RMD News
The Rotational Molding Division of SPE Newsletter

2nd and 3rd Quarter Volume 18 Issue

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Looking Forward to 2019

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ROTATIONAL MOLDING

In this issue:

TOPCON 2018

TopCon 2018

TopCon 2018 was one of the best technical conferences to date with well over 100 in attendance!
The main focus of TopCon 2018 was Materials, Machinery, Molds, and More!

If you missed this year's conference please get ready for **TopCon 2019** which is scheduled for June 11th , 12th, and 13th at the Cleveland East Marriott

Thank you to this year's sponsors!

And BIG a thank you to Vince Costello and his team from Diversified Mold and Casting for allowing us to tour their facility!!

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Newsletter Comments/Questions? Contact:

Sponsorship: Russ Boyle at
Russ.boyle@gulfviewplastics.com
or call (727) 379-3072

Editor: Melissa Inman at (919) 888-0940
Melissa.inman@gulfviewplastics.com

Asst. Editor: Dr. Peter Mooney
PlasRes@aol.com or call (336) 998-8004

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In The News:

Rotational Molding: Rotating Between New Materials and New Markets

In order for rotational molding to thrive, experts say expanding into new materials is essential

In many ways rotational molding is the ideal method for making hollow plastic items. It involves pouring a fixed amount of plastic powder into a mold, which is heated to melt the powder and rotated about two axes to coat the interior walls with molten plastic. This method doesn't require any pressure, meaning the mold can be simpler with thinner walls and cheaper to produce than molds that have to withstand high pressure.

This simple process is flexible enough to produce hollow items of almost any size - from tiny components for hearing aids to 70,000-liter storage tanks and everything in between, including toys, medical implants, kayaks and traffic cones. Because the molds are cheap, as are rotational molding machines, it lends itself to small production runs that would be uneconomical with a more expensive technique such as injection molding.

It also lends itself to producing items with comparatively thin walls such as storage tanks. This is both because it naturally produces walls with a very consistent thickness and because the molten plastic tends to accumulate in the comers of the mold, producing thick external corners that aid rigidity.

Rotational molding has one important drawback, though: its almost complete reliance on polyethylene, which accounts

for 97 percent of the market for rotational molding materials. This dominance of polyethylene has always kept rotational molding as a fairly niche plastic molding technology, consuming just 0.7 percent of global plastic production. But things are gradually beginning to change, fueled by a growing recognition that rotational molding has the potential to break into many new markets if only it can move beyond polyethylene.

"For the industry to grow, we need to work with more materials”, says Aldo Quaratino, technical director at Matrix Polymers, a UK-based global supplier of materials for rotational molding. "There are so many other polymers we're not really doing anything with because of the difficulty of adapting them for rotational molding" than with other plastic molding techniques.

There are ways to make other polymeric materials more suitable for rotational molding. For example, antioxidants can be added to polymeric materials to reduce the thermal degradation caused by oxidation or the rotational molding can be conducted in an inert gas such as nitrogen rather than air. New techniques such as cryogenic grinding can also produce powders from a wider range of polymers than conventional grinding techniques.

But these approaches add complexity and expense to the rotational molding process, and for the vast majority of applications polyethylene is perfectly acceptable, especially given the availability of a wide range of different polyethylene grades with different properties. This doesn't just mean high density and linear low-density polyethylene, but various grades specifically designed for rotational molding.

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These grades are generally produced by incorporating various additives into polyethylene to modify its chemistry and thus its physical properties. For example, hexene or butene is regularly added to enhance stiffness and impact strength. Another option is to use peroxide-based additives to induce the formation of chemical bonds between the polyethylene polymers. The resultant cross-linked polyethylene also boasts enhanced stiffness and impact strength, as well as improved chemical resistance, allowing it to be used to produce tanks for storing aggressive chemicals.

In addition to enhancing the properties of polyethylene, additives can also confer entirely new properties, producing polyethylenes that are flame-retardant, electrically conductive or antibacterial. Still, these additives can only do so much, and polyethylene is simply unsuitable for certain applications, which has tended to keep rotational molding away from these applications.

