ASI ADHESIVES & SEALANTS INDUSTRY

A bnp media PUBLICATION

Structural Bonding and Repair

Additive Manufacturing

RadTech UV+EB 2022

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ASI ADHESIVES & SEALANTS INDUSTRY

VOLUME 29, ISSUE 5

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FROM THE EDITOR

>> Susan Sutton, editor-in-chief

A STRUCTURAL SHIFT

While structural adhesives provide step-change innovations beyond mechanical fastening, multiple factors need to be taken into consideration to ensure optimal results.

Design engineers are increasingly embracing a shift from mechanical fasteners to structural adhesives in sectors ranging from automotive and aerospace to energy and construction. In fact, the market for structural adhesives is projected to grow at a 6.9% CAGR (2021-2030) to reach a value of $27.9 billion worldwide by 2030.[1]

This evolution only stands to reason, as structural adhesives can offer compelling advancements for assembly applications, such as lightweighting opportunities, enhanced weather and corrosion resistance, and improved stress distribution. Making the switch is more complicated than simply laying down a line of off-the-shelf adhesive, however.

"During the design exercise, critical attention must be paid to the potential effects of mechanical and thermal stress requirements, particularly in dynamic bonding applications," write Huntsman's Catherine Schoenenberger and Jose Fanjul in this issue. "Furthermore, assembly, manufacturing methodology, and cost factors must all be considered when proposing a joint design."

While structural adhesives provide step-change innovations beyond mechanical fastening, multiple factors need to be taken into consideration to ensure optimal results. Turn to "Generating Efficiency and Productivity in Structural Bonding and Repair with Acrylic Chemistry" for the full story.

Many adhesives—structural and otherwise—benefit from a curing step in order to achieve their full strength. Attendees of this month's RadTech UV+EB 2022 in Orlando will have the opportunity to learn all about ultraviolet (UV) and electron beam (EB) technologies for adhesives, sealants, and coatings in myriad end-use applications. Take a look at "Previewing RadTech UV+EB 2022" for a sneak peek.

Manufacturers and formulators of adhesives and sealants are increasingly seeking sustainable options for their operations, whether in their raw materials/chemicals selection or their facilities' processes. I spoke recently with Christopher vom Berg of the Renewable Carbon Initiative to better understand what renewable carbon is, as well as how our industry might benefit from this concept. Learn more in "Renewable Carbon and the Quest for a Reduced Carbon Footprint."

Susan Sutton is Editor-in-Chief, Integrated Media, of ASI magazine. If you wish to send a letter to the editor, please email suttons@bnpmedia.com. Letters must include the sender's address, phone number, and email address, when possible. Letters may be edited for space and clarity.

Reference

1. "Structural Adhesives Market by Substrate, Product Type, Resin Type, and Application: Global Opportunity Analysis and Industry Forecast, 2021-2030, July 2021, https://www.alliedmarketresearch.com/structural-adhesives-market-A12353.

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GENERATING EFFICIENCY AND PRODUCTIVITY IN STRUCTURAL BONDING AND REPAIR WITH ACRYLIC CHEMISTRY

The right adhesive joining solution can have tremendous influence on operational efficiency, productivity, and profitability.

By Catherine Schoenenberger, Innovation Manager-Industrial Adhesives, Huntsman Advanced Materials GmbH; and Jose Fanjul, Strategic Marketing Manager-Adhesives, Huntsman Advanced Materials Americas

Market studies indicate that the use of structural adhesives will continue to show significant growth in the coming years. Whether for first joining operations, maintenance, or repair operations, the use of paste adhesives offers many advantages compared to welding or traditional mechanical fastening, including ease of use, environmental resistance, sealing, stress distribution, and joining dissimilar materials.

However, we must not forget that from a processing point of view, liquid or paste adhesives set a few challenges. The main issues affecting efficiency, productivity, and profitability are:

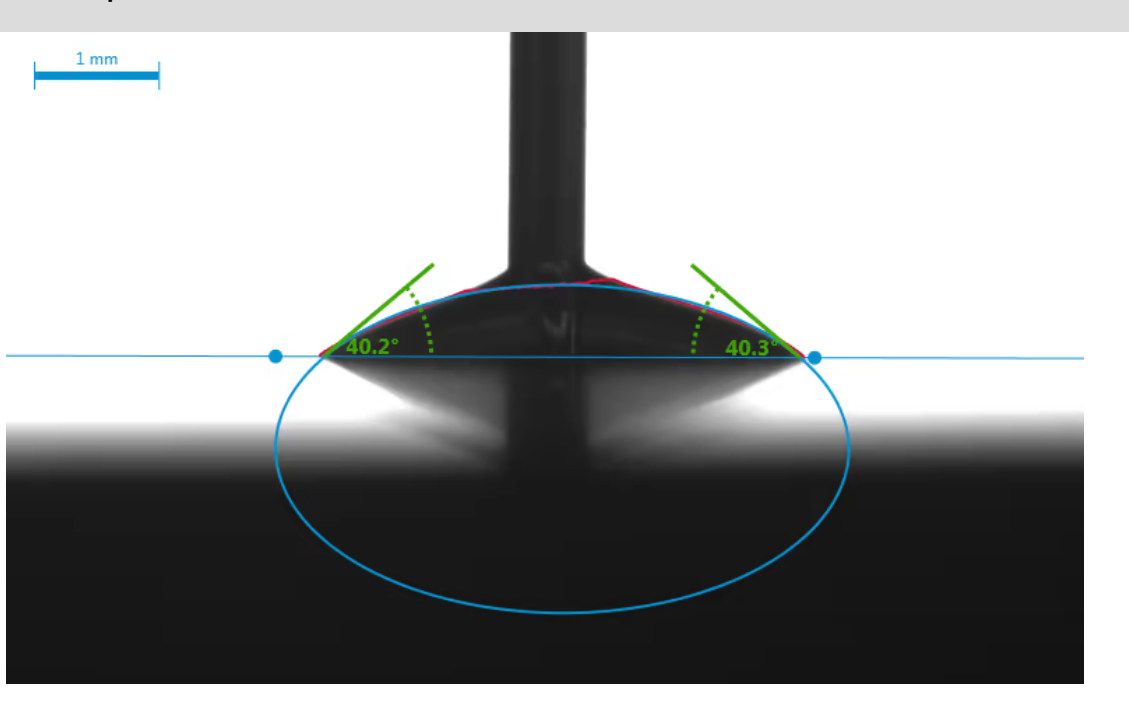
- Surface preparation and primer requirements—to achieve optimal bonds, surface preparation and/or primers are often required, adding time, labor, and costs to the overall process
- Bond performance—it is often hard to find an adhesive that has bonding capabilities with multiple substrates; too often, inventories must be increased with numerous adhesive references
- Cure times—it is often difficult to find an adhesive that achieves fast or optimal cure to improve productivity
- Transport and storage—some adhesives have, for instance, a flammable classification that poses risks during transportation and/or storage, or they require special and expensive conditions for this
- Toxicity profiles—several adhesives on the market today present non-friendly toxicity profiles, presenting risks to operators and adding costs for protective equipment and specialty handling devices
- Employees' wellbeing—it is too often the case that employee wellbeing and satisfaction are affected by aggressive or unpleasant odors, especially in closed working environments requiring additional installation of expensive mitigation devices

Reducing Pre-Bonding Operations

Substrate surface preparation for adhesive bonding is extremely important in determining joint performance. Without proper surface preparation, even the best adhesive will not produce a durable, high-strength joint. Surface preparation cleans the adherend surface and/or introduces chemical functional groups at the surface to promote wetting and chemical bonding between the adherend and the adhesive.

