



THERMOSETTING

August 2013

QUARTERLY NEWSLETTER ON **THERMOSET** TECHNOLOGY & EVENTS

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COMPOSITES: LIGHTWEIGHTING THE CARS OF TOMORROW

SEPTEMBER 11-13, 2013

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The Automotive and Composites Divisions of the Society of Plastics Engineers (SPE®) International invite you to attend the 13th-annual **SPE Automotive Composites Conference and Exhibition (ACCE)**, September 11-13, 2013. The show – which has become *the world's leading automotive composites forum* – will feature technical paper sessions, panel discussions, keynote speakers, networking receptions, & exhibits highlighting advances in materials, processes, and applications technologies for both thermoset and thermoplastic composites in a wide variety of ground-transportation applications.

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The **SPE ACCE** typically draws nearly 650 attendees from 14 countries on 5 continents who are interested in learning about the latest composites technologies. Fully a third of attendees work for an automotive, heavy truck, agricultural / off-road equipment, or aerospace OEM, and roughly a fifth work for a tier integrator. Few conferences of any size offers such an engaged, global audience vitally interested in hearing the latest composites advances.

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We've moved to a larger venue. A variety of sponsorship packages – including displays, conference giveaways, advertising and publicity, signage, tickets, and networking receptions – are available. Companies interested in showcasing their products and/or services at the **SPE ACCE** should contact Teri Chouinard of Intuit Group at teri@intuitgroup.com.

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LETTER FROM THE DIVISION CHAIR



Kevin Casey
Division Chair

Dear Thermoset Division Members and Colleagues,

We are very pleased to announce the TOPCON 2014, Thermoset Topical Conference, which will be held on February 24-26 in Tucson, Arizona. Our SPE Thermoset Division will present the most recent developments in composite technologies and market applications at the Loews Ventana Canyon Resort. The TOPCON 2014 is designed to build on a solid track record of increasing composites awareness, while bringing together guest speakers, industry leading members and colleagues who have supported our industry for many years.

As the new 2013 Chair, I have been very impressed with our membership organization, our Board of Directors and of course, the impressive TOPCON event held in New Orleans last February. The technical papers, displays, conference organization and most of all, the pride shown by each attending member, confirmed to me that the thermoset composite industry is thriving in creating new industry changing innovations! Our Board of Directors has been active in defining our 2013 goals which include expanding SPE Thermoset Division Membership, launching the use of social media to broaden the awareness of composites, initiating a university "outreach" program, sponsoring scholarships to create the next generation of thermoset enthusiasts and of course, to building on the tremendous success of our TOPCON conference.



The SPE Board of Directors has an additional goal to expand the SPE membership within each of our own organizations by hand selecting new associates to join our team. We would also like to ask for your support in the endeavor by encouraging both co-workers, customers, suppliers and other industry members to join our organization for continued success for years to come. Thank you very much for your support of the SPE Thermoset Division and we look forward to seeing you all in Arizona next February!

Best Regards,

Kevin Casey

*Chair, SPE Thermoset Division
Vice President, Sales and Marketing
Mar-Bal, Inc.*

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TOPCON 2014

“THE WESTERING OF THERMOSETS”

- **Group nightly rates of \$169 per night**
- **Outdoor Gala Reception, live entertainment**
- **SPE Golf Outing**
- **Accenture Match Play Championship held weekend prior**
- **Tucson Rodeo held weekend prior**
- **Technical papers being accepted**



SPE’s hottest conference will be held Feb. 24-26 at the Loews Ventana Canyon Resort. SPE Thermoset Division will present the most recent developments in thermoset composite technology. Guest speakers will represent the mining, medical, appliance, food service, oil and gas, electrical and automotive industries.

TUCSON. AZ

Feb. 24-26, 2013



MOLDING & RESIN IMPROVE WEAR RESISTANCE

A composite bulk molding compound prevents wear and downtime

Archimedes invented the first centrifugal pump about 200 B.C. in Ancient Greece. Since then, pumps, centrifugal and otherwise, have had the same continuous problem—wear. One part must turn while the other remains stationary. Centrifugal pumps have changed little since then—an impeller turns and liquid is pumped in the desired direction. The first wear bushing was probably soft wood to protect the hard wood. Therefore, wear equals downtime.