This is what companies such as Matrix Polymers are now actively trying to change - by adapting other polymers so that they can work with rotational molding just as easily as polyethylene does. "We modify the chemistry of other polymer materials so that the customer can use the material under their conventional molding parameters", explains Quaratino. In other words, it allows their customers to use the new material in exactly the same rotational molding machines in exactly the same way as they do with polyethylene.

Their basic approach once again involves using additives in order to improve properties such as melt viscosity, but this is proving to be quite a challenge. "It's easy to say we need a viscosity modifier, but there are so many on the market. So which one is the right one", says Quaratino. To find out Matrix Polymers is testing a wide range of additives and investigating the chemistry of different plastic materials at their research laboratory in Liverpool, England.

"The challenge is to understand the chemistry, have the right people in the lab performing the tests accurately, including tests for rheology and viscosity, and understand the test methodology because the interpretation of the test is paramount", he says.

And this all takes time and effort: "The work is immense."

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This hard work is now beginning to bear fruit. For example, in conjunction with the British rotational molding company, Enduramaxx, Matrix Polymers recently developed and launched a new fluoropolymer (polyvinylidene fluoride or PVDF) for rotational molding. Fluoropolymers such as PVDF are high-performance plastic materials able to withstand high temperatures and high chemicals. Matrix Polymers specifically developed its novel PVDF so that Enduramaxx could use rotational molding to produce large tanks for storing aggressive chemicals at temperatures up to 140°C, as a replacement for heavy steel tanks.

Matrix Polymers has developed a new material that should allow rotational molding to enter an entirely new market: a version of polyamide-6, also known as nylon-6, that can be used to produce vehicle fuel tanks. At the moment fuel tanks in cars are usually made from steel, but car manufacturers would like to replace them with lighter plastic tanks in order to improve fuel efficiency and decrease carbon dioxide emissions.

Rotational molding would seem to be an ideal method for producing hollow plastic fuel tanks, but these fuel tanks need to be very stiff and able to hold fuel at temperatures of around 120°C, both of which are a problem for polyethylene which melts at that temperature. They're not a problem for polyamide-6, which can withstand temperatures of up to 150° and is four to five times stiffer than polyethylene, but polyamide-6 doesn't readily lend itself to rotational molding.

"It's incredibly hard to rotomold", confirms Quaratino. "We spent so much time to understand how we could make polyamide-6 a little bit more fluid by decreasing the viscosity of the polymer when it's molded."

After five years of hard work they produced a version of polyamide-6 that retains all the properties required for fuel tanks, but can also be rotationally molded. The new version is called Revolve PA HIU.

This is all much to the delight of rotational molding companies, which quickly spied the opportunity to enter a new and impressively large market.

"The response has been incredible", says Quaratino. "Rotational molders working in the automotive sector tell me this is fantastic because this material will open up so many opportunities."

Following this success Matrix Polymers is applying the same approach to other polymers, including polypropylene and polycarbonate, that don't naturally possess the necessary properties for rotational molding. It is also continuing to work on novel ways to improve the properties of polyethylene.

"Another big challenge is that it's really difficult to stick anything to polyethylene, and yet there are so many products where polyurethane foam is added to polyethylene products", reports Quaratino. "Polyurethane foam doesn't stick to polyethylene, and so in many cases there is delamination and product failure. So we're trying to come up with a. new chemistry where there would be a chemical bond between polyurethane foam and polyethylene."

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Quaratino doesn't think polyethylene will be usurped from its position as the top rotational molding material any time soon, but he does predict a great opportunity from expanding the range of materials that can work with rotational molding.

"Polyethylene will be the dominant material in the industry, but for the industry to grow we need to work with materials that are different from polyethylene. So I'm thinking about polycarbonate, acrylonitrile butadiene styrene (ABS), and polystyrene, for example. In the next five to 10 years I see more rotational molders embracing this vision and culture. I feel optimistic; the industry has huge potential."

ABOUT THE AUTHOR

Jon Evans is a science writer and editor. He has written for many print and online publications, including New Scientist, Chemistry World and Chemistry & Industry, and his first book, Understand Science, is published by Hodder Education. He is also the founder of JES Editorial Ltd., a copywriting company that produces a wide range of products and services, including press releases, website text and technology briefings, for companies, universities and scientific societies. Jon can be contacted at www .1eseditorial.com.