Contaminants include grease, dust, and oil; metal surfaces also become contaminated with oxides generated by corrosion. Surface preparation methods that are used depend on the class of adherend and the type(s) of surface contaminant(s). Generally, surface treatments can be mechanical, chemical, electrical, or even use plasma, UV light, or lasers for surface modification.

Figure 1. Surface contamination can be assessed by measuring the wetting angle of various liquids.



Surface preparation methods all have something in common: they are time consuming and thus negatively influence productivity and profitability. Epoxy or polyurethane adhesives are extremely dependent on surface preparation quality, whereas methyl-methacrylate-based adhesives are known for their "self-cleaning" action on numerous contaminated surfaces. Most recent developments in acrylic chemistry and formulation[1,2,3] enable the design of adhesives that are often more efficient in that aspect, reducing or nearly eliminating the need for surface preparation to meet high bonding performance.

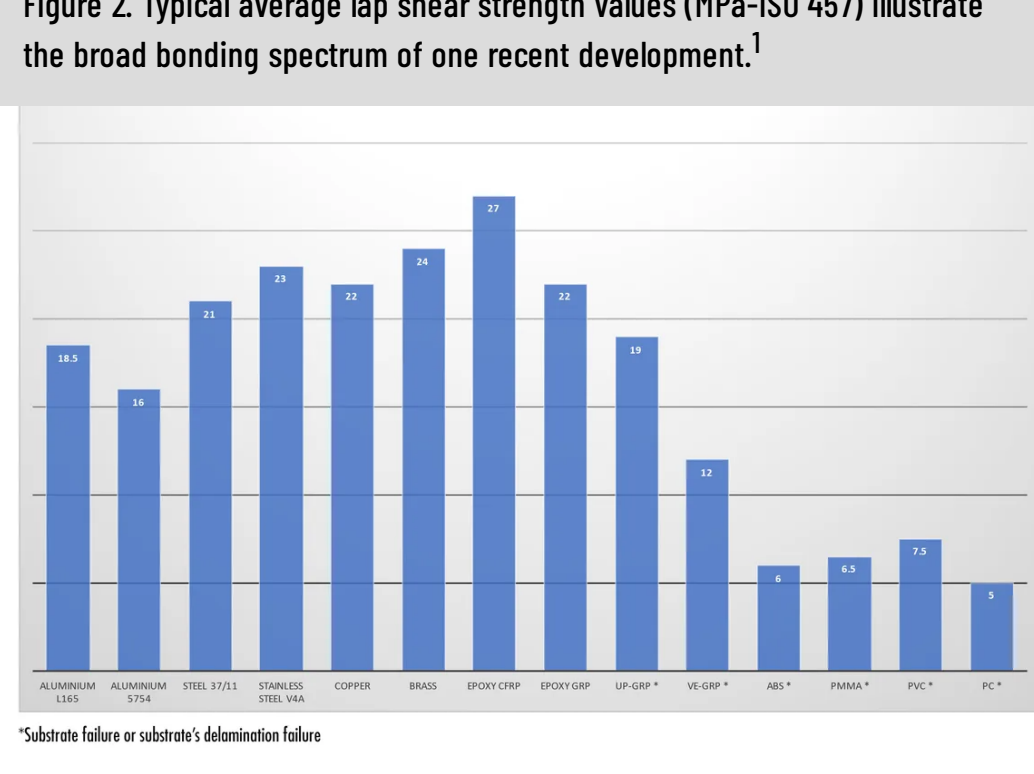
Reducing Inventory and Complexity

When various substrates must be bonded on the assembly lines or during repair operations, the solution has often been to increase the number of adhesive choices. The need to bond multiple materials in the same workshop, and specifically to bond dissimilar materials, is growing due to more innovative and ambitious designs. In addition, these designs are leading to the increased use of adhesives over traditional mechanical fastening methods, given their multiple advantages when joining complex components.

The use of multiple highly specialized products increases inventory costs and adds complexity in supply logistics, workshop planning, and organization. Due to these challenges, innovation is driving new products that offer multi-material bonding capabilities. What this means for the end user is the ability to reduce the number and types of adhesives in their inventory.

To reach optimal bond strength for applications that involve joining dissimilar substrates, many factors must be considered, including: service conditions; joint design; curing constraints; and thermal, electrical, or mechanical targeted performance. A critical parameter to consider is the difference in coefficients of thermal expansion (CTE) between the substrates. In addition to resistance to the different stresses imposed by the applications (e.g., impact, vibrations, shear, and environment), the adhesive joint must survive the substrates' dimensional changes due to a temperature increase or decrease. It is essential to consider these issues before choosing an adhesive system.

Figure 2. Typical average lap shear strength values (MPa-ISO 457) illustrate the broad bonding spectrum of one recent development.[1]



*Substrate failure or substrate's delamination failure

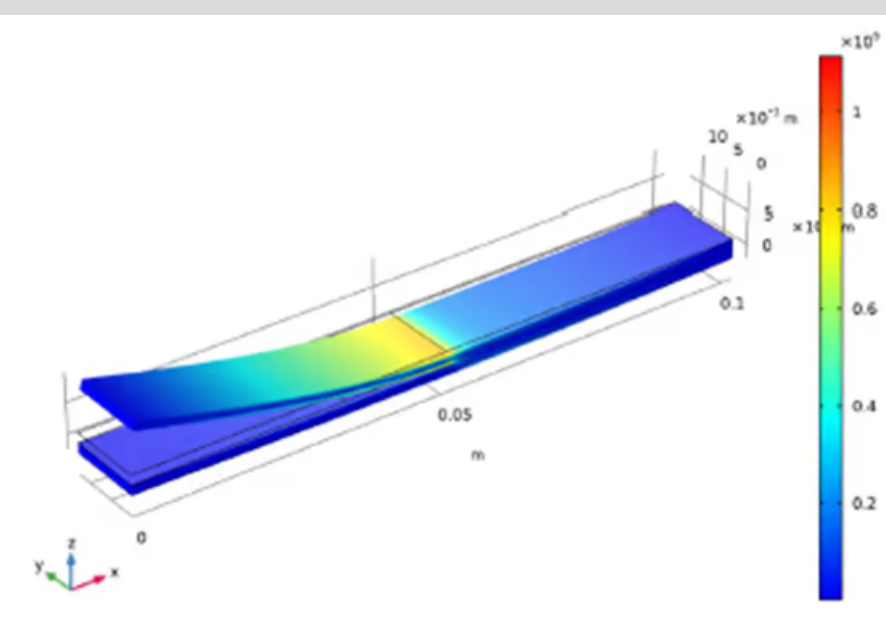
Recently marketed acrylic adhesives have been designed to offer compatibility to a wide spectrum of substrates, offering strong adhesion to metals, composites, and thermoplastic materials. Some of these adhesives also demonstrate high toughness and/or flexibility to withstand important differences in dimensional changes between the substrates and also to minimize the potential of failure from fatigue or hysteresis due to the forces generated in the joint. Such adhesives[1] can be used for many different applications and replace several specialized products, consequently reducing inventory, lowering complexity, and minimizing the training needed by workers.

