p.m. - 4:00 p.m. - BOARD OF DIRECTORS' MEETING, REGENCY BALLROOM

5:00 p.m. - Bus departs from Hilton Hotel to Wisconsin Club, Tailgate Party and Brewers Baseball Game

Saturday, September 24, 2005

8:00 a.m. - 12:00 noon - Board Members Assist in Parts Competition Setup

6:15 p.m. - Welcome Reception, Convention Center Hall A, 3rd Floor

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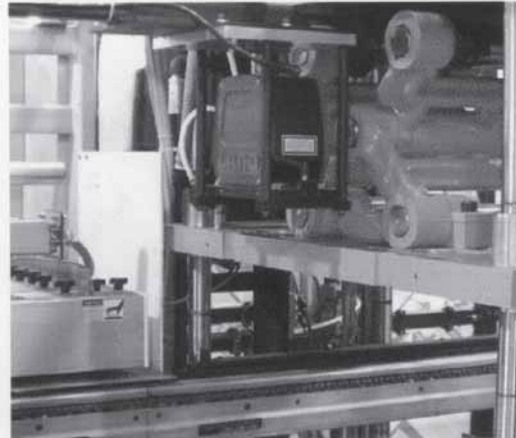


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Enhanced TPO Thermoforming Using High Melt Strength Polyolefin Elastomers¹

BY K.L. WALTON, M.K. LAUGHNER, LAWRENCE J. EFFLER, E.S. GISLER,
DUPONT DOW ELASTOMERS LLC, GENEVA, SWITZERLAND

Abstract

Hard TPOs have grown rapidly in the automotive industry because of their favorable cost/performance characteristics and injection molding processability. Other plastics processes are now either currently used or under investigation. Processes such as blow molding and thermoforming offer the potential to manufacture large parts with much lower tooling costs than injection molding. However, it is well known that conventional polypropylene exhibits poor melt strength. This deficiency has limited its use in either large part extrusion blow molding or thermoforming.

Recently, polypropylene producers have introduced high melt strength polypropylene into the market. These polypropylenes have much higher melt strengths than conventional materials. They are being promoted for used in hard thermoplastic olefin (TPO) applications requiring high melt strengths.

However, other components, particularly the impact modifiers, can now play important roles in the thermoforming characteristics of hard TPO compounds. In a series of experiments, significant changes in TPO Rheology were observed, depending on the level and type of impact modifier used. The characteristics of ethylene/ α olefin copolymer impact modifiers and their effect on hard TPO thermoforming performance will be discussed.

Introduction

Propylene based compounds continue to successfully replace engineering polymers in automotive exterior and interior applications. The primary driver for this substitution is raw material cost. A

desire for lower conversion cost has led some Tier I suppliers to examine methods of large part manufacturing other than injection molding. For example, it is possible to manufacture similar large parts using either thermoforming or blow molding that were formally reserved for injection molding. The primary advantage of these conversion processes is lower capital, including tooling costs. On the other hand, it is well known that conventional polypropylene exhibits poor melt strength (1). The low melt strength stems from the lack of melt strain hardening. This deficiency has limited its use in blow molding. Thus, conventional polypropylenes have very narrow processing windows for most thermoforming and blow molding applications.

Several approaches were attempted to improve polypropylene (PP) melt strain hardening characteristics. For example, high-pressure LDPE was blended with PP at 15-20% (wt) to yield a PP composition with some extrusion coating capability (2). The LDPE has long chain branching (LCB), which causes the polymer to exhibit melt strain hardening, an important attribute in several processes. The LDPE has some compatibility with the PP and thus has an influence on the melt behavior. This blend approach has also been extended to thermoforming applications.

PP manufacturers are now offering alternatives to conventional technology by providing products with LCB incorporated into the polymer backbone. The LCB structure causes the polymer to exhibit melt strain hardening, an important attribute for thermoforming. Numerous methods have been described to incorporate LCBs into PPs (1, 3-5).

Constrained geometry catalyst (CGC) technology utilizes a proprietary catalyst and solution process based on transition metal chemistry, with titanium being the most commonly used transition metal. This catalyst technology enables the copolymeriza-

¹ This paper, presented at 2005 SPE ANTEC, Boston, has been edited for publication in TFG. Any errors or omissions are solely the responsibility of the technical editor.

tion of ethylene with different potential alpha olefin comonomers. For example, DuPont Dow Elastomer's newest plant manufactures both ethylene/1-octene and ethylene/1-butene copolymers using this catalyst. These copolymers are widely used as PP impact modifiers because of their elastomeric nature, compatibility with PP, and pellet form.

The combination of CGC catalyst and the solution process allows the development of reactor conditions, which can be tuned to produce ethylene copolymers containing LCB 96). By judicious reactor control, ethylene alpha olefins (EAOs) with differing levels of LCB are produced (7).

This paper investigates the use of EAOs having high and medium LCB levels in PP as impact modifiers. The effects of these impact modifiers on PP thermoforming characteristics are highlighted.

Experimental

Sample Preparation

The three EAO samples in this study were produced in DuPont Dow's commercial facilities using CGC technologies. Three commercially available PPs were examined. Selected properties are shown in Table 1.

Blend compositions were melt compounded using a Coperion ZSK25 corotating twin screw extruder. The compounded pellets were extruded on

a 50 mm Killion extruder equipped with a 610 mm wide EDI sheet die feeding a 600 mm wide Davis Standard three-roll stack having chromed polished rolls. The die gap was adjusted to yield a 1.1 mm thick sheet. Roll speed was adjusted to minimize orientation. Tables II - IV (see page 12) show the compounded samples tested.

Thermoforming

The sheets were tested for thermoformability using a Lamco thermoformer equipped with 12 individually controlled quartz heaters, top and bottom. An infrared pyrometer was positioned at the bottom of the oven to monitor sheet surface temperature. The average power setting was 40% for the top and 55% for the bottom. Square sheets 56 cm x 56 cm were cut and clamped. After reaching the desired temperature as measured by the oven pyrometer, the sheet was indexed out of the oven, surface temperature was measured via a hand-held pyrometer, and the sheet was vacuum formed into a 14.5 cm x 14.5 cm cavity mold with 2.4 cm depth. The sheets were thermoformed over a temperature range. The temperature at which complete part thermoforming was achieved in the inside cavity was called the "minimum temperature." The temperature at which the sheet formed a hole during vacuum forming was called the "maximum temperature."

(continued on next page)

Table I
Polymers Tested

Grade	Type	Comonomer	Melt Viscosity dg/min	Melting Temp. (° C)	Density (kg/m ³)
PP1	PP high LCB	impact Copolym.	1.8 ^a	163	903
PP2	Clarified PP homopolym.	none	0.42 ^a	164	905
PP3	PP homopolym.	none	1.35 ^a	165	905
EB1	EAO hi LCB	butene	0.25 ^b	93	901
EB2	EAO med LCB	butene	0.28 ^b	48	870
EO1	EAO med LCB	octane	1.6 ^b	93	897
ABS1	Extrusion grade	terpolym.	1.2 ^c	N/A	1040

a = melt flow rate at 230°C, 2.16 kg. wt.

b = melt index at 190°C, 2.16 kg. wt.

c = melt index at 230°C, 10 kg. wt.

N/A = not applicable. ABS has no crystalline melting point

Table II
Simple Two-Component Blends

Compound	PP1	PP2	EB1	EB2	EO1
1	100	0	0	0	0
2	0	100	0	0	0
3	90	0	10	0	0
4	90	0	0	10	0
5	90	0	0	0	10
6	0	90	10	0	0
7	0	90	0	10	0

Table III
Three-Component TPO Composition, [wt. %]

PP3	PP1	EB1
50	50	0
85	0	15
0	70	30
0	100	0
0	85	15
70	0	30
35	35	30
100	0	0

Table IV
Fully-Formulated TPOs

Compound Ingredient	A wt. %	B wt. %
PP3	48	44
PP1	8	12
EB1	24	24
Talc	20	20
Antioxidant	0.2	0.2

For selected samples, the thermoforming sheet sag was measured as a function of index temperature. A video capture technique was used to obtain the data.

Physical Properties

Sheet hardness was measured according to ASTM D2240. The tensile properties were determined according to ASTM D638. Instrumented dart impact was measured according to ASTM D3763. Sheet tear strength was measured according to ASTM D1004.

Rheological Measurements

Dynamic shear tests were conducted at 190, 210, and 230°C on a Rheometrics dynamic spectrometer

model ARES, with a parallel plate fixture of 25 mm and 2 mm cap setting. A 15% strain level was used on all samples.

