RMD News

The Rotational Molding Division of SPE Newsletter

2nd Quarter 2020 Volume 20 Issue

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INSPIRING PLASTICS PROFESSIONALS

In this issue:

Chair's Letter

Thank you to those that took the time to vote for the new Board of Directors for the Rotational Molding Division.

With just over 200 individuals making up our Division, we need everyone to be involved. Each of us has unique strengths, talents, and abilities and we need volunteers to help lighten the load as a Board Member or Committee Member because these positions are currently covered by just a few people. We need Vice Chairs, committee volunteers, and more. Please, step-up and get involved by helping to strengthen the Rotational Molding Division. Committees include the following:

- Awards Committee
- Education Committee
- Intersociety Relations Committee
- Intra-Society Relations Committee
- Membership Committee
- Public Relations Committee
- Publications Committee
- Newsletter Committee
- Safety and Health Committee
- Newsletter Committee
- Technical Program Committee
    - ANTEC Committee
    - TopCon Committee
- Design Competition Committee
- Website Committee

As a group I believe that we need to be more diligent at promoting our Division. We need to have greater involvement by those in our Industry especially those that are new and those that are younger. We need to Mentor, share, grow, and "plant seeds", especially with the next generation, as they will be the ones that will continue to grow our industry and make Rotational Molding even more than it is today.

I look forward to working together with all of those that make up the SPE Rotational Molding Division.

In The News: RMD Member In The News

RMD MEMBER IN THE NEWS

During the First Quarter of 2020, long time SPE Member, Glenn Beall, was honored by the Society's Medical Plastics Division. The MPD elected Glenn to the Emeritus Status, recognizing his many years of service to the Society and the Division.

According to the By-Laws, an SPE Member who has accumulated twenty years of membership, and who is over seventy years of age, is eligible for Emeritus Status, and upon request, shall be given such status upon certification by the Chief Staff Executive.

Glenn Beall joined SPE in 1960, and has remained an active member until the present time. He is a Charter Member of the MPD. Elected to the Division's Board of Directors in 1981, and as Secretary of the Board in 1982. He edited the Division's newsletter from 1982 until 1985. The Division's Chairman died unexpectedly in 1984, and Glenn was chosen as Chairman. At that time the Division's membership was strong and growing. However, the Board of Directors was in a state of disarray with only a Chairman, Treasurer, and 5 or 6 active Board Members. It took a few years, but the MPD is once again a very active, full service Division, with a fully reconstituted Board of Directors and a growing membership approaching a thousand.

After 34 years, Glenn officially resigned from the MPD Board of Directors in 2016, and now serves as the Division's Volunteer Emeritus/Historian.

While serving on the Board, Glenn was chosen to receive the MPD's most "Valuable Division Member" Award in 1984, 1985, and 1986, and the Division's "Outstanding Contributions" Award in 1994 and 2016.

When asked why he devoted so much time to SPE, Glenn commented that in the beginning SPE was the best Plastics Technology learning opportunity available. Later on SPE provided the best Plastics Industry networking opportunity. He also enjoyed the camaraderie of like minded people. Many of those he met on one SPE Committee or another became lifelong friends. Even in this hi-tech age, who you know is important to both your business career and your general life.

Editor's Note: Glenn Beall, Roy Crawford, and Jim Throne founded the SPE's Rotational Molding Division in 1996. The Division is fortunate to have such an experienced person as Glenn on the RMD Board of Directors.

In The News: Jerico's Sustainable Materials

New Jerico Sustainable Line Holds Promise for Post-Consumer Waste

Wadsworth, OH, USA - Jerico Plastic Industries, Inc. will launch its full line of sustainable polymer compounds under the banner of J-Sustain. The line will consist of several compounded products which will aid in promoting sustainable polymer compounds, clean waterways, and the recyclability of post-consumer waste in rotational molding.