Optimizing Design and Processing Times

When designing adhesive applications, optimizing joint design is an important consideration. Adhesive joints, unlike those that are mechanically fastened, provide designers with the freedom to focus on the various stresses a particular joint is expected to endure at its projected service temperature. During the design exercise, critical attention must be paid to the potential effects of mechanical and thermal stress requirements, particularly in dynamic bonding applications. Furthermore, assembly, manufacturing methodology, and cost factors must all be considered when proposing a joint design.

To facilitate designers' work, material models provide a wealth of information about the physical, mechanical, and thermal behavior of adhesives.[4] The main disclosed properties that allow engineers to achieve fast and accurate application simulations include tensile properties, Poisson's ratio, fracture toughness, coefficient of thermal expansion, glass transition temperature, lap-shear strength, T-peel strength, cured density, volumetric shrinkage, and shore hardness. These properties provide engineers with the data they need to predict the combined effect of design parameters and adhesive properties over the process and operational conditions of their project, helping them reduce time and expense in their respective applications.

Figure 3. Stress localization simulation during joint delamination.



In terms of processing, two different time-related factors are important: application time and curing time. The application time, also called open time, corresponds to the time allowed for workers to apply the adhesive and put it in contact with the two substrates to be bonded. Curing time refers to the time needed for polymerization; it dictates how long it will take to allow manipulation of the joint and/or its use under loads. Both of these time factors influence productivity in parts assembly, as well as in maintenance or repair operations. For acrylic chemistry, the choice for various combinations of these two processing times is expanding.

Recent innovations in catalysts for acrylic chemistry allow advanced adhesives manufacturers to offer several reactivities of a given adhesive, offering end users optimized processing times and the opportunity to improve productivity in their assembly and repair operations, even in demanding conditions. Two examples are worth mentioning to illustrate this trend.

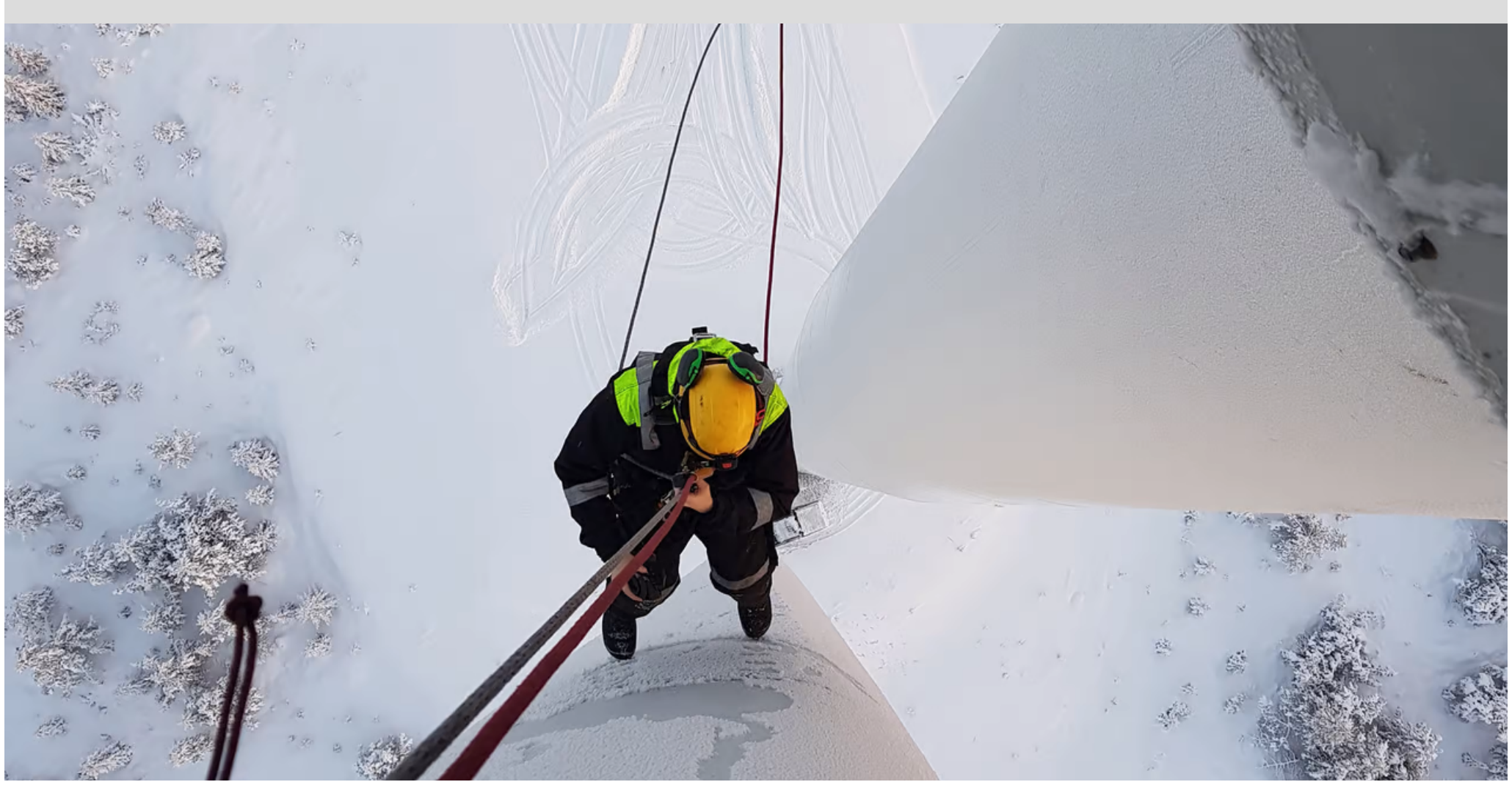
The first example is an acrylic adhesive[1] that features more than 50% elongation and a high resistance to hot and wet environments. This adhesive offers 5- and 15-min open times, allowing for applications as varied as bonding primary and secondary train structures, mid-sized interior rail coach parts, bus and truck components, large panels on trailers, small- and medium-sized interior parts, or even boat fittings.

The second example is an extremely fast-curing acrylic solution[2] that is able to cure between -20°C (-4°F) and 40°C (104°F) in wet conditions and even under water/salt water. Products with two different reactivities (1.5- and 5-min pot life at room temperature) allow various applications for which either the ultra-fast reactivity or the low-temperature or underwater curing capabilities are needed.

Dynamic applications for this solution can be found in the maintenance and repair domain, where engineers must consider downtime and resource utilization factors that can mean the difference between profit and loss. Handling these two variables in extreme environments requires finely calibrated planning and execution. For the repair of wind turbines under extreme conditions (e.g., at -20°C), for example, downtime due to repair and maintenance directly affects the turbines' efficiency and profitability. The ability to work effectively under these conditions is a highly sought-after solution in the wind industry.

Minimizing downtime is key, but the challenging environment of wind farms requires highly skilled and costly technicians working in tight time windows. Therefore, there is an increasing need to be able to complete repair work on demand, "anytime and anywhere," rather than in established repair seasons. Their ability to cure in challenging environments enables recent acrylic adhesives solutions to help reduce wind turbine downtime by 25-50% and total repair time by up to 90%.

The ability to work effectively under extreme conditions is a highly sought-after solution in the wind industry.



Similar applications are seen in repair operations in the marine industry, where challenging conditions such as humidity and extreme temperatures are present. The reduction of vessel downtime is critical. In fact, in many cases, the boats have to be repaired in the water between maintenance cycles. As a result, the performance of the right adhesive, as well as its processing capabilities to meet the needed cure performance, are paramount.