New materials, sophisticated impeller angles and propulsion are the only differences in 2,200 years. Wear between the stationary and rotating components is still the main cause of downtime. It has always occurred at the interface between moving and stationary surfaces and has been an accepted, unavoidable drawback. The industry practice for pump manufacturers is to design a cheap sacrificial bushing, just like the soft wood, to abrade away and spare the more expensive shaft. To replace the shaft or the bushings requires downtime, which is the most expensive factor. Pump users need multiple pumps so that one can be taken offline for rebuild of the wear components while another is

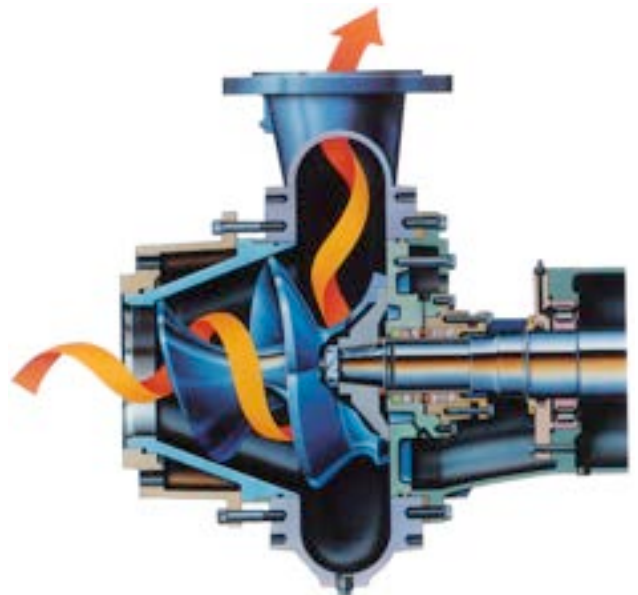
“THERMOSET RESIN IS THE KEY TO THE FUNCTIONALITY OF THIS NEW BMC”

serviced. Increasing uptime is an advantage of parts molded from the new bulk molding compound.

A new, composite, bulk molding compound (BMC) does not follow the age-old maxim of reducing the coefficient of friction (CoF) between the shaft and the wear bushings as a means of reducing friction/wear. Instead, the surface contact area between the shaft and the bushing is simply reduced. Wear components are molded from the compound and filled with soft, strong fibers and round, ceramic spheres. The perfectly round and smooth ceramic spheres protrude from the surface



The Archimedes Screw 200 BC



The Archimedes Screw after 2,200 Years



of the molded part and only a small area of the surface of each sphere actually makes contact with the shaft instead of the entire molded bushing.

Thermoset Resin

A thermoset resin is the key to the functionality of this new BMC because of its high glass transition temperature (T_g), chemical resistance and unsurpassed adhesion to fillers. Bushings molded from this compound made with the new resin have a typical T_g of around 250 C (482 F) with continuous use temperature in most applications of around 200 C (392 F). Excursion temperatures to 300 C (572 F) are not uncommon. In one application, a pump was returned from the field for rebuild with the epoxy paint on the outside of the housing scorched from friction heat generated internally by abuse. The rebuild manufacturer reported that the new BMC wear bushing and the shaft under the wear bushing looked like new.

As previously stated, the ceramic beads protrude from the surface of the molded part and are the only contact point between the bushing and the shaft. Just like marbles imbedded in concrete, it does not matter the CoF of concrete because the concrete does not touch the shaft. The round beads only make contact with the shaft and only at the point of intersection or the tip of the ball. These perfectly round spheres do not wear the shaft because of their shape and smoothness. The fiber reinforcement used is softer than the shaft which leaves nothing capable of inducing shaft wear. After more than three years in the field in water pump applications, neither the bushings nor the shafts have shown measurable or visible wear.

The ability of this resin to adhere to fillers is the reason Kevlar and ceramic beads can be used to hold them in place for machining. The fiber reinforcement is similar to rebar in concrete—without it there is little strength. Nothing adheres to Kevlar, according to the manufacturer, but adhesion to Kevlar was achieved with this resin that was equal to epoxy resin to glass. This is



why parts molded from this composite BMC are the first long-fiber, Kevlar-filled parts that can be machined cleanly and hold tolerance (see Figure 3).

Dimensional creep with temperature is another reason that other resins do not adhere to their fillers. Adhesion and exceptionally-low creep allow the composite BMC parts to keep their fillers in place.

