

July 2020

Pureview

REPORTING THE WORLD OF POLYURETHANES FOR OUR CUSTOMERS

HUNTSMAN

Enriching lives through innovation

Huntsman Building Solutions

Creating a world leading spray polyurethane foam business



**TPU helping in battle
against COVID-19**

**New footwear material
qualified by uvex**

**Driving forward new
automotive materials**



Exciting opportunities beyond current challenges

Tony Hankins, President, Huntsman Polyurethanes

The world has changed significantly since the last edition of *PU Review*. This magazine aims to showcase our innovation, including case studies of how we're solving technical challenges in partnership with our customers. However, I would like to start this editorial with some thoughts on COVID-19, which has sent shock waves around the world since the start of the year, impacting all our lives, and wreaking havoc on economies and businesses.

It's times like this when I truly marvel at the human spirit. Over the last few months, I've been struck by the flexibility and ingenuity that people have shown in all walks of life and across all the different industries we operate in. Faced with adversity, everyone has pulled together and embraced new ways of working. I am particularly proud that Huntsman has been able to help in the fight against COVID-19 – providing materials that help protect frontline workers in hospitals, as well as in other essential industries. There's a great example of this on page 5, in a story about the use of our thermoplastic polyurethane (TPU) elastomers in powered air purifying respirators.

Until a vaccine is developed, the uncertainty and challenges will continue. But we're keeping our eyes firmly fixed on the future and are pushing ahead with initiatives that will deliver the innovative solutions that our customers need. This is exemplified by the recent launch of Huntsman Building Solutions (HBS), which was formed after we acquired leading North American spray polyurethane foam (SPF) company Icynene-Lapolla in February and combined it with Demilec – another leading SPF company – which Huntsman acquired in 2018. This combination creates one of the world's leading SPF providers.

I'm excited about the opportunities that lie ahead for HBS. SPF is a highly attractive growth business; we have a product offering which is second to none that provides significant environmental benefits – not just in terms of energy savings, as they are the most effective thermal insulants in the market; but, also in terms of the upcycling of PET bottles and scrap, which are used in our TEROL® polyols, a key ingredient in the production of SPF.

You can learn more about HBS and its plans for the future in our main feature on pages 8 to 11. I hope you enjoy the read!



New Taiwan TEROL® polyols plant starts up

In May, Huntsman announced the mechanical completion, start-up and first production run of its new 22,000-ton TEROL® aromatic polyester polyols plant in Kuan Yin, Taiwan. The 3,600-square meter polyols plant, completed one month ahead of schedule, expands Huntsman's downstream polyurethanes capabilities within the Asia-Pacific region.

TEROL® polyester polyols are a critical component in the production of MDI-based polyurethane insulation systems – the most effective insulants available in the market, as measured by R-value. Insulation products based on TEROL® polyols include polyisocyanurate (PIR) boardstock systems, spray polyurethane foam (SPF) and pour-in-place applications, including entry doors, garage doors, coolers, refrigerators and commercial freezers.

Huntsman utilizes a proprietary process in the production of its TEROL® polyols, which enables it to upcycle scrap polyethylene terephthalate (PET) bottles that would otherwise end up in landfills or in rivers and oceans. The Taiwan site is expected to upcycle the equivalent of

440 million 500ml PET bottles annually in its manufacturing process.

Kenny Pan, Vice President Asia Pacific, Huntsman Polyurethanes, said: "In less than 18 months, we were able to build a world class polyols manufacturing plant within our existing systems house site, and successfully produce the first production run of a highly anticipated family of polyols for our Asia-Pacific customer base. The polyester polyols produced at this site will have a two-fold benefit for both Huntsman and its customers."

"First, they will allow Huntsman to quickly expand its downstream MDI-based insulation business in the region. With the recent acquisitions of two of the leading SPF companies in the world, and the subsequent

integration of them into the newly established Huntsman Building Solutions platform, we are now able to quickly and efficiently supply energy-efficient SPF systems to customers in Asia-Pacific. Secondly, we are using a manufacturing process that actually helps the environment by using recycled PET bottles as a feedstock. This is a win-win for both Huntsman and its customers."

The new facility in Taiwan marks the first time Huntsman has manufactured its TEROL® polyols outside of the United States. Huntsman provides TEROL® polyols to customers in the Americas and Europe from its plant in Houston, Texas, where it upcycles the equivalent of one billion 500ml PET bottles per year. |

melanie_li@huntsman.com

Double endorsement for Huntsman's spray polyurethane foam products



Huntsman Building Solutions' spray foam insulation systems have received a double endorsement from the North American construction industry. Heatlok® HFO Pro insulation won the 2020 Spark Award from the National Association of Home Builders' (NAHB) Leading Suppliers Council (LSC); while the team's Sealection® 500 spray foam insulation is being used in The New American Home 2020.

When NAHB chooses its annual Spark Award recipient, the organization looks for a product or service that provides impactful solutions to modern building industry challenges. This year, Huntsman Building Solutions' Heatlok® HFO Pro insulation was a prime candidate to win the trophy – delivering a high-performance spray foam insulating technology that has a reduced environmental impact.

Designed to protect against air, water and vapour intrusion, Heatlok® HFO Pro delivers ultra-low global warming potential (GWP), alongside superior sprayability, adhesion and compressive strength.

Heatlok® HFO Pro achieves R-11 insulation values that exceed the ASHRAE 90.1

continuous insulation requirements at 1.5 inches; is a Class II vapor retarder at 1.5 inches thick; is certified by the Air Barrier Association of America (ABAA); and is NFPA 285 certified for use with brick, stone and masonry exteriors.

The seal of approval

The company's second accolade relates to The New American Home 2020. This 6,428 sq. ft. property, designed and constructed by Sun West Custom Homes in Henderson, Nevada, showcases the leading technological advancements that the housing industry has to offer. While the building was under construction, Huntsman Building Solutions' Sealection® 500 was sprayed into the thermal

shell of the dwelling – into wall cavities and the underside of roof deck areas. Chosen for its superior insulating capabilities and ease of use, Sealection® 500 helps to create a comfortable living environment by minimizing drafts, outside noise and the entry of allergens and pollutants. Best of all, this spray foam insulation can reduce heating and cooling costs by up to 50 percent.

The New American Home is designed and constructed to meet the National Green Building Standard Emerald level certification, as well as Energy Star® and net-zero status. |

eric_stebel@huntsman.com

Two further TEROL® polyols receive UL environment certification

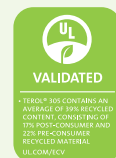
The Underwriters Laboratories (UL) has certified two more TEROL® aromatic polyester polyols. TEROL® 305 and 352 polyols join the growing number of TEROL® polyols that have received UL certification – an accreditation that verifies Huntsman's pre-consumer recycled, post-consumer recycled and renewable resource content claims, via a review of its manufacturing practices and raw materials sources.