Safer Logistics and Operators' Wellbeing

One of the latest developments[3] within the acrylic adhesives family focuses on solving issues linked to safety and working conditions. Often-reported drawbacks of standard methyl-methacrylate-based adhesives include their strong odor and their classification as flammable products. The first issue is linked to the use of a methyl methacrylate monomer in the formulation, while the second is a result of the nature of the catalyst package.

Strong and uncomfortable odors affect workers' health and satisfaction, especially in closed working environments. In addition, some of these adhesives are classified as respiratory irritant substances, which require protective equipment for application. This in turn affects productivity, costs, and, importantly, employees' wellbeing. The flammable classification has other consequences as well, such as transportation and storage in specialized environments. All of this can negatively affect costs.

A recently marketed acrylic adhesive[3] benefited from an innovation in monomers (eliminating the methyl methacrylate) and from a pioneering catalyst package. The implementation of both advances lead to the emergence of a second generation of acrylic adhesive that keeps all the benefits of first-generation products while providing additional benefits. The adhesive offers up to 90% less smell, is non-flammable, has a snap-curing behavior, and comes in two open-time versions. It displays high impact and crash resistance due to 50%+ elongation, and its more friendly toxicological profile and non-flammable classification help to lower risks, along with the subsequent transportation and storage costs.

Figure 4. Comparison of new acrylics and standard MMAs.

	Low Odor	Non Flammable	Tox Profile	Surface preparation	Fast Cure
Latest Acrylics	✓	✓	✓	✓	✓
Traditional MMA's	✗	✗	✓✗	✓	✓

Sustainability Considerations

As innovations help drive acrylic adhesives to grow in market share among the different chemistries used for structural adhesives, one can expect that their sustainable character and particularly carbon footprint will be in focus. Several new bio-based monomers are under evaluation in development laboratories; their use, if technically possible, will contribute to lowering the global warming potential of the adhesives (expressed in Kg of CO_2 emissions/Kg of manufactured adhesive).

Preference is given today to what is commonly called "second-generation" feedstocks, mainly those derived from ligno-cellulosic origin and not competing with food production even if their availability at industrial scale is currently much lower than that of the first generation. In the future, the third generation related to algal biomass will certainly also be linked to the utilization of CO_2 as feedstock.

In addition to bio-based monomers, chemists and formulators are also looking to the possibilities of using recycled chemicals (due to upcoming requirements from legislation such as the EU Green Deal) and assessing the possibility of implementing the "mass balance" concept by using bio-attributed raw materials as advised by the Ellen MacArthur Foundation.[5] Needless to say, many great things are on the horizon for acrylic chemistry and acrylic adhesives.

For more information, visit www.huntsman.com.

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Note: Photos courtesy of Blade Solutions AB. Figures courtesy of Huntsman Advanced Materials.

ASI ADHESIVES & SEALANTS INDUSTRY

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Applying AI to Paints and Coatings R&D

June 1, 2022 at 2 PM EDT

AI and Smart Data Management accelerate the development, discovery, and reformulation of paints and coatings. Domain-specific challenges that often arise when applying AI to paints and coatings, will be discussed with examples of how Citrine has overcome these.

Learning Objectives:

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- See an end-to-end case study
- Hear how formulations companies are rolling out AI-guided workflows across their business units.

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SPEAKER:

Jacob Mohin
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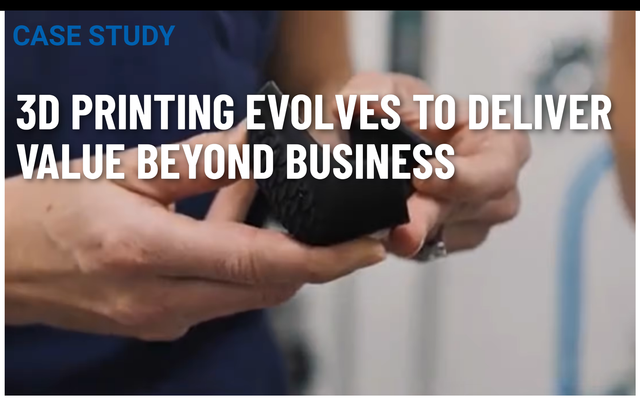
Citrine Informatics

CASE STUDY

3D PRINTING EVOLVES TO DELIVER VALUE BEYOND BUSINESS



3D printing technology has led to meaningful change across industries, but we're only starting to see how it can help create change in communities.

By Cindy Deekitwong, Global Head of Marketing, Incubator Business at Henkel Adhesive Technologies, Henkel Corporation Inc.

Additive manufacturing/3D printing has grown into a $14 billion industry since its inception, according to McKinsey, and the market's annual growth rate is 22%.[1] Many can agree on the potential 3D printing has when it comes to innovation and being able to create prototypes and items with minimal material use, but its value is extending beyond that original purpose.

For example, in Austin, Texas, a technology company is using 3D printing to address the housing crisis.[2] In addition, at the University of Virginia, 3D printing is being used to generate better tumor models to support cancer research. 3D printing technology has led to meaningful change across industries, but we're only starting to see how it can help create change in communities.

Best Foot Forward

Purps, an endangered African penguin living in a colony at the Mystic Aquarium in Mystic, Ct., injured her ankle and needed support to enhance her mobility and improve her quality of life. ACT 3D Equipment and Services, a partner of Henkel's LOCTITE brand, had provided an original boot that required frequent replacement.

"The original boot was successful in improving Purps' gait, but we found that it needed to be replaced often due to wear and tear," said Emily Turcan, Act 3D applications engineer. "We knew the boot needed to be reprinted in a more durable material such that it could withstand the environmental aspects of Purps' everyday life."

Act 3D reached out to Henkel's LOCTITE team for support and, together with local middle school students and other community partners, created an enhanced boot for Purps so she could continue to live an active life. The team used the LOCTITE brand's elastomeric resin, which includes high-performance mechanical properties that contribute to the durability, tear strength, and long-term stability of Purps' boot.

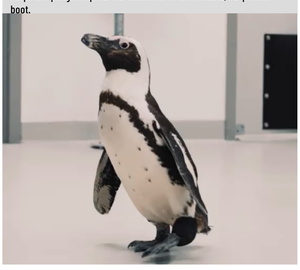
Advancing Telehealth Capabilities

Interest in telehealth has significantly increased due to the COVID-19 pandemic, with McKinsey estimating 3x more investment in virtual care and digital health in 2020.[3] This substantial growth led the Henkel team to partner with WeMed, a French start-up that wanted to quickly respond to the accelerating demand.

WeMed designed a connected SKOP stethoscope to support teleconsulting and remote monitoring. The stethoscope uses a biomimetic design based on the human ear to maximize performance. Due to the specific geometry of the SKOP design, however, it can only be efficiently executed through additive manufacturing.

The SKOP stethoscope's complex geometry relies on 3D printing.

Purps the penguin sports her elastomeric resin-based, 3D-printed boot.



In collaboration with WeMed, Third, and Nexa3D, Henkel provided a customized material in less than a month, enabling a faster time to market. With Nexa3D printers, Third's manufacturing expertise, and LOCTITE's customized material, the team was able to successfully bring a more cost-effective and efficient stethoscope to full-scale production and meet the needs of thousands of patients. The stethoscope has been tested and embraced as a device of choice by cardiologists, pulmonologists, general practitioners, emergency physicians, and nurses.

