

# CPI Polyurethanes 2019

## RESILIENCE FOR GROWTH

Polyurethanes sector poised for strong growth amid shifting macro trends



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# COMMENTARY

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**“Companies clearly view the resilient polyurethanes sector as a growth business”**

**D**espite macroeconomic and regulatory challenges, polyurethanes (PU) are in the sweet spot as their resilient properties are readily applied to key mega trends in energy efficiency, sustainability and mobility.

PU spray foam insulation to make buildings more energy efficient is gaining in popularity and the industry is innovating at a fast pace to achieve greater energy savings with ultra-low global warming potential (GWP) as well as providing more versatile uses with properties such as fire resistance and lighter weight.

New PU materials are being developed for more comfortable, customized and lighter weight automotive interiors and PU coatings are not only being used in auto surface interiors but in athletic attire for higher performance and wind turbine blades for corrosion prevention.

The use of thin PU layers in electronics to protect printed circuit boards (PCB) and other electronic components is also set to surge as electronics become more complex with higher demands in terms of temperature and chemical resistance.

Many more innovations are being developed in the PU sector, including the use of recycled or bio-based materials to produce key PU raw materials. US-based Huntsman is using scrap waste polyethylene terephthalate (PET) to produce polyester polyols for use in its methylene diisocyanate (MDI)-based PU spray foam insulation while Germany-based Covestro is using carbon dioxide (CO<sub>2</sub>) to produce polyols for soft PU foams for mattresses and furniture.

Companies clearly view the resilient PU sector as a growth business. Most recently, US-based Huntsman announced the sale of its intermediates and surfactants business to Indorama to focus on its core businesses, of which polyurethanes is the largest. The company will seek to build and acquire PU systems houses worldwide to offer more customized and nimble solutions to changing customer needs.



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# CPI facilitates key industry shifts

The Center for the Polyurethanes Industry is facilitating innovation, sustainability, safety and regulatory transitions

CYNTHIA CHALLENGER VERMONT

**W**ith their unique array of characteristics, polyurethanes contribute to the development of effective solutions for many of the global challenges that exist today. The Center for the Polyurethanes Industry (CPI) strives to, through extensive advocacy efforts and various initiatives and programs, enhance the sustainability and safety of polyurethanes, foster innovation and ensure regulatory developments are based in sound science.

"CPI's efforts are designed to provide the most accurate and impactful information to key decision makers in the industry, government and general public to enable society and industry to work together to make the best possible products for many applications based on PU technology," said Ernest Wysong, chair of CPI's Polyurethanes Technical Conference and global technology leader, Opteon Spray Foam & Panel Applications at Chemours.

The Conference serves many functions for CPI, its members and the PU industry at large. First and foremost, according to CPI's senior director Lee Salamone, it provides a mechanism for highlighting innovation in the PU industry and a forum for sharing technical developments in all different PU chemistries and end uses.

**ALAN ROBINSON**  
NAA commercial director for Dow  
Polyurethanes & Chlor-Alkali & Vinyl

**"With globalization and advances in digitalization, our workforce needs will grow... People need to be prepared"**



The conference program includes technical sessions, professional development programs and opportunities for networking and exhibiting, noted Julie Rabino, vice president, rigid raw materials sales at Covestro and CPI Steering Committee vice chair.

Announcement of the winner of CPI's annual Innovation Award, which recognizes important innovations throughout the value chain, takes place at the closing session of the conference after attendees have a chance to vote for one of two finalists.

For the second year in a row, three university students will be brought to the 2019 conference to share their research, network and find opportunities in the PU industry. The goal is to increase their understanding of the PU industry and how they can be productive leaders for the future, according to Salamone.

## ENGAGING STUDENTS

Engaging students in the innovation process is also a means for developing new talent and contributing to the sustainability of the PU industry, according to Wysong. The PU industry today is facing a lack of an experienced talent pool and not enough emphasis on education, according to Alan Robinson, NAA commercial director for Dow Polyurethanes & Chlor-Alkali & Vinyl (CAV).

"With globalization and advances in digitalization, our workforce needs will grow. For example, the digital worker will increasingly interface with machines, the Internet of Things and artificial intelligence. People need to be prepared, and we can address this gap through information sharing, continued education and trainings," said Robinson.

Few college programs specifically address PU technology, however, notes Wysong. "CPI is one organization that offers the special training that students need and focuses on helping newcomers network and gain relevant work experience," he said.

Wysong also notes there are tremendous learning opportunities at the Technical Conference, and CPI has a broad Professional Development Program with both introductory and advanced courses taught by experts from industry and academia designed to meet the needs of both people new to polyurethanes and those with years of industry experience.

The Conference is also designed to provide a variety of networking opportunities with diverse experts in the industry.

## SUSTAINABILITY SESSIONS

In addition to sustainability of the industry, this year's PU Technical Conference will include many sessions on the sustainability and safety of polyurethanes and PU raw materials.

Sustainability encompasses many aspects, from energy efficiency and emissions reductions to recycling and the circular economy, and is a key trend in the industry today. There is, for instance, growing consumer demand for energy-efficient solutions across multiple markets, according to Jaime Garza, vice president of isocyanates and monomers in North America at BASF.

## ERNEST WYSONG

Chair of CPI's Polyurethanes Technical Conference and global technology leader, Opteon Spray Foam & Panel Applications at Chemours

**"CPI's efforts are designed to provide the most accurate and impactful information to key decision makers in the industry, government and general public to enable society and industry to work together to make the best possible products"**

"The bed-in-the-box sales channel for foam mattresses continues to gain momentum and has solidified itself as an important segment in the North American bedding market. Polyurethanes also significantly contribute to sustainability via energy efficiency enhancement," said Garza.

PU's also improve infrastructure resilience and facilitate safer and more efficient methods for energy transport, observes Grace Showalter, vice president of construction and performance materials in North America for BASF. "The industry is addressing sustainability by increasing the use of low global warming potential (GWP) blowing agents and safer raw materials in product formulations," said Showalter.

A related trend is the shift to circular products and processes that offer environmental and social benefits to customers and end-users, according to Robinson.



“PU has a good reputation with respect to durability and versatility, but PU products are known for being difficult to recycle. We are committed to building the narrative that PU products have a positive sustainability story, while also looking for new innovations in raw materials and end-of-life solutions,” Robinson said.

BASF and many other companies are also proactively working along the entire value chain on sustainable, large-scale solutions to address the challenges of plastic waste through participation in the Alliance to End Plastic Waste (AEPW), a global alliance of nearly 30 companies that was founded to identify solutions for reducing and eliminating plastic waste in the environment.

CPI’s Sustainability Committee is hard at work amending the overall CPI strategic plan to provide more support for sustainability, according to Rabino.

“This Committee serves as a knowledge center for the polyurethanes industry and advocates for fair and open markets on many priority issues for the industry, including those related to blowing agents, building codes and standards, fire safety, raw materials, recycling and life cycle management,” said Rabino.

CPI is also working to further energy efficiency legislation. The Building Codes and Standards workgroup has been focused on the development of the 2021 I-Codes administered by the International Code Council (ICC).

In addition, the Spray Foam Coalition submitted several proposals to the International Resi-

dential Code (IRC) and participated in the development of proposals promoting energy efficiency through the Energy Efficient Codes Coalition.

#### **AUTOMOTIVE PANEL**

In response to the growing importance of sustainability, the Polyurethanes Technical Conference in 2019 has many sessions focused on various aspects of the topic. A global automotive panel with representatives from Ford, Toyota, Honda and Volkswagen will provide members of the automotive value chain the opportunity to meet and discuss issues around the harmonization of VOC regulations.

One of the automotive technical sessions will also focus on VOC reduction, light-weighting and adhesion. The Conference Keynote speaker – Debbie Mielewski from Ford – will discuss what her company is doing to incorporate bio-based raw materials into PUs used for the manufacture of automotive components.

Several presentations will provide other ex-

amples of the successful incorporation of renewably sourced raw materials into commercial products. Other sessions will look at various aspects of recycling and the circular economy in the flexible foam area, with European and US colleagues discussing the latest progress in the industry. Product stewardship is another component of sustainability in which CPI is actively involved. The creation of sustainable raw materials and end of life opportunities continue to be challenges in the PU industry, according to Robinson. In addition, he notes there needs to be greater user safety observed by workers and manufacturers when working with raw PU materials and finished products.

“In order to address these challenges, we need to collaborate more with downstream and upstream partners to make an impact and discover new solutions together,” said Robinson.

#### **OSHA ALLIANCE**

To help get more information to employers so they can better understand PU chemistry and increase worker safety, CPI has been participating for the past two years in the OSHA Alliance, a voluntary partnership with OSHA in 2017.

“The Alliance is designed to facilitate the exchange of information exchange between the two organizations in a non-regulatory manner,” explained Salamone.

Several new safety documents were developed and numerous events were held, including the attendance of OSHA compliance assistance officials at downstream trade conferences. Sala-

#### **GRACE SHOWALTER**

VP of construction and performance materials in North America, BASF

**“The industry is addressing sustainability by increasing the use of low global warming potential blowing agents”**

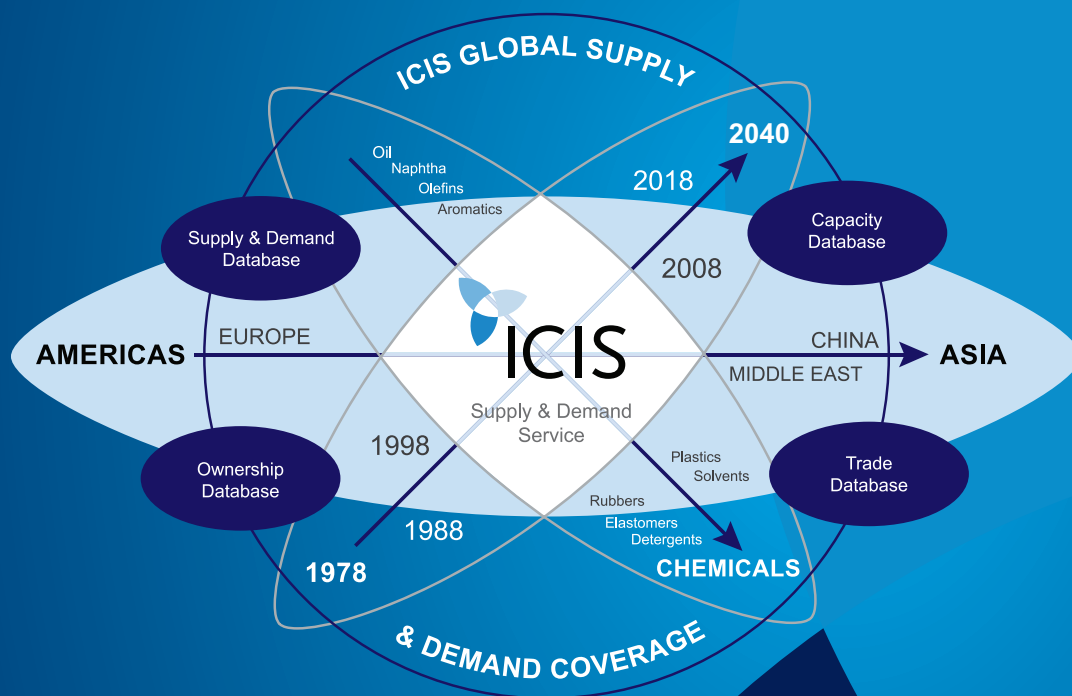




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» mone is hoping to expand the Alliance for an additional term and broaden the conversation around PU safety.

Several OSHA experts will be manning the OSHA Alliance booth and participating in other ways at the PU Technical Conference.

State and local legislative trends that are important to the polyurethane industry, from chemical-specific regulations, like fire retardant bans for instance, to energy code bills, to finished article legislation such as recycling requirements, according to Rabino.

"CPI engages on these issues to ensure that outcomes are based on the best available science," said Rabino.

### TRANSITION TO HFO

Top regulatory issues faced by the PU industry relate to the uncertainties around the transition from hydrofluorocarbon (HFC) to hydrofluoroolefin (HFO) blowing agents, increasing state regulation of flame retardants and EPA's risk-based screening of high-priority chemicals under the new TSCA legislation.

CPI's Blowing Agents workgroup advocates for fair and open markets for polyurethane products by supporting the development of consistent regulations that allow sufficient time for the polyurethanes industry to transition to low GWP foam blowing agents, according to Rabino.