Les Yamato, Business Manager at Huntsman Polyurethanes, said: "While all TEROL® polyols contain recycled content, seven of our products – TEROL® 250, 256, 305, 352, 563, 649 and 925 – have now been certified by the UL. Our UL-certified products contain up to 60 percent recycled content – material that would otherwise have ended up in landfill sites, in the ocean or added to the growing waste stream."

In 2014, Huntsman became the first U.S. polyester polyol manufacturer to receive UL certification. Today, Huntsman offers one of the broadest ranges of aromatic polyester polyols

available and can customize polyol solutions to meet customer application requirements. TEROL® polyols have hydroxyl values ranging from 105 to 460. Huntsman manufactures its TEROL® polyester polyols at a facility in Houston, Texas. The polyols are subsequently used in the production of MDI-based polyurethane insulation products, including polyisocyanurate boardstock systems, spray polyurethane foam (SPF), insulated metal panels and pour-in-place applications. |

eric_stebel@huntsman.com



Driving forward the development of new automotive materials

Polyurethane materials developed for the automotive industry have to deliver on many different levels. They need to be lightweight, tough and durable. Additionally, if used in a vehicle's interior, materials have to be tactile, comfort enhancing and free from odor-generating emissions. Original equipment manufacturers (OEMs) also require that they are quick and easy to work with, thus increasing productivity. With these requirements in mind, Huntsman recently developed two new materials with game-changing capabilities.

VITROX® Advanced design and processability

VITROX® RTM 00410 resin is a new two-component, snap cure, polyurethane system, which can help optimize the production of complex, three-dimensional, composite parts with tight dimensional tolerances. Designed to meet the short cycle times required in the automotive OEM industry, VITROX® RTM 00410 resin combines a flexible, low-viscosity, injection window with a fast cure at moderate tooling temperatures. Featuring Huntsman's patented, snap cure technology, the injection window of VITROX® RTM 00410 resin can be carefully controlled by manufacturers and adjusted to suit the geometry of the parts being produced.

Compatible with high-pressure resin transfer molding (HP-RTM), dynamic fluid compression molding (DFCM) and wet compression molding (WCM) techniques, VITROX® RTM 00410 resin delivers excellent fiber wet out and limited press build-up upon injection. This enables auto part manufacturers to use low-density core materials. The result is lighter sandwich parts, made with less resin, with no compromise on rigidity, strength and durability.

Parts made from VITROX® RTM 00410 can also be demolded quickly – helping manufacturers maximize line productivity and cut back on tool cleaning costs.

RIMLINE® Moldable and tunable

RIMLINE® FC (foam core) is a two-component polyurethane-based system, developed specifically for use as a core material in the manufacture of sandwich composite structures. A cost-effective solution for the production of affordable sandwich composites, RIMLINE® FC technology can provide greater engineering design freedom and enable increased productivity in production plants.

Versatile and durable, RIMLINE® FC technology has good flow behavior and can be molded into complex 3D shapes – both thick and thin. It is also tunable to help meet OEM manufacturing needs. The system can be used jointly with glass or carbon reinforcements to build a preform. Following impregnation with a composite resin, either by resin transfer molding (RTM) or WCM molding processes, the final semi-structural sandwich composite can be constructed.

RIMLINE® FC technology was developed to complement Huntsman's VITROX® composite resins, but can be overmolded with other composite resins, which exhibit very good adhesion properties – without the need for a separate surface treatment.

ilse_vanden_brande@huntsman.com



RUBIFLEX®

RUBIFLEX® foam – delivering ultimate flexibility in pillow production

Pillow manufacturers now have more flexibility when it comes to producing viscoelastic memory foam products, thanks to the development of a new adjustable foam technology from Huntsman. RUBIFLEX® SS 32056 foam is a novel, water-based system that can be used to create soft touch, memory foam pillows with a very low, low or medium density – depending on requirements.

Offering an excellent compression set and recovery rate, RUBIFLEX® SS 32056 technology enables the production of pillows that can be condensed down to a smaller size for packaging and distribution purposes – helping manufacturers reduce transport costs and retailers save on shelving space.

Once unpacked, pillows based on RUBIFLEX® SS 32056 foam, effortlessly spring back into shape. With good indent force deflection capabilities, pillows will also remold themselves, throughout the night, as a person's sleeping position shifts. Increasing comfort levels further, RUBIFLEX® SS 32056 technology is highly

breathable, allowing air to flow through the foam, which prevents moisture build up.

Lastly, RUBIFLEX® SS 32056 technology is manufactured without the use of flammable blowing agents. |

viviane_remondini@huntsman.com

Soothing the switch to polyurethane for Stamplas spa baths

Stamplas is a private Brazilian company that specializes in injection molding, stamping and tooling manufacturing. Among the many products that Stamplas produces via these techniques are a range of whirlpool spas and bathtubs – which are available under the Aquaplas brand. One of the largest bathtub manufacturers in Brazil, Stamplas produces more than 10,000 spas and bathtubs per year from its base in Campinas, São Paulo.



Historically, Stamplas has used UPR (unsaturated resin polyester) resin technology, reinforced with fiberglass, to create its spa and bathtubs. However in 2015, the business decided to switch to polyurethanes as the core material in its production process.

Stamplas' decision was driven by environment, health and safety (EHS) concerns, but also by the need to ensure better process productivity. The business wanted to change to a polyurethane-based system that would require less material consumption, produce less waste and have a faster cure time.

Prior to the switch, Stamplas had invested heavily in a modern robotic injection machine. The only machine of its kind in South America, the equipment helps the business

guarantee the quality, repeatability and accuracy of its production process. Looking for a polyurethane material that would work with this machine, Stamplas turned to Huntsman's team in Brazil for help.

Looking in depth at Stamplas' requirements, the Huntsman team in Taboão da Serra – supported by colleagues in Asia – developed a one polyol-based polyurethane system. Through a series of comparative laboratory tests, Huntsman confirmed that its system would deliver better flexural strength and adhesion results on acrylic substrates than materials already available. The team then moved on to piloting the material at Stamplas' plant – ensuring it would achieve the same results, in situ, on the customer's production line.

Following a successful trial, Stamplas confirmed an order for the system, which is known as RIMLINE® SK 17002 RUBINATE® 8700. Initially, Stamplas will be using the product to create hundreds of spa and bathtubs.

Daniel Rosenvasser, Interim Director, South America at Huntsman, said: "Throughout its long history, the guiding principles that have driven Stamplas have been innovation, differentiated design, good quality and solid relationships with national and international companies in a broad range of segments. We are proud to be working with Stamplas and to have developed a polyurethane system that matches their requirements and their production set up so perfectly." |

viviane_remondini@huntsman.com

TPU elastomers helping the frontline battle against COVID-19

Since the COVID-19 pandemic began, Huntsman has been producing thermoplastic polyurethane (TPU) elastomers for manufacturers of essential medical personal protective equipment (PPE) around the world. Huntsman's TPUs are being used to produce hospital gowns, face masks, mattress covers, tubes, valves, cable jackets and, notably, powered air purifying respirators (PAPR).