In The News: 2018 Design Competition Winners Announced

Winners of the 2018 Rotational Molding Product Design Competition Announced

AKRON, Ohio, July 6, 2018 – Winsell, Incorporated, announced the winners of the 2018 International Rotational Molding Product Design Competition. The goal of this annual contest is to inspire emerging industrial design students to create breakthrough consumer products that utilize the latest technologies in rotational molding. Judging criteria include: originality, process-ability, growth potential, beauty and visual appeal, tool-building compatibility, and use of appropriate materials and category compliance.

This year over 60 students participated in the design competition. The entries included the following design schools: The Columbus College of Art & Design, Pennsylvania College of Technology, the University of Wisconsin Stout, Purdue University, Penn State, and Milwaukee Institute of Art & Design.

First Place was awarded to Sarah Niehaus of Purdue University for her design of the **Paddle Buddy** wagon. Using rotomold techniques, the Paddle Buddy is a toy wagon that transitions from a pulled wagon to rider-motivated vehicle. The Paddle Buddy employs a detachable handle and allows 1-2 riders to be pulled. Once the handle is detached, it enables an internal pedal system that permits riders to drive and steer.

First Place winner: Paddle Buddy by Sarah Neihaus of Purdue

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In The News: 2018 Design Competition Winners Announced

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Second Place was awarded to Annalie Fitzgibbon and Stacey Johnson of Penn State Erie, Behrend College, for their design of an outdoor fountain. The fountain targets the growing market of bringing indoor luxuries into outdoor living spaces. The fountain is functional and acts as an outdoor statement piece.

Second Place winner: Outdoor Fountain by Annalie Fitzgibbon and Stacey Johnson of Penn State Erie, The Behrend College

10 Honorable Mentions were awarded to the following students:

- Purdue University: Franz Cerwinka, Dewy Yu, John Munroe, Piper Stamper, Mary Smith, Jie Chen
- University of Wisconsin-Stout: William Frey
- Northern Michigan University: Levi Schwamlien, Jordan Walker-Jenkins
- Penn State Erie, Behrend College: Nick Jeffers, Mike Riley

The Rotational Molding Product Design Competition is organized by Winsell, Incorporated, with support from our 2018 sponsor, Diversified Mold & Castings.

“The rotational molding industry is fueled by the creative ideas of product designers,” says Fred Shockey, chairman and CEO of Winsell, Incorporated. “When we cultivate and celebrate emerging talent in the field, we will thrive. The Product Design Competition gives us a glimpse into the future of rotational molding, while also ensuring that future.”

About Winsell, Incorporated

Winsell, Incorporated, headquartered in Akron, Ohio, is the world’s only 100% dedicated supplier of granite-effect colorants for rotational molding applications. Through extensive research and continuous innovation of granite formulations, the company provides trouble-free processing solutions to rotomolders. To learn more, read about the Winsell Granite Difference. Visit Winsell online at www.winsellinc.com, on Facebook and also follow us on Twitter.

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In The News: Look Back at ANTEC 2018

Look Back at ANTEC 2018

This year's SPE ANTEC was held in Orlando May 7-10. In particular, the conference was combined with the NPE, show offering more visibility to the papers being presented and more opportunity the ANTTEC attendees to visit the NPE booths. This year was very busy as a total of 56,000 participants attended the different activities.

As usual, a rotomolding session was organized on the first day. Due to the relatively high number of papers submitted, the whole afternoon was filled with papers on different subjects such as additives, materials, foaming, and composites as well as process optimization characterization. The presentations were well-attended with an average of 25 people. Overall, the session was truly international with papers coming from Canada, Italy and Mexico. Here is a list of the papers' abstracts for references without any specific order.

Optimization Of The Rotational Molding Processing Of Agave Fiber / LMDPE Composite Materials

R. G. López-Gozaleznúñez, A. Barajas-Cervantes, E. O. Cisneros-López, J. R. Robledo-Ortíz, P. Ortega-Gudiño, R. González-Núñez, Universidad de Guadalajara, México.

Denis Rodrigue, Université Laval, Canada.