Products will be fully-formulated PE compounds for optimal processing and will be ready to use in most applications. Products will range in concentration of post-consumer recycled waste, with options available in 10%, 25% and 40%. The recovered PE plastics have been collected and recycled to help prevent the plastic from reaching oceans and waterways that empty into the seas. Jerico Plastic Industries has a long history in post-industrial recycling and development of a wide range of formulations that can incorporate plant-based PEs.

These blends provide a good balance of performance and physical properties with good impact performance. Data to support these findings is available along with Technical Data Sheets.

"We have offered a number of these products, such as Envirolene, for some time now. Our product engineers have continued to develop formulations and combinations that will fill the growing world-

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In The News: Jerico's Sustainable Materials

wide need for a "greener" compound that helps our planet," states Brandi Frey, Corporate Operations Officer

With manufacturing facilities in Minerva, Ohio and Greensboro, Georgia, Jerico Plastic Industries, Inc. is committed to excellence in rotational molding and custom compounding. As a custom manufacturer of color compounds, specialty resins and recycled products, the company currently offers rotational molding PP, sustainable polymer compounds, cross-linkable PE, flame retardant PE and special effects PE compounds, PU to PE adhesion compounds, custom compound development, toll post-industrial recycling services for rotational molding, toll pulverizing, and compounding services.

For more information, contact Brandi Frey, Corporate Operations Officer — 330-730-1140, info@jericoplastic.com or Stephen Copeland, President — steve@jericoplastic.com.

In The News: ROTO PATENT REVIEW

IMPROVED POLYETHYLENE ROTATIONAL MOLDED PARTS

U.S. Patent #9,862,169 B2, issued January 9, 2018.

Any molder wishing to reduce cycle time, shrinkage and warpage, will want to study this patent.

It claims that blending polyethylene with the correct amount of a aliphatic polyester such as polylactic acid, an ethylene/styrene copolymer, and an unsaturated acid monomer, an acrylic ester monomer, and an ionomer, will result in the following improvements.

Rapid coalescence of bubble.
Reduced mold shrinkage.
Reduced warpage.
Reduced overall cycle time.

All of these advantages also result in,

Improved impact strength.
Improved stiffness.

This all sounds too good to be true. Maybe it is, but that is what the patent claims. The specific mixture of materials and other details are explained in Patent #9,862,169 B2, which can be downloaded at www.pat2pdf.org.

TWO COLOR OR NO COLOR ROTATIONALLY MOLDED PARTS ARE NOW POSSIBLE

U.S. Patent #10,252,449 B1, issued April 9, 2019.

Many molders have had to turn down a potential rotation molding project because the product required a two colored wall, or a small translucent section in an otherwise opaque product.

This patent describes a process that treats the contrasting color or translucent part as an insert in the mold for the final product. The pre-form, or insert, is made of the same, or similar resin that is only cured well enough to allow it to be handled.

During the molding process the insert is attached to the inside surface of the final product mold. As the mold is heated, the insert continues to cure and its outer edges fuse with the final product's main wall.

The overall process and the method for producing the pre-forms are described in this patent which can be downloaded at www.pat2pdf.org

Editor's Note: Roto Patent Reviews provided by Glenn Beall

In The News: Recent Developments in Rotomolding

Recent Developments in Rotomolding

By: Denis Rodrigue, Université Laval, Québec, Canada.
Denis.Rodrigue@gch.ulaval.ca

1- A comparative study of mechanical, dynamic mechanical and morphological characterization of tampico and coir fibre-reinforced LLDPE processed by rotational moulding

Abhilash, S. S.; Lenin Singaravelu, D.