When the court remanded part of the most recent EPA rules for transitioning to HFOs, several states moved to take action on the issue. A number of states have passed regulations restricting the use of HFCs, with many adopting the initial EPA timelines.

"CPI acts as a liaison between manufacturers and state legislatures, working to ensure that regulations are clearly defined, consistent with one another and based on sound science," noted Salamone. A representative from EPA involved in development of new federal framework legislation for moving to HFOs will be speaking at the Technical Conference. There will also be several papers presented on different alternatives, how to use them/adjustments that need to be made and the benefits that can be realized.

"These presentations reflect the commitment of the PU industry to move forward and provide alternatives, as well as the data needed to support the transition to new blowing agents,"

### JULIE RABINO

VP rigid raw materials sales, Covestro and CPI Steering Committee vice chair

**"This Committee serves as a knowledge center and advocates for fair and open markets on many priority issues for the industry"**



Wysong said. The Blowing Agents working group has also released a chart to assist members in tracking the regulatory and legislative progress regarding phase-down of the use of HFC blowing agents.

### FLAME RETARDANTS ADVOCACY

With respect to state legislative activity around flame retardants, CPI is instrumental in helping coordinate advocacy among flame retardant manufacturers, polyurethane trade associations and key downstream stakeholder organizations, according to Rabino. Legislation has been proposed in 23 states on various flame retardants, with five state proposing bans of all flame-retardant chemistries.

"In the past, the focus was largely on children's products, mattresses and upholstered furniture, but efforts have become much more expansive since passage of California's very broad bill (AB-2998). CPI with other groups within the American Chemistry Council are helping ensure that legislation is based on science and that bans of chemicals that can be used safely is not in the best interest of the marketplace or consumers," Salamone said.

The Fire Safety working group serves as a knowledge center for the CPI membership and polyurethanes industry on matters concerning the fire performance of rigid and flexible polyurethane products," Rabino added.

### LEE SALAMONE

Senior director, CPI

**"CPI acts as a liaison between manufacturers and state legislatures, working to ensure that regulations are clearly defined"**



CPI also has various working groups providing information to the EPA on different chemicals that could be subject to review. EPA is initially conducting a risk-based screening process of 20 potential high priority chemicals from the TSCA work plan.

Other areas of interest for CPI include the Portman and Shaheen Energy Savings and Industrial Competitiveness Act.

"This legislation directs the Department of Energy to take a more active role in increasing the stringency of the model building energy codes, with the goal of improving these model building energy codes to the maximum level of energy efficiency that is technologically feasible and life-cycle cost effective," Rabino explained. Many of these issues will be discussed as part of the regulatory roundtable scheduled for Wednesday.

"CPI has invited speakers from EPA to discuss to discuss the significant new alternatives policy

### JAIME GARZA

VP of isocyanates and monomers in North America, BASF

**"The bed-in-the-box sales channel for foam mattresses... has solidified itself as an important segment"**



program and from Europe to talk about the REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) regulation. There will also be a focus on safety and environmental aspects and assessing the risks of isocyanates. As a result, the panel should be very interesting and highly informative," Wysong said.

With information provided on regulatory issues, new product developments and solutions for advancing the sustainability of polyurethanes and PU raw materials combined with many different educational and networking opportunities, this year's CPI PU Technical Conference will provide attendees with the resources they need to be successful in the PU industry going forward. The sector does, Garza notes, face some challenges related to the impacts of recent trade policy moves between the US and China, which have introduced uncertainty in several broad markets and could curb consumer spending and corporate investment.

While PU demand has softened somewhat in 2019, Robinson points out that there continues to be growing demand for PU products, specifically those that deliver on next-generation comfort and durability in bedding, light-weighting and noise reduction in automotive and insulation efficiency in construction applications. CPI's latest comprehensive survey of raw material consumption in polyurethane markets in the US, Canada and Mexico reflects this trend.

"From 2016 to 2018, the industry experienced growth of 3.9%," noted Rabino. Total production in North America was 9005.8m lb in 2018.

That growth, asserts Wysong, is due to the innovation, which is reflected in the presentations given at the PU Technical Conference.

"The themes of the conference are linked directly to the research areas of interest in the PU industry. The conference provides a way for everyone in the PU value chain to share information, thoughts and ideas, which in turn enables the industry as a whole to accomplish greater goals," Wysong said.

"The impact of polyurethanes on end-use markets is also indicated by the range of application-specific topics addressed at the conference. The industry is clearly committed to bringing new performance attributes and enhancing all aspects of PU products and raw materials, including safety and sustainability, with the goal of benefiting end-user markets," he concluded. ■

# Strong outlook for US polyurethanes

An overall driver for PU market expansion is the general health of the US economy, but each end-use segment also has individual factors leading to growth



CYNTHIA CHALLENGER VERMONT

**T**he US polyurethanes (PU) industry is showing resilience amid the US-China trade war and a slowdown in automotive as unique properties and a focus on energy efficiency drives growth.

The US PU market has stayed fundamentally robust with decreasing prices of isocyanates, according to Grace Showalter, vice president for construction, performance materials in North America at BASF. Dow estimates it to be an approximately 6-7bn lb market with recent years showing a steady growth rate generally around 1.5 times GDP, said Alan Robinson, NAA commercial director for Dow Polyurethanes & Chlor-Alkali & Vinyl (CAV). He also notes that growth in PU demand has quickly utilized new capacity builds in the US, indicating a balanced industry utilization rate.

## US-CHINA TRADE IMPACT

However, uncertainties created by the ongoing tariff issues between the US and China may impact the PU industry. "BASF benefits – as do customers – from free trade as any kind of duty represents an indirect tax. We are therefore concerned about the US announcements, and the response of several of its trading partners, to impose import tariffs on a wide range of products that could affect the chemical industry and its numerous customer industries," said BASF's Showalter.

"BASF strongly believes in the value of open markets and a rules-based global order.

CHRISTINE BRYANT

SVP for polyurethanes, North America, Covestro

**"Light-weighting, sound control, energy efficiency – all of these attributes are driving the expanded use of polyurethanes"**



The push for energy efficiency is driving greater use of PU in construction applications

We hope governments will, in the end, resolve trade disagreements through sustained multilateral dialogue and in respect of WTO rules,” she added.

Most PU manufacturers and raw material suppliers are insulated somewhat because the industry is fairly consolidated and companies have multiple production facilities located in critical countries around the world, according to Christine Bryant, senior vice president for polyurethanes in North America at Covestro. She does note that there are some raw material suppliers that are planning to build plants in the US.

### GOING TO THE MATTRESSES

One trade issue with China that has had a direct impact involves the mattress industry. Starting in the second half of 2018, there was a large increase in Chinese mattress imports to the US.

The US mattress manufacturing industry filed an antidumping lawsuit in late 2018, and duties were imposed in May 2019.

“Even though Chinese manufacturers are moving production to other Asian countries in order to be able to continue shipping to the US, our customers have reported that there has been a slight decline in the overall import of mattresses into the US,” observes Bryant.

Going into 2020, the US economy is expected to remain relatively strong but experience a slight slowdown. There has been, in fact, a weakening in several key PU end-use markets.

“The US is experiencing a softer automotive and bedding market, and a slight softening in new construction compared to the last five years, according to Robinson. But, overall, American PU markets continue to match GDP growth in 2019.

### JAIME GARZA

VP of of isocyanates, monomers, North America, BASF

**“Composites in wind and solar power applications will also include a growing amount of polyurethanes”**



Despite these trends, the demand for versatile PU chemistry will continue to grow due to its ability to deliver a unique set of properties and performance to a myriad of different applications, asserts Jaime Garza, BASF’s vice president of isocyanates, monomers in North America.

Rising demand for PU is expected by all players in the construction, bedding, carpeting, automotive, consumer appliance and footwear markets.

### ALAN ROBINSON

NAA commercial director for Dow Polyurethanes & Chlor-Alkali & Vinyl

**“Regulations, sustainability oriented consumers and brand owners are all factors driving the industry”**



### ENERGY EFFICIENCY DRIVE

An overall driver for PU market expansion is the general health of the US economy, but each end-use segment also has individual factors leading to growth. In the construction industry, the implementation of energy efficiency codes is leading to the greater use of both rigid and spray foam PU insulation, according to Bryant.

PU innovation hasn’t stopped at a building’s walls, though, notes Pavneet Mumick, vice president of technology & innovation at Huntsman Polyurethanes.

“We are now starting to see more and more interest in PU-based solutions for concrete floorings, adhesives, window frames, heating distribution and much more,” said Mumick.

This sector is, however, facing the challenge of an increasing shortage of labor in both skilled and unskilled positions that extends out to builders and general contractors, according to Jan Buberl, vice president – Americas at Huntsman Polyurethanes.

“A disconnect exists between the types and quantity of construction needed and the availability of workers,” said Bryant.

PU insulation is also seeing greater use in cold-chain applications due to increased demand for lightweight, thermally efficient solutions that can keep products farm fresh while also meeting industry regulations, Robinson said.

### AUTOMOTIVE SHIFTS

In the automotive sector, there is demand for light-weighting of vehicles for reduced fuel consumption and greenhouse gas emissions, a desire for reduced noise, vibration and harshness (NVH) and a higher demand for larger vehicles that require more raw materials, said Robinson.

“In today’s connected world, vehicles are becoming more than just an avenue to get from Point A to Point B – they are becoming extensions of our homes and offices, and sound quality inside the vehicle’s cabin is becoming increasingly important in all vehicle models,” Mumick said.

### BED-IN-A-BOX TREND

The bedding market, meanwhile, is experiencing a shift from traditional big-box stores to bed-in-a-box retailers that utilize direct-to-

consumer shipping.

“Consumers want convenience but also place a high value on comfort. These retailers therefore require a material that can be compressed and shipped, while delivering customizable comfort for a restful sleep, which is driving PU innovation for this application,” said Robinson.

Composites in wind and solar power applications will also include a growing amount of PUs, while substitution in adhesive and coating applications also favors significant growth of PUs, according to Garza. “Overall, our customers are driving growth – they are looking for new uses of our technology to remain competitive within their current applications and markets, as well as breaking into new markets to expand their offerings,” said Showalter.

“Going forward, digitalization and sustainability will be important trends impacting PU innovation for all applications. Digitalization is a growing trend across all industries, and BASF expects it to have strong impact on the PU market for end users and suppliers,” she added.

### GRACE SHOWALTER

VP for construction, performance materials, North America, BASF

**“Our customers are driving growth – they are looking for new uses of technology to remain competitive within current markets”**



“The use of digital tools and artificial intelligence is enabling companies like Covestro to help customers better formulate and more efficiently manufacture their products,” said Bryant.

### SUSTAINABILITY FOCUS

Another key focus of the PU industry is to create more sustainable solutions throughout the entire value chain – from raw materials to end-of-life goods.

Today, added Mumick, interest in sustainability is at an all-time high, and everyone is talking about the importance of creating the “Circular Economy”.

Robinson noted that identifying opportunities for innovation in this environment requires close customer collaboration, hands-on knowledge of local market needs and smart capital investment decisions for development and growth.

One example is the development of hydrofluoro-olefin (HFO) blowing agents with low global warming potential (GWP) as alternatives to the hydrofluorocarbons (HFCs) currently used in PU spray foam production.

» Dow collaborated with a vending machine manufacturer to create a brand new low-GWP PU foam insulation solution to meet the more stringent ENERGY STAR version 4.0 that provides a 15% weight reduction and 10% thermal insulation improvement over the incumbent low-GWP system.

Demilec, (a company acquired by Huntsman) has also developed a new HFO blowing agent that has a zero-ozone depletion potential (ODP), ultra-low GWP and high renewable/recyclable closed-cell foam for the insulation industry.

Another more sustainable insulation solution from Huntsman is a halogen-free polyisocyanurate insulation developed with Centria for its insulated metal panels that still maintains the fire and safety performance of the

**PAVNEET MUMICK**  
VP of technology & innovation,  
Huntsman Polyurethanes

**“We are now starting to see more interest in PU-based solutions for adhesives, heating distribution and more”**



product, according to Mumick.

To help builders overcome the labor shortage issue, Covestro developed prefabricated, pre-insulated panelized walls for residential construction applications that can be shipped to the site and allow shorter build times with potentially fewer workers.