Results and Discussion

Rheological Characteristics

Figure 1 compares the tan deltas of the three PPs. The relatively flat response of the tan delta curve to frequency in Figure 1 infers that LCB is present in PP1. As seen in Figure 2, the relative flatness of the tan delta curve for EB1 infers a significantly higher LCB level than either EB2 or EO1.

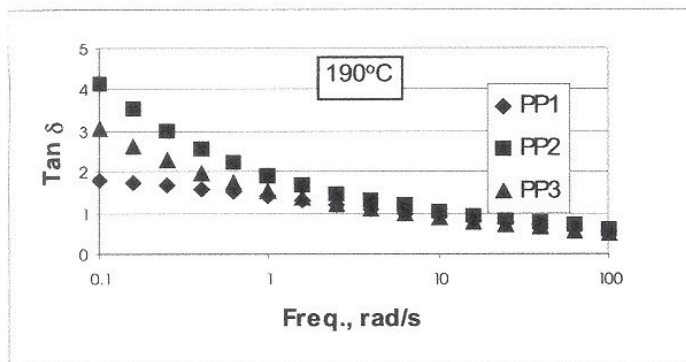


Figure 1. Tan deltas versus frequency of the tested PPs.

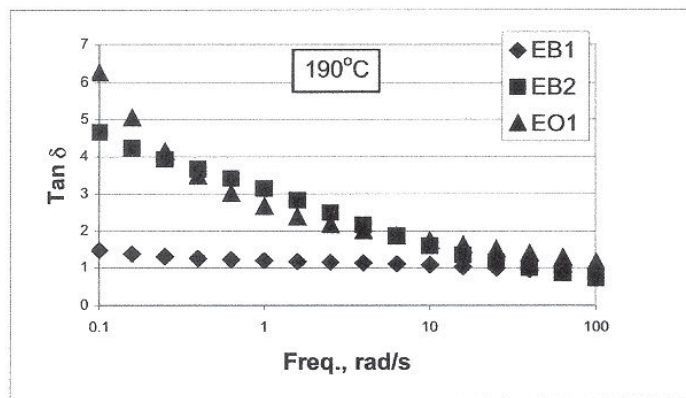


Figure 2. Tan deltas of the tested elastomers in the melt state.

Thermoforming Comparison

Simple Two Component Blends: Figure 3 compares the thermoforming window of PP2 alone and blended at 10% (wt) with EB1, EB2, and EO1. As seen, PP2 (unbranched homopolymer PP) exhibits a very narrow thermoforming window. All of the EAOs improve the PP2's thermoforming window. The widest thermoforming window is observed with compound #3 containing 10% EB1. The sheet of compound #4 exhibits localized thin spots during thermoforming. It is apparent that the incorporation of an EAO with high LCB levels significantly

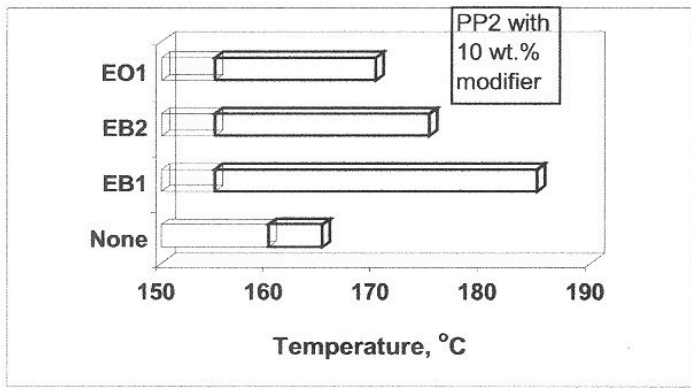


Figure 3. Effect of impact modifier on PP2 thermoforming window.

improves the thermoforming window of standard PP homopolymers by 25°C.

Figure 4 compares the thermoforming window of PP1 alone and blended at 10% (wt) EB1 and EB2.

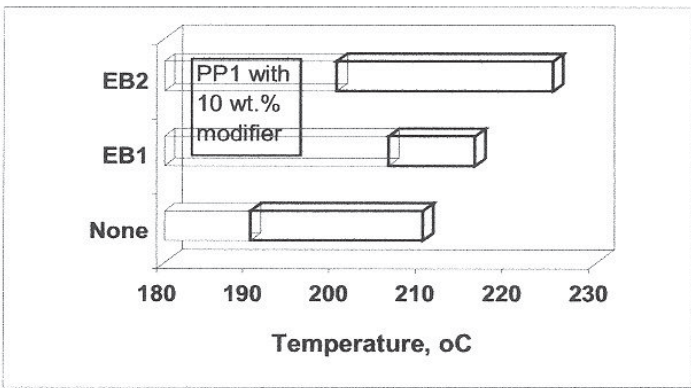


Figure 4. Effect of impact modifier on PP1 thermoforming window.

Note that a much higher temperature is required to thermoform the PP1-based compounds. Sheets based on PP1 exhibit very little sag, indicating significantly higher melt strength than PP2-based sheets. However, little change in the breadth of the thermoforming window is observed. Further, at elevated temperature, hole formation readily occurs. Also, during thermoforming, high levels of sheet “nerve” are observed. No thermoforming benefit is observed by adding EB1 to PP1. However, by adding EB2 to PP1, the thermoforming window increased by 30°C. With EB2 present, the sheet deformed more readily at higher temperatures with no rupture. Perhaps the addition of a lower LCB EAO with reduced melt elasticity improves the melt extensibility of a composition having a branched PP.

Simple Three-Component Blends: It has been previously reported that blends of branched PP with standard PP homopolymers and a branched impact modifier yielded compositions with optimum performance for thermoforming (8). A Three-component mixture design was formulated to determine

the effect of standard PP, branched PP, and branched EB blends on thermoforming sheet sag. The experimental compositions are shown in Table III. ABS1 was used for benchmark comparison. Figure 5 compares the sheet sag versus temperature of selected compounds from this study. A wide range of sheet sag characteristics is seen for these compounds.

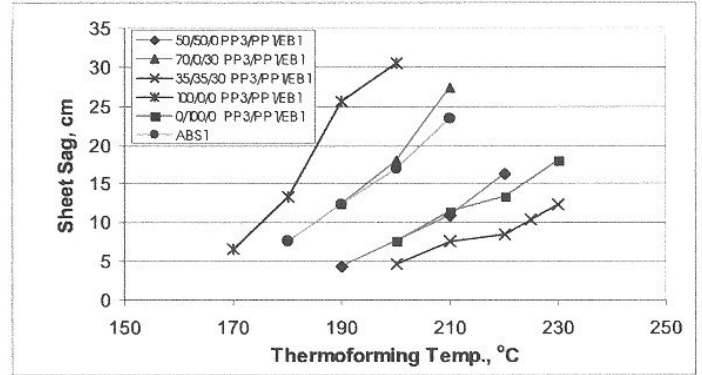


Figure 5. Three-component TPO thermoforming sage range.

As expected, standard PP3 alone sagged most. On the other hand, pure PP3 exhibited low sag. The lowest sag observed was with blends of PP1, PP3, and EB1. The ABS1 sag characteristic is shown in the the middle of the sag curves.

Fully Formulated TPOs: Based on the three component results, two optimize TPO compounds were evaluated and compared with ABS1. Table IV describes these two TPO compounds. Figure 6 shows the temperature-dependent sag characteristics of these two compound. As seen, The sag characteristics of both compounds match the ABS1 sheet sag characteristics reasonably well, with the TPO B compound having the better match of the two. The sag characteristics and sag time of TPO B closely matches that of ABS1 at 210°C.

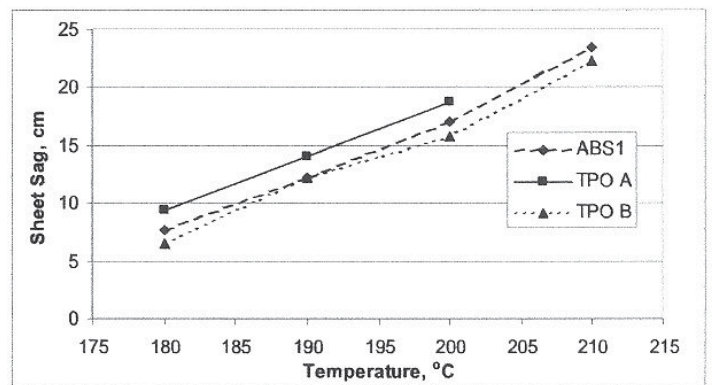


Figure 6. Thermoforming sag comparison, TPO-A, TPO-B, and ABS1.

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Physical Properties

Figures 7 and 8 are radar plots comparing the effects of adding 10% (wt) impact modifier on the physical properties of PP. As shown in Figure 7, all impact modifiers improve the impact strength of PP1 at 0°C.