In this work agave fiber (20% wt.) / LMDPE composites were processed by rotational molding with a commercial antioxidant type and UV stabilizer polyolefin additive in order to determine its influence on the process cycle. The aim was to reduce the processing temperature to ensure non-degradation of the agave fiber. The samples were mechanically characterized by impact, bending and traction tests. The results show that a biocomposite part without defects can be obtained at a peak internal air temperature (PIAT) of 210ºC, which represents a reduction of the process cycle time to obtain a part with the same characteristics without additives and without significant mechanical property changes.

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Mechanical Characterization Of Polyethylene/Carbon Nanofiber Composites Prepared By Rotational Molding

Z. Zepeda-Rodríguez,[1] M. R. Arellano-Martínez,[1] R. González-Núñez,[1] E. Cruz-Barba,[1] A. Zamudio-Ojeda,[2] Denis Rodrigue,[3] M. Vázquez-Lepe.[4]

[1]Departamento de Ingeniería Química, [2]Departamento de Física, Départment de génie chimique, [4]Departamento de Ingeniería de Proyectos, [1,2,4]Centro Universitario de Ciencias Exactas e Ingenierías, Universidad de Guadalajara, México. [3]Université Laval, Québec, Canada.

Nanocomposites of linear-medium-density-polyethylene (LMDPE) and carbon nanofibers (CNFs) treated with oxygen cold plasma were prepared by rotational molding, mixing 0.01, 0.1 and 1% wt. of CNFs by dry-blending. The objective of this work was to study the effect of concentration, surface chemistry and morphology of the carbon nanofibers on the morphology and mechanical properties of these nanocomposites. The XPS results indicate that the plasma technique increases the oxygen functional groups in CNFs. For the

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nanocomposites the addition of CNFs modifies the mechanical properties, but the main changes occur when CNFs treated by cold oxygen plasma were used.

Surface Treatment Of Agave Fibers And Its Compatibilization With PLA To Produce Rotational Molded Biocomposites

M.E. González-López, E.O. Cisneros-López, A.A. Pérez-Fonseca, D.E. Ramírez-Arreola, R. Manríquez-González, J.R. Robledo-Ortíz, Universidad de Guadalajara, México

D. Rodrigue, Université Laval, Canada

The aim of this work was to evaluate the effect of surface-treating agave fibers on the compatibility of PLA-agave biocomposites produced by rotational molding. The agave fibers were treated by immersion in a solution of maleic anhydride-grafted PLA (MAPLA). The effect of treatment on the physical and mechanical properties was investigated at different fiber contents (10, 20, 30 wt.%). The improved compatibility due to the grafting of PLA chains onto the fiber led to enhanced mechanical properties in comparison with untreated fiber biocomposites as a result of an effective stress transfer. In particular, tensile strength increased from 25 to 41 MPa and modulus from 1.30 to 1.74 GPa at 20 wt.%. It was possible to observe lower water diffusion coefficients, indicating that grafting MAPLA decreases the fiber hydrophilicity and promotes better fiber wetting.

Morphology And Mechanical Properties Of Poly(Lactic Acid)/Polyethylene Blends Produced By Rotational Molding

Eduardo Ruiz-Silva[1], Luis Carlos Rosales-Rivera[1], Jorge Ramón Robledo-Ortíz[2], Denis Rodrigue[3] and Rubén González-Núñez[1]

[1]Departamento de Ingeniería Química, Universidad de Guadalajara, México.

[2]Departamento de Madera, Celulosa y Papel, Universidad de Guadalajara, México.

[3]Department of Chemical Engineering and CERMA, Université Laval, Canada.

Blends of poly(lactic acid) (PLA) and linear-medium-density-polyethylene (LMDPE) at different weight ratios were prepared by rotational molding using a laboratory-scale biaxial machine. The blends were previously produced by two different methods: i) dry-blending using a high-shear mixer and ii) melt-blending with a twin-screw extruder. The prepared blends were characterized in terms of morphology, mechanical (tensile, flexural and impact) and thermal (DSC) properties. The morphological results showed a clear incompatibility between both polymers in which the domains of the minor phase have well-defined spherical shapes and a broad size distribution. On the other hand, the results of the mechanical properties were found to depend on the blend preparation method. In general, blends prepared by melt-blending presented slightly

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higher flexural and tensile properties compared with those prepared via dry-blending. For impact strength (Charpy), an increase was observed until a maximum value was attained around 25% wt. of PLA for dry-blending and 6% wt. in melt-blending, after which the value decreased.