#### CAPACITY ADDITIONS

Investment is not only taking place in R&D. Some companies are adding capacity in the US to meet the expected ongoing growth in demand for PU products.

Covestro is building a new methylene diisocyanate (MDI) unit at its Baytown, Texas site. BASF is in the second phase of its MDI plant expansion in Geismar, Louisiana.

Huntsman recently announced plans to build a new MDI splitter at its Geismar site that will allow the company to expand its range of MDI-based solutions.

In 2018, Huntsman acquired spray foam insulation producer and distributor Demilec as part of its core strategy to move downstream and go from supplying polyurethane components to supplying fully formulated MDI systems, said Buberl.

Further consolidation downstream occurred when commercial and industrial

**JAN BUBERL**  
Vice president – Americas at  
Huntsman Polyurethanes

**Huntsman acquired spray foam insulation producer and distributor Demilec as part of its strategy to move downstream”**



building envelope products firm Carlisle Construction Materials acquired PU products company Accella Performance Materials.

These ongoing investments clearly reflect continued expectations for growth in the US PU market. Showalter anticipates demand to stay at a healthy level, despite headwinds from the global geopolitical landscape.

“The outlook for growth in the US PU market continues to be solid, as opportunities for replacement and performance improvement in many applications drive demand,” said Robinson.

Growth opportunities for polyurethanes, concludes Showalter, will be in the areas of sustainability, efficiency and digitalization. ■

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# Opportunities in global megatrends

Jerry MacCleary, chairman of the ACC board of directors, outlines how the PU sector is well positioned to thrive with shifts in mobility, digitalization, and sustainability

CYNTHIA CHALLENGER VERMONT

**J**erry MacCleary spent many years with Covestro, starting in 1979 as an accountant and most recently serving as chairman and CEO of Covestro LLC. He also currently holds the position of chairman of the American Chemistry Council's (ACC) Board of Directors and its Sustainability Committee, and he previously served as chairman of the CPI Steering Committee.

All of this experience has given him a unique perspective on the chemicals industry and the polyurethane (PU) sector. And he is excited about the future because of the three key trends impacting all aspects of business today: mobility, digitalization and sustainability.

## MOBILITY SHIFTS

Shifts in expectations for mobility strongly support the plastics and PU products produced by Covestro.

"The rise of electric and hybrid vehicles in conjunction with the expanding reliance on ride sharing is disrupting the automotive industry. The focus is moving away from driving to riding and from personal ownership to shared ownership. The ultimate impacts remain uncertain, but we can expect significant changes in automotive design, with much more customization required in vehicles of the future," MacCleary said.

The executive believes strongly that plastics, and particularly PUs – from foams and coatings to adhesives – will play a critical role in advancing solutions that offer more comfortable, quieter and energy efficient rides.

## DIGITALIZATION CUTS WASTE

Digitalization is already improving business efficiency and enabling the development and implementation of new business models.

"Big data, artificial intelligence and robotics are all enhancing operations on an individual company basis and across whole supply chains. Companies are able to streamline production, establish new organizational

structures and find new and creative ways to engage and interact with their customers," explained MacCleary.

"Digitalization will eventually make PU manufacturers and their customers more efficient, leading to less waste generation. Many of these technologies are just being introduced, and they will continue to evolve and change the industry for the next several years," he added.

Sustainability is perhaps the most important trend driving change in the PU and wider plastics and chemical sectors.

"It is essential today that companies develop sustainability strategies that are fundamentally integrated into their business and innovation strategies," MacCleary said.

"Customers, employees and shareholders all expect manufacturers to have a purpose beyond making a profit – one that involves tackling the social challenges facing the world today," he added.

## UN SUSTAINABILITY GOALS

Covestro, when it was carved out from Bayer, adopted early on the 17 United Nations Sustainability Development Goals, driven by a desire to embed sustainability into its business and innovation strategies.

The goals, according to MacCleary, were used as a framework to develop the firm's own specific goals and targets and to set the direction for innovation within the company.

"By 2025, 80% of our research and development project spend will be tied to one or more of the UN Sustainability Development Goals, helping to solve overarching societal challenges," he said.

This approach has led to a change in how Covestro develops new products and is continually pushing people to look at different materials and technologies, from bio-based raw materials to recycling and advancement of the circular economy.

For instance, the company has developed polyols for flexible foam from waste carbon dioxide, something previously thought impossible to do.

**JERRY MACCLEARY**

Chairman and CEO, Covestro LLC

**"Customers, employees and shareholders all expect manufacturers to have a purpose beyond making a profit"**



"This technology is a great example of innovation at Covestro today and how we are implementing sustainability as a key driver," noted MacCleary.

## A TRUE CIRCULAR ECONOMY

Companies like Covestro, or even entire industries, cannot solve major challenges alone, however, according to MacCleary. ACC's Sustainability Committee in collaboration with all stakeholders is working to establish metrics for the industry through an open and transparent process. Strongly supported by ACC, the Alliance to End Plastic Waste was launched in early 2019.

"Everyone agrees that plastic does not belong in the environment. It was not the intent when plastics were initially developed, and the industry must be part of the solution," said MacCleary.

The Alliance, which today comprises 34 global companies across the value chain from manufacturers to converters and retailers, has to date raised \$1.1bn – close to its first goal of \$1.5bn – to develop solutions for minimizing and managing plastic waste; promoting recycling, reuse and recovery; and establishing appropriate infrastructure and capacity around the world.

"Our goal is to achieve a true circular economy with zero waste going to landfills. We need new technologies and infrastructure to get there, and the Alliance, through collaborating and by bringing best practices and talent from around the world and across many industries to bear on these problems has the capacity to develop the needed solutions," said MacCleary. ■



Ford is now using a total of 12 plant-based materials on their vehicles

# Bio-based materials benefit all

Deborah Mielewski is developing a series of new applications with unique properties for bio-based materials at the Ford Motor Company

CYNTHIA CHALLENGER VERMONT

**W**hen Deborah Mielewski began leading the plastics effort at Ford Motor Company in 2000, she wanted to develop new materials that were more sustainable. At the time, the idea was not that well received, but with the support of local management and Bill Ford, she launched a small project focused on reducing the environmental impact of polyurethane (PU) foam.

Her first approach was a simple one: replace the petrochemical oil used to produce PU with

hydroxylated soybean oil. There were many failures – smelly, flat foams in fact. And the price of oil at that time was quite low, so most people did not think there was a serious opportunity for bio-based PU foams in the future, even if they could compete on performance.

Mielewski did not give up, though. Her team kept reformulating and balancing the chemistry, using a range of new catalysts, blowing agents and surfactants. After years of slow improvement, they developed bio-based polyurethane foams that met every single automotive specification.

“PU foams for vehicles have very high per-

formance requirements, so we had to be absolutely certain our new foams performed as well – or better! – than the petroleum-based products,” Mielewski noted.

It was 2007 then – right when oil prices rose dramatically to more than \$140/bbl. That is when “the phone started ringing off the hook” and Ford launched its first soy-based PU foam for use on the 2008 Ford Mustang.

Within the next six months, the bio-based PU foam technology migrated to six other programs. Today, every single North American vehicle has seat cushions, backs and headrests containing soy foam, according to Mielewski, who is currently senior technical leader for sustainable and emerging materials at Ford Motor.

Many competitors and other industrial sectors also use the technology because Ford has taught its suppliers how to make the sustainable foams. “We share our knowledge freely so that the impact on the environment can be greater,” she said.

## OTHER NATURAL MATERIALS

The excellent reception of the soy-based foams led Mielewski to investigate the use of other natural materials, including various natural fibers as replacements for glass and talc fillers.

“A lot of my time is spent identifying potential partners that have agricultural waste products we can utilize, which allows us to have an even greater impact we on the planet,” she said.

Ford is now using a total of 12 plant-based materials on their vehicles, including wheat straw, coconut, cellulose fibers (from tree

pulp) and rice hulls.

In the lab, the company continues to work on agricultural by-products such as coffee chaff, almond and shrimp shells and even recycled currency – a mixture of linen and cotton fiber – used to, appropriately, produce coin trays.

In many cases, the performance of the products are improved along with weight reduction and reduced environmental impact.

#### NEW PU FOAM SOLUTIONS

Mielewski has also continued to develop new solutions for PU foams using different soybean and algal oils, as well as carbon dioxide.

“Imagine in the future taking waste emissions from industry and making valuable materials from them,” she said.

Ford recently launched a new application of a soy foam gasket on the air filter of the F-150 truck that has the highest content of soy yet and is the first under hood application for bio-based urethanes.

Every day, her team learns something new. Oils from algae afford more viscoelastic properties compared to the rigid properties obtained with soybean oils. Ground-up shrimp shells when added to PU foams lead to more facile nucleation, affording lower-density foams with good mechanical properties using less urethane.

In fact, Mielewski notes that plant-based oils often have structural advantages that allow the development of PU foams with unique functionality not possible to achieve with petroleum-based oils.

#### GRAPHENE USE

In her advanced material role, Mielewski has been exploring the use of graphene with some success. Her team found that the addition of a tiny amount of single-layer graphene (< 0.2% by weight) increases the heat and sound absorption properties of urethane foam by 30%.

Last November, Ford was the first high-volume manufacturer to utilize the power of graphene in production vehicles. Urethane foams containing the advanced material can be found on more than 10 under hood components on the Ford F-150 and Mustang, and plans for other programs and applications are in the works.

The key to all of these successes, Mielewski stresses, has been the constant support she has received from Ford leadership, including the resources she has required to do her job well. The long history of innovation at Ford has also been a factor.

“Henry Ford was a passionate inventor, always looking to partner with the ag industry and utilize ag materials. Way back in the



**DEBORAH MIELEWSKI**

Senior technical leader for sustainable and emerging materials, Ford Motor Company

**“Henry Ford was a passionate inventor, always looking to partner with the ag industry... We are excited to carry on that tradition, benefiting the automotive and other industries”**

1940s, he put wheat straw in steering wheels and soy in enamel for paint. We are excited to carry on that tradition, benefiting the automotive and other industries, farmers, our customers and the planet simultaneously,” she concludes enthusiastically. “I have the best job in the company!” ■



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# PU industry advances recycling, sustainability

From mattress recycling to chemical recycling technologies and reuse of waste gases, the sector is making strides toward a circular economy

**SIMON WESTBROOK** COLOMBIA

**R**ising consumer demand for greater sustainability is creating significant opportunities for the global polyurethane (PU) industry.

In the automotive sector, strong, lightweight PU applications help boost fuel efficiency and reduce emissions, while in construction, PU insulation boasts superior fire and thermal performance at much lower thicknesses than other competing materials.

"This gives architects and builders a versatile product that meets stringent energy codes, allowing them faster construction with higher design flexibility," said Rohit Ghosh, BASF's head of marketing for construction and performance materials.

## MATTRESS RECYCLING INITIATIVES

The pressure on producers, however, to conform to ever-stiffer legislation on the reuse and recycling of plastics is intensifying. The way we deal with products such as mattresses and furniture – two key markets for flexible PU foam – at their end-of-life stage has, in particular, become a target for lawmakers.

The EU last year revamped its rules on solid waste disposal, forcing the entire mattress and furniture supply chain to radically reassess the way it manages waste materials over the next decade.

**STEVE RUSSELL**

ACC vice president of plastics

**"Plastics makers in Europe and Canada have committed to the same end-goal, and we are all working to get there quickly."**

"In the next 10 years, the end-of-life options for mattresses, furniture and PU foam will completely change because landfilling will be gone and waste-to-energy will be drastically reduced," said Michel Baumgartner, secretary general of the European Association of Flexible Polyurethane Foam Blocks Manufacturers (EUROPUR).

"And that means we need to find solutions to do something else with those materials," he added.

One option, Baumgartner said, is to increase mechanical recycling, whereby techniques such as rebonding, powdering and compression moulding allow PU to be reused in its polymer form.

## FINDING NEW MARKETS

Although the technology for mechanical recycling already exists – rebond, for example, accounts for nearly 90% of the US carpet underlay market, according to the American Chemistry Council (ACC) – the challenge for the industry is finding new market outlets.

"The EU is a net exporter of trim, so if you take end-of-life mattresses and furniture and you make blocks that you either bond together to make carpet underlay, or that you sell directly as blocks, well, the market demand is limited," Baumgartner said.