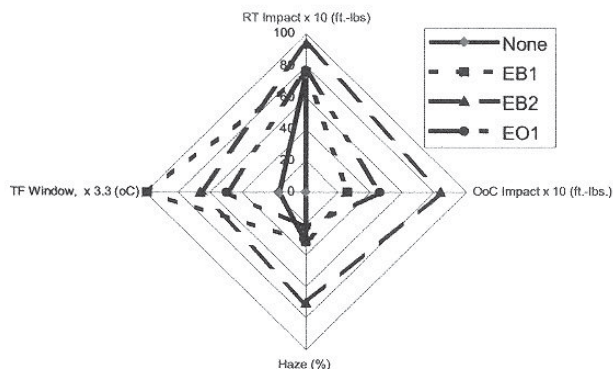


Figure 7. Radar plot of PP2 properties with and without 10% (wt.) impact modifier.

However, the low crystallinity EB2 is a more efficient impact modifier. Because the refractive index of EB1 and EO1 matches that of PP2, sheets are quite clear. As a result of the comonomer content, the crystal structures of these two EAOs match the refractive index of PP. On the other hand, the refractive index of low crystallinity EB2 does not match those of other EAOs. As a result, sheet based on EB2 is hazier. High clarity impact-modified thermoformable TPOs may prove useful in translucent applications or in parts where color depth is important.

Figure 8 compares the effect of adding impact modifier to PP1. The DSC melting point indicates that the product is not a random copolymer. On the other hand, the 0°C impact value of PP1 is higher than that for a standard homopolymers. This suggests that it contains an impact modifier. Additional modifier has little effect on its impact strength. It is evident that PP2 is not designed for transparent applications. The haze of PP2 alone is quite high. It is likely that the haze is partially the result of a low crystallinity im-

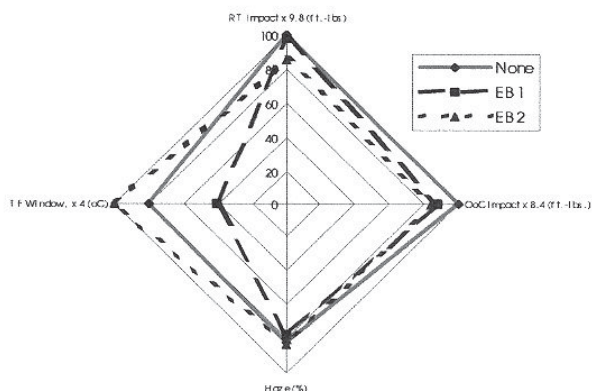


Figure 8. Radar plot of PP1 properties with and without 10% (wt.) impact modifier.

part modifier compounded into the PP during its manufacture. Additional impact modifier had little effect on haze.

Conclusions

The thermoforming characteristics of standard PPs can be significantly improved with the addition of newly developed LCB impact modifiers. Higher crystalline impact modifiers match the refractive index of PP and yield compositions with good clarity. Lower crystalline impact modifiers yield optimum impact modifications.

The branched PP examined in this study exhibited a high level of melt strength, but low melt extensibility. The addition of an impact modifier with low levels of LCB improved the melt extensibility and thermoforming window of this PP.

TPOs containing optimized levels of standard PP, branched PP, and branched EAO yield thermoforming sag characteristics similar to a thermoforming grade ABS.

Acknowledgments

The authors thank Doug Waszneciak for his help in manufacturing the sheets and thank the testing lab personnel of DuPont Dow Elastomers for providing physical property data on the various polymers and formulated compounds.

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Collaborative and Methodical Product Development Reduces Time From Concept to Production

BY ERIC HAUSSERMAN, PREMIER MATERIAL CONCEPTS, FINDLAY, OHIO

The most effective product development initiative ensures that all parties involved have input ... from the resin supplier, all the way through to the end-user since so many factors must be taken into consideration when deciding on a material or a finish.

First and foremost the function of the finished product must be taken into account. How is the product going to be installed? What elements is the product going to face? What is the expectation as far as life of the product? These could include: UV stability, chemical resistance, co-efficient of friction, fire rating, etc. For example, PMC developed a Thermo Plastic Elastomer (TPE) insert for a household step stool. The design of this product covered many of the factors mentioned above. A product was created that achieved a high co-efficient of friction, so that the user would not slip off the stool when in use. It also was chemical resistant, as step stools are often used around cleaning supplies. If not the insert could become easily and quickly degraded.

Next we took into consideration the processes that the material would go through as it was manufactured into a finished product. What kind of temperature is the product going to see in secondary processes? Is any pressure going to be applied to the sheet in secondary processes? Could the material be scratched as it goes through secondary processes? These include: Thermoforming, die cutting, lamination, injection molding, etc.

Consideration of these factors above was critical for this project. First we discovered that the material would go through a secondary die cutting operation. So the material designed had a very clean trim permitting it to be die cut very efficiently. Next the insert was to be placed inside an injection mold. The material we developed withstood a very high temperature, did not "bleed," and maintained a very crisp, clean edge, when the molten plastic was shot behind it.

Creating this product was a very collaborative effort. There was involvement from the resin supplier, the sheet extruder, the die-cutter, the manufacturer of the footstool, and of course feedback from potential end-users. The product was developed, qualified, put through all of the specified testing, and we were able to go from concept to production in 45 days.

We also believe using a "Stage Gate" approach enhanced our success. It made sure everyone knew the objectives, whether we have met our objectives, and that the proper resources were being allocated.

The following steps are an example of an effective Stage Gate process:

- 1. Investigation/quote phase**
 - a. Product criteria
 - b. Product design
 - c. Manufacturing process(s) design
 - d. Quotation
- 2. Sample/Prototype phase**
 - a. List requirements
 - b. Sample run
 - c. Testing
 - d. Submission
 - e. Customer feedback
- 3. Approved product/proceed to production**
 - a. Forecast
 - b. Finalization of manufacturing processes/equipment
 - c. Vendor releases
 - d. Quality plan
- 4. Post Production analysis**
 - a. Continuous improvement opportunities
 - b. Other product/market applications

Product development, and determining the right finish for your thermoplastic product, is a very complex process. If the proper steps are not followed, this can be a very expensive and inefficient process. If you involve everyone, follow the right steps, you can "get the right finish" for your thermoplastic materials and reduce the number of days necessary for the development of your product.

Premier Material Concepts (PMC), is a custom manufacturer of TPE, ABS, HIPS, PP and acrylics for thermoforming, POP display material, converters and custom fabricators. PMC, a division of Rowmark, Inc., serves diverse industries including marine, industrial, aerospace, government, agriculture, automotive, displays, signage, electrical and furniture. For additional information about Premier Material Concepts (PMC) visit their Worldwide Web at www.buypmc.com.

Proper Colleting and Collet Maintenance in CNC Routing of Plastic^{1,2}

BY VAN NISER, ONSRUD CUTTER, LIBERTYVILLE, ILLINOIS

Introduction

Rigidity is a key factor in the routing of plastic material. The problems associated with rigidity involve the part as well as the machine. Parts must be held solidly with established fixturing techniques, and the machine must be appropriately maintained to insure the cutting tool is following the proper tool path in a rigid and concentric fashion. One of the elements that aids in this whole process lies in the area of proper colleting of the router bit and the ongoing maintenance procedure associated with router collets.

Types of Collets

The half-grip and full-grip collets are the two basic types found in CNC routers. Half-grip collets are identified by slits running from the bottom or mouth of the collet toward the top for about 80% of the collet length. These collets are often counter-bored at the top, so that the shank of the tool does not contact the entire length of the collet. The force holding the collet is primarily generated at the mouth of the collet, and proves ideal in situations where the shanks of the router tools are not long enough to fill the entire collet, Figure 1.

The full-grip collet is identified by slits running from both ends of the collet, which creates specific collet sections. Full-grip type collets allow for squeezing pressure to be exerted over the entire length of the collet, Figure 2.

¹This article appeared in *Plastic Distributor & Fabricator*, Nov/Dec 2004, and is reprinted with permission of David Whelan, Editor/Publisher. For subscription information, please contact www.plasticmag.com. The article has been edited by TFQ Technical Editor, who is responsible for any alteration in content or intent.

² Although the article addresses plastic trimming issues, the information is directly applicable to pattern makers and craftsmen working in other materials such as wood.

