ASI ADHESIVES & SEALANTS INDUSTRY

A bnp media PUBLICATION

RAW MATERIALS AND CHEMICALS ROUNDTABLE

Adhesives for Sustainable Packaging

Harnessing Renewable Carbon

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ASI ADHESIVES & SEALANTS INDUSTRY

VOLUME 28, ISSUE 3

FEATURES

DEPARTMENTS

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FROM THE EDITOR

>> Susan Sutton, editor-in-chief

A NEW DIGITAL AGE

Many of the adaptations innovated in the past year due to the necessity of COVID-19 have actually made our lives easier and more efficient—and we aren't looking back.

The seriousness of the COVID-19 pandemic entered the consciousness of most people I know (in the U.S., anyway) in March 2020. I specifically remember circling the date on the calendar when it truly sunk in for me: March 13. What a difference a year makes.

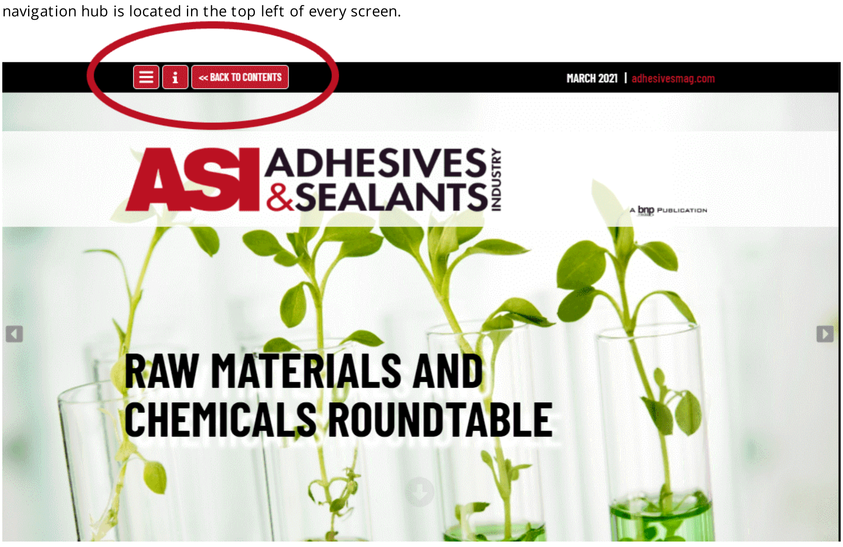
Today, we realize that the impacts of the coronavirus outbreak are extensive and labyrinthine, affecting most facets of our lives. I think back to eating out at restaurants, going to the movies, or even just enjoying a simple family barbecue, and it seems like a different lifetime. While we will surely return to activities such as these, many of the adaptations we innovated due to necessity have actually made our lives easier and more efficient—and we aren't looking back.

The global prevalence of our digital communications and activities is a prime example. With lockdowns and closures in full force, we turned online for everything: work, entertainment, shopping (both personal and business), and more. In doing so, we discovered (or created) a new digital age.

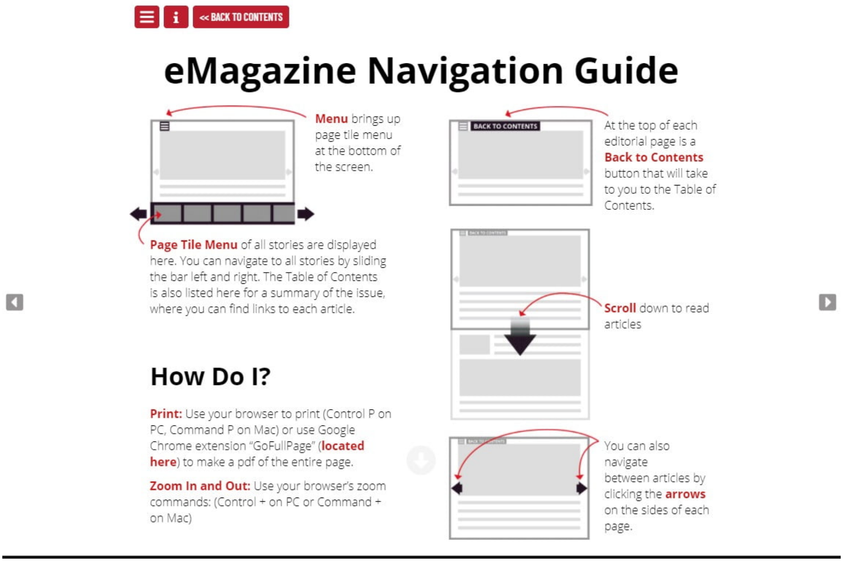
According to survey results from McKinsey & Co.,[1] "Far from a local phenomenon, the shift to digital and remote engagement has been embraced by decision makers in all countries surveyed worldwide. B2B sales leaders have moved from being 'forced' to adopt digital in reaction to the widespread shutdowns in the early stages of COVID-19 to a growing conviction that digital is the way to go."