In the US, a pioneering non-profit group is working to expand post-consumer PU markets, boost recycling rates and help reduce the 50,000 mattresses discarded nationwide every day.

The Virginia-based Mattress Recycling Council (MRC), created by the International Sleep Products Association (ISPA), uses a small fee levied on consumers in California, Connecticut and Rhode Island – the three US

**ROHIT GHOSH**

Head of marketing for construction and performance materials, BASF

**"Pilot projects show that products made with chemically recycled raw materials exhibit the same high quality and performance"**



states that have enacted mattress recycling legislation – to hire transporters and recyclers to collect and dismantle end-of-life mattresses.

"Once the recyclers dismantle the units, they sell the reclaimed materials – primarily PU and latex foam, steel, fabric and fibre, and wood – to third parties for use in making other products. The recyclers keep the revenue they earn from selling these materials," said Ryan Trainer, president of the MRC and the ISPA.

The MRC, which last year processed over 1.7m mattresses in all three states, has launched several research projects focused on improving the markets and uses for post-consumer PU foam and other recoverable materials.

"Our objective is to use what we learn from these efforts to increase the amount of post-consumer material that can be recycled and to help our recyclers become more financially sustainable," Trainer said.

## BREAKING DOWN POLYMER CHAINS

Of course, mechanical recycling is not the only practical solution for dealing with end-of-life materials.

Chemical recycling processes such as glycolysis, hydrolysis, pyrolysis and hydrogenation take materials that are tricky to salvage,

**RYAN TRAINER**  
President, MRC and ISPA

**“Once the recyclers dismantle the units, they sell the reclaimed materials to third parties for use in making other products”**



such as mixed or unclear plastics, to create new products.

The real challenge here, according to Baumgartner, is how to move from the technology that works in the lab to something that can survive at an industrial scale and in market conditions.

Some exciting projects are taking shape.

BASF's ChemCycling initiative uses thermoplastic technology to convert non-recyclable plastics into syngas or pyrolysis oil, which is then fed into the production process to make virgin-grade recycled materials.

ChemCycling late last year began developing for the first time pilot products derived from chemically recycled plastics, including mozzarella packaging, refrigerator components and insulation panels. BASF is now aiming to leverage thermochemical recycling technology and apply it on an industrial scale.

“The pilot projects with customers from various industries have shown that products made with chemically recycled raw materials exhibit the same high quality and performance as products made from fossil resources,” Ghosh said.

“To move from the ongoing pilot phase to market roll-out, however, various issues will need to be resolved. The existing technologies for transforming waste plastics into recycled raw materials must be advanced and adapted for use at an industrial scale, in order to ensure the consistently high quality of the pyrolysis oil, for example,” he added.

## RECYCLING WASTE GASES

Feedstock options that curb carbon footprints are also creeping into production processes. The EU-funded Carbon4PUR initiative, for example, uses chemocatalysis technology to turn waste gases from steel factories into polyols for PU production.

The initiative, with its 14 member companies and organizations spread across seven European countries, will cut the carbon footprint of PU intermediates by 20-60% compared with products derived from crude oil, and save 70% of the energy used in conventional chemical processes.

Covestro, the coordinator of Carbon4PUR, is also using its own technology to capture carbon dioxide (CO<sub>2</sub>) for the production of its trademark cardyon polyols.

The Germany-based company has been producing cardyon at a 5,000 tonne/year plant in Dormagen, Germany, since 2016. The polyol, which contains up to 20% CO<sub>2</sub>, is used to produce soft PU foams for mattresses and upholstered furniture, but could also be used in the future to make rigid foam, moulded foam and elastomers.

“The plant is for demonstration purposes and serves not only to supply first-time users but also to further develop the technology,” said Richard Skorpenske, head of PU advocacy and sustainability at Covestro.

“If the market launch of CO<sub>2</sub>-based polyols at the Dormagen plant goes well, Covestro envisions production on a much larger scale,” he added.

## CIRCULAR INDUSTRY ECO-SYSTEMS

US-based Dow, meanwhile, is working with steel manufacturers ArcelorMittal and Tata Steel IJmuiden to build similar pilot projects in northern Europe that use an innovative Dow catalyst to convert waste gases from blast furnaces into naphtha.

**RICHARD SKORPENSKA**  
Head of PU advocacy and sustainability, Covestro

**“If the market launch of CO<sub>2</sub>-based polyols at the Dormagen plant goes well, Covestro envisions production on a much larger scale”**

Dow is now rolling out a new PU sustainability strategy to focus on four key pillars – safe materials, sustainable materials, the circular economy and the carbon footprint.

“From raw materials to end-of-life goods, we see growing consumer demand to create sustainable products and processes throughout the entire value chain,” said Marcel Moeller, marketing director for Dow Polyurethanes Europe, Middle East, Africa and India (EMEA).

“Building circular industry eco-systems with well-functioning operations and supply chains are critical to success. Therefore, PU formulations and materials will need to adapt to provide greater sustainability for applications and end-uses,” he added.

**MICHEL BAUMGARTNER**  
Secretary general, EUROPUR

**“In the next 10 years, the end-of-life options for mattresses, furniture and PU foam will completely change.”**



## TACKLING POLLUTION

Developments in the PU industry should be welcomed as part of a wider trend towards more responsible production and management of chemicals and plastics.

Tackling the scourge of pollution, in particular, has become a top priority.

**MARCEL MOELLER**  
Marketing director, Dow Polyurethanes EMEA

**“Building circular industry eco-systems with well-functioning operations and supply chains are critical to success.”**



In January this year, a group of 27 producers, consumer goods companies, retailers and waste management firms joined forces to launch one of the most comprehensive efforts to date to curb plastic waste in the environment. The Alliance to End Plastic Waste (AEPW), which now boasts 40 members, aims to spend \$1.5bn over the next five years to help clean up oceans and rivers and promote waste management projects in some of the world's worst-polluted regions.

## COMMITMENT TO GOALS

Just 10 rivers – eight in Asia and two in Africa – transport more than 90% of river-based plastics to the ocean, while the majority of plastic debris originates from five fast-growing economies in Asia – Indonesia, the Philippines, Vietnam, Thailand and China, according to research from Ocean Conservancy.

The ACC, meanwhile, last year unveiled ambitious goals to make all plastic packaging recyclable or recoverable by 2030, and to recycle or recover all plastic packaging used in the US by 2040.

To achieve this, companies are teaming up with governments, trade groups and non-profits to invest in infrastructure, develop innovative technologies and design new materials, products and packages that increase reuse.

The ACC also wants all North American manufacturing sites operated by its plastics division members to participate by 2022 in Operation Clean Sweep-Blue, an initiative that aims to keep plastics out of waterways.

“The response to these goals has been overwhelmingly positive,” said Steve Russell, ACC's vice president of plastics.

“We believe they are both achievable and critical to plastics' long-term growth and viability. Plastics makers in Europe and Canada have committed to the same end-goal, and we are all working to get there quickly,” he added. ■



Covestro rigid foam expert Stefan Hopf inspects a metal sandwich panel

# PU to see new growth applications

Usage will increase from the insulation and automotive sectors, while higher growth areas will be in wind turbines and electronics

SEAN MILMO LONDON

Since they were first developed around 80 years ago as a natural rubber substitute, polyurethanes (PU) have established themselves in a wide range of global downstream consumer product and industrial sectors. This is due to their durability, high strength, flexibility, elasticity, adhesion and binding properties in coatings.

Their versatility will ensure they continue to find opportunities for achieving high growth rates and added-value applications to boost margins. Polyurethanes should maintain strong worldwide compounded annual growth rates of around 7% from 2019-2025, according to US-based Grand View Research.

Some of this growth will be in sectors in which PU already has a strong presence, in particular construction, furniture and transportation, which account for over three quar-

ters of US output, according to the American Chemistry Council (ACC).

But a large proportion of the growth is likely to come from sectors which currently make up only a relatively small proportion of PU production in the US and elsewhere, at least in volume terms.

These are likely to include packaging, textiles, electronics and footwear, which according to the latest end-of-use PU market survey in 2016 by the ACC's Center for Polyurethanes Industry (CPI) accounted for only 5-6%.

They are mostly fast expanding global markets bolstered by innovative technologies whose needs PU has the adaptability to accommodate.

A big impetus behind growth in PU will increasingly be tough regulations and quality and performance standards, many of them set by downstream industries themselves.

## PENETRATON IN INSULATION

A lot of the legislation and quality targets affecting PU, both in the manufacture of the polymer itself and the downstream production and application of their products, will stem from efforts to combat climate change by reducing energy consumption and emissions of CO<sub>2</sub> and other global warming gases.

An important area covered by climate change rules will be insulation in which polyurethanes tend to outperform competing materials. The average R-values – or resistance to heat flow – of PU rigid foams, the polymer's main insulator, are at least a third higher than extruded/ expanded polystyrene (XPS/EPS) and glass fibre or rock wool.

PU should extend its clear leadership in insulation technologies whose application extends beyond building and construction to sectors like transportation and appliances such as refrigerators.

Spray PU foams (SPF) should continue to expand their share of the construction insulation market because of their contribution to achieving zero net energy (ZEN) levels in a rising number of buildings.

SPF helps to minimise energy loss in buildings by covering holes and cracks in ceilings, walls and roof structures. In a study on SPF, Global Market Insights estimated that residential roofing applications accounted for around 30% of the global SPF market in 2016. The foams also help prevent any air or soil pollutants from entering structures, thereby maintaining a healthy environment in buildings.

Huntsman's SPF technology was recently selected to insulate one of the first homes in Houston, Texas, US to be evaluated for a LEED-H Platinum certification – the highest ranking under the green housing program for Leadership in Energy and Environmental Design (LEED).

SPF was used in the walls, ceilings, attics and underside of the roof decks to provide a tight thermal and air barrier, which significantly reduced heating and cooling costs, according to Huntsman.

#### MARC FRICKE

Project and marketing manager, high-performance insulation, BASF

**“Thanks to an unparalleled combination of product properties, it enables space-saving insulation solutions in both the construction and transportation sectors”**

At the K2019 plastics trade show in Düsseldorf, Germany, from October 16-23, BASF is showcasing two materials representing a new generation of energy efficient aerogel-based insulation materials. The company sees the use of materials in combination with renewable energies as being “the secret of success for the housing of the future”.

One of them – Slentite – is the first purely PU-based aerogel ever to be produced, according to BASF. Its aerogel insulation panels consist of around 90% air, permitting insulation up to 50% slimmer than conventional materials.

“Thanks to an unparalleled combination of product properties, it enables space-saving insulation solutions in both the construction and transportation sectors,” explains Marc Fricke, project and marketing manager, high-performance insulation at BASF.

In response to the demand for lighter-weight, more energy efficient vehicles, BASF has introduced new foam systems within its Elastoflex E product group which achieves in cars up to 30% weight reduction and foam densities of around 120g/L (grams per litre). This results in very light and thin instrument panels or door elements.

#### RENEWABLE RAW MATERIALS

BASF has also developed for its Elastoflex foam portfolio systems based on renewable raw materials. These include castor oil which can be used to produce complex components that are both light and thin.

Buyers of the next generation of electric and autonomous automobiles and other vehicles are likely to want materials which are similar to those in their homes – environmentally friendly by being bio-based and energy efficient.

Through the use of bio-based polyols, PU is well positioned to respond to this demand because it is able to combine a biological base with strength and durability.

Mitsui Chemicals of Japan and SKC Polyurethanes of South Korea are providing a jointly developed castor oil-based polyols for PU in the latest self-drive model of ZMP Inc, a Japanese car manufacturer.

Hisashi Taniguchi, ZMP's chief executive, said the company wants to create automated designs which “resonate with people”. Furthermore, he explained, “we think it's essential to make use of materials that are both people-friendly and environment-friendly”.

#### CAR OF THE FUTURE

Covestro is presenting at the K2019 plastics fair concepts for the interior design of the car of the future.

“We are particularly focused on the [interior design which] can be both living and working space in an autonomous vehicle, offering customized experiences to the user,” said Jochen Hardt from global mobility marketing at Covestro. “Future vehicle concepts for electromobility offer car manufacturers opportunities for completely new room concepts and additionally open up new ground for brand differentiation.”

The company sees PU as being among the materials providing a means for car differentiation through its ability to provide soft or molded foam in seats and other upholstery, instrument panels, trim parts and roof linings. Covestro also produces thermal polyurethane (TPU) coatings, from which surfaces can be created as desired – from soft to hard – particularly in cars.