Sustainable Developments

3D printing is also part of Henkel's sustainability efforts, the overall goal of which is to triple the value created through business activities in relation to the company's environmental footprint by 2030. Through a partnership with TerraCycle to help reduce waste, Henkel became the first organization worldwide to offer a recycling solution for anaerobic and light-cure adhesive packaging.

Henkel provides customers that have 3D printing operations with a recycling box where used containers of UV-curable 3D resins and cyanoacrylate-based adhesives are placed and later recycled by TerraCycle. This year, the program was able to collect enough recycled packaging to begin exploring opportunities to upcycle the waste and create something new.

For more information, visit www.henkel-northamerica.com.

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Note: Images courtesy of Henkel.

Image courtesy of aapsky *via www.gettyimages.com.*

EPOXIES FIND INCREASING USE AS STRUCTURAL ADHESIVES

Epoxy adhesives offer high shear strength while bonding efficiently to a wide range of substrates.

The global epoxy adhesives market is expected to reach $11.6 billion by 2026, according to a recent study by Polaris Market Research. Epoxy is increasingly being used as a structural adhesive across diverse industries. These adhesives offer high shear strength while bonding efficiently to a wide range of substrates, including wood, glass, and metal. They also provide minimal shrinkage, superior thermal and chemical resistance, and cohesive strength.

Epoxy adhesives can be altered and modified to deliver a wide range of properties and offer customized solutions. For example, toughened epoxy adhesives are used in the automotive, construction, and aerospace industries due to the need for greater strength and chemical resistance.

Epoxy adhesives are available in one- and two-component formulations. The demand for one-component epoxy adhesives is expected to increase significantly from 2020-2026. One-component epoxy adhesives are cured at temperatures between 250-300°F and offer superior adhesion properties, high strength, and greater environmental and chemical resistance. They are usually applied through trowel or extrusion by beads and are capable of efficiently filling and sealing gaps between surfaces.

Application Opportunities

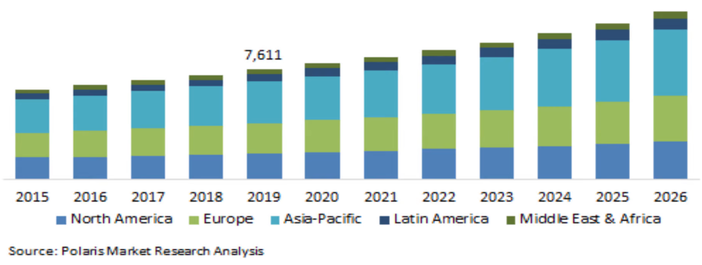
Epoxy adhesives are used in diverse industries such as defense and aerospace, construction, automotive, energy and power, marine, electrical and electronics, and others. The construction segment accounted for the highest share in 2019.

The energy and power segment is expected to grow at a significant rate from 2020-2026. Increasing environmental awareness and government initiatives are encouraging consumers to turn toward solar, wind, hydropower, and fuel cells. The use of epoxy adhesives enables these renewable systems to withstand harsh environments, extreme temperatures, chemical abrasion, and mechanical stresses.

Growth in Asia-Pacific

The Asia-Pacific region dominated the global market in 2019 and is expected to maintain its leadership to 2026 (see Figure 1). Rising growth in industrial applications, urbanization, and the automotive sector supports demand for epoxy adhesives in the region, while increasing applications in the construction, defense and aerospace, and marine industries further increase opportunities for market expansion.

Figure 1. Epoxy adhesives market by region, 2015-2026.



Source: Polaris Market Research Analysis

Rising demand for miniaturized and high-performing electronics, along with increasing awareness regarding the adoption of electric vehicles, fuels growth in this region. Leading global players are expanding their presence in the developing nations of China, Japan, India, and South Korea to tap the growth opportunities offered by these countries.

Additional details are available at www.polarismarketresearch.com.

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PREVIEWING RADTECH UV+EB 2022

Attendees of RadTech UV+EB 2022 can expect over 100 informative presentations, multiple educational opportunities, and a comprehensive exhibition showcasing the latest in ultraviolet- and electron beam-related technologies.

RadTech will hold its RadTech UV+EB 2022 conference and exhibition May 9-12, 2022, at the Hyatt Regency Orlando in Orlando, Fla. This 18th biennial event will feature an educational program with over 100 presentations focusing on ultraviolet (UV)- and electron beam (EB)-related technologies, multiple educational opportunities, and a comprehensive exhibition.

Short Courses

RadTech UV+EB 2022 will offer several short courses at varying levels to enable professionals to expand their knowledge in a way that suits their experience and background. Mike Idacavage, Ph.D., of Radical Curing, LLC, and Neil Cramer, Ph.D., of Arkema-Sartomer Americas, will hold the UV/EB Professional Short Course on Monday, May 9, from 1-4 p.m.

Advanced Photopolymerization Topics will be detailed by Susan Bailey, Ph.D., and Molly Hladik, Ph.D., both of Michelman, on Monday from 1-5 p.m. Also on Monday, 4-6:30 p.m., David A. Walker, Ph.D., co-founder of Azul 3D, and NIST's Jason P. Killgore, Ph.D., will give the Photo-Polymer Additive Manufacturing (PAM) Professional Short Course.

A course focusing on Design of Experiments for UV/EB Scientists and Engineers will be taught by Allan Guymon, Ph.D., of the University of Iowa. This course will be given in two parts: on Tuesday, May 10, from 7-9:30 p.m.; and on Wednesday, May 11, from 12-2:30 p.m.

Conference Sessions

Conference sessions will be held from 8 a.m.-5 p.m. on Tuesday and Wednesday, and from 8 a.m.-4 p.m. on Thursday. The conference kicks off Tuesday morning with presentations in tracks such as Structural & Flexible Electronics, Cationic/Photoinitiator, and Introduction to the Basics of UV/EB Curing. Tuesday morning will also feature a panel on Challenges and Opportunities for UV+EV Curing in Energy Storage Applications (11-11:45 a.m.). Sessions focusing on numerous additional tracks will be held throughout the day, including Chemistry and Molecular Design, Equipment, and Sustainability.

Tuesday afternoon will offer a special session focused on Turning Regulatory Challenges into Customer Victories from 3-3:45 p.m. RadTech Energy Curing Users Resource Group members will discuss interpreting regulatory directives and appropriate perspectives for addressing regulatory and sustainability questions from companies and regulators.

Wednesday's tracks will focus on topics such as Next Level Formulations, Analytical, Optimized Materials, and Specialty Applications. Several panels will also be held on Wednesday, including The Future of Additive Manufacturing Materials (11-11:45 a.m.), What Do You Want to Ask a Government Official about Additive Manufacturing? (12-12:45 p.m.), and Is UV+EB Sustainable? (3-3:45 p.m.).

The conference wraps up on Thursday with tracks focusing on Building Materials, Scratch Resistance/Protective Coatings, a Global Market Overview, and more.

Exhibition

The RadTech UV+EB 2022 exhibition will be open on Tuesday and Wednesday from 10 a.m.-6 p.m., and on Thursday from 10 a.m.-2 p.m. More than 80 companies will showcase products and technologies such as UV LEDs, coatings, formulations, and more.

Registration and additional details are available at www.radtech2022.com.

PRODUCT PROFILE

UV-ACTIVATED SILICONE ADHESIVES FOR AUTONOMOUS AUTOMOTIVE SENSORS

Newly developed UV-activated, dual-cure silicones can protect sensors in autonomous vehicles from the heat, cold, moisture, and stress that result from the rigors of the automotive environment.