Widely used throughout the world, PAPR is a type of breathing apparatus that provides frontline health care workers a very high level of protection against viruses, such as COVID-19. The battery-powered PAPR purifies contaminated air through a filter mounted on a PAPR blower unit that delivers clean air through a lightweight breathing hose into the wearer's head covering.

BioThane, a manufacturer of coated webbing located in North Ridgeville, Ohio, makes the waist belts that hold the PAPR battery pack in place. Huntsman's IROGRAN® TPU coats the webbing, ensuring the highly durable belts are easy to thoroughly clean. Additionally, BioThane uses the same TPU-coated webbing to create systems for other patient transfer applications, where scrubable materials are vital.

Ethan Boron, President of BioThane, said: "We have been serving medical and safety markets for decades and sincerely appreciate and thank the frontline workers for their dedication. We are working hard to supply the belting required for these applications to ensure they have access to the PPE they so urgently need."

Tony Hankins, President of Huntsman's Polyurethanes business, added: "We are pleased to be helping in the fight against COVID-19 and honored to be a critical supplier to BioThane. This is the latest effort in a series of initiatives we've undertaken across the world in response to the pandemic, including the donation of our polyurethane systems to manufacture insulation panels for pre-fabricated quarantine hospitals, and to our customers producing spandex for medical PPE, such as masks, protection suits and shoes." |

simone_richter@huntsman.com



JEFFADD® scavenger technology reduces aldehyde emissions in PU foam

Scientists at Huntsman have developed a new JEFFADD® scavenger technology that can reduce overall aldehyde (formaldehyde and acetaldehyde) emissions in polyurethane foams. *PU Review* found out more.

Over the past few years, there has been a concerted push across the polyurethanes industry to reduce volatile organic compound (VOC) and fog emissions from polyurethane foams. This initiative has won worldwide support from government officials, polyurethane foam manufacturers, raw material suppliers and end-users. Various polyurethane foam markets have also initiated protocols in support of this work, including the automotive sector; the construction industry; and furniture and bedding manufacturers.

Through the implementation of emission testing methods, and the introduction of specifications and certified emission programs, the polyurethane industry's understanding of foam emissions has grown, and novel emission-reducing technologies have emerged. Today, this work continues on twin tracks with the polyurethane industry continuing to optimize the solutions it has already created; while also looking beyond VOC and fog emissions, at how best to reduce aldehyde emissions in final foam products.

Reducing aldehyde emissions

Renowned for pushing the boundaries, Huntsman has been a part of this effort and

has recently developed its JEFFADD® AS-76 aldehyde scavenger additive. Used in combination with the JEFFCAT® amine catalysts, JEFFADD® AS-76 aldehyde scavenger technology can help create polyurethane foam products that exhibit low levels of acetaldehyde, formaldehyde, fogging and VOC emissions.

Explaining more, Matt Meredith, Technology Manager at Huntsman, said: "When freshly produced polyurethane foam is exposed to light or air, it slowly begins to oxidize. This process is visible via the foam yellowing. This change in color does not indicate that the physical performance of the foam is deteriorating. However, it can be a sign that aldehyde by-products have been generated when alkoxyated polyols, surfactants and methylamino groups in catalysts have reacted with oxygen."

Continuing he said: "Reducing aldehyde emissions is not as simple as cutting back on the raw materials that contain it. Trace amounts of aldehydes can be found in all components of a polyurethane formulation – with some ingredients carrying higher levels than others. A far more effective option is to incorporate antioxidants and/or aldehyde-reactive nucleophiles into foam formulations

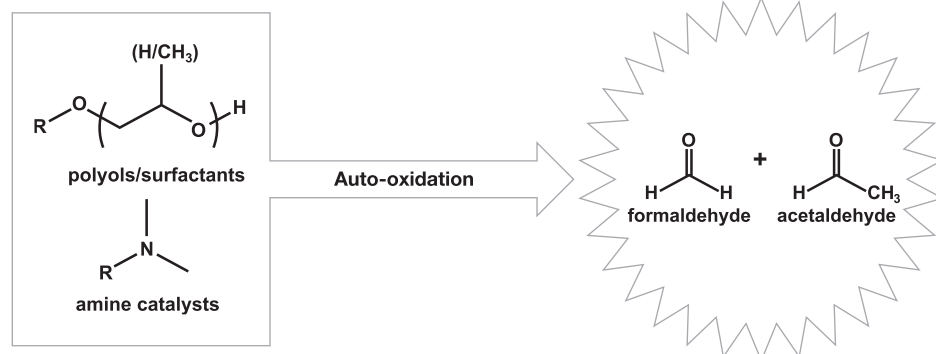
that can help trap and react to aldehydes – before they can escape into the atmosphere. These kinds of chemistries typically include phenolic antioxidants, tri-alkylphosphites, reactive amines, acid C-H compounds with electron withdrawing groups (EWG) and hydrazides."

"Obviously, when introducing any new raw material to an already established formulation, it's important to properly qualify the new component to ensure it will not have a negative impact on other aspects of the formulation or the polyurethane foam production process. For our team, this was a top priority. Our aim was to develop a patented solution, which would reduce aldehyde emissions in the final polyurethane foam, while maintaining the low VOC and fog emission, integrity, and physical properties foam manufacturers expect when using our chemistries."

The evolution of aldehyde scavengers

When the polyurethane industry first started to focus on reducing aldehyde emissions, the target molecule was formaldehyde. The aim was to find a solution that would work in a reacting polyurethane matrix, without consuming the reactive species of the isocyanate during foam formation. The next step was to come up with a scavenger technology that would not have a negative effect on VOC and fog emissions, front-end reactions or the physical properties of the polyurethane formulated system.

Initially, the team at Huntsman developed the patented JEFFADD® AS-28 and JEFFADD® AS-53 aldehyde scavengers. Both products were designed to reduce formaldehyde emissions, while maintaining other foam properties. However, as the need to reduce formaldehyde emissions became more widely understood, polyurethane foam producers, specifically those in Asia, began to call



Auto-oxidation of PU foam raw materials.

for solutions that could also reduce acetaldehyde emissions.

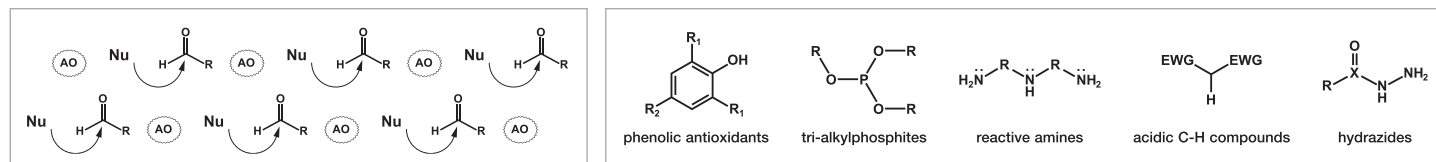
Continuing, Geert Dries, Technical Manager Material Science at Huntsman, said: “Many formaldehyde scavengers help reduce formaldehyde emissions, but in doing so, negatively impact on acetaldehyde emissions and the low emission integrity of the polyurethane formulated system. Our challenge was to develop a solution that would help reduce formaldehyde emissions, but also keep acetaldehyde emissions low and below emission requirements for

formulated systems. The result of that work is JEFFADD® AS-76 scavenger technology.”