JOURNAL OF INDUSTRIAL TEXTILES

DOI: 10.1177/1528083720929363

Natural fibres find their application as a reinforcing agent for polymer composites to obtain parts with improved mechanical properties. Manufacturing of non-metallic products is incorporated with natural fibres for better strength and to reduce cost. Rotational moulding is a process used for the manufacturing of hollow plastic products, especially water tanks, plastic fuel tanks, barrels, kayaks, refrigerated panels, etc. Incorporation of natural fibres to reinforce polymers in rotational moulding process is a tedious task; since there is no control over fibre and polymer powder mixture, which is rotating bi-axially, it may lead to fibre agglomeration. The present work investigates the mouldability of linear low density polyethylene composites with tampico and coir fibre as the reinforcement agents using a bi-axial rotomoulding machine. NaOH-treated fibres with 5, 10 and 15% by weight have been added to the linear low density polyethylene matrix, and the composites were prepared by rotational moulding process. Mechanical properties such as tensile strength, flexural strength, impact strength and hardness have been investigated. Dynamic mechanical behaviour such as storage modulus, loss modulus and tan delta of the different composites has been investigated with dynamic mechanical analyser. Fractured surfaces were examined qualitatively with the help of a scanning electron microscope for determining the interfacial properties and fibre adhesion between the fibres and the linear low density polyethylene matrix.

2- Effect of Fiber Content on Mechanical and Morphological Properties of Bamboo Fiber-Reinforced Linear Low-Density Polyethylene Processed by Rotational Molding

Abhilash, S. S.; Singaravelu, D. Lenin

TRANSACTIONS OF THE INDIAN INSTITUTE OF METALS, 2nd International Conference on Recent Trends in Metallurgy, Materials Science and Manufacturing (IMME), 73(6), 1549-1554 (2020).

DOI: 10.1007/s12666-020-01922-y

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In The News: Recent Developments in Rotomolding

Rotational molding or rotomolding is a powder processing technique used for the manufacturing of hollow plastic products. The present work investigates the moldability of long bamboo fiber as the reinforcement for linear low-density polyethylene (LLDPE) matrix. The temperature of the mold, oven and internal air temperature of the mold has been recorded to study the heat transfer rate while processing composites with different weight percentage. Mechanical properties were found to be improved by 5% fiber addition, and beyond that, the properties were reverted. Morphological characterization was done to analyze the interfacial properties of fiber and matrix. The present work successfully incorporated long bamboo fibers with LLDPE powders and uniformly distributed these fibers along the sides of the mold without applying any external pressure. Thus, it is concluded that fiber incorporation is possible in the rotomolding process and homogenous randomly oriented fiber dispersion can also be achieved by the rotational molding process.

3- Investigation of tensile properties of polymeric nanocomposite samples in the rotational molding process

Daryadel, M.; Azdast, T.; Khatami, M.; Moradian, M.

POLYMER BULLETIN

DOI: 10.1007/s00289-020-03225-0

Rotational molding is a plastic manufacturing process that is used to produce seamless, one-piece, and hollow parts by rotating a mold subjected to heat and then cooling it. The aim of this study is to investigate the tensile properties of produced polymeric nanocomposite samples by rotational molding. Linear low-density polyethylene was considered as the polymeric matrix, and nanoclay was added at various weight percentages of 0, 1, and 2 as reinforcement. The effects of weight percentages of nanoclay and processing conditions including rotational speed and processing temperature are investigated on the tensile properties of nanocomposite samples based on the design of experiments according to the L-9 orthogonal array of Taguchi approach. Scanning electron microscopy tests were performed on the nanocomposite samples in order to study the possible agglomeration regions of the nanoclays in the polymeric matrix. The results indicate that the processing temperature is the most effective parameter on the tensile strength and Young's modulus of nanocomposite

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In The News: Recent Developments in Rotomolding

samples. Tensile strength and Young's modulus were increased by 21% and 33%, respectively, by increasing the processing temperature. Also, the rotational speed is found to be the second effective parameter on the tensile properties.