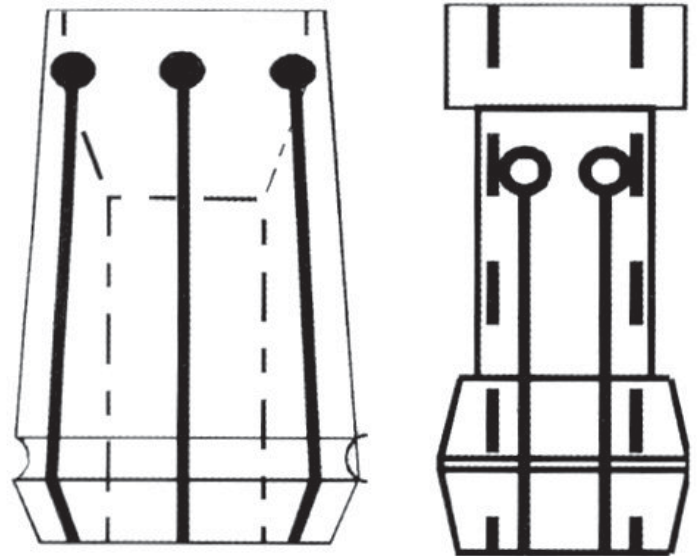


Figure 1. Half-Grip Collets.

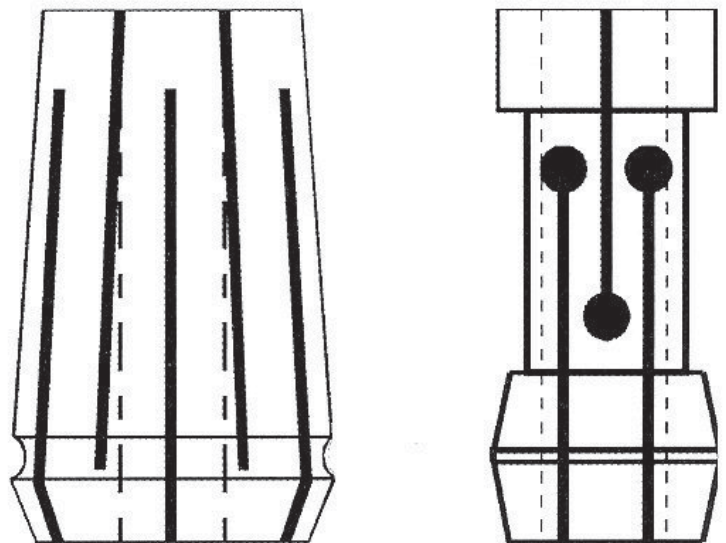


Figure 2. Full-Grip Collets.

Proper Colleting

The proper method of colleting a router bit in the full grip collet is to fill at least 80% of the depth of the collet. This allows the tool to be equally distributed on all sections of the collet and provides an environment where the tool runs in a true circle

or concentricity. Without concentricity, the finish of the plastic will be adversely affected and tool failure can occur. There are situations where the 80% rule cannot be maintained because of inadequate shank length or extreme reach problems. Consequently, it becomes necessary to fill the void in the top of the collet with a filler or collet life plug. This is a practical solution to avoid collapsing of the collet, which may result from not following the 80% rule, Figure 3.

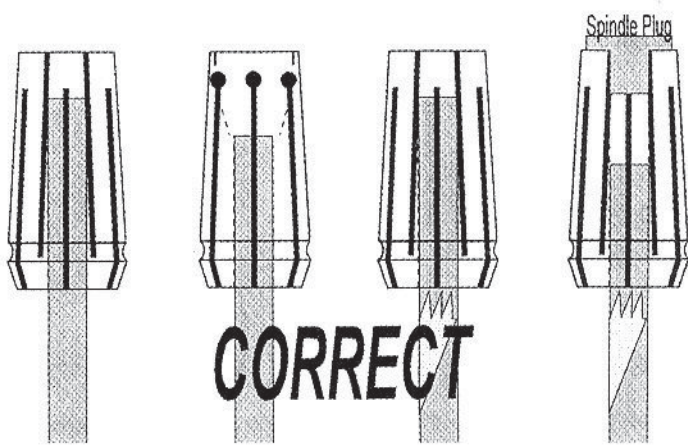


Figure 3. Proper Tool Colletting.

In all router bits, there is an area known as the flute fadeout section of the tool. This is formed when the grinding wheel utilized in the manufacturing of the tool exits the work piece. In order to properly collet a router bit, the mouth or bottom of the collet must contact the router bit slightly above the flute fadeout. Over-colletting or allowing the flute fadeout portion to extend inside the collet can damage the collet. This is a common cause of tool breakage, Figure 4.

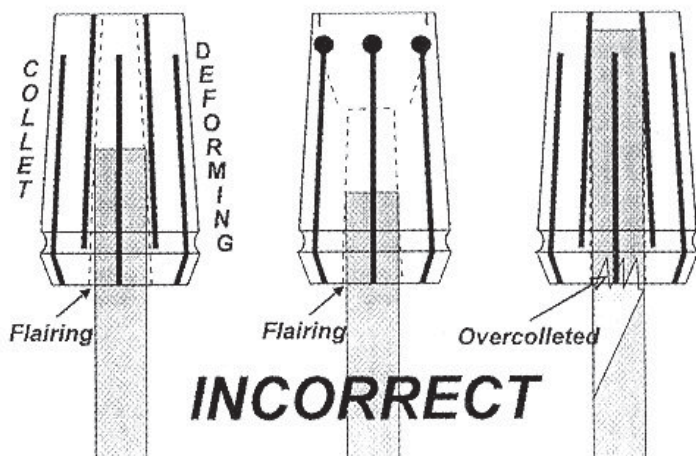


Figure 4. Incorrect Tool Colletting.

Collet Maintenance

Router bits and collets are expected to operate accurately in a work environment inundated with heat and grime. Plastic chips formed by the cutting action of the router bit carry with them resins that migrate through the slits of the collets and adhere to the inside of this closely toleranced mechanism. The resin build-up usually concentrates nearest the mouth of the collet. At this point, the tool is no longer being equally gripped, causing a loss in concentricity and tool run-out. Once again, the lack of a router tool running in a true circle affects the finish of the part and may cause the ultimate demise of the tool, Figure 5.

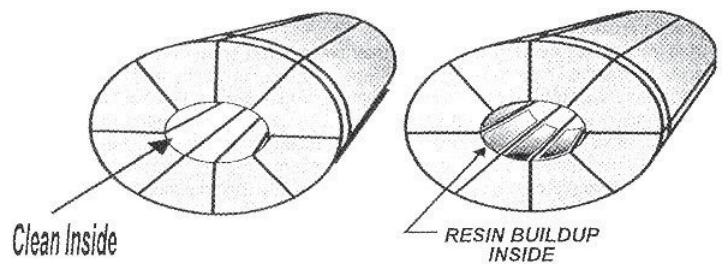


Figure 5. Collet Examples.

Fortunately this problem is easily resolved by cleaning the collets after every tool change. The procedure involves the use of a non-abrasive brass tube brush applied inside the collet in combination with a cleaner such as Rust Free™. All surfaces inside and outside the collet, inside the spindle taper, and matching and mating surfaces of quick-change tool holders, should be thoroughly cleaned and dried before being reassembled. Also the collet nut should be cleaned of resin and chip build-up and regularly replaced to ensure the integrity of the whole collet system, Figure 6.

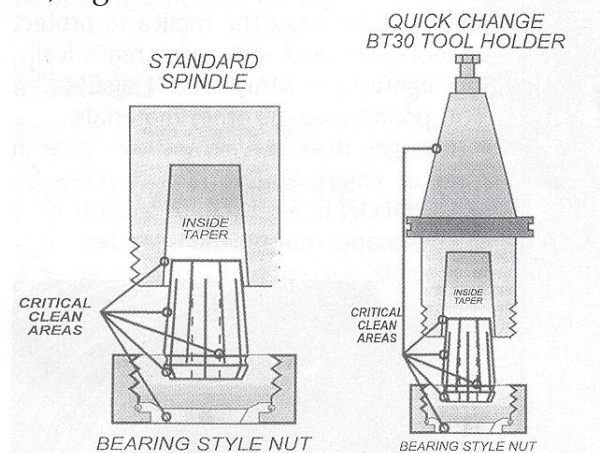


Figure 6. Full-Grip Collets.

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Collet Replacement

Collets are manufactured from spring steel and regular usage causes a loss of elasticity. Therefore, it becomes necessary to replace collets on a regular interval as part of an ongoing maintenance program. With diligent attention to proper collet maintenance, the average collet should be replaced about every 400-600 hours. Avoiding regular replacement can lead to brittle collets, which may crack or break, and cause permanent damage to the spindle. Re-

placement of collets is a much more economical alternative than replacing router bits or expensive spindles.