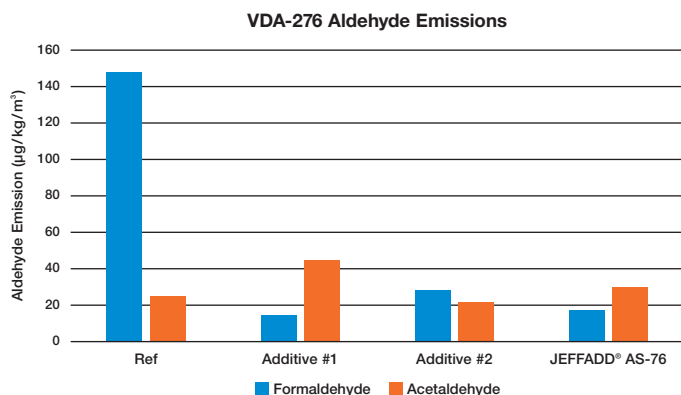
During the development of JEFFADD® AS-76 scavenger technology, the Huntsman team evaluated three possible options, at various usage levels, in a low emission, high resiliency, molded polyurethane formulation. The team used two different tests to assess aldehyde scavenging performance: the VDA-276 testing method to monitor aldehyde emissions and the VDA-278 test to assess VOC and fog emissions.

“Reducing aldehyde emissions is not as simple as cutting back on the raw materials that contain it. Trace amounts of aldehydes can be found in all components of a polyurethane formulation.”

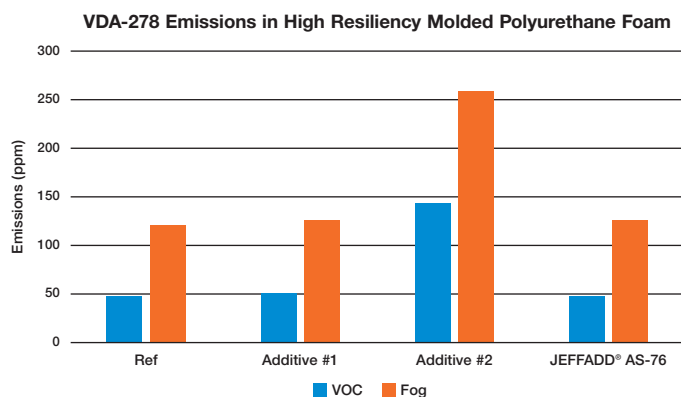
MATT MEREDITH, TECHNOLOGY MANAGER AT HUNTSMAN



Nucleophiles concept and chemistries to reduce aldehydes in polyurethane foam.



Graph 1: VDA-276 formaldehyde and acetaldehyde emissions.



Graph 2: VDA-278 VOC and fog emissions.

Graph 1 illustrates the aldehyde reduction performance of the three aldehyde scavengers, including the recently commercialized JEFFADD® AS-76 aldehyde scavenger.

The VDA-276 testing results indicated that all three aldehyde scavengers successfully reduced formaldehyde emissions. Focusing on the acetaldehyde analysis, Additive #1 increased the acetaldehyde emission, while both Additive #2 and the JEFFADD® AS-76 aldehyde scavenger maintained or slightly increased the acetaldehyde emission respectively. The JEFFADD® AS-76 aldehyde scavenger also reduced the formaldehyde emission by a factor of 10.

The second phase of development was to determine the VOC/fog emissions of the polyurethane formulated systems with the aldehyde scavengers versus the standard polyurethane formulation. Graph 2 illustrates the VOC/fog emission analysis.

VDA-278 test results indicated that both Additive #1 and the JEFFADD® AS-76 aldehyde scavenger maintained the low emission integrity of the polyurethane formulated system, while Additive #2 significantly increased VOC and fog emissions.

Concluding, Frank Rodriguez, Regional Marketing Manager for PU Additives at Huntsman, said: “We are incredibly proud of our work on the development of JEFFADD® AS-76 aldehyde scavenger. This technology is a stepping stone for understanding and developing the next generation of aldehyde scavengers that will further reduce formaldehyde and acetaldehyde emissions, and allow us to start developing solutions to target more challenging emission species.” |

frank_rodriguez@huntsman.com
geert_dries@huntsman.com
matt_meredith@huntsman.com

Creating a world leading SPF business



Huntsman Building Solutions was created in May 2020, following Huntsman's acquisition of leading North American spray polyurethane foam (SPF) company Icynene-Lapolla in February 2020. Icynene-Lapolla has been integrated with Demilec, also a market leader in SPF applications and which Huntsman acquired in 2018. Together, the businesses are now one of the world's leading SPF providers and the fifth largest insulation manufacturer. The Huntsman Building Solutions brand name was announced in May and the combined Business now provides customers with an extensive offering of energy-saving open-cell and closed-cell SPF products, for residential and commercial property owners.

Simon Baker (left), former President, Demilec, and Doug Kramer, former president, Icynene-Lapolla, (right), were both instrumental to the integration of the legacy SPF businesses into Huntsman Building Solutions and had the combined goal of capturing the very best features from both companies. Going forward, Doug is President of the U.S. business and Simon is President of the Canadian and international businesses. The Huntsman Building Solutions corporate office will be in The Woodlands, Texas, within Huntsman's global headquarters, and this is where Doug, Simon and the leadership team is based.

PU Review recently spoke to Doug and Simon to find out more about the recent acquisition of Icynene-Lapolla, the formation of Huntsman Building Solutions, and what this development means to the polyurethanes industry.



PU Review (PU R): In February 2020, you were both appointed as Presidents of the new SPF company, which is now called Huntsman Building Solutions. Please could you explain your respective roles in the company, how you will work together, and give our readers some insight into your career history.

Doug Kramer (DK): My background is in the spray foam industry, where I have more than 30 years of experience. I entered the business in the late 1980s, where I started in operations. I then moved into technical roles and eventually sales. During that time, I managed sales of SPF products to IPI International, Foam Enterprises and BASF, before starting Lapolla Industries in 2005. I founded the business with Monica Longtin and Keith VanStavern, both of whom are still onboard with Huntsman Building Solutions today.

Simon Baker (SB): I have more than 30 years of experience in the Polyurethanes industry, with Huntsman and ICI, its predecessor. During my career, I have worked in Europe and Asia, coming to North America in 2015. The first part of my career was spent in purchasing, supply chain and operations. I subsequently moved into commercial roles, where I led Huntsman's European Insulation business, including its SPF platform. I have been very active in the development of our downstream strategy, including the acquisition and management of many of Huntsman Polyurethanes' downstream businesses, including Demilec in 2018.