Light detection and ranging (LiDAR) is a surveying technology that measures distance by illuminating a target with a pulse of light. In use for over 60 years in military, aerospace, robotics, and meteorological applications, LiDAR is currently experiencing a boom of interest due to the expectation that it will be one of the main types of sensors to enable autonomous, or "self-driving," cars.

Within this realm, advanced driver-assistance systems (ADAS) utilize silicone around their automotive packages (e.g., camera, radar, etc.) in order to seal them from the external environment. Additional uses in these advanced device package areas also include potting/encapsulating for microelectromechanical systems (MEMS) and optical bonding.

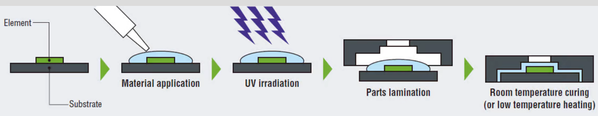
Automobile manufacturers have identified approximately 200 sensor areas around the vehicle that will be instrumental in achieving commercialization and meeting safety goals. The main commonality is the need to protectively seal these key sensor platform areas from the heat, cold, moisture, and stress that result from the rigors of the automotive environment.

UV-Activated, Dual-Cure Silicone Solutions

In an effort to advance silicones for LiDAR and related automotive sensor applications, Shin-Etsu Silicones of America, Inc. (SESA), a U.S. subsidiary of Shin-Etsu Chemical Co. Ltd., has developed a UV-activated, dual-cure silicone series that includes the KER-4410 and KER-4440 products as focal points. Silicones contain compounds that feature a main chain of siloxane bonds that provide distinct advantages over epoxy alternatives, including heat stability, cold resistance, stress releasing, no curing shrinkage, and addition/radical polymerization.

Once the silicone adhesive is applied and exposed to UV, the sensors or components are placed on the board and other board processes can be conducted in parallel (see Figure 1). This dual-cure system saves processing time, requires no need for ovens at high temperatures, doesn't shrink during curing (vs. epoxies), and delivers no added stress.

Figure 1. The dual-cure system saves processing time, requires no need for ovens at high temperatures, doesn't shrink during curing (vs. epoxies), and delivers no added stress.



The series' UV-activated cure silicone has a time lag from UV irradiation to the start of curing that is different for each product. The UV addition type is irradiated with UV light and then cures fully at room temperature or with elevated temperatures.

The adhesives' curing shrinkage rate is less than 0.1%, which is small compared to general organics such as acrylic and epoxy UV resin. KER was coated and cured around a copper substrate in a 2-mm thickness and showed no signs of warpage.

KER-4410

Key properties of KER-4410 include: hardness, A10; tensile strength, 2.3; elongation, 350; and appearance, colorless and slightly cloudy. After UV irradiation, it takes 10-15 min at 23°C until the KER-4410 material starts to cure. It is also possible to bond the base material after UV irradiation, making the adhesive suitable for bonding non-transparent materials such as metal to overcome shadow-cure areas. Heat treatment also reduces curing time.

While KER-4410 features a long open time (15-20 min), the specific open time depends on the UV-integrated light intensity. The recommended open time is within 15 min for 3,000 mJ/cm^2 and within 5 min for 12,000 mJ/cm^2.

KER-4440

Key properties of KER-4440 include: hardness, A43; tensile strength, 6.1; elongation, 430; and appearance, creamy white and translucent. KER-4440 gels in a short time (within a few minutes) after UV irradiation, so it is recommended to perform UV irradiation after placing the substrate.

By changing the UV irradiation conditions, it is also possible to slightly adjust the curing start time. When laminating after UV irradiation, curing should be performed before the gelation starts. After UV irradiation, KER-4440 fully cures at 23˚C in one day; however, the adhesive strength will be further improved by heat treatment at 80˚C for 1 hr.

"Shin-Etsu's depth of experience and knowledge as a silicone material leader in the automotive sensor market has provided a spring board for us to launch the KER- 4410/4440 series across a myriad of key LiDAR and ADAS market segments," said Chad Kobylanski, SESA's automotive segment manager. "We strive to be at the forefront of this by evolving essential products in this line, and developing solutions for these unique and demanding applications."

For more detailed information, visit www.shinetsusilicones.com.

Images courtesy of Shin-Etsu Silicones of America, Inc.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RENEWABLE CARBON AND THE QUEST FOR A REDUCED CARBON FOOTPRINT

Lots of options are available for companies that are trying to address sustainability. What is renewable carbon, and how can it play a role in reducing an organization's carbon footprint?

By Susan Sutton, Editor-in-Chief, Integrated Media

The concept of sustainability has evolved to become one of society's key megatrends, and companies in all industries—including adhesives and sealants—are striving to reach aggressive goals to reduce their carbon footprints. It can be a tricky process to maneuver, as sometimes overwhelming options and myriad buzzwords often make it difficult for companies to determine the best course of action for their business.

Renewable carbon is a principle that offers a lot of promise. But what exactly is renewable carbon, and how can it play a role in reducing an organization's carbon footprint? I reached out to Christopher vom Berg of the Renewable Carbon Initiative to learn more. A partial transcript is included below, and I invite you to listen to our full conversation in the Bonding with **ASI** podcast.

Christopher vom Berg
Renewable Carbon Initiative

What are the goals of the Renewable Carbon Initiative?

The initiative and the companies in the initiative have the understanding that it's essential to switch away from fossil carbon to alternative renewable carbon sources. There's also the understanding that so far that is not properly reflected in policy so much. Yes, there is some development going on, but not as much as we would like to see. The initiative came together with the overarching goal to support the transformation and to push the transformation of our economy from fossil carbon to renewable carbon.

When we talk about renewable carbon, we're talking about embedded carbon. We actually mean the carbon that is found in the molecule, the structure of any material or chemical. There's quite a lot of carbon, and it does make up a fair share of the overall carbon footprint. If you incinerate the product at the end and the carbon bound gets released, this is the carbon we are tackling.

When we talk about replacing fossil carbon—I assume it's quite clear what we mean, fossil carbon that comes from crude oil, from coal, from natural gas through feedstocks that can be used for the chemical industry—we try to replace it with renewable sources. We've identified three alternative renewable sources. One is biomass, so you can use plants and trees to replace the fossil carbon with biomass.

There is CCU, carbon capture utilization. Instead of dragging the fossil carbon from underground, you use the carbon that is above the ground, either directly capture—you take it out of the air again—or there's big industry plants and their emissions. You can capture them immediately and you reuse the carbon in those emissions. That is carbon capture utilization.

And finally, you have recycling. You know mechanical recycling—just collect it and reuse it again. But more directed towards the future, there's also chemical recycling, where you take waste that is maybe not so good anymore for mechanical recycling and you do some chemical processes in order to bring it back to a more elemental state that you can use again for other products.

What are the various factors that should be included when considering a company's overall carbon footprint?

When you're a company, you usually look at what are the processes that we own, what are the buildings that we own that generate carbon as CO_2 emissions? And it is a lot. You have your buildings that have heating and electricity needs. You might have a carpool, you might have business travel, you might have commuting, you're buying products.

Emissions are grouped into scope one, scope two, scope three. Scope one is the emissions that you directly generate with your own company offices and production facilities. Then scope two is the emissions that occurred because you use electricity and energy and heat, so the kind of the things you need to run your processes. That also includes the car emissions, for example, that belong to the company.