A major outlet for PU textile coatings has been artificial leather surfaces but areas for new coatings applications have been opening up, to make more use of the polymer's durability and abrasion resistance combined with softness and lightness. PU coatings can, for example, be combined with moisture-resistant PU adhesive to make clothing more weather resistant.

#### PU IN WINDMILL BLADES

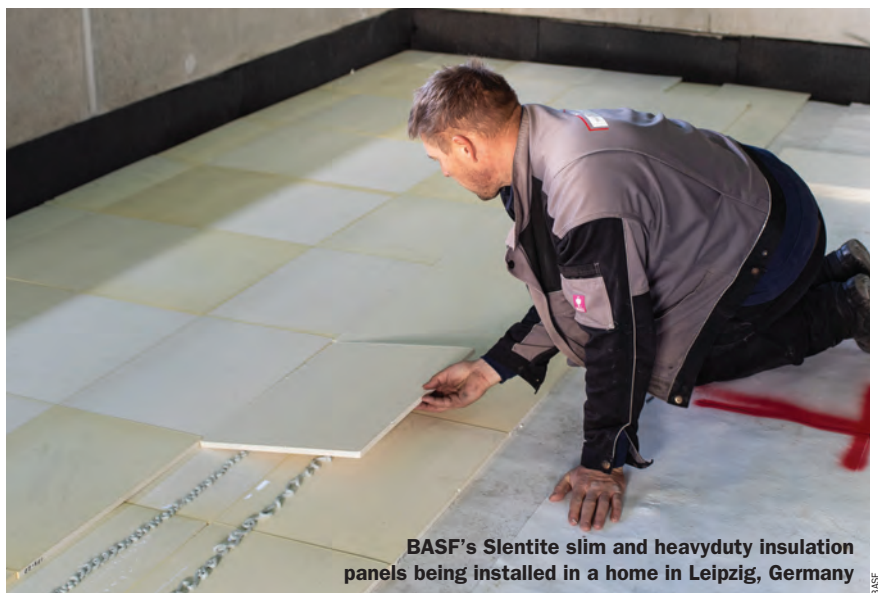
PU's resilience is seen as providing a solution to the corrosion problems with wind turbine rotor blades.

Coatings layers and the composite materials underneath on the longitudinal edges of rotor blades are in some areas slowly being destroyed by the effects of rain hitting the edges at high speed.

A consortium led by the Technical University of Denmark – the world's largest public research institute focused on wind energy – is conducting a research project on erosion mechanisms and on the development of new coatings to give rotor blades permanent corrosion protection.

Besides manufacturers of wind turbines and their blades, the consortium's members include Covestro and Hempel, the Danish-based specialist in anti-corrosion coatings.

“We are working at high speed to develop a raw material for a specialized, robust paint



**BASF's Slentite slim and heavyduty insulation panels being installed in a home in Leipzig, Germany**

» system,” said Matthias Wintermantel, head of market and business development, infrastructure coatings at Covestro, which has long-term plans to make rotor blades entirely of PU. “It will significantly increase the service life of rotor blades, while also reducing maintenance expenses and associated costs.”

#### ELECTRONICS USAGE TO SURGE

Of the sectors which currently account for a relatively low share of total PU output, electronics probably has the most promise because the polymer can contribute significantly to the expansion of existing and also some pioneering technologies.

PU coatings have a key role in protecting printed circuit boards (PCBs) and other electronic components as they shrink in size while become more complex.

The usual protection method is to use “potting” compounds to encase the device in a plastic pot to shield it from the surrounding environment. But in a growing number of applications potting is being replaced by conformal coatings which provide a thin protective layer over all parts of the device. They are more suitable for circuit boards in small spaces like in smart phones.

In many circumstances PU outperforms conformal coating materials such as acrylic, epoxy and silicone because it provides more effective resistance against humidity and chemicals such as solvents. They also promote miniaturization by insulating against signal traces from circuit boards which are close together. They also prevent “tin whiskers” or the growth of metal fibres from tin in components which can cause short circuiting in PCBs.

“Many conventional materials are becoming obsolete because they are failing to meet new maximum operating temperatures or providing insufficient coverage required for successful condensation tests, which are needed by global manufacturing automotive manufacturers,” said Phil Kinner, global business and technical director of conformal coatings at Electrolube, explaining why his company had earlier this year launched a 2K series of conformal coatings.

In the longer term, PU could help to take additive manufacturing on an industrial scale from 3D to 4D printing by attaching time to the existing three dimensions of length, breadth and depth. This would be done by using PU layers containing electronic sensors which respond to external factors and enable the 4D product to change its properties over time.

PU-based electronic skins are already being developed for use in robots. In Japan, Mitsui Chemicals is involved in the development of PU gels and photo-elastic PU for use in synthetic skin materials and in manipulators or hands of robots. ■

# PU expands in sports equipment

Polyurethanes are increasingly being incorporated in the latest sporting goods innovations from footwear to swimsuits and helmets – all designed for high performance

SEAN MILMO LONDON

**T**he wide variety of properties in polyurethanes (PU) make them highly suitable as a raw material for the making of sports and leisure wear and equipment.

The design requirements and technological complexity of some of PU-based sports and leisure products has resulted in their production taking place in North America and Europe rather than in the global manufacturing centres of Asia.

Consequently, the relatively fast growth at the premium end of the sports and leisure products sector has enabled developed economies to win back market shares in some segments from Asian producers.

The challenge for PU producers and converters has been how to take advantage of this technological progress in the sports sector.

The design and making of sports equipment has become an interdisciplinary operation involving polymer scientists, chemists, physicists, physiologists and experts in biomechanics.

This has led to the development of intricate composites, often involving PU combined with other polymers or metals or ceramics. The result has been the introduction of new materials which have transformed sports by attracting many more participants.

A major sport like golf has stimulated the development of a range of new materials for balls and clubs, golf bags and carts, and gloves and shoes.

In big spectator sports such as football, baseball, cricket and track and field, large quantities of different materials including PU are required for the building and maintenance of stadiums, pitches and running tracks.

Among the main benefits of PU in sports and leisure is elasticity, giving it the ability to respond well to tensile stress without causing discomfort. Thermoplastic polyurethane (TPU) elastomers can be molded and shaped to match different parts of the human body. Spandex elastic PU fibres derived from TPU are used in swimwear, athlete clothing and sports footwear.

Spandex fibres are being applied to strengthen fabrics and materials such as continuous fibre reinforced thermoplastic (CFRTP). PU coatings can also help toughen textiles in sports shoes and clothing.

Covestro is developing TPU-based CFRTP with advanced chemical resistance properties and flexibility in a wide temperature range. There is strong demand for the material especially from the footwear and sports equipment industries, according to the company.

“Thermoplastic composites enable signifi-



Covestro produces environmentally friendly waterborne PU coatings for apparel



**BASF's Infinergy, the world's first expanded TPU, is used in the sole of Adidas' Boost shoe**

cant increases in production speed for mass production," said Christian Wilms, head of technology at Covestro's thermoplastic composite business.

PU foam is used as an insulator in sports and leisure wear such as ski gloves and boots. In sneakers, its strength and resilience has been extended from the exterior of the soles where it provides resistance against abrasion, wear and tear to applications inside the sole where it supports and protects the foot against the stresses of running.

#### INSIDE THE SOLE

BASF's Infinergy – the world's first expanded thermoplastic polyurethane (E-TPU) consisting of a closed-cell, elastic particle foam – has been incorporated into an Adidas running shoe range as a midsole. It absorbs the foot's impact while running. As soon as the compression from the foot is released, the E-TPU foam springs instantly back into shape.

The midsole consists of 2,500 TPU highly elastic foam beads, providing a highly effective cushioning system.

Impact resistance is not just being confined to shoes but being improved in sports equipment with the aid of PU foams. To reduce impact-induced vibration, tennis and other racket handles are being made with a mix of materials. Some designs comprise multiple carbon fibre-reinforced layers wrapped around a soft inner core of injected PU foam.

#### REDUCING DRAG

The use of advanced foams in intricately designed footwear can be controversial because of the advantages they can give over competitors in sporting events. There have been similar arguments about the application of PU in tightly fitting clothing because they can reduce an athlete's drag or speed loss in sports like swimming.

The sportswear company Speedo has created a swimsuit which is considered to have helped the world's top swimmers achieve faster times. It is similar to a full body suit, covering the torso and legs, so that only the feet, arms, and neck are exposed to water. It is made from nylon-elastane material which compresses the body into a more hydrodynamic shape enabling faster movement.

The key feature of the suit is its PU panels which can decrease drag by around a quarter.

Speedo launched earlier this year a new swimwear range co-developed with HeiQ Materials of Zurich, Switzerland – a textile innovations spin-off from the Swiss Federal Institute of Technology (ETH). It was the result of three years of consultation with swimmers and their coaches and an extensive study of shark's skin.

#### 3D PRINTED SKATEBOARD

To improve the performance of materials, including PU, some sports equipment is now being made through 3D printing. The Italian company Roboze, a 3D specialist, launched in

August 2019 a 3D-printed skate board made of a mix of high-performance polymers.

The bearings are made of TPU with strong abrasion, wear and tear resistance. The skateboard's board and bases have been printed in carbon polyamide as a lightweight alternative to metal. The wheels are made of polypropylene (PP) and the washers polyether ether ketone (PEEK).

US-based Riddell, a leading helmet designer and producer, and Redwood City, California-based Carbon, a Silicon Valley digital manufacturing technology development company, have formed a partnership to create a 3D-printed PU elastane lattice helmet liner. The product is a finalist for this year's Center of Polyurethanes Industry's (CPI) Polyurethane Innovation Award.

At the core of the technology is a system based on Carbon's software and materials for a liner made up of more than 140,000 struts which are customized to be precisely contoured to the athlete's head and to provide additional protection against impact. The system is derived from Riddell's database of over 5m impacts captured by Riddell's smart helmet technology.

"Our platform enables companies like Riddell to make products that were never thought of before," said Joseph DeSimone, Carbon's chief executive and co-founder.

It is an example of how sports equipment manufacturers are now employing concepts which are at the frontier of technological innovation. ■

# State regulations present challenges

The proliferation of new US state regulations is causing confusion and challenges for the polyurethanes industry. The CPI seeks to provide clarity for manufacturers

CYNTHIA CHALLENGER VERMONT

Over the past several years, there has been a growing tendency for state legislatures to consider new regulations they believe will address perceived concerns about various types of chemicals and chemical-containing products.

The primary driver for states is the need for speed and to meet the demands of their constituents, according to Paul Coleman, senior manager for industry affairs at Huntsman Polyurethanes, who is also a member of the Center for the Polyurethanes Industry (CPI) Product Stewardship, Sustainability and Outreach Committee and the Polyurethane Foam Association's Executive Committee.

Science-based review of chemicals under

the Toxic Substances Control Act (TSCA) legislation, which was recently amended by the Frank R. Lautenberg Chemical Safety for the 21st Century Act, takes time.

The amendments to TSCA were passed in 2016 and for the last three years EPA has been working hard to simultaneously build the new TSCA regulatory framework to prioritize, evaluate and if needed manage the risks of chemicals under their conditions of use, and to begin the process of prioritizing and evaluating them. From the outside, it may appear to some states that EPA's progress in regulating chemicals has been slow, but that is not in fact the case, according to the CPI.

"Some state legislatures are building out more robust chemical regulations in the perceived absence of strong federal regulations,"

PAUL COLEMAN

Senior manager for industry affairs, Huntsman Polyurethanes

**"Some industry participants... want to see things move ahead... others would like to see the issue addressed"**



notes Stephen Wieroniey, director at the CPI.

Broad-brush regulations have been passed in California (the Safer Consumer Products program) and Washington (Substitute Senate Bill 5135), and New York Governor Andrew Cuomo has called for development of similar legislation (Consumer Right to Know Act announced in January 2019).

The American Chemistry Council's (ACC) position is that federal actions are being taken to regulate chemicals and states should allow them to be implemented before developing individual programs, which can be duplicative and conflicting and create significant difficulties with respect to compliance by industry.

## HFO BLOWING AGENTS

Some state activities have direct impacts on the polyurethane industry. The federal mandate to replace hydrofluorocarbon (HFC) blowing agents used for the production of most PU products with hydrofluoro-olefins (HFOs) was partially vacated in 2017. A similar decision regarding spray foam applications was handed down in March 2019. As a result, there currently are no federal requirements to replace HFCs.