Rotational Molding Of Hybrid Composites Based On Linear-Low Density-Polyethylene/Ground Tire Rubber/Maple Wood Fibers

Y. Dou, D. Rodrigue, Université Laval, Canada

In this work ground tire rubber (GTR) and maple wood fibers (MWF) were dry-blended with linear-low-density-polyethylene (LLDPE) to produce hybrid composites by rotational molding. In particular, the effect of a coupling agent (maleated polyethylene, MAPE) was studied to modify the mechanical properties of hybrid composites. Each compound was characterized in terms of morphology, density and mechanical properties (tensile, flexural and impact). The results showed that the addition of GTR leads to little improvement of impact strength in wood fibers composites (WFC). Meanwhile the addition of MAPE improved interfacial adhesion further, resulting in better hybrid composites properties.

3-Dimensional Characterization Of The Quality Of Foam-To-Skin Bonding Of Rapid Rotationally Foam Molded Integral-Skin Cellular Composites

Utkarsh, I. Raktim, G. Rizvi, R. Pop-Iliev

University of Ontario Institute of Technology, Oshawa, Ontario, Canada

Rapid rotational foam molding (RRFM) was used to manufacture integral-skin composites consisting of various combinations of polyethylene (PE) and polypropylene (PP) skins that are completely surrounding respective foamed cores made of PE and PP by implementing a suitable chemical blowing agent (CBA) in extrusion. This paper presents the results of implementing a comprehensive 3-dimensional (3-D) characterization technique for evaluating the quality of the obtained foam-to-skin interfacial bond of such RRFM composites. As the internal cellular structure and bonding depends on different polymer material properties and processing conditions, a 3-D model was developed to map the region of bubble-into-skin penetration using a mi-

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cro CT scanner. The experimental results revealed that the reconstructed 3-D model of LLDPE skin has the best bond quality and cell penetration into the skin with porosity of 74.6%.

3-D Characterization And Mechanical Analysis Of Polyethylene Foams Processed In Rapid Rotational Foam Molding

P. Karimipour-Fard, W.Y. Pao, R. Pop-Iliev, G. Rizvi

University of Ontario Institute of Technology, Oshawa, Ontario, Canada

Rapid rotational foam molding (RRFM) products are integral cellular composites that consist of a solid skin which encapsulates a foamed core. This paper focuses on characterizing the morphologies in 3-D and identifying the key mechanical properties of respective integral-skin polyethylene (PE) cellular structures produced in RRFM by making use of micro-CT Scanner. Two types of PE grades were used to produce the foamed core whereas a PE and PP grades were used to produce the surrounding solid skin layer. The effects of varying relevant processing parameters such as foam-filling directions, processing temperatures and skin temperatures on the quality of the obtained foams were studied. In addition, the correlations between the resulting cellular structures, cell size distribution, and cell densities have been assessed. Finally, simultaneous stress-strain behavior and 3-D structure changes were monitored with in-situ compression testing.

Quality Monitoring Of Rotational Molded Parts sing A Non-destructive Technique

F.P.C. Gomes[1], A. Garg[2], P. Mhaskar[2], M.R. Thompson[1]

1- Center for Advanced Polymer Processing, and Design, McMaster University, Hamilton, ON, Canada

2- McMaster Advanced Control Consortium, McMaster University, Hamilton, ON, Canada

Achieving optimal quality for rotational molded parts requires a determination of specific conditions for oven temperature and heat/cool time. Traditional tests used to assess the quality of samples rely on destructive methods such as impact testing. This paper presents an innovative approach using ultrasonic testing associated with multivariate statistical modeling to evaluate the quality of molded polyethylene (PE) parts from several different batches. The results showed a good correlation of predicted quality using non-destructive data with both impact-energy failure and melt-flow index, indicating the potential of this technique to be applied for the quality monitoring of this process.