DK: On a day-to-day basis, I will focus on the U.S. market and Simon will focus on Canada and international markets, but we will work together to ensure that we both utilize our industry relationships and experience to maximize the overall results of our business. Further, as we build one global platform that will have a common goal of technology, messaging, branding and differentiation, consistency is imperative.

SB: It is unusual to have one company with two Presidents, but we believe that our respective skills and experience are very complimentary and will be of great benefit to Huntsman Building Solutions, as we bring the legacy companies together. We will have one leadership team, which will report to both Presidents and be responsible for developing and executing our strategy consistently across all commercial, operational and functional aspects of the business globally.

PU R: What are the relative strengths of the two legacy companies; what are the prime advantages of bringing the two businesses together; and how will customers benefit from this?

DK: All three legacy companies have similar models and a comparable value focus. There is incredible brand equity in the trade names of the products of all companies, with well-established, solid industry reputations. In addition, the legacy companies have a heavy focus on added value selling, such as technical field services, architectural and engineering services, as well as driving customer relationships. Ultimately, the broad portfolio of the combined, and future technologies, will differentiate our platform globally.

SB: The combination of Demilec and Icynene-Lapolla brings together the most respected names in the SPF industry. This has multiple benefits for customers. First and foremost, it gives them access to unrivalled technical know-how and the broadest range of SPF products available, across all key markets, worldwide.

Together, the companies have nearly 100 years of industry experience and have played a leading role in introducing numerous innovations across both open cell and closed cell arenas. We share many values, including a passion for our customers, strong ethical and safety standards, and a commitment to driving insulation innovation in the industry.



DK: We are backed by Huntsman's world-scale MDI manufacturing sites in North America, Europe and Asia and its TEROL® polyester polyols plants in North America and Asia. This will enable us to cross-seed our geographical efficiencies and our technology to ensure local and global coverage.

Our focus for future is firmly fixed on sustainability and developing environmentally-friendly building envelope solutions. Our product lifecycle and future technologies are the linchpins of our culture and mission. We intend to optimize other Huntsman resources and embrace the values from one of the world's leading polyurethanes companies.

PU R: What other products do you offer?

SB: Beyond spray foam, we offer complementary products, such as roofing foams with acrylic or silicon elastomeric top coatings and polyurea coatings – mainly for containment applications. We also offer elastomeric wall coatings for commercial applications, concrete lifting products, ditch break foams and a variety of pour-in-place rigid systems for garage doors, cold stores, precast modular buildings and HVAC installations.

DK: Huntsman Building Solutions also offers an extensive range of proportioning equipment and accessories for the processing of SPF, including rigs from the leading suppliers in the industry. We offer a virtual one-stop shop for SPF contractors (see side bar on page 11).

100 Years' Combined Heritage in Spray Polyurethane Foam

1974

Lapolla Industries was established in 1974 by Angelo Lapolla, as a small acrylic coatings manufacturer in Tempe, Arizona. Doug Kramer and another investor acquired the business in 2005, and quickly expanded nationally, while vertically integrating in SPF technology in 2007. With the headquarters and centralized manufacturing in Houston, Texas, Lapolla expanded internationally, actively selling in 35 countries globally. Lapolla Industries sold to FFL Partners in October 2017.

1983

In 1983, **Demilec** opened operations in Montreal, Canada. At the time, the Company was mainly providing closed cell spray polyurethane foam to the Canadian market. In 1997, it expanded the business into the United States, and established an R&D and manufacturing site in Dallas, Texas. In 2000, the Company constructed a polyols plant at its Boisbriand, Quebec, facility. In 2013, Demilec was acquired by Sun Capital Partners, Inc. The following year, Demilec acquired a 224,000 square foot location in Arlington, Texas, to support its continued growth in North America.

1986

Icynene was established in 1986 in Mississauga, Ontario, Canada, with a specific focus on open cell SPF for residential insulation. Icynene, the pioneer of open cell commercialization, marketed the technology to architects and consumers, eventually becoming the leading brand to builders nationwide. Icynene continued to broaden its product portfolio to include closed cell SPF. Icynene also saw international expansion with brand recognition globally. Icynene was acquired by FFL Partners in November 2014.

PU R: Will any products be discontinued?

SB: Huntsman Building Solutions will continue to innovate products to ensure that we can always offer our customers the best technologies available to meet their needs. Our intention is to continue to serve all current applications, and over time, migrate to the best product offerings from all three legacy companies. When new products are ready, we will work with our customers to facilitate a smooth transition, supported by our skilled, field-based, technical service support associates. This process reflects a similar approach that the companies have successfully followed in the past.

PU R: How is the integration of the two businesses progressing and what are the main synergies that you foresee?

DK: We are committed to maintaining the entrepreneurial dynamics of the legacy brands and the market facing expertise they are known for throughout the SPF industry. In parallel, we will enhance the business through Huntsman's world-class resources and ensure best practices and efficiencies are in place across our combined operations. We will ensure that the culture of the company reflects the fact we are one company with one common mission.

PU R: Will all of your SPF products now use Huntsman's MDI and TEROL® polyols, which are manufactured using upcycled PET scrap?

DK: One of the most exciting components is our commitment and alignment to sustainable technology. We strongly believe in



the environmental benefits that spray foam delivers, which includes the use of the upcycled PET content found in TEROL® polyols. These polyols are the backbone of our "green" building solutions. The global value of our SPF solutions to the environment and consumers is almost immeasurable.

PU R: The combined new business has been named Huntsman Building Solutions. Can you tell the readers more about the name and whether your non-SPF products will be part of this business?

SB: The acquisitions of Icynene-Lapolla and Demilec created a fantastic opportunity to create a new brand and combine the names and reputation of one of the world's leading providers of downstream MDI-based solutions, with the industry's leading SPF companies. We could not be more excited, and proud to carry the Huntsman name on our banner. Huntsman's proprietary technology puts us in a unique global position. Using Huntsman's TEROL® polyester polyols, we can recycle post-consumer waste and put it straight into construction materials that are eco-friendly and sustainable; deliver cost savings to consumers; and make buildings more comfortable and energy efficient, while enabling a meaningful reduction in their carbon footprint. That's a win-win on lots of levels for everyone. As the business continues to grow, our downstream focus will continue to expand to other environmentally sustainable and innovative construction materials.

PU R: Now that you have a new company name, what happens to the Demilec and Icynene-Lapolla company names and the products associated with each?

DK: All legacy company names have been part of the spray foam market for many years and have developed a strong following. With Huntsman Building Solutions, we are entering an exciting new era and have the opportunity to build a leading position as a truly global SPF insulation provider. To simplify our brands over time, Huntsman Building Solutions will

be building our portfolio around three well-known product families. The first is from the FOAM-LOK® SPF family. This open cell SPF product line has found great success in residential and commercial interior wall, ceiling and attic applications. The second will be built around the legacy HEATLOK® closed cell SPF platform, which provides superior insulation in commercial applications, including walls, roofs and building exteriors. Rounding out the brands, will be our THERMO-FLEX® family of acrylic coatings systems. These products are designed to protect, preserve and prolong the life of commercial/industrial roofs.