EPA is developing a new framework regulation for its Significant New Alternatives Policy (SNAP) program, but states have begun to implement restrictions to fill the void. California, Washington and Vermont have already passed legislation, and at least five additional states (Connecticut, Delaware, New Jersey, New York and Maryland) are considering action. In most cases, these regulations adopt the pha-



Some states are strengthening chemicals regulations, directly impacting the PU industry

seout timelines that existed in the initial federal regulations, but they are not all the same.

Whether or not members of the PU industry were in favor of the EPA SNAP rules regulating HFC use, at least they benefited from a level of clarity, according to Coleman.

"The challenge for industry advocacy here is that some industry participants have put a lot of work into their new blowing agent solutions, are happy with what they have and want to see things move ahead at this point, while others would like to see the issue addressed along other lines," said Coleman.

"There is a lot of uncertainty in the industry concerning the timing of the transition from HFC to HFO blowing agents, and institution of individual state regulations is only adding confusion because many companies involved in the sector operate across multiple states," said Ernest Wyson, global technology leader for Opteon Spray Foam & Panel Applications at Chemours and chair of CPI's Polyurethanes Technical Conference.

Given the current situation, however, there is no way to avoid a patchwork of state regulations, observes Wieroniey.

"To the extent possible, industry should ensure that the dates included are at least closely aligned so there isn't a need to sell multiple products and manage multiple and vastly diverse compliance requirements," he said.

CPI is working closely with state legislatures to ensure that any new regulations they implement are clearly defined – particularly regarding the definitions for what is being replaced in which end-use markets – and as consistent as possible from one state to the next.

"We are trying to be a liaison between manufacturers and state regulators with the intention of fostering the development of a common set of definitions," notes Lee Salamone, CPI's senior director.

#### FLAME RETARDANTS LEGISLATION

Many state legislatures are also passing legislation banning flame retardants used in different PU products.

In the past, the focus was largely on flexible PU foams used in mattresses, children's products and upholstered furniture and the target was generally halogenated flame retardants, compounds that have largely been removed from the flexible foam market.

#### STEPHEN WIERONIEY

Director, Center for the Polyurethanes Industry (CPI)

**"It is important that innovative solutions be commercialized and available in the fire safety tool box"**



More recently, however, states are passing legislation that is much broader, with some expanding to include organohalogen retardants and others that ban the use of all compounds classified as flame retardants in various applications, such as California's 2018 Assembly Bill 2998, according to Wieroniey.

Legislation has been proposed in 23 states on various flame retardants, and an additional five states have proposed bans on flame retardants, Salamone notes.

"While the flexible foam market has in general moved away from the use of additive flame retardants to the incorporation of barrier materials and other assembly-style approaches to meet fire-performance requirements, the banning of all flame retardants in upholstered furniture can impact the chemicals used in barrier materials and fabrics and in general and can prevent the use of innovative solutions," Wieroniey said.

#### ERNEST WYSONG

Global technology leader for Opteon Spray Foam & Panel Applications, Chemours

**"There is a lot of uncertainty... concerning the timing of the transition from HFC to HFO blowing agents, and institution of individual state regulations is only adding confusion"**

CPI is working closely with the ACC North American Flame Retardant Alliance (NAFRA) to coordinate advocacy efforts. The two organizations are educating state representatives regarding the benefits of innovative chemistries that could reach the market in the next 5-10 years, including polymeric and reactive flame retardants that overcome many of the concerns regarding leaching of FRs into the environment.

"It is important that innovative solutions be commercialized and available in the fire safety tool box, and CPI and NAFRA are actively seeking to get exemptions for these novel solutions included in any new state regulations," said Wieroniey.

They have had some success in Minnesota and Rhode Island. "The state bill recently passed in Minnesota is encouraging because it makes exceptions for FRs that are polymeric or have been evaluated under the new TSCA and found to pose no significant risk for the use in question," noted Coleman.

In addition, the long-awaited National Toxicology Program study on TCPP (tris(chloropropyl)phosphate) will likely prove to be a significant factor in how the FR regulatory debate plays out for the PU foam industry, he added.

The challenge and key issue going forward, asserts Coleman, is to ensure that any new

#### LEE SALAMONE

Senior director, Center for the Polyurethanes Industry (CPI)

**"We are trying to be a liaison between manufacturers and state regulators [in order to develop] a common set of definitions"**



state regulations are scientifically sound.

"Some groups are pushing dubious read-across assessments that steer us towards some inappropriate FR regulations. I think the new TSCA and the recent Minnesota state bill are encouraging developments here," he said.

Salamone adds that it is not only inappropriate to ban chemicals that can be used safely, but not in the best interest of the marketplace or consumers.

"CPI will continue to work with various partners to advocate with state legislatures to ensure that any new regulations are well-defined, based on science and sufficiently narrow to allow products to pass appropriate safety tests," she concluded.

#### ANALYSIS AND DEBATE

At a very high level, Coleman notes that the industry is doing what it has always done: collaborating to work through the various issues, establishing appropriate industry positions via rigorous analysis and debate, and then making the case for what should and should not happen based on clearly outlined reasoning.

"The CPI is a great and very professional forum to get that work done. Regardless of the specifics of the issue at hand, the PU industry is always striving to make sure our products do not pose a significant risk to human health or the environment, and the regulations that help achieve that important goal need to be scientifically sound and fair to all the various materials involved," said Coleman.

Individual companies are challenged to provide customers with the solutions they want, yet also meet regulatory requirements, regardless of any uncertainties, which is getting further and further from a "one size fits all" type of situation, according to Coleman.

"At Huntsman, we try and make reasonable assessments about the direction things are heading and do development work that will address those needs. In doing so, we are able to come up with good products that the market wants in a timely fashion," said Coleman.

It is also important to stress that while there will always be challenges, the PU industry is well-positioned for an exciting period of growth and innovation in the years ahead, he added. ■

# Phasing out HFC blowing agents

With so much time and money already invested, PU companies are not about to abandon their work and return to old formulations. Other countries continue to pledge to phase out HFCs



**The PU industry forges ahead with blowing agents with low global warming potential**

**AL GREENWOOD** HOUSTON

**U**S polyurethane (PU) producers are phasing out blowing agents based on hydrofluorocarbons (HFCs), despite the absence of regulations from the federal government.

Instead of the federal government, state regulations and the uncertain timeline for decisions under earlier litigation had encouraged PU companies to develop products using new types of blowing agents based on hydrofluoroolefins (HFOs).

PU producers use blowing agents to produce air pockets in foam. Those cells provide PU foams with many of their properties, be it flexibility or insulation.

The problem with HFC-based blowing agents is that they are powerful greenhouse gases. HFOs have much lower global warming potential (GWP), which is why they are replacing HFCs in many blowing agents.

To fight climate change, regulators in the US and around the world set deadlines to phase out HFCs. In the case of the US, it issued two rules in 2015 and 2016 setting various deadlines to phase out HFCs. The deadlines were

organized by application, so some products had to phase out HFCs sooner than others.

Replacing blowing agents is a difficult process because it often leads to changes in other components of the PU. With that in mind, the deadlines gave companies plenty of time to develop new formulations that would accommodate new blowing agents.

## LAWSUIT AND IMPLICATIONS

In the US, Arkema and Mexichem sued the federal government, challenging the legitimacy of the regulations.

The lawsuits left the PU industry in a conundrum. If they stopped working on new formulations and the government won the lawsuit, then they would not have enough time to develop new products that would comply with the regulations. Their products could be banned throughout the country.

That was too big a risk. As a result, they continued to develop new formulations while the litigation worked its way through the court system.

In 2017, an appeals court ruled in favour of the two companies. By then, some of the deadlines had passed, and companies were already

complying, said Stephen Wieroniewy, director for the Center for the PU Industry (CPI).

For other applications with more distant deadlines, companies had already made much progress in developing new formulations, he said. With so much time and money already invested, PU companies are not about to abandon their work and return to their old formulations.

## US CLIMATE ALLIANCE

Independent actions from states gave companies more reason to stick with their new formulations. Several banded together and formed the US Climate Alliance, a coalition committed to upholding the goals of the 2015 Paris Agreement, which dealt with the much wider issue of greenhouse gases. So far, 24 states are members.

Out of these, California, Washington and Vermont have already adopted regulations that set deadlines to phase out HFCs, with many of them taking effect between January 2020 and January 2021, Wieroniewy said. Other members of the alliance have indicated they plan to adopt deadlines to phase out HFCs.

## HONEYWELL

**"Many system houses have already launched their HFO product lines and are complete with their formulation work. They are progressive and see that an HFC transition is underway around the globe"**

Honeywell, which makes HFOs, said many states are embracing the intent of the federal program and are adopting regulations in a consistent way. This allows companies to sell products that can comply with a multitude of state regulations.

"We've seen states rapidly respond to uncertainty at a federal level to keep the HFC phaseout on track, and we would welcome additional state programs that are consistent with actions already taken," Honeywell said.

If PU companies do not meet these deadlines, then their products could be banned from those states. California is a big market, and it could be a significant loss if companies lose access to that state.

If more alliance members adopt deadlines, then the companies could lose access to even more states if they do not reformulate.

This, combined with the uncertainty of the litigation, led companies to adopt new formulations – even without federal regulations.

“It would be unfortunate if any company didn’t have a solution at this point,” Wieroniewy said. “When you tie in the state regulations, manufacturers really need to be prepared for the transition.”

#### POLYURETHANE INNOVATION AWARD

The move away from HFCs is readily apparent at the CPI’s Polyurethanes Technical Conference. Every year, the conference issues the Polyurethane Innovation Award.

Since 2015, every winner played a key part in the transition from HFCs to HFOs. In 2015, Honeywell won for its Solstice Liquid Blowing Agent, which is made with HFOs.

Shepherd Chemical won the following year for its bismuth-based catalysts that are compatible with HFO-based blowing agents. Shepherd’s award illustrates the challenges that the PU industry had to overcome to change their formulations to accommodate the new HFOs.

Chemours won in 2017 for Opteon 1100, its

**STEPHEN WIERONIEWY**  
Director, Center for the Polyurethanes Industry (CPI)

**“When you tie in the state regulations, manufacturers really need to be prepared for the transition”**



HFO-based blowing agent. Demilec, part of Huntsman, won in 2018 for developing a spray foam that incorporates HFOs. The companies developed these products amid the uncertainty surrounding federal regulations.

Honeywell said the transition to HFOs remains strong. The company has been selling its Solstice Liquid Blowing Agent since 2013. It started up its plant in 2014, and the company continues to convert applications to its Solstice platform.

“The reasons that we continue to see a strong pace of adoptions are clear – in addition to regulations, customers see the benefits of how the foam formulated with Solstice performs, as well as the environmental advantages,” Honeywell said.

“Many system houses have already

launched their HFO product lines and are complete with their formulation work,” the company said. “They are progressive and see that an HFC transition is underway around the globe and want to stay ahead of the curve.”

#### INTERNATIONAL EFFORTS ON HFC

Outside of the US, countries continue to pledge to phase out HFCs by ratifying the Kigali Amendment.

This was an addition to the Montreal Protocol, a decades-old agreement that phased out older refrigerants and blowing agents that were destroying the ozone layer. The Kigali Amendment expanded the scope of the Montreal Protocol to cover refrigerants and blowing agents that contribute to climate change. The amendment went into effect at the start of this year.

Although the US has yet to ratify the Kigali Amendment, more than 80 countries have done so. Europe introduced the so-called F-gas regulation, which is designed to phase-out HFC-based blowing agents across the EU by 2023. Japan has adopted a program to rapidly phase out the use of HFCs in blowing agents by 2021.

While regulations vary by country, Honeywell said most major PU applications are already undergoing some level of transition. ■

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# PU intermediates under pressure

Looking forward, sufficient supply and lower demand growth in the midst of a global economic downturn is expected to maintain downward pressure on prices

ZACHARY MOORE HOUSTON

Prices for most major polyurethane (PU) intermediates declined throughout the first half of 2019, as slower than expected economic growth and sufficient supply levels weighed on market sentiment.

Global economic growth is expected to fall short of expectations in 2019. Purchasing Managers' Indexes (PMIs), a key measure of industrial growth, are showing contracting activity in Europe and China. The US most recently moved into contraction territory after around three years of expansion.