Indeed, the majority of McKinsey's survey respondents are fully embracing the switch to digital. "More than three quarters of buyers and sellers say they now prefer digital self-serve and remote human engagement over face-to-face interactions—a sentiment that has steadily intensified even after lockdowns have ended."

ASI is leaning in to the digital switch as well, with the launch of the dynamic new eMagazine format you're experiencing now! Instead of a traditional page-turning type digital issue, articles are now designed in a vertical orientation to simplify your reading experience. To access the full text of each article and review the easy-to-read graphics, you'll simply scroll down each page. In addition, it's easier than ever to navigate within each issue; the navigation hub is located in the top left of every screen.



You have the ability to move to different articles using the arrows on the left and right sides of your screen, or with the dynamic menu bar. Once you select the menu bar via the hamburger menu located at the top left of each page, all of the articles will scroll along the bottom of the screen. The Table of Contents can be accessed from the dynamic menu bar as well, or by selecting Back to Contents at the top left of each page. For a review of the eMagazine's general navigation, select the "i" button.



We're really excited about this new platform's additional functionalities and enhancements. I'd love to hear what you think! Please contact me at (330) 564-3440 or suttons@bnpmedia.com to share your thoughts.

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.

1. A. Bages-Amat, L. Harrison, D. Spillecke, and J. Stanley, "These eight charts show how COVID-19 has changed B2B sales forever," McKinsey & Co., October 14, 2020, www.mckinsey.com/business-functions/marketing-and-sales/our-insights/these-eight-charts-show-how-covid-19-has-changed-b2b-sales-forever.

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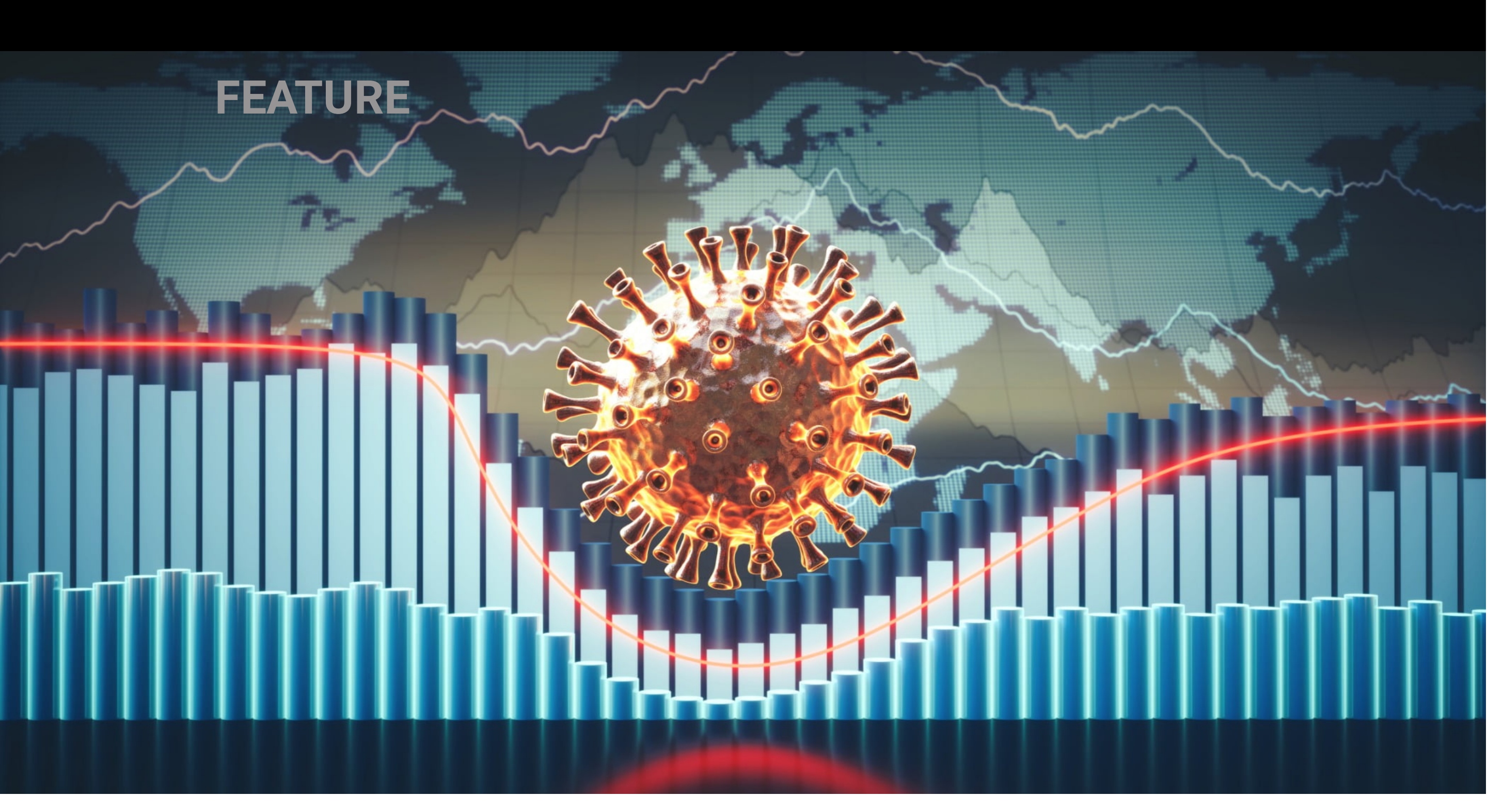
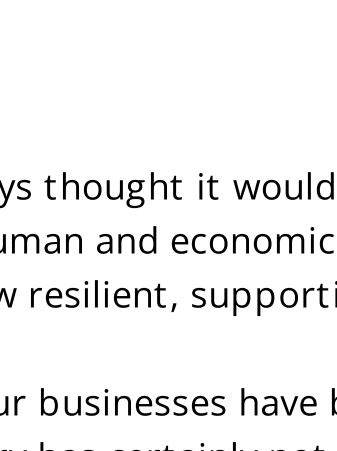