Scope three emissions occur because you, for example, buy a product that you use as a resource for your processes. For example, you purchase some crude oil that you use for your product, and the emissions for the crude oil production and extraction would go in your scope three emissions.

Nowadays when people talk about the company carbon footprint and companies say that they are carbon neutral (so they have no emissions because they offset them), it's usually focused on scope one and scope two, just what they control themselves. The emissions coming from the value chain beforehand, they are often not included in that. Scope three, along the whole value chain, that is a much more complex process, which often needs a lot of networking and working together and acting together in order to properly get a scope three emission reduction.

What are some steps that companies can take when they're looking to reduce their carbon footprint?

I think in general, it depends kind of on what company we talk about. If you're just office based, you usually have electricity and heating and commuting that are the major things you want to address. If you're a producing company, of course, the production processes. In general, the majority of carbon comes from energy use, so that is usually the first lever you look at. Reducing the energy, maybe using renewable energy instead of the grid mix that you get out of the market, these are usually the strongest and first ways how to reduce the carbon footprint.

When we talk about scope three emissions and what I mentioned before, renewable carbon, the embedded carbon in products, that is usually nowadays quite not so well addressed. It's just not properly included because the emissions of embedded carbon do only occur at the end of life. It's often not properly considered when you say, look, I bought some raw material, let's say some biomass with carbon contained. In the end, that gets released, of course. Biomass is a specific case because the carbon is captured from the atmosphere and then released again, so it's a net zero balance.

Now let's go back to fossil feedstocks. You buy some crude oil, and the emissions that appear at the end of life are often not considered. When companies talk about reducing their carbon footprint, of course, energy, electricity is the first major lever to consider when you're a producing company, but also in particular when you talk about scope three, looking at the embedded carbon that then leads to emissions at the end of life is also very important.

Learn More

The RCI recently published a policy paper entitled "Renewable Carbon as a Guiding Principle for Sustainable Carbon Cycles." The paper includes 11 policy recommendations focusing on the topics of renewable carbon, carbon management, support for the transformation of the existing chemical infrastructure, and the transformation of biofuel plants into chemical suppliers. Long and short versions of the policy paper are available as free downloads at https://renewable-carbon-initiative.com/media/library.

For additional details regarding the RCI's objectives and how your company can get involved, visit www.renewable-carbon-initiative.com.

POWDER COATING SUMMIT

Presented by PCI Paint & Coatings Industry

September 8-9, 2022

The Westin Lombard, Lombard, IL

Co-Located with Coatings Trends & Technologies

REGISTRATION IS NOW OPEN

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With demand for low-VOC and more sustainable coatings on the rise, powder coatings are a growing and important segment of the coatings industry. That's why Paint and Coatings Industry magazine has partnered with ChemQuest Powder Coating Research to develop the Powder Coating Summit (PCS). This powerful, annual event offers educational technical lectures and fascinating on-site lab demos from leading raw material and equipment suppliers that will provide you with the most up-to-date powder technology that will help your company keep up with the trends. The PCS now co-locates with Coatings Trends & Technologies. Coatings suppliers and manufacturers who are involved in both liquid and powder coating technology can attend both events simultaneously.

Coatings manufacturers and suppliers who are involved in both liquid and powder coating technology can attend both PCS and CTT with the Combo Registration option.

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OPPORTUNITIES FOR BIO-BASED ADHESIVES

Bio-adhesives have rapidly gained traction as an alternative to traditional synthetic adhesives.

Image courtesy of MadamLead via www.gettyimages.com.

The global market for bio-adhesives reached nearly $2.2 billion in 2021. Looking forward, IMARC Group expects the market to reach $4.81 billion by 2027, expanding at a CAGR of 13.9% from 2022-2027. Bio-adhesives refer to natural polymeric materials with adhesive properties or glues that comprise biological intermediates such as gelatin, starch, or cellulose.

Bio-based adhesives have rapidly gained traction as an alternative to traditional synthetic adhesives due to their environmentally friendliness, sustainability, and cost effectiveness. As a result, bio-adhesives find extensive applications across numerous industries, including medical, packaging and paper, construction, wood, and personal care.

Expanding Applications

Bio-adhesives are finding increasing applications across various end-use sectors. For instance, in the healthcare industry, bio-adhesives are rapidly replacing conventional invasive wound closure methods (e.g., surgical sutures, staples, and wires) due to their antibacterial, antioxidant, anti-inflammatory, better wound healing, and leakage protection properties. In addition, they are also employed for skin-bonded monitoring devices, wound care dressings, and transdermal drug delivery methods.

The widespread adoption of bio-adhesives for specialty packaging, flexible packaging, printed sheets lamination, and cigarettes and filters is also augmenting product demand. Moreover, the implementation of stringent regulations regarding synthetic adhesives and several favorable initiatives undertaken by various governments to promote the use of eco-friendly products are propelling market growth.

Additional Growth Opportunities

Leading adhesives companies are investing heavily in research and development activities to launch innovative bio-adhesive variants to expand their product portfolios and attract more customers. Other factors, including the escalating demand for sustainable packaging, the rising popularity of plant-based adhesives, easy availability of raw materials, and increasing construction and renovation activities, are also creating a positive market outlook.

Additional details are available at www.imarcgroup.com.

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FOCUSING ON WORKFORCE DEVELOPMENT

Employee training is vital to improve core competencies and increase productivity and capabilities across all sectors.

By Jennifer Abril, President and CEO, SOCMA; and Bill Allmond, President, Adhesive & Sealant Council

How do you train new and current employees or onboard incoming personnel? Your answer today may not be the same as it was in early 2020. With the lasting impact of the pandemic on all areas of industry, as well as natural advancements in technology and equipment, training is vital to build and improve core competencies and increase productivity and capabilities across all sectors.

For both specialty chemicals and adhesives and sealants, quality training is paramount. Ensuring the safety of employees and their ability to successfully operate equipment is the number-one priority. In these unprecedented times, workforce development issues seem to compound each other, making onboarding new operators and training long-term employees a necessary and integral part of a chemical plant's success—in safety and in business.

Supporting Performance and Empowerment

Providing "Solutions for Specialties" is engrained in SOCMA's mission to promote the highest levels of safety and strengthen the business operations of its membership. The Adhesive and Sealant Council (ASC) maintains similar core objectives, promising to "support in the development of existing educational programs" for the industry. With values so closely aligned, our two organizations are excited to partner together to provide ChemOps Training, a program to engage higher performance and empower industry workers.

What if you don't have the number of workers you need to keep up with the high demand specialty chemicals and adhesives and sealants are experiencing? Throughout our respective sectors, labor shortages and recruitment and retention are significant hurdles for almost every company.

Companies are seeking solutions to train and onboard a workforce that is reduced in some cases, making efficiency in training more important than ever. A decrease in operators can also lead to trimming back on capacity and production, potentially leading to a vicious cycle and ultimately affecting company morale and the bottom line.

ChemOps Training includes 3D animations, self-assessments, and learner progress tracking to provide comprehensive operator training in systems, practices, and processes for the chemical industry at large. Units and modules cover material from basic science concepts and risk management practices to plant equipment and are accompanied with interactive exercises to ensure operators retain the information. The tool's newest features were implemented through an instructional design strategy, underpinning clear learning objectives within each unit to ensure that any worker, whether new to the industry or in need of a refresher, can meet expectations.

As capabilities and processes evolve and customer demand increases, optimized training for workers is essential to perform safely and effectively and deliver high-quality products. ChemOps Training enables companies to maintain strong safety cultures and provides efficient training options for the specialty chemicals and adhesive and sealant industries. The program is adaptable and customizable to your facility, providing a personalized experience for your operators.