A number of economic indicators suggest the world economy may be nearing a recessionary period, limiting demand for many industrial commodities, including PU systems.

PU demand has slowed in Asia and Europe, as many buyers are opting for lower-cost substitutes in place of PU foams. Demand for PU has held up better in the US, although one result of this has been greater flows of PU and intermediate products into the US market.

## ASIA PMDI IMPORTS

Polymeric methylene diphenyl diisocyanate (PMDI) supplies have remained long in the US throughout much of 2018 and 2019, as Asian exporters have been maintaining elevated allocation levels to the North American

market, which has offered better netbacks than Asia for most of the period.

Large volumes of Chinese imports arrived in the first half of 2018, as buyers built up stocks ahead of the implementation of additional tariffs on Chinese MDI imports, causing the US to shift from a net exporter to a net importer of MDI in 2018, according to the ICIS Supply and Demand Database.

Chinese imports have slowed since the implementation of additional tariffs stemming from the ongoing trade war between the US and China, but remain at fairly high levels as Chinese suppliers have maintained allocations to the US in order to defend their market share.

According to the ICIS Supply and Demand Database, China is the by far the largest exporter of MDI to the US, accounting for over 70% of total US imports in the first half of 2019.

## MMDI DYNAMICS

In the monomeric MDI (MMDI) market, prices have recently started to move down after remaining strong throughout 2018 and the early months of 2019.

MMDI demand had been stronger than demand for most other PU intermediates as it has been displacing toluene diisocyanate (TDI) in some mattress applications such as "bed-in-a-box" applications.

This improvement in demand had kept MMDI supplies tight for much of 2018 and

**MMDI demand had been stronger than demand for most other PU intermediates as it has been displacing toluene diisocyanate (TDI) in some mattress applications such as 'bed-in-a-box' applications**

parts of 2019, although supply has gradually loosened in recent months.

Much of this is due to a slowdown in consumption growth. According to data from the American Chemistry Council (ACC) and Vault Consulting, total sales of MMDI in the North American market showed year-on-year growth in the first quarter, while data for the second and third quarters indicate year on year decreases from 2018.

Much of this slowdown in demand has been caused by a more modest than usual up-tick in demand from the construction sector, which experiences its high season in the second and third quarters in the Northern Hemisphere.

The construction sector is a major consumer of MMDI-based foams.

MMDI prices, as assessed by ICIS, reached a peak in the first quarter of 2019 but have begun to decline in the succeeding months.

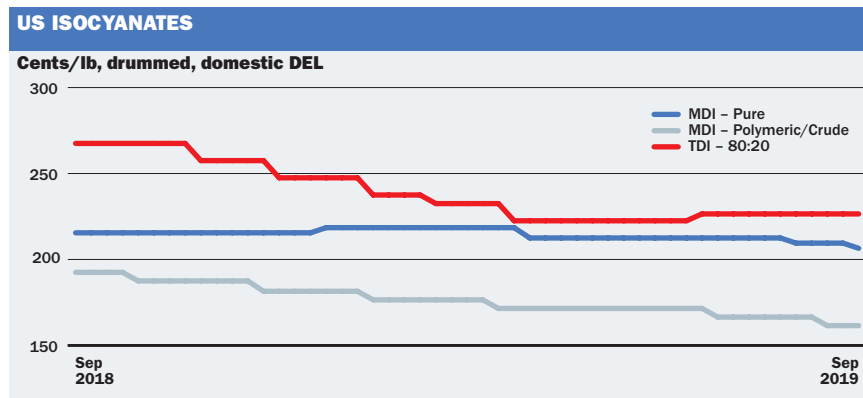
These declines have thus far been modest, with the result that MMDI continues to carry a significant premium over PMDI.

## TDI GLUT FROM NEW CAPACITY

In the TDI market, persistently tight supply and steadily rising prices throughout 2017 and the first half of 2018 have given way to a situation of persistently long supply and steadily declining prices from the second half of 2018 through the first half of 2019.

BASF resumed full operations at its 300,000 tonne/year TDI plant in Ludwigshafen, Germany in the second half of 2018, while Wanhua Chemical started up a new 300,000 tonne/year plant in Yantai, China in late 2018.

These plants, whose combined nameplate capacities are sufficient to cover 25% of global TDI demand, have created a situation of global



TDI oversupply and reduced operating rates.

According to the ICIS Supply and Demand Database, TDI operating rates for 2019 stand at around 70%. Average industry operating rates are forecast to improve gradually and to reach the 80% threshold by 2024.

The glut of new TDI capacity has arrived on the market at a time when TDI demand is facing headwinds.

The automotive sector is facing declining demand this year following sharp declines in sales to China and India. Participants in the US automotive market have expressed concerns that sales might also trend lower in the coming months and year.

Additionally, TDI has been losing market share to MMDI in the furniture and bedding sector while the sector in general has also posted disappointing results for 2019. These factors are likely to keep sentiment in the TDI market bearish over the coming months. Prices for polyether polyols have also been coming under downward pressure in recent months.

#### PROPYLENE DRAGS ON POLYETHER POLYOLS

The US polyether polyol market is structurally long and prices tend to follow the direction

of propylene feedstocks with a lag of one to two months.

The US propylene market has been long for most of 2019 after the year 2018 was marked by several periods in which supply tightness generated significant upward movements in prices.

Depressed prices for ethylene for much of 2019 have encouraged flexible feedstock crackers to use propane and butane rather than ethane as cracker feedstocks, resulting in greater production of cracker co-products such as propylene.

Propylene produced by refineries has also stayed high for much of the year, as refiners have been maintaining high operating rates to build fuel stockpiles ahead of the IMO 2020 regulations on bunker fuels for ocean freight.

Additionally, the economics of on-purpose

**The BASF and Wanhua plants, whose combined nameplate capacities are sufficient to cover 25% of global TDI demand, have created a situation of global TDI oversupply and reduced operating rates**

propylene production via propane dehydrogenation (PDH) units has been healthy for most of 2019. Propane prices have been depressed for much of the year on high production from the oil and gas sector, resulting in a wide spread between propane and propylene prices.

On the demand front, the slowdown in various key consuming sectors for PU foams has caused a slowdown in polyol demand.

#### PU INTERMEDIATES OUTLOOK

Looking forward, sufficient supply and lower demand growth in the midst of a global economic downturn are expected to maintain downward pressure on prices for all PU intermediates in the months ahead.

Compressed producer margins are likely to be the main limiting factor on any downward movements in prices. Tracking a broader trend of lower margins for producers of commodity chemicals, many major producers active in the isocyanate and polyol markets have posted lower rates of profits over the first two quarters of 2018.

This has already spurred a few increase initiatives in polyurethane intermediate markets, although these initiatives have so far met with limited success. ■

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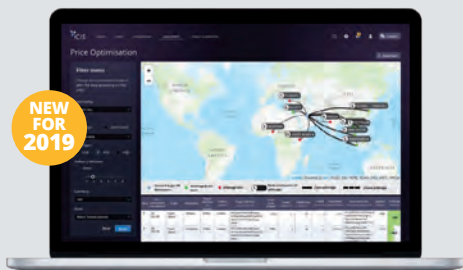
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# Isocyanates, polyols a challenge

The demand and prices of TDI and polyols continue to be depressed while more polyols capacity becomes available in Saudi Arabia

IZHAM AHMAD SINGAPORE

**T**he Middle East market for polyurethane (PU) foam products and their component chemicals witnessed a rather depressed first half of the year and there are few signs that any significant relief is on the horizon.

Isocyanates are used with polyols for the production of flexible or rigid PU foam applications, including mattresses, footwear, insulation panels and car components.

ICIS data showed that toluene diisocyanate (TDI) prices in the Gulf Cooperation Council (GCC) region have been on a downtrend since hitting record highs of \$4,650/tonne CFR (cost & freight) GCC in March 2018.

Prices fell to a low of \$1,675/tonne in February this year before recovering. However, the rebound turned out to be false dawn, with prices only getting as high as \$2,050/tonne in mid-May before reversing direction again.

GCC TDI prices resumed their fall, hitting \$1,700/tonne in mid-August, after producers struggled to pass on the full extent of their price increases to the end-users.

Middle East buyers said some producers had been holding on to a bullish outlook as they cited expectations of supply tightening.

However, not all buyers were fully convinced as they noted competitively priced TDI cargoes, including those from Middle East and European producers, were still

heard to be available in some parts of the Middle East.

"Some of these suppliers are trying to convince the buyers the prices are going up sharply, hoping the buyers will panic and stock up even though there is no demand," said a Middle Eastern source.

In fact, supply did decline somewhat as some Asian producers went into a regular maintenance shutdown period around the middle of the year. However, the market barely noticed the reduced supply as prices continued to drift lower through that period.

## PMDI SLUMPS AS WELL

Similarly in the polymeric methylene diphenyl diisocyanate (PMDI) market in the GCC, prices have been largely stable to soft following a brief recovery period in May.

In the week of 29 August, PMDI import prices in the GCC were stable at \$1,400-1,500/tonne CFR GCC, reflecting most of offers and selling indications in the week. These marked six-month lows for PMDI prices in the GCC.

Buying interest was muted and demand was considered to be slow due to sluggish economic growth conditions and geopolitical tensions in the Middle East.

"Demand is still not so good," said one major supplier.

Sentiment has also been dented by the uncertainty over US-China trade talks and the

threat of rising political tensions between the US and Iran.

As for polyols in the Middle East, the market is largely one that closely monitors the polymer polyols market, which is essentially combined with TDI for the production of flexible foam products.

With TDI prices being under severe downward pressure in recent months, demand and hence prices for Middle East polyols in general have also been less than stellar, although price moves have been less volatile.

For example, demand in the Middle East for 10-13.5% polymer polyols (POP) was essentially stagnant even as prices dropped to near two-year lows.

In the week ended 29 August, spot import prices of drummed POP cargoes were at \$1,550-1,650/tonne CFR Middle East, their lowest since January 2017.

Some Asian suppliers kept offer levels unchanged the week ended 29 August while others reduced offers to encourage buying interest in a generally subdued environment.

Many suppliers said they had offers and discussions ongoing during the week but firm deals remained difficult to secure due to the weak buying sentiment.

"The [polyols] price is under pressure but it is not falling by much because the producers keep their prices up to factor in the propylene oxide price level," said a Middle East source.

Polyols demand is generally subdued and prices have been under downward pressure, tracking a similar trend in the market for co-component isocyanates in the Middle East.

This is partly also driven by similar price reductions in Asia as well, where sentiment has been dented by the ongoing US-China trade war, market sources said.

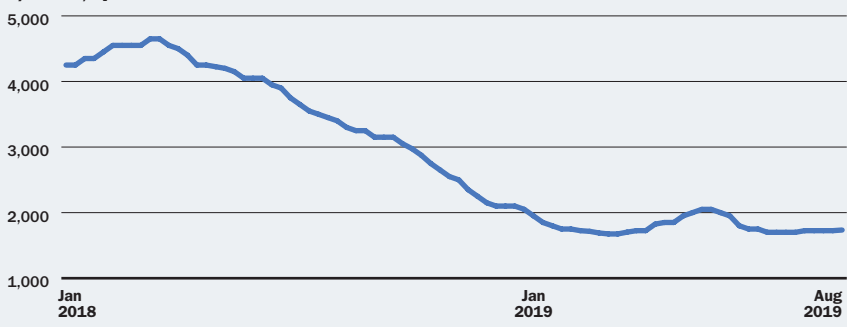
There is also the issue of potential new supply weighing down an already pessimistic market, some sources said.

In August, Sadara Chemical started selling and producing polymer-blended polyols in the Middle East market.

It previously only produced conventional grade polyols at its plant in Jubail, Saudi Arabia. ■

## MIDDLE EAST TDI

\$/tonne, spot CFR GCC



# Asia PU challenged by US-China trade war

Gloomy economic factors, ample availability of PU products and environmental checks in China cloud the outlook for Asian market players

JASMINE KHOO SINGAPORE

**T**he Asian polyurethanes (PU) markets are likely to remain plagued by pessimism on economic woes brought about by the US-China trade war for the rest of 2019, market sources said. Impacts from the trade war such as the heavy devaluation of the Chinese yuan and dampened buyer confidence continue to exert pressure on the Asian markets.