SB: We are confident that customers will understand the decision to rebrand to Huntsman Building Solutions. We expect them to feel reassured by the continued high levels of service, innovation and support that will be delivered by a highly experienced and passionate team, which is supported by a committed and responsible corporate owner.

PU R: What is the existing global footprint of Huntsman Building Solutions and what are the plans for global growth?

SB: Currently, around 10 percent of the portfolio is sold outside North America, across a growing range of countries in Europe and Asia. The legacy companies have strong positions globally, throughout Europe and Asia.



Two SPF Product Ranges

Open-Cell Range

FOAM-LOK™
SPRAY FOAM INSULATION

Closed-Cell Range

HEATLOK® 

Roof Coatings Range

THERMO-FLEX™
ACRYLIC COATING SYSTEMS

These positions are now further enhanced by Huntsman's existing downstream enterprises (DSEs), which are strategically located throughout the regions, across more than 35 countries worldwide. Take, for example, Icynene-Lapolla's legacy business in the United Kingdom. Now, as part of Huntsman Building Solutions, and working together with Huntsman's systems house in King's Lynn, U.K., we will be able to solidify our position in the U.K. by manufacturing product locally.

The same holds true in other countries for both legacy companies. Icynene-Lapolla has market share in the United Kingdom, South Korea, Netherlands, Scandinavia, France and Eastern Europe, while Demilec is strong in Russia, the Middle East and Canada. The two footprints are very complementary. Being able to partner with regional Huntsman systems houses, and bring along our technology and downstream expertise is very exciting, and having regional manufacturing capabilities is a real game changer.

PU R: *What are the main challenges and opportunities facing the industry over the next five years and how do you see Huntsman Building Solutions developing over that timeframe?*

DK: The challenges for the industry start with the need to move towards licensing of contractors to help ensure consistent and quality installations and standards. As the world continues to embrace spray foam and its high-performance values, standards, testing and contractor licensing will continue to be a forefront issue.

Second, the world will continue to require more eco-friendly technologies, such as our HFO (hydrofluoro-olefin) technology. This will be driven by international government collaborations, such as the Montreal Protocol. We are prepared to support these initiatives with leading product innovation and are in a prime position globally to assist those markets to transition to better, safer and more environmentally-friendly products. This is both a challenge and an opportunity.

The opportunity as the largest SPF platform in the world will be to continually drive that leadership through innovation and experience. Our collective experience in this industry means we can share our knowledge and expertise in the evolving SPF market, teaching others what we have learned, helping them more easily navigate the future in SPF and construction materials.

PU R: *Do you foresee any additional bolt-on acquisitions taking place over the next few years? Perhaps an SPF equipment manufacturer, another polyol manufacturer or even a catalyst company?*

SB: The Huntsman Building Solutions platform lends itself very well to future expansion. We will grow organically, working with existing construction-focused business units already within the Huntsman portfolio. In time, we may also expand via additional bolt-on acquisitions. We have some clear ideas about targets that would offer great strategic potential. |

Innovative Construction Products



Spray Foam Roofs

FOAM-LOK® spray foam roofing insulation system is a sustainable solution for a wide range of commercial, agricultural, industrial and residential applications. This advanced insulation and roofing system is UL Class A fire-rated and Energy Star® rated. Once applied to any roof shape and substrate, the system seals the building envelope to stop heat transfer/loss through the roof deck, thus minimizing air infiltration.

Protective Coating Systems

THERMO-FLEX® acrylic coatings are specifically designed to protect FOAM-LOK® spray polyurethane foamed roofs from wind uplift, ultra-violet (UV) damage and ponding water. THERMO-FLEX® is a cost-effective, roof coating system for use over new and existing roof substrates.

THERMO-SIL® silicone roof coating system is designed to provide a protective wear surface, reflectivity and renewability to any low-slope roofs. This silicone coating is specially formulated to protect FOAM-LOK® spray foam to create a complete roofing system.

THERMO-PRIME™ and **THERMO-SIL®** silicone epoxy primer are specially formulated primers to be used with THERMO-FLEX® and THERMO-SIL® product lines. THERMO-PRIME™ and THERMO-SIL® silicone epoxy primers create tenacious bonds to many substrates, such as concrete, aluminum, steel and many more.

RESTORATION™ COATING SYSTEM (RCS) provides building owners with a cost-effective option to stop roof leaks and provide a watertight, aesthetically-pleasing roofing solution for all commercial roof substrates. This water-based, high solids elastomeric system is designed to prolong the life of existing roofs to avoid a costly re-roof for building owners.

Equipment and Rigs

Huntsman Building Solutions also offers a full range of equipment to support spray foam contractors on the job site. Brands sold include Graco™, Polyurethane Machinery Corporation (PMC), 3M Company, Allegro® Industries and Bullard®. Mobile spray foam trailers (rigs) are also sold to include custom buildouts for the interior equipment, such as proportioning equipment, reactors, spray guns, air compressors and other equipment to complete the outfitting. Everyday items, such as safety and personal protective equipment (PPE), including supplied air are also sold.





Recycling shoe waste is child's play!

With more than 1.3 billion people living in India, the country's footwear industry has to make a lot of shoes to keep up with demand. Manufacturers produce an estimated half-million pairs of shoes each day for Indian consumers – a process that generates some post-production scrap.



As a leading supplier of polyurethanes to the footwear industry, Huntsman has found a clever use for this leftover material – transforming it into a valuable resource that can be used to resurface outdoor athletic tracks and playgrounds.

Adapting a technique employed for recycling car tires, Huntsman has created a way of re-granulating surplus material into small chunks and then binding them together with a polyurethane-based adhesive. The result is a low-density material that can be used to create soft, springy, high-quality surfaces.

This development offers shoe manufacturers a major step forward when it comes to dealing with post-production waste. At the moment, most companies either collect the material and send it to cement kilns, where it is burned to create energy; or pay to have the material chemically treated and turned back into a liquid that can be used to make new shoe soles – a longer-term, more costly solution.

To demonstrate the caliber of its process and the resulting material, Huntsman has built a pilot unit at its Chakan, India, manufacturing site, where the company can granulate, bind and produce prototype slabs of polyurethane crumb. The business has also recently resurfaced a playground at a local school, which it has supported for many years.

In late 2019, Huntsman replaced a dirt and concrete play area with the granulated material

– creating a smooth, UV-resistant surface that is safer for the school's 120 students to play on. The surface is also more aesthetically pleasing and very durable; while shoes generally have a lifespan of several years, the surface produced will last up to a decade, extending the useful life of the material.

As well as improving play areas, Huntsman's polyurethane crumb recycling technique can also be used to create or refurbish communal exercise and recreational spaces and walking tracks – a major advantage in a densely populated country, such as India, where green space is limited, and where recycling is a national imperative. India has one of the highest recycling rates for PET plastic bottles and containers in the world.