Rigidity and concentricity are the key elements in any routing application. The simple process of properly colletting router tools, maintaining collets, and replacing them at regular intervals will safeguard the productivity of the operation and ensure that the finish of plastic parts is not jeopardized.

For more information on this or other cutter issues, contact Onsrud Cutter, 800 Liberty Drive, Libertyville IL 60048, email: vniser@onsrud.com. ■

Tsunami Relief – Thermoforming Style!

On December 26, 2004 at approximately 8:00 am a magnitude 9.3 earthquake devastated the ocean floor off the coast of Northwest Sumatra. The resulting Tsunami traveled thousands of miles across the Indian Ocean, taking the lives of nearly 300,000 people in countries as far apart as Indonesia, the Maldives, Sri Lanka and Somalia.

Early in 2005, the Thermoforming Division started to investigate a way we could help out. Our thoughts were to find a truly unique way to make a difference. We looked into some of the more conventional disaster relief funds, Unicef, Red Cross and Worldvision. That is when I received a phone call from my sister, Barbara McConachie, a registered nurse who has made numerous relief trips to 3rd world countries. Her group, PRN International, was looking to send a small group of doctors and nurses over to Sri Lanka to assist with the relief efforts. This group was experienced in the most efficient way to get in and get busy.

At our winter Board of Directors meeting in Florida, I submitted a request for a donation to PRN International. The request was unanimously approved. On January 28th, 3 doctors and 5 nurses from Bridgeport Hospital left New York for Sri Lanka. Twenty-eight pieces of luggage filled with donated antibiotics, vaccines, analgesics, skin ointments and baby formula made the trip as well. Our volunteers worked their way up the northern coast of Sri Lanka (Ampara) and partnered up with healthcare providers from around the world.

During their stay the PRN relief team treated over 200 people in 3 different refugee camps on a daily basis; revisiting these same people every other day trying to prevent a outbreak of Malaria and Cholera. The physical injuries treated were pneumonia, diarrhea, fevers, open wounds and cellulitis. The physiological wounds were just as bad if not worse; most of the people lost 3 out of 4 family members. Depression and Post Traumatic Stress Syndrome is

rampant. The widespread devastation witnessed by these workers cannot be put into words. PRN International and my sister would like to thank the Thermoforming Division for their \$2,500 donation. The Thermoforming Division would like to thank the volunteers at PRN International for actually doing what most of us just talk about. We would like to think that in some tiny way, though PRN International, D25 made a difference, Thermoforming Style.

~ By Mike Sirotnak, Solar Products ■



History of Thermoforming – Part I

BY STANLEY R. ROSEN, PLASTIMACH CORPORATION, LAS VEGAS, NEVADA

Thermoforming Pioneers 1930-1950

The development of modern machinery for the thermoforming industry took place on the shoulders of very perceptive pioneers during the years 1930-1950. These experimenters did not have the modern tools or hindsight we now possess yet they developed many of the processes we currently employ. Information contained in this article was abstracted from periodicals, patents, and conversations with industry innovators. Some firms during this period developed proprietary equipment to thermoform their products and they are nameless at this time.

A great deal of development effort pre-World War II went into forming airplane acrylic canopies free of flaws. E. L. Helwig of Rohm and Haas Company in Philadelphia, an acrylic resin manufacturer, has two patents using different techniques which when modified can be used today.

Figure 1. Helwig's patent, filed on 11-27-1938, illustrates the forming of a canopy from a pre-heated sheet of acrylic forming which utilizes a hot fluid under variable pressure. The mold was water cooled so that sheet surface facing the cavity would chill and be hard enough to avoid being marred against the mold surface. The inner surface sheet would be free of blemishes since its contact is with the hot fluid. This process is similar to a modified method used today where air pressure forms sheet against a temperature-controlled mold producing high quality parts.

Ed. Note I: The philosopher Santayana said, "Those who cannot remember the past are destined to repeat it." Stan Rosen is undertaking a prodigious project – identifying the pioneers who laid the foundations of the industry we know so well. Although shaping of sheet extends back to pre-history – oil-heated and shaped tortoise shell and steam-heated and shaped wood, Stan begins the journey in the 1930s. We hope you enjoy the trip!

Ed. Note II: Each year since 1982, the SPE Thermoforming Division has honored a leader in the thermoforming field. Bow Stratton was the 1983 Thermoformer of the Year. Bob Butzko was the 1985 Thermoformer of the Year. And Stan Rosen, the author of this article was the 1991 Thermoformer of the Year. Stan can be reached at thermoipp@earthlink.net.

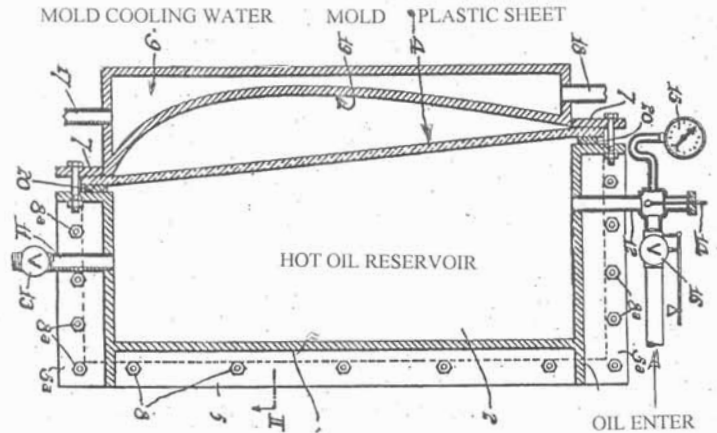


Figure 1. H. E. Helwig of Rohm and Haas Corp. filed for a patent 11-27-1936 using hot oil pressure for forming acrylic.

Figure 2. Helwig patent filed, on 8-28-1942, describes a male snap-back technique using an oven-heated acrylic sheet which is clamped to the device with quick-acting clamps or bolts. Figures 2-1 and 2-2 exhibit the use of vacuum to pre-stretch the hot sheet and allowing atmospheric pressure to force the cooling plastic to the male cavity. Figures 2-3 and 2-4 show air pressure creating a bubble of hot plastic which, after the air is exhausted from the

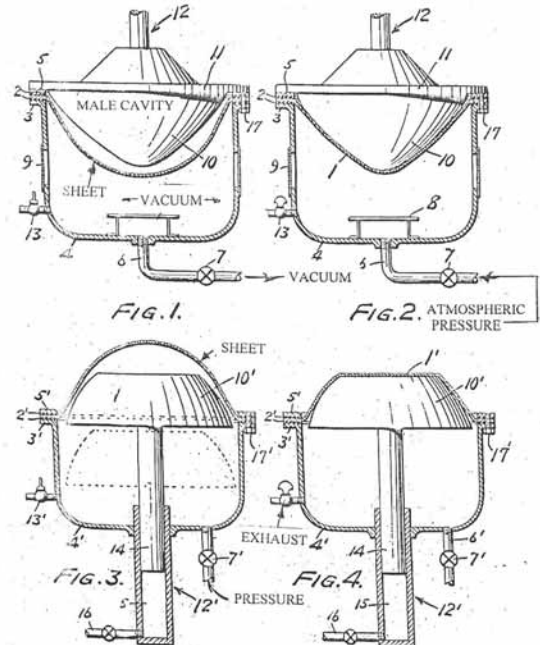


Figure 2. H. E. Helwig filed for a patent 8-28-1942 using snapback forming.

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chamber, the cooling sheet then conforms to the cavity. The expansion of the surface of the hot sheet before forming is used to assist in producing uniform wall thickness on the finished part. This process appears to be the first patent in which a male cavity is used in thermoforming.

Figure 3. R. E. Leary of Dupont Corp., patent filed 12-27-1940, illustrates vacuum forming using two methods of controlling a radiant heat source to achieve a uniform wall thickness.

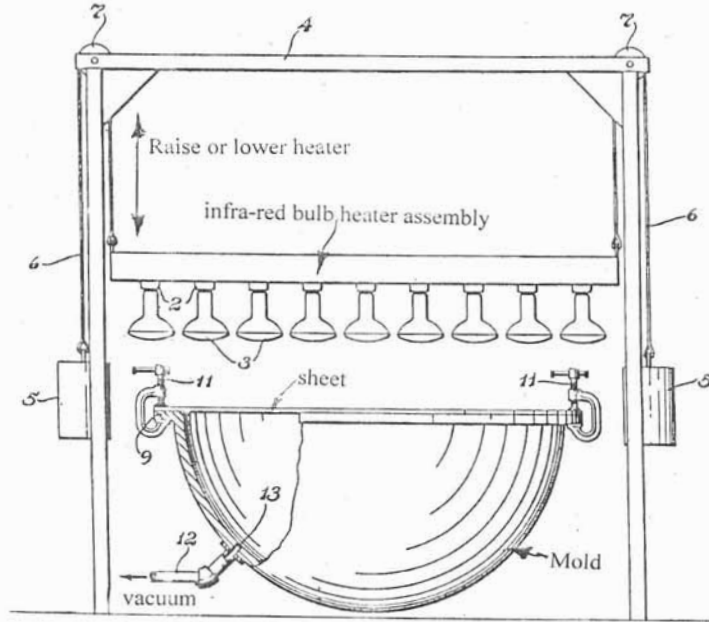


Figure 3. R. E. Leary of DuPont Corp. filed for a patent 12-27-1940 for a vacuum forming apparatus.