Many Asian PU markets saw dismal performance in the first three quarters of 2019, with some registering significant price drops amid lackluster demand and oversupply.

According to ICIS data, during the period from 15 May to 24 July, prices for polymeric di-p-phenylene isocyanate (PMDI) plunged from an average of \$1,900/tonne CFR (cost & freight) southeast (SE) Asia to \$1,375/tonne.

In the same time period, PMDI prices in China plummeted from \$1,900/tonne CFR China to \$1,405/tonne.

Many market participants said that price declines were typically stemmed only when seller margins were eroded and subsequent offers were firmly maintained, or when buyers had to restock inventories after a prolonged period of inactivity.

It was seldom that Asian market players saw prices bottoming out because of actual improvement in demand, market players commented.



Polyurethanes demand in Asia remains challenging

Uncertainty over the near-term price movement was identified as another factor driving pessimism. Gloomy economic factors, ample availability of PU products and recent developments such as environmental checks on facilities in the key Chinese market constantly clouded the near-term outlook for Asian market players.

"These days, it is difficult for us to count on typical seasonal demand to make any assumptions or predictions about the near future. Demand is no longer a matter of good or bad. It is merely bad, or worse," said a northeast Asia-based producer for polyether polyols.

Not only was China demand weak but markets such as India were also observing sluggish import activity.

## NORTHEAST ASIA-BASED POLYETHER POLYOLS PRODUCER

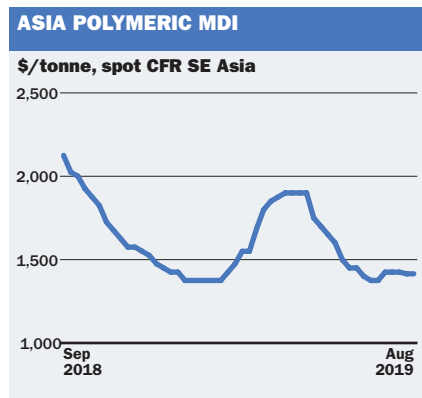
**"These days, it is difficult for us to count on typical seasonal demand to make any assumptions or predictions about the near future. Demand is no longer a matter of good or bad. It is merely bad, or worse"**

tite in China and India, southeast Asia became a popular export destination for regional producers and traders. This in turn led to increased competition among sellers to liquidate their stocks, which once again, posed a new challenge to Asian market players.

Considering the abovementioned factors, many market players were of the opinion that the fourth quarter of 2019 would be riddled with persistent economic and demand woes.

However, some were more optimistic, citing potential improvement in cargo uptake ahead of widely observed festivities such as Christmas, when buying appetite could potentially be boosted.

Among these market players, some also said that the PU markets are unlikely to see further downward pressure in terms of pricing and sentiment, as margins are already squeezed for many regional producers. ■



## INDIA TDI UPTAKE SLOW

The toluene diisocyanate (TDI) market experienced slow uptake from India-based importers for a large part of 2019, as ready availability and competitive pricing in the local Indian market saw buyers keeping their procurement mostly to the domestic front.

"With the broader markets such as China being so unpredictable now, it is less risky for us buyers to purchase locally. Delivery is faster, cargo sizes can be smaller, and that makes it preferable to importing," an Indian TDI buyer commented.

Amid comparatively weaker import appe-

# Europe sees mixed MDI, TDI trends

The weak European polyurethanes market should cushion any impact from Saudi Arabia's isocyanates outages resulting from the attack

FERGUS JENSEN LONDON

The European upstream polyurethane (PU) market has seen mixed trends and several major milestones in a period of increased volatility for isocyanates and polyols this year. Following a long slide that ended in record lows in the first half of 2019, contract prices of toluene diisocyanate (TDI) and crude methylene diphenyl diisocyanate (MDI) have made marginal recoveries.

After hitting an all-time high of €3,500/tonne in April 2018, TDI prices hit their lowest levels in 13-and-a-half years in April this year with the low end of the contract range priced at €1,500/tonne. After hitting all-time highs in September 2017, this February crude MDI prices hit their lowest levels since ICIS began reporting on the contract in 2002.

European markets as of mid-September have yet to price in the strikes at Saudi Aramco's Khurais and Abqaiq sites. Abqaiq is a major upstream supplier to Sadara Chemical, operator of Al Jubail II, which has a 400,000 tonne/year polyether polyols plant, a 200,000 tonne/year TDI plant and a 400,000 tonne/year MDI plant.

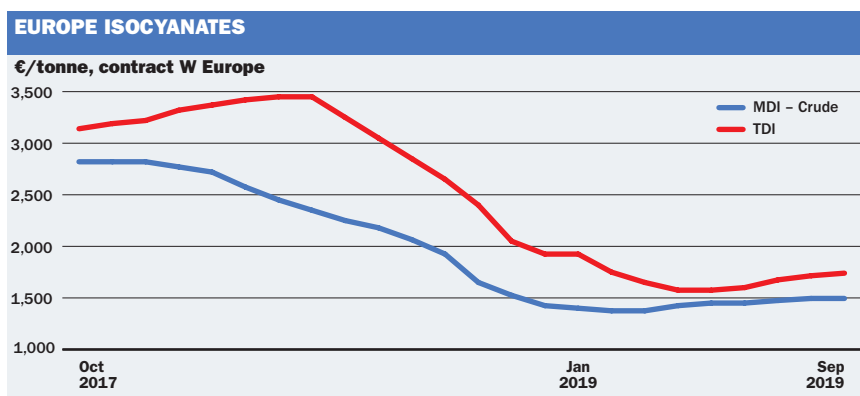
Al Jubail II shipped nearly 20,000 tonnes of isocyanates and an estimated 60,000 tonnes of polyols to Europe in the first half of this year, ICIS trade data showed.

Pure MDI prices have yet to recover from a slide that began in September 2018, and polyol prices have shown some erosion resulting from increased competition from imports.

## TDI MARGINS IMPROVE

The PU market broadly continues to battle with length exacerbated by weaker demand particularly from the automotive, bedding and construction sectors, and imports of material and downstream goods.

The slowdown in global manufacturing has been a key driver of dampened isocyanates consumption in 2019 and will potentially continue to be so for the rest of the year. The US and China have imposed additional tariffs on isocyanates and PU products, and this has



added pressure to the market.

Several outages are expected through Q4 2019, comprising of more than half the output from the structurally oversupplied European TDI market.

Covestro is expected to close its 250,000 tonne/year plant in Dormagen, Germany, for two weeks in mid-September. BASF has closed its 70,000 tonne/year plant in Schwarzeide, Germany, for maintenance and will shut its 300,000 tonne/year plant in Ludwigshafen, Germany, in the autumn. These outages follow a month of maintenance by Borsodchem at its 290,000 tonne/year TDI plant in Kazincbarcika, Hungary, in mid-July.

Concerns around potential tightening resulting from these turnarounds have helped producers recover margins.

There have been several unconfirmed reports of imports of TDI from South Korea, China and the Middle East.

Lower isocyanates prices may encourage some end-users to return to downstream PU foam, after switching to PU alternatives was seen in bedding and insulation sectors when prices spiked in 2018. However, price volatil-

ity is still a deterrent. For TDI, an expected seasonal pick-up in demand following the European summer holiday lull failed to materialise as of mid-September.

## MDI IMPORTS RISE

The European crude MDI market has been similarly lengthy for much of 2019. Some marginal price recovery has been seen since April, supported by steady demand from the construction sector and concerns after the delayed restart of Huntsman's MDI plant in Rozenburg, the Netherlands, and the turnaround of Borsodchem's Kazincbarcika plant in July.

As of September, the market was looking balanced. Pure MDI has similarly seen weaker demand, particularly in thermoplastic urethane used for shoe and sandals soles, water pipes and coatings.

European flexible slabstock polyols prices have followed a similar price path as TDI, and have been in decline through much of the year due to excess supply, including from cheaper imports from China, South Korea and the Middle East.

Reports of aggressively priced imported material and special offers from suppliers point to further market erosion, with producers grappling to retain customers.

There were some supply issues reducing output of polymeric polyols grades from Repsol, although supply was generally ample. ■

**Al Jubail II shipped nearly 20,000 tonnes of isocyanates and an estimated 60,000 tonnes of polyols to Europe in the first half of this year**

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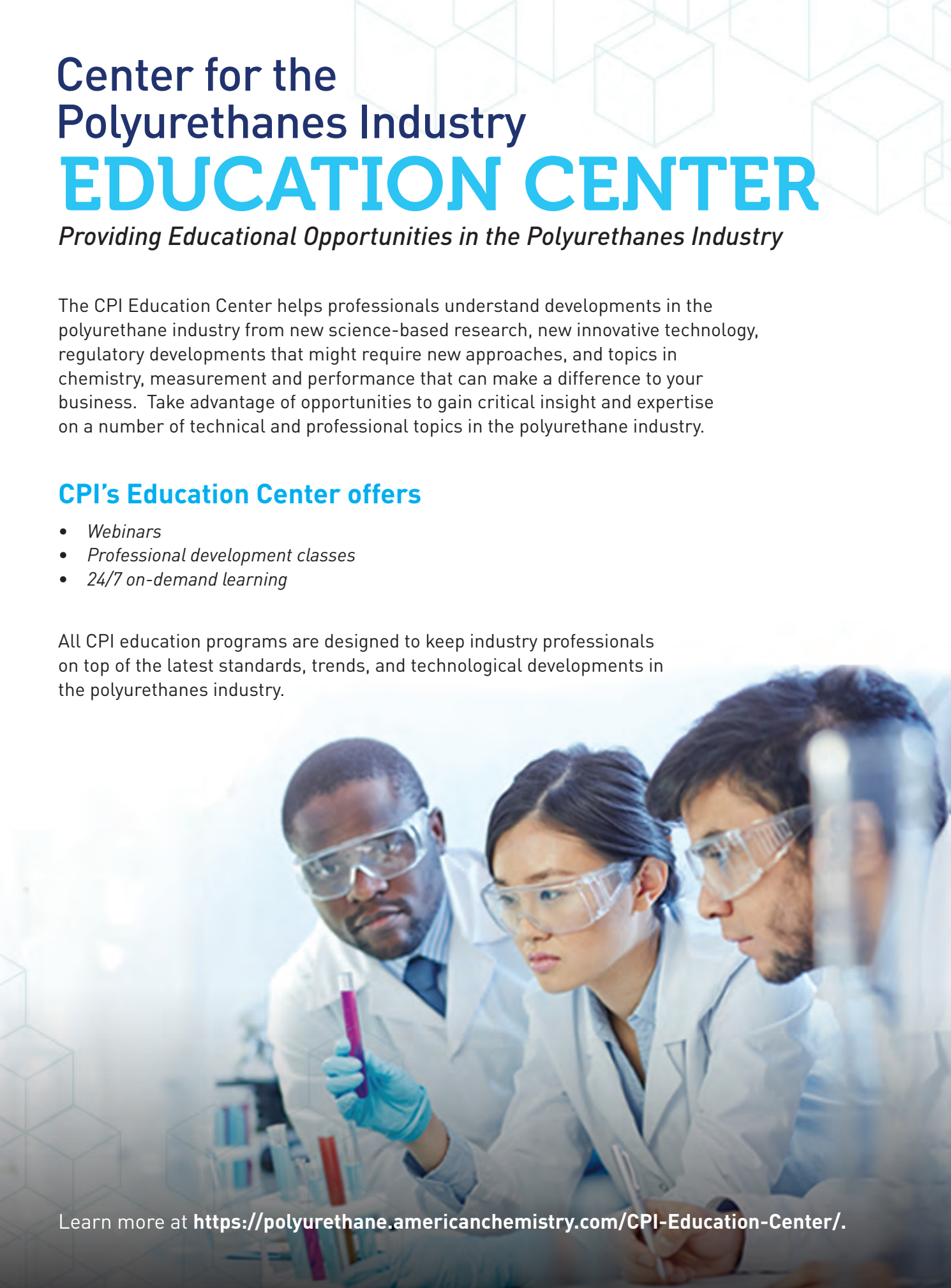
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A photograph of three scientists in a laboratory setting. They are wearing white lab coats and safety goggles. The scientist on the left is a Black man, the one in the middle is a woman, and the one on the right is a man. They are all looking intently at a test tube held by the woman in the center. The background is slightly blurred, showing laboratory equipment and shelves.

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