Huntsman is now working to scale up its rubber crumb process. A number of key footwear manufacturers have expressed an interest in recycling their waste via this method. Huntsman is currently planning another pilot project in Calicut, Kerala – where many footwear companies have offices and headquarters. Longer term, the process could have broader appeal beyond dealing with footwear production waste. In India, and in other countries, the ultimate goal would be to recycle millions of pairs of discarded shoes, keeping them out of landfill or from polluting the countryside and oceans. |

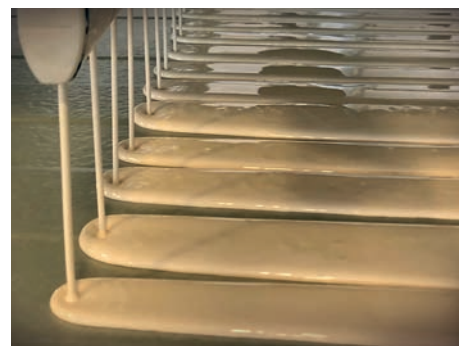
neha_phale@huntsman.com



Children in India, happily enjoying their new playground.

DaltoPIR® insulation systems added to *FM Approval Guide*

Huntsman's DaltoPIR® fire-rated foam insulation systems are designed to transform the production of fire retardant, polyisocyanurate (PIR) sandwich panels. Recently, a number of products in the DaltoPIR® range were added to the Specification Tested listing as an identified component in the *FM Approvals – Approval Guide*. FM Approvals is a recognized and internationally respected leader in third party testing and certification.



DaltoPIR® products listed in the FM Approvals – Approval Guide now include:

DaltoPIR® HFR 33334

DaltoPIR® FR 33336

DaltoPIR® XHFR 33338

DaltoPIR® XHFR 33341

DaltoPIR® XHFR 33342

Offering a different viscosity build up in rising foam, DaltoPIR® foam systems enable more stable, and more consistent processing. This in turn can help panel producers achieve better panel planarity and quicker line speeds. Furthermore, the resulting foam has very low friability, which contributes positively to the long-term properties of panels.

Kurt Jander, Sales Leader Insulation Systems at Huntsman Polyurethanes, said: "Having a component of DaltoPIR® insulation systems

listed in the FM Approval Guide can help panel manufacturers speed up and facilitate FM approval procedures for their own finished products. Our DaltoPIR® insulation systems can also enable fire ratings to be met, as well as other product performance needs." |

ilse_vanden_brande@huntsman.com

New DALTOPED® material used in next generation safety shoe

An innovative polyurethane midsole material, developed by Huntsman's footwear team for the safety and military shoe market, has been tested and qualified by personal protective equipment (PPE) manufacturer, uvex, for use in its uvex 1 G2 safety shoes.



DALTOPED® DuraLite Energy lightweight polyurethane combines the high cushioning and energy return properties expected of sports footwear, with the durability needed to create long-lasting, protective work shoes.

Low-density midsoles made from DALTOPED® DuraLite Energy polyurethane material mix excellent shock absorbing and rebound properties with good stability. This combination of properties can help prevent tired feet from rolling and reduce lower leg fatigue for people on the move all day.



Hydrolysis resistant, and equipped with good compression set characteristics, DALTOPED® DuraLite Energy polyurethane can maintain dynamic performance at a wide temperature range, meaning feet stay cushioned and comfortable, even in sub-zero conditions.

From a processing perspective, DALTOPED® DuraLite Energy polyurethane also provides numerous benefits. With excellent flow properties, the material can be used for direct-on processing and can be made to work with conventional footwear machinery, as well as the latest automated shoe manufacturing systems. Thanks to its raw material consistency, DALTOPED® DuraLite Energy polyurethane material also offers a lower rejection rate versus standard midsole products.

Sylvie Van Aerschot, Marketing Manager for Footwear in Europe at Huntsman, said: "An important part of manufacturing comfortable safety shoes and military boots lies in using a durable, but lightweight midsole technology, such as DALTOPED® DuraLite Energy polyurethane, which has very good energy return properties."

DALTOPED® DuraLite Energy polyurethane was launched in February at the global footwear industry event, SIMAC. |

ilse_vanden_brande@huntsman.com

Rewarding PU innovation in sustainability



Every year, Huntsman organizes the Chief Executive's Award for Innovation in Sustainability. This internal awards program, which has been running since 2011, recognizes teams across the corporation that have initiated projects with a strong environmental theme.

Commenting on the scheme, Huntsman CEO Peter Huntsman, said: "Since we started this program, we've had more than 170 submissions from project teams and manufacturing facilities across the globe. I am proud of the work that our associates are doing to seek sustainable solutions, and I commend them all for their efforts."



WINNER

Chief Executive's Award for Innovation in Sustainability

In the 2019 awards program, Huntsman Polyurethanes' TEROL[®] polyols team in Houston took the highest accolade. The team received top honors for their efforts in transforming discarded PET plastic bottles into polyester polyols, which are subsequently used in energy-saving spray foam and refrigerant insulation. Since 2015, the TEROL[®] site has upcycled the equivalent of more than five billion plastic bottles that would otherwise have been destined for landfill or found their way into oceans. The resulting PET scraps are used to make the most effective, energy saving insulants on the market today, reducing the cost of heating and cooling homes and commercial buildings, and prolonging the shelf life of perishable foods.

eric_stebel@huntsman.com



HIGHLY COMMENDED



Footwear manufacturing for the future

Huntsman Polyurethanes' footwear experts have developed a novel technology that is enabling one of the world's biggest footwear brands to increase automation in the manufacture of its sports shoes. The technology delivers multiple production, energy saving and environmental benefits – while enabling the customer to still produce sports shoes that are lightweight, comfortable and long-lasting. Most sport shoes are produced in Asia using rubber outsoles and EVA midsole materials. Production is labor intensive and often uses solvents and halogen-containing glues.

Huntsman's technology reduces manufacturing steps from eight down to two, with the polyurethane midsole bonded directly to

the outsole and upper in a single injection step. Free from solvents and halogen-containing glues, the technology can help improve worker safety.

The new process also saves energy due to a lower process temperature and no rubber vulcanization. At present, it is projected that more than 15 million pairs of sport shoes will be produced via this method by 2021 – with the customer eventually planning to scale up to more than 50 millions pairs globally.

simone_richter@huntsman.com

HIGHLY COMMENDED



Transforming flexible packaging

Every year in China, 600 billion flexible packets are produced for food and beverage, household and personal care products. Flexible packaging is made from three to four layers of substrates bonded together with a laminating adhesive, traditionally made using solvents. Huntsman Polyurethanes' team in Shanghai has developed SPEEDLAM™ adhesives, a solvent-free polyurethane adhesive that can be used to create flexible packaging in a healthier, more efficient, more sustainable way. SPEEDLAM™ adhesives are free from volatile organic compounds (VOCs), making them safer for workers in flexible packaging factories.