Kevlar and ceramic-filled wear bushing components machined to (+/-) 0.001 inches (0.254 millimeters)

All thermoplastics, by definition, must move with heat or creep. When creep occurs, adhesion and mechanical lock on the fillers is lost, long before dimensional stability. Most crystalline thermoplastics lose function at their T_g while thermosets retain functional strength and adhesion to fillers for excursions of 50 C to 100 C above their T_g. The Kevlar starts to fail at 180 C but recovers when cooled. As long as the base resin holds it in place, all is well. The carbon fiber is not affected by temperature in the ranges of pump operation and also

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conducts the heat away from the wear component. This thermal conductivity allows for higher operating temperatures by conducting the heat to the housing and out of the pump.

The other challenge of the Kevlar is strong base. This is evident in boiler applications when the boiler cleaning chemicals are added directly into the pump (against manufacturer's guidelines), instead of downstream. Adding directly into the pump or immediately in front of it causes a concentration at the pump exponentially higher than the diluted form in which cleaner is designed to be used. This dissolves the Kevlar and leaves the equivalent of concrete without rebar. As a result, the bushing fails.

To address the boiler cleaner and temperature problems of Kevlar, a new fiber was introduced. Two fiber reinforcements are currently used with the ceramic spheres in the manufacture of the composite BMC.

The proven Kevlar and a new, soft, thermally conductive carbon fiber are combined with proprietary graphite powder, each fiber used depending on the requirements of the application. Wear components molded from the Kevlar BMC have been in the field for more than four years with no wear-related failures.

The new conductive carbon fiber and combined graphite powder version has been introduced to improve the chemical resistance over the Kevlar.

This also provides thermal conductivity. The new composite BMC has passed house testing by several customers and is now being field tested.

The Kevlar parts are slightly more elastic for press fits while the carbon fiber is easier to machine. Both the Kevlar and the carbon fiber-filled molded parts offer similar physical properties. Kevlar also absorbs 7 percent water at ambient temperature. A processing mechanism was developed that reduced the water

absorption of the molded part equal to glass-filled epoxy, which is the benchmark for fiber-filled compounds. Even after machining the molded part, the Kevlar does not absorb water. In the field, no indications of water absorption have been observed.

Although field tests have not been completed, it appears that the thermal conductivity of the carbon fiber will be especially valuable in higher temperature applications as the heat will pass through the molded part instead of building up with an insulating effect of normal composites.

Synopsis

Kevlar is attacked by strong bases while the carbon fiber is affected by galvanic corrosion in sea water. It appears each has challenges, but new fillers are constantly being tested in research and development. The new resin appears impervious to temperatures below 200 C. The latest effort is to test a special glass fiber combined with the ceramic spheres for sea water applications. It is known that the wear component will not wear, but it is not yet known if the new glass will wear the shaft or if

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The SPE Thermoset Division welcomes industry related news, press releases and articles regarding new technology. Please forward any material you would like considered for inclusion in our newsletter to Grapevine Marketing & Experiences: shelane@gvineme.com.



Molding & Resin, continued

the ceramic beads will maintain the needed separation and prevent wear.

The concept of using ceramic beads to reduce the surface contact area is new. The function of the molded part is totally dependent on the adhesion and dimensional stability found in the new resin. Because this BMC composite is new, addressing any failure mode is the focus. The goal is to define and recommend a product for each application and cover the widest possible temperature and chemical range with zero wear to the bushing or shaft. The resin seems to adhere to everything, so fillers that were never successfully used, such as Kevlar, can now be tested. Adhesion to polytetrafluoroethylene (PTFE) has even been successful.

As soon as any wear with the Kevlar parts in the water pumps is found, those limitations will be known. P&S

Author Bio:

Randy Lewis is director of engineering at Zeon Technologies, Inc. He has spent almost 40 years in every area of the plastics molding and compounding industry. He can be reached at rlewis@zeontech.net, lewispr@earthlink.net or 803-493-4173.

WORLD'S FIRST HIGH VISIBILITY LED HEADLIGHTS

Truck-Lite, a known leader in heavy-duty lighting innovations, showcased the world's first custom LED headlights for the truck market at the Mid-America Trucking show, March 21-23, 2013 in Louisville, KY. The high-performance, custom-engineered LED headlights offer superior nighttime visibility and enhanced safety for Class 8 trucks. They also feature highly accurate reflector components produced using BMC's injection molded BMC 304 composite material.



Truck-Lite's current custom headlight is designed for the Freightliner Cascadia® model, and specifies BMC 304 for use as its injection molded reflector substrates.