1. This heater assembly can be raised or lowered relative to the plastic sheet line. Moving a heat source away from or toward the sheet is a powerful method of heat control. The distance of a radiant source to its receptor is not a linear function and a small movement can create big differences in temperature distribution across a sheet surface.

2. Each lamp in the heater assembly is individually controlled so that the heating pattern can be zoned to promote a uniform temperature distribution across the sheet. This patent suggests the use of radiant heating at the forming site rather than preheating the sheets in an oven and later transporting them to a mold.

Figure 4. J. J. Braund, patent filed on 2-17-1936, is not a plastics fabricating patent but it has an interesting concept. Braund in the early 1930s started to develop a process to produce inexpensive three-

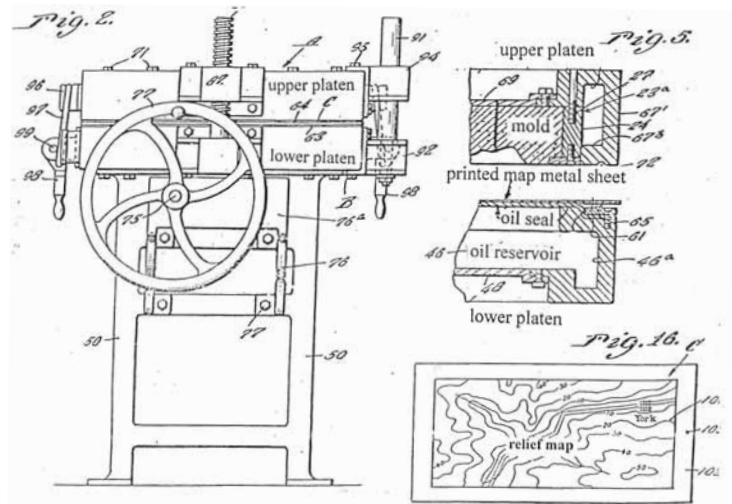


Figure 4. J. J. Braund filed for a patent 2-17-1936 for a relief map duplicating machine.

dimensional relief maps for the U.S. Coast and Geological Survey. A relief map sheet is distortion printed with each color referring to a specific elevation. When formed, the map might use green for sea level at the sheet line and white for the tips of the mountains in the deepest part of the mold. This technique locates a pre-printed sheet of ductile metal facing a female mold mounted above the blank. The back face of the sheet is sealed to a shallow box and the whole assembly is locked in a powerful clamp frame. Hydraulic oil under pressure is

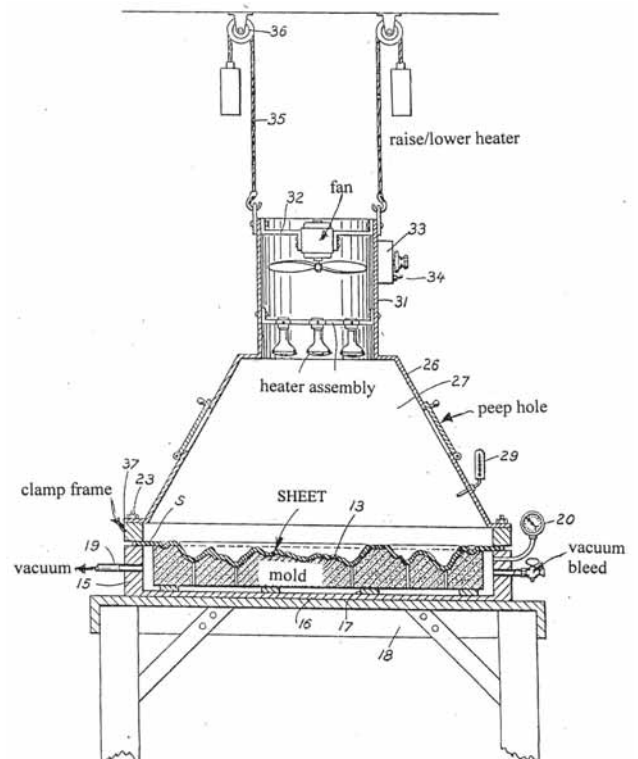


Figure 5. J. T. Braund filed for a patent 9-24-1946 for a relief mat vacuum former using convection heat.

pumped into the box, forcing the metal sheet to flow into the mold. If the date of the above patent was 1946 instead of 1936, Braund could have chosen to substitute a plastic sheet instead of metal and might have used air instead of oil pressure.

Figure 5. J. J. Braund filed a patent on 9-24-1946, which describes a system for vacuum forming plastic relief maps similar to his earlier 1936 metal forming methods. This sheet heating system is analogous to R. E. Leary's oven, except the heater provides convection heat transfer rather than radiant heating. The top fan creates an air flow through the

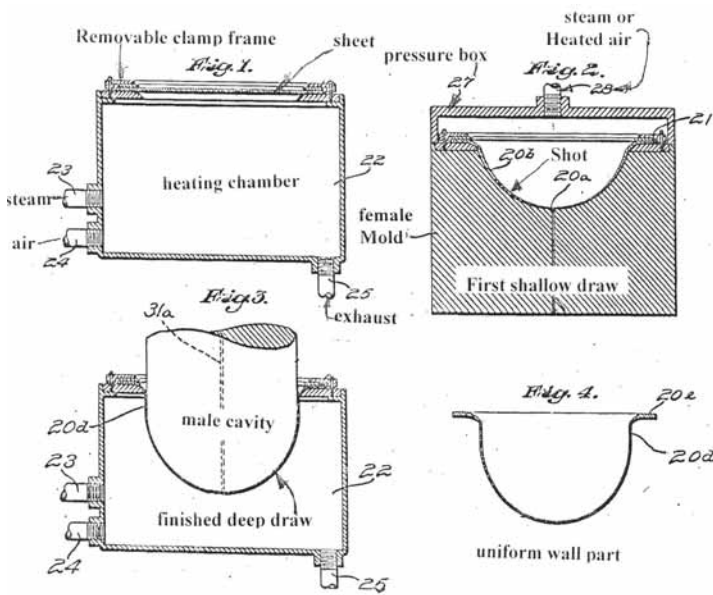


Figure 6. F. E. Wiley of Plax Corp. filed for a patent 6-1-1944 for a method of deep drawing plastic sheets.

bank of heat lamps which increases the air temperature within the hood and heats the plastic to forming temperature. Braund claims this method creates a very uniform sheet temperature for accurate registration of pre-printed sheet to vacuum forming mold.

Figure 6. F. E. Wiley of Plax Corp., Hartford, Connecticut, filed for a patent on 6-1-1944. It is concerned with forming techniques which produce a uniform wall thickness on deep drawn parts. This system is a three-step process in which the sheet is pre-heated, and in the second operation it is drawn to a shallow depth in a female cavity. A third operation draws the sheet to the deeper finished size on the male cavity. The heating medium is steam, which raises the sheet to forming temperature in all the steps and the clamp which holds the pre-

heated sheet frame is moved manually from step to step. Wiley has developed four similar variations of this technique. (Only one is illustrated as follows:)

Figure 6-1 is a steam heating chamber. In Figure 6-2, a shallow female mold and sheet is pressure-formed using steam and its wall thickness is at a minimum at (20a) and thickest at (20b). In Figure 6-3, the sheet is steam-reheated with male cavity (31) lying in the shallow form to prevent distortion. When the sheet reaches forming temperature the steam is exhausted and the cavity (31) is extended to final depth while atmospheric air pressure forces the sheet against the cavity. The male cavity draws material from the upper side wall (20d) and very little from the tip (20a) which results in a fairly uniform product, Figure 6-4. ■

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**PART II WILL FOLLOW
IN THE NEXT
THERMOFORMING
QUARTERLY**

Understanding How a Sheet Stretches¹

BY JIM THRONE, SHERWOOD TECHNOLOGIES, INC., DUNEDIN, FL

We began our discussion of part design by reviewing why we might not want to quote on a job. But let's suppose that we did quote on the job. And we got it. Now what?