For more information, contact the authors at jabril@socma.org and bill.allmond@ascouncil.org.

Co-locating!

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PRODUCED BY: PCI Paint & Coatings Industry

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Coatings manufacturers and suppliers who are involved in both liquid and powder coating technology can attend both CTT and PCS with the combo registration option.

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A QUANTUM LEAP FOR COATINGS FORMULATIONS

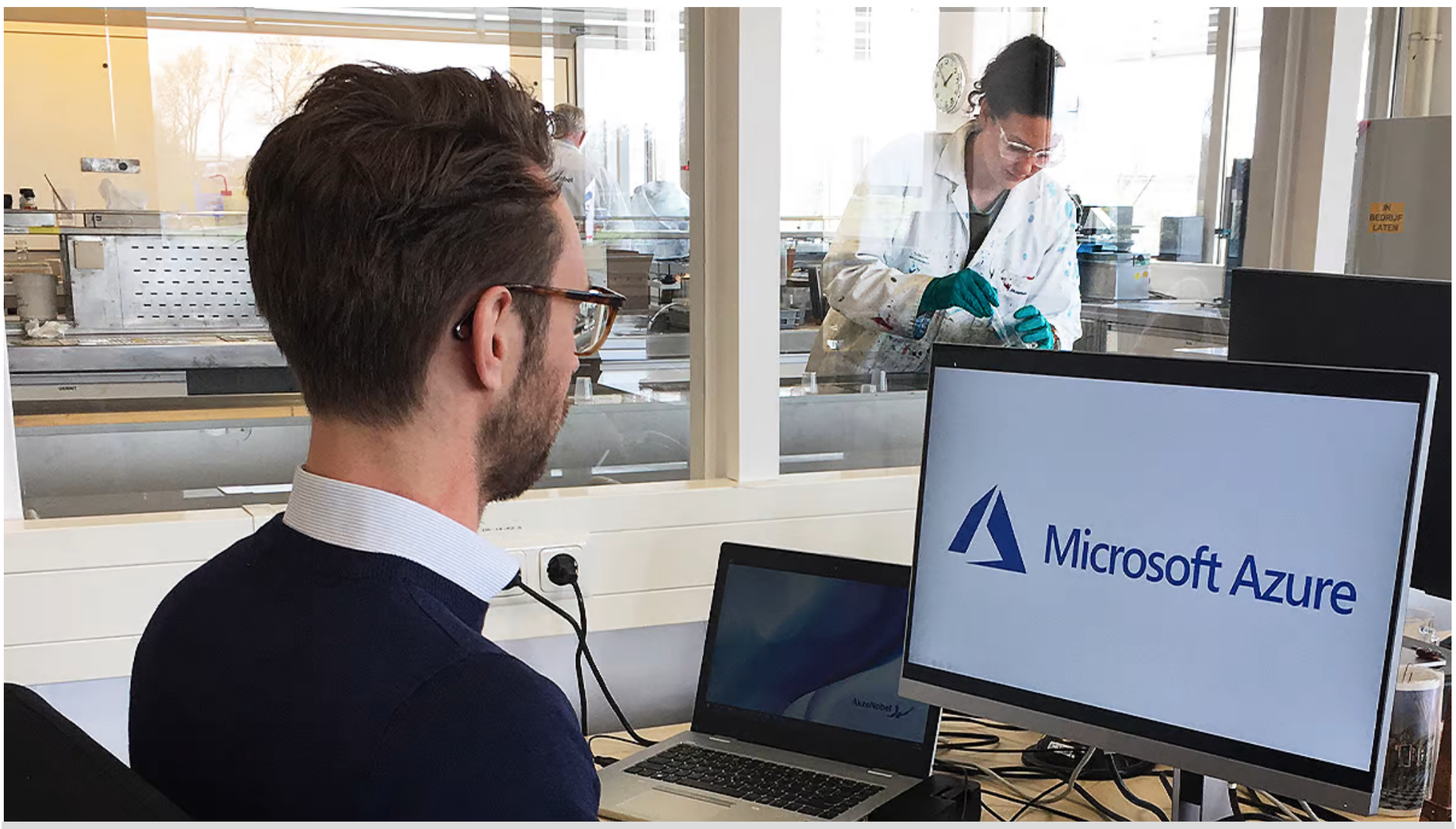
A new partnership is exploring the creation of more advanced and sustainable coatings products through quantum computing.

AkzoNobel and Microsoft have teamed up to explore how quantum computing could help fast-track the development of high-performance and more sustainable paints and coatings. Scientists from both organizations will co-develop what will effectively be a virtual laboratory. The aim is to conduct experiments using quantum computing and other Microsoft Azure cloud services.

Quantum chemical computation is capable of simulating chemical reactions at an unprecedented level of accuracy. Together, Microsoft and AkzoNobel will explore how this can contribute to creating more advanced and sustainable products through collaborative experimentation and development.

“This is a really exciting partnership which has the potential to be truly groundbreaking,” said Klaas Kruithof, AkzoNobel’s chief technology officer. “We’re incredibly proud to partner with Microsoft and investigate how we can take our digital research into a new dimension. Innovation demands collaboration and this is a fantastic way for us to keep pushing boundaries so we can make a sustainable and long-lasting difference to our customers and the planet.”

According to Matthias Troyer, Ph.D., distinguished scientist in Microsoft’s Azure Quantum program, “The promise of quantum computing and other Azure services to accelerate solving chemistry and materials problems—and their associated workloads—is immense. We’re thrilled to partner with AkzoNobel to drive new value and deliver world-changing impact.”



Quantum computing has the potential to reduce the time it takes to find substitute ingredients for making products more sustainable, with new functionalities, or for replacing scarce raw materials.

Myriad Opportunities

Quantum chemistry offers game-changing industrial applications and possibilities. It could help to overcome many of the practical boundaries associated with traditional laboratory methods, such as the availability of raw materials, physical equipment capacity constraints, toxicity, and environmental conditions. As a result, these efforts could drastically reduce the time it takes to find substitute ingredients for making products more sustainable, with new functionalities, or for replacing scarce raw materials.

“Combining our track record for pioneering product development with Microsoft’s cloud and quantum computing expertise represents another huge step forward in the digitization of our research,” said Pim Koeckhoven, technology director in Research and Development at AkzoNobel. “Up until now, the quality of traditional computer simulations hasn’t been up to the task. Microsoft’s Azure Quantum system offers incredible opportunities for us to take our research into an entirely new digital realm and speed up the development of new novel catalysts and chemical reactions.”

To learn more, visit www.akzonobel.com and https://azure.microsoft.com/en-us.

Note: Images courtesy of AkzoNobel.

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ADHESIVES & SEALANTS INDUSTRY (ASI) ADHESIVES & SEALANTS INDUSTRY (ISSN: Digital 2328-1049) is published 12 times annually, monthly, by BNP Media, Inc, 2401 W. Big Beaver Rd., Suite 700, Troy, MI 48084-3333. Telephone: (248) 362-3700, Fax: (248) 362-0317.

Change of address: Send old address label along with new address to ADHESIVES & SEALANTS INDUSTRY, P.O. Box 2146, Skokie, IL 60076. Email: asi@omeda.com. For subscription information or service, please contact Customer Service at: Phone: (800) 952-6643 and Fax: (847) 291-4816.

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