4- Rotational Molding of Polyamide-12 Nanocomposites: Modeling of the Viscoelastic Behavior
Shirinbayan, M.; Montazeri, A.; Sedeh, M. N.; Abbasnezhad, N.; Fitoussi, J.; Tcharkhrtchi, A. INTERNATIONAL JOURNAL OF MATERIAL FORMING
DOI: 10.1007/s12289-020-01558-9

Nowadays, polyamide 12 (PA-12) is considered as an interesting polymer in the rotomolding process to manufacture different pieces like the liner part in the storage hydrogen tank (type IV). In this study, the pure polyamide-12 and PA12 pieces, incorporated with 0.5%, 1% and 3% wt Nano Carbon Black (NCB), were manufactured by the rotomolding process. Different rotomolding parameters such as heating temperature, time of heating, and cooling rate have been optimized to obtain the ideal piece. The effect of volume fraction of NCB in terms of physicochemical and mechanical properties has been studied. Afterward, the optimal volume fraction of NCB is revealed using different characterization methods. The tensile results specified the addition of NCBs until 0.5% improved the tensile behavior. The addition of NCBs more than 0.5% decreases the mechanical properties in terms of failure stress and strain, while it has no significant effect on the elastic modulus of PA-12. The bi-parabolic the Perez model has been used to study the viscoelastic behavior of PA-12 using the Cole-Cole method. The constants of the Perez model indicate a good correlation between viscoelastic experimental results and the model used.

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In The News: Recent Developments in Rotomolding

5- Rotational Molding of Linear Low-Density Polyethylene Composites Filled with Wheat Bran Hejna, A.; Barczewski, M.; Andrzejewski, J.; Kosmela, P.; Piasecki, A.; Szostak, M.; Kuang, T. POLYMERS, 12 (5),1004, 2020
DOI: 10.3390/polym12051004

Application of lignocellulosic fillers in the manufacturing of wood polymer composites (WPCs) is a very popular trend of research, however it is still rarely observed in the case of rotational molding. The present study aimed to analyze the impact of wheat bran content (from 2.5 wt.% to 20 wt.%) on the performance of rotationally-molded composites based on a linear low-density polyethylene (LLDPE) matrix. Microscopic structure (scanning electron microscopy), as well as physico-mechanical (density, porosity, tensile performance, hardness, rebound resilience, dynamic mechanical analysis), rheological (oscillatory rheometry) and thermo-mechanical (Vicat softening temperature) properties of composites were investigated. Incorporation of 2.5 wt.% and 5 wt.% of wheat bran did not cause significant deterioration of the mechanical performance of the material, despite the presence of 'pin-holes' at the surface. Values of tensile strength and rebound resilience were maintained at a very similar level, while hardness was slightly decreased, which was associated with the porosity of the structure. Higher loadings resulted in the deterioration of mechanical performance, which was also expressed by the noticeable rise of the adhesion factor. For lower loadings of filler did not affect the rheological properties. However, composites with 10wt.% and 20 wt.% also showed behavior suitable for rotational molding. The presented results indicate that the manufacturing of thin-walled products based on wood polymer composites via rotational molding should be considered a very interesting direction of research.

6- Rotomolding and polyethylene composites with rotomolded lignocellulosic materials: A review
Espinoza León, L .D. V.; Escocio, V. A.; Visconte, L. L. Y.; Jandorno Jr, J. C.; Vasques Pacheco, E. B. A.
JOURNAL OF REINFORCED PLASTICS AND COMPOSITES, 39(11-12), 459-472 (2020).
DOI: 10.1177/0731684420916529

Rotomolding is a versatile process used in the manufacture of thermoplastic polymeric materials to produce large hollow plastic parts. The aim of this review article was to discuss the rotomolding process and show the properties of the polyethylene composite and rotomolded lignocellulosic fibers, which are processed for prolonged periods under temperature. The main process parameters studied are the shaft speed of the equipment, molding temperature, polymer particle size, polymer melt flow index, and amount of material, which must be well controlled to achieve a non-degraded product with homogeneous thickness and no porosity. Rotomolded

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In The News: Recent Developments in Rotomolding

composites containing sisal, pine, coir, banana, flax, and maple wood fibers, among others, have been evaluated primarily for their mechanical (impact, flexural, and tensile strength) and morphological properties. The type, content, and treatment of lignocellulosic fillers are the most widely studied variables in polyethylene-based rotomolded composites. Fiber content was the variable that most influenced mechanical properties, particularly impact strength and hardness due to the voids formed by the hydrodynamic volume between the polymer matrix and lignocellulosic filler. Chemical treatment of the fiber by mercerization with NaOH made it more hydrophobic and the addition of maleic anhydride-grafted polyethylene as a coupling agent improved the interfacial adhesion between the non-polar polymer matrix and polar filler. However, the best mechanical property results were obtained with the use of maleic anhydride-grafted polyethylene.