Designer's Corner

DESIGNER'S CORNER
Part #12

REINFORCING FEATURES PART 2

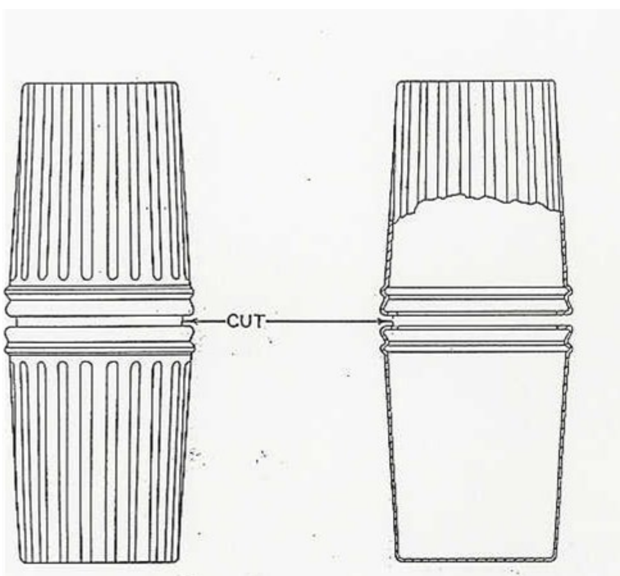
By: Glenn Beall

Editor's Note:

This is the 12th in a series of twenty-six articles that will review how to design rotationally molded plastics parts and products. We look forward to publishing these articles over many issues. This is a great opportunity for newcomers to the community as well as an always appreciated chance for review of important information.

This is the second of three articles that discuss techniques for providing increased strength on thin-walled rotational molded products.

The rotational molding process is noted for its ability to produce closed, hollow parts. This is an ideal attribute for play balls and floats or tanks and containers that require only small openings.



There are, however, large quantities of open-topped tanks, drums, containers and other products produced by rotational molding. It is a common practice to mold a long, cylindrical or square part that is cut in the center to produce two shorter containers open at one end. The two refuse containers shown in Figure 1 were produced using this technique. It is even more common to mold a tank of the required size and then cut a large opening in one end (Figure 2A).

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Designer's Corner

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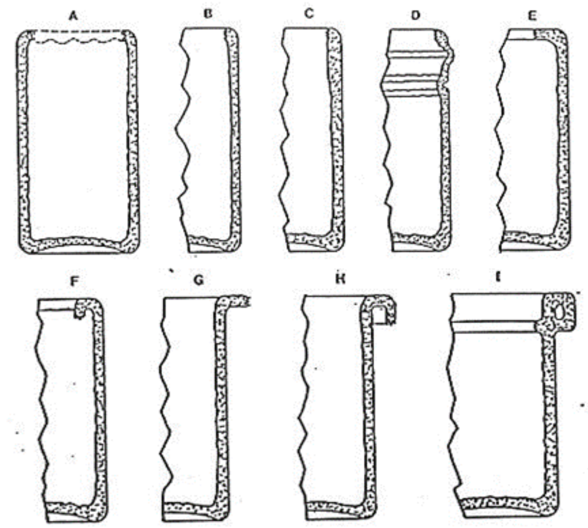
Removing one end of the tank produces a weak side-wall at the open end of the product (Figure 2B). That wall could be strengthened by increasing the thickness of the whole tank (Figure 2C), but that would be a waste of material and cycle time.

In some instances it is possible to strengthen the top edge of the tank by foaming the same amount of plastic material to produce a thicker and stiffer wall. The top of this type of tank could also be stiffened by incorporating an inward or outward projecting rib just below the top of the tank (Figure 2D).



A thin-walled tank with the same strength could be produced by removing the top wall so as to leave an inward-projecting flange on the part (Figure 2E). This flange could provide even more strength if it also extended a short distance down into the tank (Figure 2F).

If an inward-projecting flange is undesirable, the flange can extend outward (Figure 2G). This structure would be even stronger if that flange also extended downward (Figure 2H).

An extremely strong tank top rim could be provided by creating a hollow box-beam type flange, as shown in Figure 2I.