The adhesives can be processed at a faster rate for greater production efficiency, and they deliver excellent bonding performance. In 2018, thousands of tons of SPEEDLAM™ adhesives were sold in the China market, enough to reduce VOC emissions by 2,400 tons; save about 12 million kilowatt hours; and create better working conditions for 5,000 flexible packaging employees. The team is now developing additional products and plans to grow market share across the globe.

melanie_li@huntsman.com

HIGHLY COMMENDED

Win-win building insulation

Today, globally, the building sector is the largest user of energy and consequently the biggest emitter of CO₂. Constructing and renovating buildings to be highly energy efficient is therefore the imperative. With people spending 90 percent of their time indoors, both at home and at work, fire safety is also a key consideration in the design of buildings. The Huntsman Polyurethanes team in Europe developed a patented DaltoPIR® insulation foam system, which delivers optimal fire and smoke safety properties, without compromising energy efficiency and costs. The system is used to create polyurethane self-supporting insulation panels that enable buildings to be erected faster with fire-safe designs.

The material's long-term durability minimizes the use of natural resources, and its excellent thermal performance reduces fossil fuel use and CO₂ emissions. For each unit of energy used in their production, the panels will save 100 times more during building use.

After successfully commercializing the product in Europe, Huntsman is now scaling up to share the technology globally, particularly in India, where the national government supports cold chain infrastructure deployment to reduce food waste.

ilse_vanden_brande@huntsman.com



Forthcoming events and technical presentations

International Forum Automotive Acoustics and Vibration, Manchester, United Kingdom (September 22-23)

Quebec Building Expo (Contech Quebec), Quebec City, Quebec, Canada (October 8)

Insulation Contractors Association of America (ICAA) Annual Convention 2020, Chicago, Illinois (October 8-10)

Air Barrier Association of America 2020 Annual Conference, Reston, Virginia (October 20-21)

CEBQ Building Envelope Conference, Montreal, Quebec, Canada (October 21)

Manitoba Building Officials Association 2020 Fall Seminar & Trade Show, Winnipeg, Manitoba, Canada (October 21-22)

Montreal Building Expo (Contech Montreal), Montreal, Quebec, Canada (November 3)

ABX | Architecture Boston Expo, Boston, Massachusetts (November 3-4)

11th International Styrian Noise, Vibration & Harshness Congress, Graz, Austria (November 3-5)

Foam Expo Europe, Stuttgart, Germany, (November 10-12)

CEBQ Building Envelope Conference, Montreal, Quebec, Canada (November 24)

Europur & Euro-Moulders Conference, Amsterdam, The Netherlands (November 24-25)

Construct Canada, Toronto, Ontario, Canada (December 2-4)

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HUNTSMAN

Enriching lives through innovation

For more information on the subjects covered in *PU Review* magazine, please contact the editor:

Eric Stebel, eric_stebel@huntsman.com +1 281-719-4602

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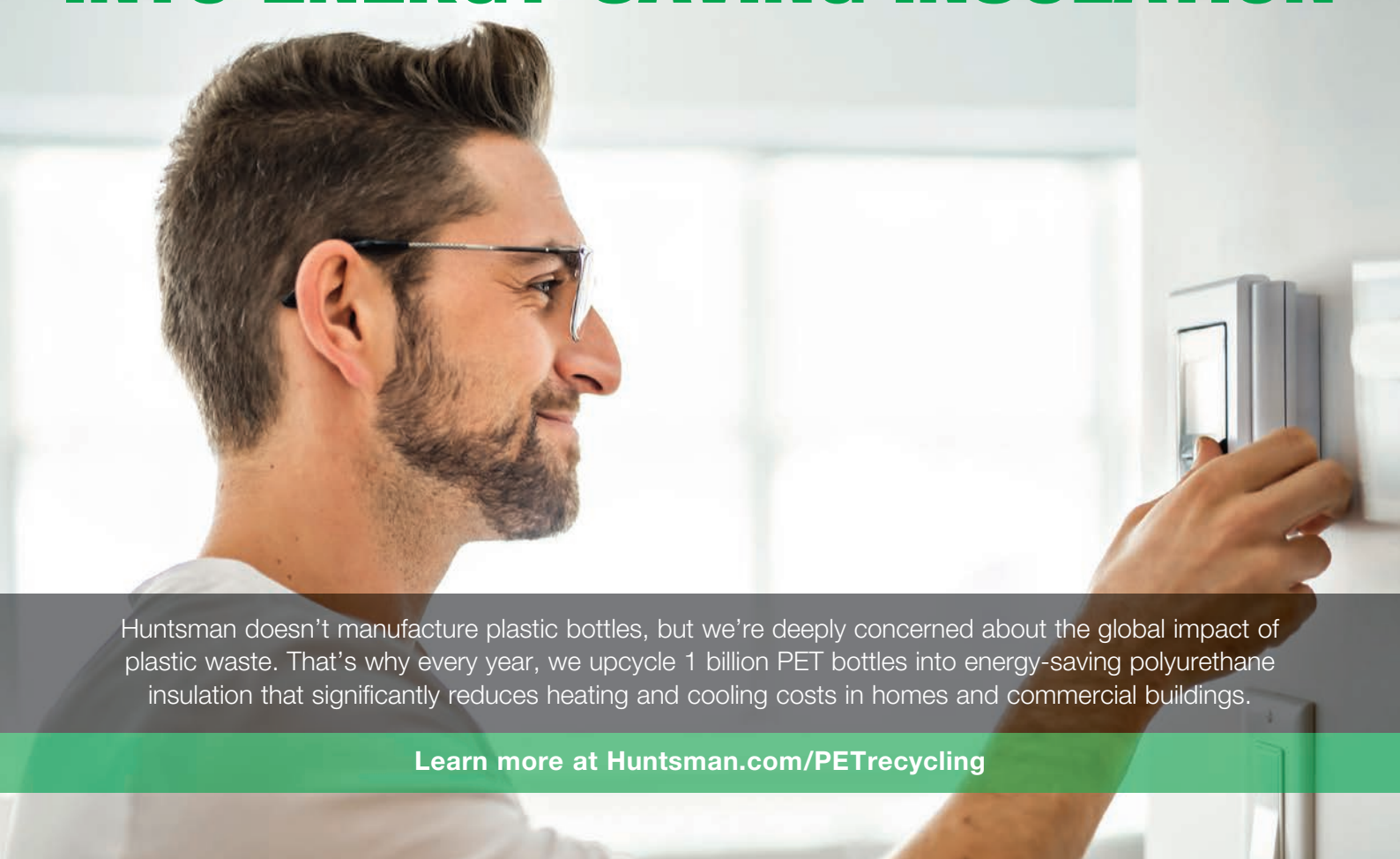
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HUNTSMAN

Enriching lives through innovation

TRANSFORMING PLASTIC WASTE INTO ENERGY-SAVING INSULATION



Huntsman doesn't manufacture plastic bottles, but we're deeply concerned about the global impact of plastic waste. That's why every year, we upcycle 1 billion PET bottles into energy-saving polyurethane insulation that significantly reduces heating and cooling costs in homes and commercial buildings.

Learn more at [Huntsman.com/PETrecycling](https://www.huntsman.com/PETrecycling)