Forming into a Mold v. Forming onto a Mold

In the not-so-politically-correct jargon of the day, if we form *into* a mold cavity, the mold is called a "female cavity." A better PC² phrase is "negative mold." If we form *onto* a mold, the mold is called a "male mold." The proper PC phrase is "positive mold." Is there a difference in forming "into" v. forming "onto"? Of course. Let's consider for the moment, forming a very simple truncated cone. If we use a mold cavity, the sheet first drapes into the open cavity, then stretches into the cavity with the sheet progressively laying on the mold surface. Keep in mind that the sheet that contacts the mold surface usually doesn't stretch any further. As a result, the sheet that is free of the mold becomes thinner and thinner as it is stretched to the bottom of the mold. The wall of the resulting part is thickest at the rim and thinnest at the bottom. The thinnest region of the part is in the corner where the wall meets the bottom. We can show arithmetically that if

¹ This is the third in a series that focuses on part design.

² PC. Politically correct.

³ We discuss draw ratio in the next lesson.

⁴ By "positive surface," we mean that surface that the customer considers to be the more important one. Usually the surface against the mold is considered the positive surface, but not always.

⁵ Efficacious: Producing or capable of producing a desired effect.



THERMOFORMING 101

the wall makes a 60-degree angle with the horizontal rim, the wall thickness decreases linearly from the rim to the corner. If the wall makes a 90-degree angle [think soup can], the wall thickness decreases exponentially.

Now consider using a truncated cone male mold. The sheet first touches the mold at the bottom of the part being formed. As the mold pushes into the sheet, the sheet stretches between the clamp and the bottom of the mold. If the sheet doesn't touch the sides of the mold until the mold is completely immersed in the sheet, the sheet thickness is usually quite uniform. If the sheet progressively touches the sides of the mold as the mold is being pushed into the sheet, the wall of the resulting part will be thickest at the bottom and thinnest at the rim.

Does it make a difference whether we form into a cavity or over a mold? If part performance is important, probably not, if the part draw ratio³ is very low [think picnic plate or aircraft engine cover]. As the draw ratio increases, however, the thinnest sections of the part begin to control the performance of the part. Several other factors can influence our decision, such as:

- Is it easier to prestretch the sheet when forming into a cavity or over a mold?

- Is it easier to machine a cavity or a male mold?
- Is the rim thickness important, as in the case of thin-gauge containers?
- And does the customer need the inside or the outside of the part to be the positive surface⁴?

Usually – but not always – mechanical plugs are more effective in stretching sheet into a cavity, female molds are easier to fabricate than male molds, and rim thickness is better controlled with female molds. We'll revisit some of these factors later.

Forming "Up" v. Forming "Down"

What does this mean? If the mold is placed above the sheet, the mold is immersed in the sheet and the part is formed up onto or into the tool. If the mold is placed below the sheet, the sheet sags into or onto the mold and the part is formed down onto or into the tool. Why is this an issue? In thin-gauge thermo-forming, forming up has advantages with female molds. Gravity helps when releasing parts from multi-cavity tooling. And the parts are properly oriented for in-line trimming. Having said that, keep in mind that it is easier to mechanically prestretch the sheet into fe-

male cavities if the molds are below the sheet.

Although the mold weight may prevent mounting the mold over the sheet in heavy-gauge forming, there are some advantages here too. For example, when a male mold is mounted over the sheet plane, sheet sag acts to prestretch the sheet prior to the mold immersion. The sheet is formed down for most heavy-gauge forming into female molds. Again, sheet sag acts to prestretch the sheet prior to forming. And certainly, it is easier to activate and maintain mechanical plugs if they reside above the sheet rather than below.

Mating Parts

It should be apparent that the part side against the mold maintains a more accurate dimension than the other side. The mold side is chosen whenever the part is to mate with another dimensioned part. For example, for an integral-lid container to be liquid tight, the outside of one half must mate with the inside of the other. This may require that one half is formed into a female mold while the other is formed on a male tool.

An Observation

When quoting on a job, it is always advisable to keep in mind the capability of your equipment to form the part in the most efficacious⁵ and least costly manner. If you can't form up, don't quote on a job that is best produced in this fashion. The more tortuous the path to perfect parts, the greater the degree of difficulty. And surely the greater the chance for quality issues. ■

Keywords: *positive mold, male mold, negative mold, female mold, draw ratio, forming up, forming down, sag*

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G. L. Beall, *The Evolution of Plastics in America (As Seen Through the National Plastics Expositions)*, Plastics Historical Society Occasional Paper No. 1, 1 Carlton House Terrace, London SW1Y 5DB, United Kingdom, 26 pdf pages when printed, sales@plastiquarian.com, ~\$18.00.

It is fitting that Beall's latest effort (1) is on the history of plastics as viewed from the exhibits seen at NPEs and (2) is on a plastic CD-ROM. It is also appropriate that in this issue, we feature the first part of Stan Rosen's review of the history of thermoforming in the Industrial Practice column. The first NPE was sponsored solely by SPI and was held in New York City in 1946. The public was invited to the inaugural Exposition and the public came – 87,000 – an attendance record that was not surpassed until 2000! Of course, after the first NPE, the conferences were ostensibly closed to all but members of the plastics industry.

Even though the public viewed plastics as wondrous things in 1946, it seemed that the industry did not really begin to believe in itself until the late 1970s. Attendance appeared to plateau below 40,000 during the intervening years. The attendance in 1982, for example, was only 41,000. Attendees in those intervening years would have seen the shift from cellulose and phenolics to polyolefins and urethanes, from a dominance of custom molders to the dominance of material suppliers and major machinery builders, from just over a billion pounds of plastic consumed a year to more than 40 billion pounds of the stuff. The attendees would have seen a 42-pound compression molded television cabinet, Monsanto's plastic "House of the Future," the newly-invented screw in-

¹ The reviewer spent many months working on both of these projects, saw them exhibited at NPE, and then watched the first fail FDA trials and the second fail economically.

jection molding machine, the blow-molded plastic milk bottle, the nitrile barrier carbonated beverage bottle, Coors molding-with-rotation (MWR) beer can¹, the Weyerhaeuser 714 composite can¹, pink flamingos, and the following litany of new plastics – LLDPE, rigid PVC, PP, EVA, ABS, mPPO (Noryl), continuous cast acrylic, ionomers, PPS, and PET. And if you were a collector, you would have tried to take home hula hoops, swimming pool noodles, and PP garden chairs, among other attractive give-aways.

This is a fascinating trip down memory lane for many of us. Beall's first show was in 1958 in Chicago; mine was in 1966 in New York City. And I'm sure that both he and I have made the effort to go to every one since. I, like Beall, remember both the excitement of the new ideas and the glitz and glamour of the exhibits. Gone are the days when exhibitors attracted us to their booths with comely lasses in very short skirts, or tickets to local shows (particularly in NYC), or fancy gentlemen's after-hours clubs where libations abounded.

Sometimes in the grim reality of today, we need to reflect on another time – not as intense, not as throat-cutting – when new ideas were not kept as secrets but were touted as representing the genius of our industry, daring the competition to better them.

Take time to seek out this CD-ROM. It's worth the time and effort. And if you weren't around for this era, read it and pretend you were. Five books out of five.



~ Jim Throne

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Council Report ... Atlanta, Georgia



BY STEVE HASSELBACH, COUNCILOR

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Registration at ANTEC was 2,658 (including participants in the seminars.) A total of 168 registrants attended 19 Society seminars.

Incoming President Len Czuba's SPE mantra is "Connect, Collaborate, Compete!"

From the Council Floor – Rebates:

The Council discussed the disposition of rebates and accepted the proposal drafted by a special subcommittee chaired by Bill O'Connell. Most changes to the rebates will take effect in 2007 with the one exception that rebates in 2006, while based on the prior system, will be paid quarterly.

The main differences between the old and new systems are as follows:

- Budgeting total rebate dollars – For example, if Council budgets rebates at \$350,000 and the actual calculation comes to \$315,000, every group would receive 111% of their calculated rebate. Likewise if rebates are budgeted at \$350,000 and the actual calculation comes to \$390,000, every group would receive 90% of their rebates. Furthermore, rebates will be paid quarterly in the same year they're budgeted. This provides Council and SPE with a couple of important advantages. First, spreading the rebate payments out helps with cash flow management. Second, paying them as part of a budget in the same year allows Council to make decisions about rebates closer to the time actual rebates will be paid, helping with balancing the budget. In the event there are catastrophic difficulties, Council has the flexibility to reduce the total rebate amount as it also reduces spending in other areas. Likewise, in times of plenty, Council would have the flexibility to distribute more funds to SPE groups.