2021 RAW MATERIALS AND CHEMICALS ROUNDTABLE

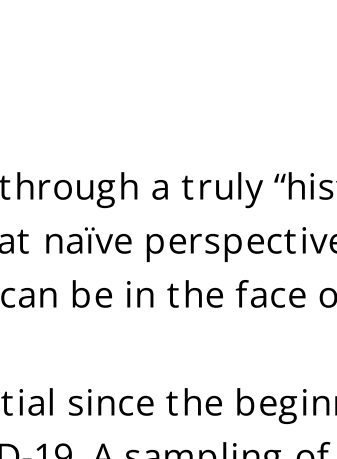
How are suppliers of raw materials and chemicals navigating the multiple diverse challenges that have impacted the industry over the past year?

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

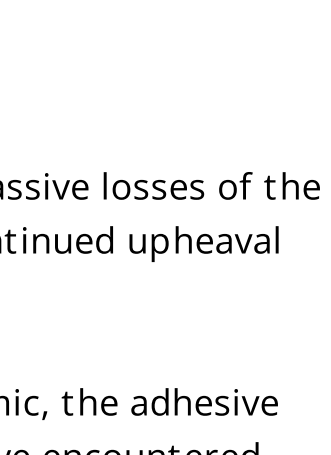
Mahendra Dorairaj, Vice President and General Manager-Adhesives, Eastman

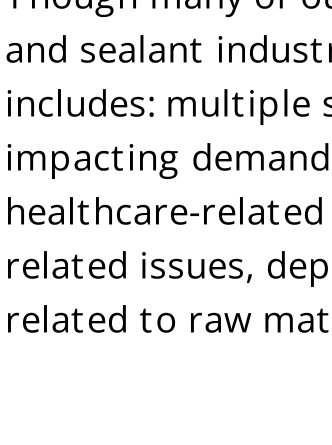


Ghislain de Quatrebarbes, Marketing Manager, Nynas

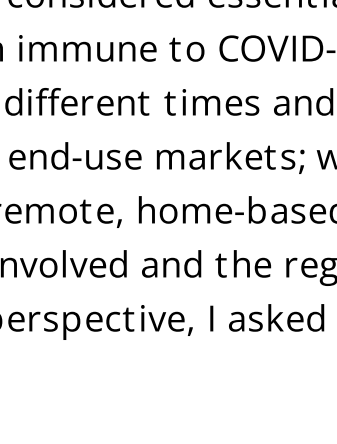


Mike Rezai, Senior Consultant, The ChemQuest Group





Howard Hubert, Chief Commercial Officer, President-CASE & Plastics, Maroon Group LLC



Cassie Popovski, Marketing Manager Infrastructure, Covestro LLC

Before 2020, I always thought it would be fascinating to live through a truly "historic" time. The massive losses of the past year—both human and economic—have cured me of that naïve perspective. However, the continued upheaval has also shown how resilient, supportive, and innovative we can be in the face of multiple crises.