7- Morphological and Mechanical Properties of Bilayers Wood-Plastic Composites and Foams Obtained by Rotational Molding

Vázquez Fletes, R. C.; Cisneros López, E. O.; Moscoso Sánchez, F. J.; Mendizábal, E.; González Núñez, R.; Rodrigue, D.; Ortega Gudiño, P.

POLYMERS, 12(3), 503 (2020).

DOI: 10.3390/polym12030503

In this work, the suitability for the production of sustainable and lightweight materials with specific mechanical properties and potentially lower costs was studied. Agave fiber (AF), an agro-industrial waste, was used as a reinforcement and azodicarbonamide (ACA) as a chemical blowing agent (CBA) in the production of bilayer materials via rotational molding. The external layer was a composite of linear medium density polyethylene (LMDPE) with different AF contents (0-15 wt %), while the internal layer was foamed LMDPE (using 0-0.75 wt % ACA). The samples were characterized in terms of thermal, morphological and mechanical properties to obtain a complete understanding of the structure-properties relationships. Increases in the thicknesses of the parts (up to 127%) and a bulk density reduction were obtained by using ACA (0.75 wt %) and AF (15 wt %). Further, the addition of AF increased the tensile (23%) and flexural (29%) moduli compared to the neat LMDPE, but when ACA was used, lower values (75% and 56% for the tensile and flexural moduli, respectively) were obtained. Based on these results, a balance between mechanical properties and lightweight can be achieved by selecting the AF and ACA contents, as well as the performance and aesthetics properties of the rotomolded parts.

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In The News: Recent Developments in Rotomolding

8- Improving the Compatibility and Mechanical Properties of Natural Fibers/Green Polyethylene Biocomposites Produced by Rotational Molding

Robledo-Ortiz, J. R.; Gonzalez-Lopez, M. E.; Rodrigue, D.; Gutierrez-Ruiz, J. F.; Prezas-Lara, F.; Perez-Fonseca, A. A.

JOURNAL OF POLYMERS AND THE ENVIRONMENT, 28(3), 1040-1049 (2020).

DOI: 10.1007/s10924-020-01667-1

In this work, sustainable rotomolded composites based on green polyethylene (Green-PE) and natural fibers (coir and agave) were studied. Fibers' surface was treated with maleated polyethylene to improve the fiber-matrix compatibility. Samples were characterized by morphology, mechanical properties (impact, tension, and flexion) and water absorption. Results showed a more homogeneous morphology with better fiber dispersion and wetting in the treated fibers composites which lead to substantial improvements of tensile modulus from 258 MPa for the neat matrix up to 345 MPa for both, treated agave and coir composites (at 30% wt), and tensile strength from 13.7 MPa for Green-PE to 15.3 MPa for 30% treated coir composites. The positive effect of the surface treatment was also observed in flexural strength with increases up to 100% and 34% in flexural modulus. Also, impact strength was increased up to 46% and water absorption reduced up to 55% for treated fiber composites compared to untreated fiber composites. As an important observation, it was possible to obtain similar or even higher mechanical properties with the Green-PE natural fiber composites than for a petroleum-based rotomolded polyethylene, which is interesting in terms of sustainability and performances for specific applications like automotive and packaging.

9- An analytical model to predict the creep behaviour of linear low-density polyethylene (LLDPE) and polypropylene (PP) used in rotational moulding

Pozhil, S. N.; Menon, N. M.; Waigaonkar, S. D.; Chaudhari, V.

MATERIALS TODAY-PROCEEDINGS, Proceedings of the 2nd International Conference on Recent Advances in Materials and Manufacturing Technologies (IMMT), 28, 888-892 (2020).