Truck-Lite's current custom headlight is designed as an aftermarket retrofit option for the Freightliner Cascadia® model

"Our strategic mission to innovate and manufacture the best lighting to increase our customer's safety, coupled with our cutting-edge optics design software has enabled us to grow and strengthen our forward lighting portfolio," said Brian Kupchella, Truck-Lite president. "Our new LED technology delivers lighting performance far and

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LED Headlights, continued

| AUGUST 2013

above traditional systems, adding increased visibility and safety. The lamp's proven durability also provides a significant cost-savings from a maintenance standpoint."

Truck-Lite's LED headlights offer improved driver visibility through its more natural light, leading to improved object recognition at night and increased daytime visibility. Truck-Lite's LED beam pattern also reduces eye-strain for drivers and reduces harsh headlight glare to oncoming traffic. An additional benefit is the significantly reduced amperage draw on the vehicle's electrical system. Vigorous field-testing, subject to extreme weather and environmental wear, substantiated the lamps exceptional durability.

Truck-Lite Co. LLC, headquartered in Falconer, New York, is a major producer of signal lighting, forward lighting, wiring harnesses, mirrors, turn signal switches, and safety accessories to the heavy-duty truck, trailer, and commercial vehicle industries. Truck-Lite's BMC 304 reflector components are produced by Jay Plastics of Mansfield, OH (www.jayindinc.com).

Additional information can be requested by email at corporate@truck-lite.com or by calling Truck-Lite Customer Service at 800.562.5012.

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INDUSTRY BULLETIN BOARD



Mar-Bal, Inc. receives the 2013 Leading EDGE Award

Thermoset industry leader recognized for Value Creation in NE Ohio

CHAGRIN FALLS, OH--(June 7, 2013) - Mar-Bal, Inc., a Chagrin Falls, Ohio-based leader in the thermoset industry and innovative solutions provider, was among an elite group of 101 Northeast Ohio mid-sized companies to be recognized at The 2013 Leading EDGE Awards on May 23 at Lorain County Community College in Elyria, Ohio. In its seventh year, this prestigious award was developed by The Entrepreneurs EDGE to recognize value-creating, mid-sized companies in the region. Qualifying companies operate within the 17 counties of Northeast Ohio and generate revenues up to \$750 million, a portion of which must be outside the region.

Honored companies were identified by the value they create in the regional economy, based on a sum of their EBIT (earnings before interest and taxes) and total taxable compensation for all Northeast Ohio-based employees.

"It was an honor to be recognized once again by Leading Edge for this admired award," stated Scott Balogh, President and CEO of Mar-Bal, Inc. "This award is a true testament to the hard work and dedication of all of our colleagues in Ohio but also in our Virginia and Missouri manufacturing facilities as well. I would like to thank Leading Edge for their recognition and we look forward to continuing our growth and value creation in NE Ohio as we further invest and innovate within our industry expanding the success of our company."

Marketing Officer at GE Capital, Trailer Fleet Services and Modular Space. Other employment experience includes Marketing Director, Supply Chain Services at FEDEX Corporation and Global Marketing Manager, Specialty Plastics at Eastman Chemical Company. Pittman holds a Bachelor's of Science in Marketing and Finance from the University of Missouri, St. Louis. He resides in St. Louis with his wife and they have two grown daughters.

BMCI ANNOUNCES LEADERSHIP CHANGES

In July 2013 Citadel Plastics (parent company to Bulk Molding Compounds, Inc (BMCI) announced Steve Pittman as President of BMCI. In his role as President, Mr. Pittman will be responsible for leading Citadel's global thermoset business and driving new growth initiatives. Mr. Pittman brings an extensive

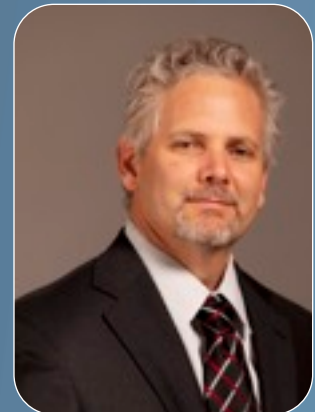


STEVE PITTMAN

background in market development and leadership roles from GE Plastics, Eastman Chemical, FedEx and most recently as the Vice President and General Manager for GE Capital, Trailer Fleet Services. "Steve brings a deep commercial background that will help us in driving strategic growth initiatives. He will engage with our key customers to deliver innovative solutions to their product needs." stated Mike Huff, Chief Executive Officer for Citadel. Mr. Pittman will report directly to Mike Huff.