All of the configurations shown in Figures 2D through 2I could be used to produce a low-cost, thin-walled part, with added strength at the open end. Some of these stiffened flanges are more complex than others, but all of these shapes could be produced with a straight opening and closing two-piece mold.

This article is a condensed extract from G. L. Beall's Hanser Publishers book entitled "Rotational Molding Design, Materials, Tooling, & Processing" available at hanser@ware-pak.com or phone (877) 751-5052.

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Paul T. Kinsella Jr.
General Manager
Direct:
pkinsella@chromacolors.com

Bob Bunday
Technical Operations Manager
815-385-8100 Ext. 360
bbunday@chromacolors.com

Roxanne Liesik
Customer Support
Direct: 815-759-2170
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Rotational Molding Division

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Please contact Russ Boyle at (727) 379-3072 or Russ.boyle@gulfviewplastics.com

View the current and previous editions of the RMD Newsletter online at www.rotational-molding.4spe.org

RMD Interim Financial Report

SPE's Rotational Molding Division
Annual Financial Report 2015 -- 2016
July 1, 2015 to June 30, 2016

	Actual	Budget
Cash Balance: Beginning Period	$73,873.70	
Cash Receipts in Period		
SPE Rebate	$581.26	$1,100.00
Interest	$34.25	$50.00
Bank fee reimbursment	$20.00	
Newsletter Ads/Sponsorships	$2,500.00	$2,000.00
TopCon 2016	$282.00	$20,000.00
* Interest--should be on last yr	$3.61	
Total Income in Period	$3,421.12	$23,150.00
Cash Disbursements		
Postage	$6.10	
Awards	$1,656.04	$1,500.00
Bank Fees	$6.00	
IDES show	$1,871.00	$3,000.00
TopCon 2016	$16,505.41	$1,000.00
Board Mtg		$1,000.00
Website		$500.00
ANTEC student activities		$1,500.00
Advertizing		$3,500.00
Total Disbursements	$20,044.55	$12,000.00
Balance at end of Period	$57,250.27	

Balance is made up as follows:	
Checking Account	$5,861.85
Savings Account	$51,388.42
Total Balance	$57,250.27

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* interst payment made 6/30/15 which should have been included in last years statement but was

Respectfully submitted
By Russ Boyle

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Russ Boyle
Gulf View Plastics
18816 Oak Way Drive
Hudson, FL 34667
(727)-379-3072
Cell (270)-823-2256
Russ.boyle@gulfviewplastics.com
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jlindsey@traffixdevices.com
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Chevron Phillips Chemical Co. LP
146 Plastics Tech Center
Phillips 66
Research Center
Highways 60 & 123
Bartlesville, OK 74003-6670
(918)-977-4761
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Dr. Denis Rodrigue
University Laval
1065 Avenue De La Medecine
Dept. Chemical Engineering RM 3546
Quebec City, QC G1V OA6
Canada
(418)-656-2903
Denis.rodrigue@gch.ulaval.ca
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(203) 321 2261
Thomas.steele@cytec.com
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Hedstrom
P.O. Box 99
Dunkirk, OH 45836
(419)-294-7269
kenwessler@prodigy.net
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Plastics Resources Group
49 Richard Lee Lane
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PRG101@comcast.net
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Stoner, Inc.
P.O. Box 65
1070 Robert Fulton Highway
Quarryville, PA. 17566
(717)-786-7355 Ext. 3118
Lwhittemore@StonerSolutions.com
Director 2015-2018

Steve Zamprelli
Formed Plastics
207 Stonehinge Lane
Carle Place, NY 11514
(516)-334-2300
S.zamprelli@formedplastics.com

SPE Liaison

Kathy Schacht
Society of Plastics Engineers
6 Berkshire Blvd. Suite 306
Bethel, CT 06801-1065
(203) 740 5430
Cell (203)-775-8490
kschacht@4spe.org

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Mark Kearns
Queens University
Ashby Building
Stranmillis Road
Belfast BT9 5AH
44 2890974700
m.kearns@qub.ac.uk

Volunteers

John Bartolomucci
Plastics and Polymer Engineering Tech.
DIF 27
Pennsylvania College of Technology
One College Avenue
Williamsport, PA 17701
(570)-320-2400 Ext. 7012
jbartolo@ptc.edu

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