DOI: 10.1016/j.matpr.2019.12.318

Rotational Moulding (RM) is a versatile plastic processing method for the production of hollow products. Since the life expectancy of RM products are over several decades, prediction of mechanical properties like creep will be useful during the design phase of a product. In this research, an analytical model based on time

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In The News: Recent Developments in Rotomolding

hardening model was developed to predict and compare the creep behaviour of linear low density polyethylene (LLDPE) and PP at 40 degrees C. The model uses some constants obtained from the experimental findings of a typical accelerated creep test using stepped isothermal method-time-temperature superposition (SIM-TTS). Based on the creep performance, the comparison of the two materials (LLDPE and PP) has been carried out and inferences have been made about their long term performance under constant stress.

10- Processing and characterization of HDPE and MDPE processed by rotational moulding

Abhilash, S. S.; Luckose, R.; Singaravelu, D. L.

MATERIALS TODAY-PROCEEDINGS, International Conference on Materials and Manufacturing Methods (MMM), 27, 2029-2032 (2020).

DOI: 10.1016/j.matpr.2019.09.052

Rotational moulding otherwise called as roto moulding is a process used to produce hollow plastic products with nearly stress free objects with the help of a bi axial rotational moulding machine which rotates the mould in two axes with minimum speed of rotation. Plastic granules pulverized into fine powders are used to produce hollow parts such as water tanks, fuel tanks, kayak boats, refrigerated panel etc. The present work investigates the mouldability of High Density Poly Ethylene (HDPE) and Medium Density Poly Ethylene (MDPE) powders by rotational moulding process. A lab model roto moulding machine has been fabricated. There are two rotating frames - an inner and an outer frame - both rotating about two mutually perpendicular axes. The driving torque is given by a motor. The machine was designed to accommodate a rectangular shape stainless steel mould. Both MDPE and HDPE were processed at three different internal air temperature and the mechanical properties were estimated as per ASTM standards. Both tensile and impact strength were observed to be improved by the increase in internal air temperature. Hardness values observed shows no significant effect on internal air temperature. The MDPE products showed higher impact strength while HDPE products showed higher tensile strength. The morphology of the MDPE and HDPE powders and the microstructure of the prod-

ROTATIONAL MOLDING

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Rotational Molding Division

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RMD Interim Financial Report

SPE RMD Annual Budget 2019

Period July 1, 2018 through June 30, 2019

	Budget	2 yr actual 2016 & 2017	2 yr pojection 2018 & 2019
Income			
Interest	$50.00	$90.00	$100.00
SPE Rebate	$500.00	$2,247.00	$2,500.00
Newsletter ads	$2,000.00	$0.00	$0.00
TopCon 2018	$39,000.00	$39,303.00	$40,000.00
Total Income	$41,550.00	$41,640.00	$42,600.00
Expenditures			
Awards	$1,500.00	$1,932.00	$2,500.00
Topcon---2018	$20,000.00	$18,055.00	$20,000.00
Board Mtgs	$1,000.00	$0.00	$2,000.00
Website	$500.00	$0.00	
Design Competition		$0.00	
Roto---local (ARM-SPE) **	$5,000.00	$7,531.00	$15,000.00
Conf & Trade show	$3,000.00	$320.00	$500.00
ANTEC student activity	$1,500.00	$1,750.00	$2,000.00
Advertising	$3,500.00	$0.00	
Counselor ***	$5,000.00	$0.00	
Total Expenditures	$41,000.00	$29,588.00	$42,000.00
Net Income/Loss	$550.00	$12,052.00	$600.00

*** No cost at present for counselor

** 2017 was ~$5000 and expect this will increase

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Submit your news story or technical article to the RMD Newsletter !

The submission deadline for the next edition is Sept. 1st.

The Rotational Molding Division would like to acknowledge and thank the following organizations that share their resources with the RMD by allowing and encouraging their employees to serve as members of the RMD Board of Directors:

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