Previous positions held by Pittman include Senior Vice President and Chief

MARIO SANDOVAL



In addition to bringing on Mr. Pittman, BMCI announced Mario Mario Sandoval joined Citadel Plastics as Vice President of Global Operations in January (2013). He will report directly to Mike Huff. Mario will be providing the senior leadership for BMC/Citadel Thermosets manufacturing efforts in North America, Europe and Asia. The Manufacturing, Engineering, Supply Chain and EH&S groups will also report directly to Mario.



- BMCI STAFF CHANGES & ADDITIONS, CONTINUED

Most recently, Mario was the Vice President and Chief Integrated Supply Chain Officer for Hollingsworth and Vose, a company that manufactures filtration media for various uses including automotive, industrial and commercial applications. He began his career and worked for seventeen years in the plastics industry at General Electric where he held various positions including Process Control Engineer, Master Black Belt, Global Manufacturing Manager and Vice President and Operations Leader for Polymershapes, a distribution business. He later became Director of Operations, Performance Materials Division for Johns Manville where he led operations for a \$500 million fiberglass business. He holds Bachelors degrees in Chemical Engineering and Computer Science from New Mexico State University.

He resides with his wife, Becky, and three children in Colorado.

The company also announced newly acquired Pratik Shah as the Market Development Manager focused on the Oil, Gas and Mining sectors. In this role, Pratik will penetrate and develop new accounts in the Oil, Gas, and Mining sectors. He will work with Sales, R&D, and Tech services team members to close new projects. He will report to Len Nunnery, Global VP of Sales and Marketing.

Pratik earned his Bachelor's degree in Chemical Technology with a minor in Polymer Chemistry at the University of Mumbai. He then earned a Master's degree in Plastics Engineering at the University of Massachusetts, Lowell. Pratik resides near Philadelphia with his wife Guiliana and three children. He will relocate to the Houston, TX region.

BMCI also announced Mark Dreslinski as the Field Technical Services Engineer. In this role, Mark will support customers on new product development and service existing business to ensure that products meet customer expectations. He will work

with Sales, Marketing, R&D, and Tech services team members to troubleshoot problems and identify corrective actions. He will report to Craig Carder, Technical Services Manager/Key Accounts.

Mark brings extensive experience in the plastics industry with a specific focus in thermoset material (BMC and SMC). He has worked in the electrical, cookware, transit, aerospace, automotive, and fluid handling market sectors. He is experienced with compression, transfer, and injection molding processing, as well as formulation and sales of BMC and SMC. Mark resides in Austinburg, OH, with his wife Mary Ann and will be based out of his home office.

WESTOOL CORP. PURCHASES NEW BORING MILL

Westool Corporation has just purchased a new horizontal Boring Mill. This mill will increase their machining envelope to 160 by 90 inches. Greg West, President of Westool Corp., says this purchase will match their current envelope on vertical high speed finishing machines. "It will greatly enhance our capacity for machining large compression molds and other tooling", he stated. The installation is due to complete by the end of September 2013. Westool Corporation is a builder of Compression and injection molds and tooling for automotive, aerospace, agriculture, truck and other industries. (www.westools.com gwest@westools.com)

- INDUSTRY UPDATES, CONTINUED

MAR-BAL, INC. DAY OF ACTION - JULY 12, 2013

Mar-Bal, Inc. had a wonderful opportunity on Friday, July 12, 2013 to help our local women's shelter, WomenSafe. The mission of WomenSafe is to provide emergency shelter and support services to survivors of domestic violence throughout northeast Ohio. Through our local United Way, our volunteers provided landscaping and lawn clean up services at the shelter. The volunteers included our President and CEO, Scott Balogh; our Vice-President of Sales and Marketing, Kevin Casey; our CFO, Jim Wojtila; our Engineering Manager - Sam Macio and other members of Mar-Bal from Operations, Human Resources, Engineering, IT, Sales and Marketing. As you can see from the attached pictures, we had a great team working hard to make a huge impact on this organization. 1 day, 15 volunteers, 20 yards of mulch, 7 flats of flowers. Ron Poff, Manager of Global Marketing and Brands at Mar-Bal, Inc. said, "The reaction from

WomenSafe and United Way ... Priceless! It was truly a humbling and blessed opportunity."



MAR-BAL'S DAY OF ACTION!