- Paying rebates quarterly – As mentioned above, this helps tremendously with cash management and will be initiated in 2006 (so rebate payments in 2006 will be based strictly on the old calculation which is based on membership as of 12/31/05, and will be distributed quarterly).

- Making the 3 changes to the calculation – These are some minor "common sense" changes that do not greatly change the individual amounts. The changes are too detailed to present here, but please refer to the proposals sent to you prior to the Council meeting if you want to review them. Again, these changes will not be implemented until 2007.

- Paying rebates only for dues paying members – In the past, folks who paid no dues (unemployed members, distinguished members, etc.) were still included in the rebate calculations. The pool of these folks is small, especially when distributed across all of our groups.

- Dropping the rebate for the seldom-collected initiation fee – SPE's initiation fee is more often dropped as part of a promotional incentive for new members. Since SPE does not collect these funds, the new system will take the small amount that was being distributed to groups out of the calculation. Again, no individual group is going to be materially affected by this change.

- Tiering Division rebates – Under the old system, Division rebates were not tiered the way Section rebates were. This makes the two systems more parallel.

- Having performance criteria for rebates – This is not entirely new. The current system requires a Board of Directors and the submission of the required financial statements. The three items below are new, and the idea here is to monitor how groups are serving members, and give the Sections/Divisions Committees a heads up on any

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group that is failing to provide these basic requirements so we can work together to get things on track.

- No rebates for sections and divisions whose council seat has been declared vacant by Council (non-attendance for 3 consecutive Council meetings)
- Requiring communication with members (demonstrate regular communications to members)
- Having a plan (helps to demonstrate that activities are ongoing)

For a full copy of the proposal, go to the SPE Leadership page at: <http://www.4spe.org/communities/leadership/0505/materials.php>.

New Charters

The Council approved the charter of the Flexible Packaging Division. Two new SIG's were presented to Council: Nanotechnology and Micromolding. A student chapter was established at the University of Mississippi.

Awards & Recognitions

In addition to the recognition of the retiring administration, two additional awards were given out. The Michael Cappelletti Excellence Award was given to Bill O'Connell and the James Toner Service Excellence Award was given to Tobi Gebauer.

Outgoing President Karen Winkler thanked her Executive Committee for their hard work. Incoming President Len Czuba introduced his Executive Committee. New Executive Committee Vice-Presidents are: Russell Broome, Héctor Dilán, Lance Neward, and William Smith. Paul Anderson is the 2005-2006 Treasurer and John Szymankiewicz is the 2005-2006 Secretary.

Presentations

Composites Division - \$1,500 Harold Giles Scholarship; \$1,000 Foundation Scholarship program

Mold Making & Mold Design - \$1,000 Student Author Travel Fund

Detroit Section - \$2,000 Essay contest; \$2,500 International Education Award in honor of Fred Schwab

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Color & Appearance Division - \$1,000 Donation to the SPE Foundation

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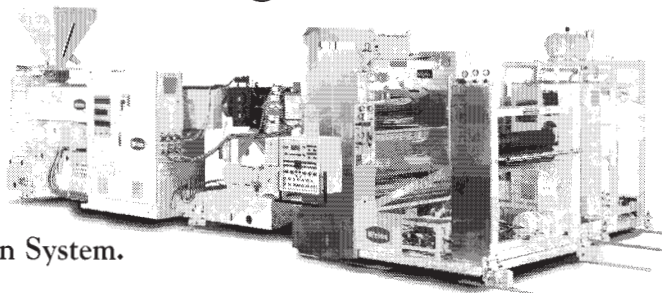
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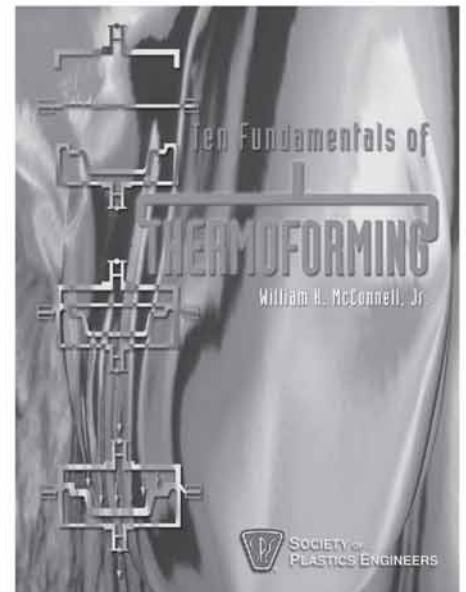


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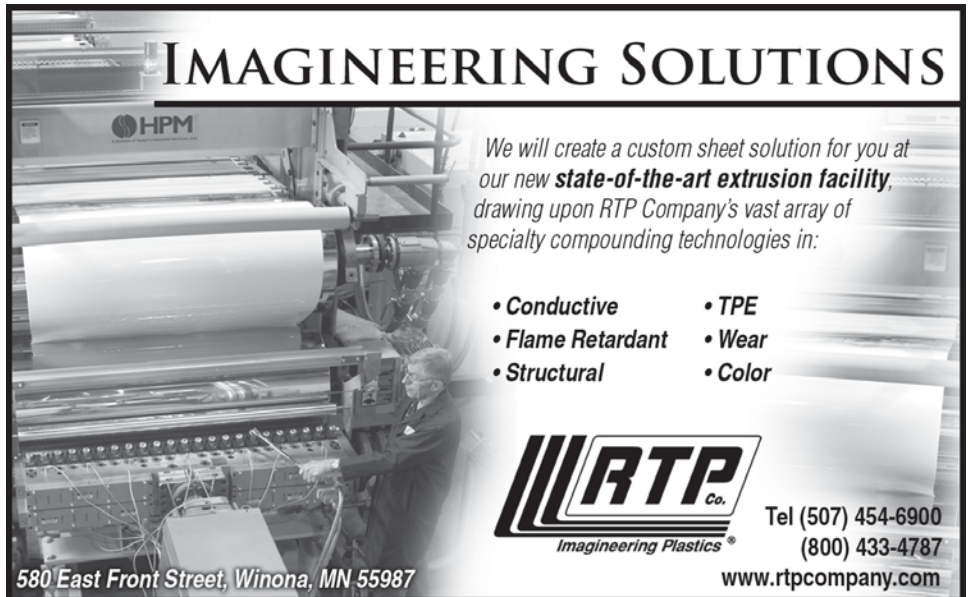
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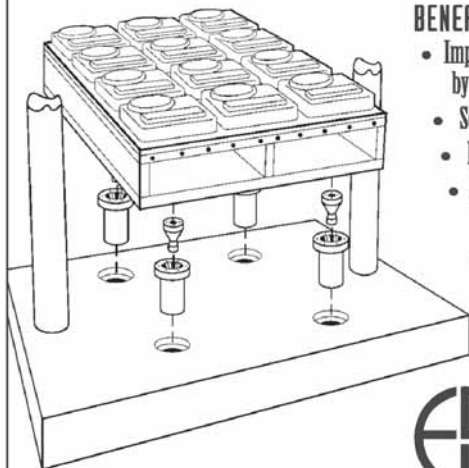
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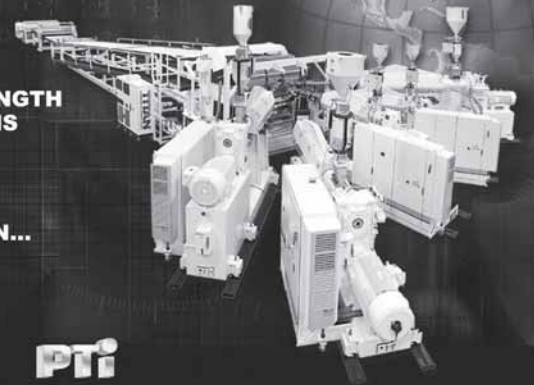
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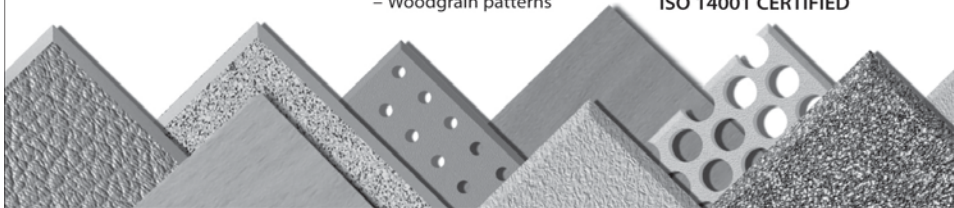
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