Though many of our businesses have been considered essential since the beginning of the pandemic, the adhesive and sealant industry has certainly not been immune to COVID-19. A sampling of the challenges we've encountered includes: multiple shutdowns, occurring at different times and to varying degrees around the world while also impacting demand differently according to end-use markets; wide-reaching production changes to help meet urgent healthcare-related needs; the adoption of remote, home-based offices for much of the workforce; and supply chain-related issues, depending on the material involved and the region of origin. To help us put the various concerns related to raw materials and chemicals in perspective, I asked key players in the industry for their viewpoints.

WHAT IS YOUR KEY TAKEAWAY FROM 2020 AND THE IMPACT OF COVID-19 ON RAW MATERIALS AND CHEMICALS USED FOR ADHESIVES AND SEALANTS?

Mahendra Dorairaj, Vice President and General Manager-Adhesives, Eastman: We've found the chemical industry to be resilient and ingenious in its response to COVID-19. The crisis has highlighted its ability to be nimble and adapt operations, R&D, and supply chains to the dramatic change in economic conditions, industry dynamics, and consumption patterns. COVID has also accelerated IT and digital infrastructure build, so firms can stay competitive and agile in the remote work environment and ensure uninterrupted communication and collaboration with customers and value chain partners.

Data analytics, artificial intelligence, and customer relationship management through online tools are increasingly important and vital to the innovation process. It's also critical to have a strong digital and social media strategy to understand the voice of the customer and respond in real time in a dynamic marketplace.

We've beefed up our capability to interact digitally and let our customers interact more dynamically with our offers. The Eastman Adhesives Portal is an excellent example. Customers can access digital interactive tools to evaluate how to formulate their adhesives with Eastman materials to get the best possible performance. It's part of our commitment to a robust digital strategy.

Howard Hubert, Chief Commercial Officer, President-CASE & Plastics, Maroon Group LLC: Our collective experience as an industry has shown the critical importance of supply assurance and reliability to manufacturers of adhesives and sealants. Our customers who faced the challenge of meeting the market needs for critical applications (e.g., medical devices, PPE, food packaging, etc.) were able to do so through the commitment and focus of their manufacturing teams and their suppliers/partners who were able to deliver on-the-fly solutions and rapid responses to a dynamic and unstable market. The experiences of 2020 have redefined what it means to be an "essential industry" and what is needed to be successful in this important industry.

Cassie Popovski, Marketing Manager Infrastructure, Covestro LLC: The resilience of the adhesives and sealants industry has been evident in the disruption of COVID-19. Manufacturing, research, and collaboration continued. Despite the challenges presented, the industry maintained focus on development and innovation for the future.

Ghislain de Quatrebarbes, Marketing Manager, Nynas: Nynas is one of the leading suppliers of hot-melt plasticizers for hygiene products (diapers), labels, and packaging and self-adhesive tapes. We operate worldwide, although the majority of our sales are in Europe. What we have learned is the important role of adhesives in ensuring the supply of consumer goods in times of lockdown. Especially in the area of packaging, it was crucial to be able to continue to deliver to our customers.

Mike Rezai, Senior Consultant, The ChemQuest Group: Offshore suppliers tend to require long and complex supply chains in supporting U.S.-based OEMs, including the sourcing of adhesive and sealant materials. Consequently, a short-term effect was inevitable due to COVID-19 temporary lockdowns and unpredictable inventory turnover that was exacerbated by fluctuating demand. Shipping during the pandemic presented challenges and increased costs across the supply chain due to a persistent shortage of truck drivers. Simply put, the geographic location of the supplier is a key consideration, with China and India being the most challenging. An additional issue related to China is that the country is taking a predatory approach. Many are seeing 12-15% export tax rebates (the highest for some time) for exported products like pigments and resins as China attempts to regain lost share due to both tariff restrictions and COVID-19.

Separately, the evaluation and creation of new materials has stalled due to social distancing measures, producing a status quo of technologies and products. Understaffed labs that are tasked with developing new products are critically falling behind with respect to formulating, validating, and ultimately commercializing innovative product portfolios. Consequently, we foresee a 10-12-month lag compared to previous periods for the introduction of new materials and innovations.

> "Our collective experience as an industry has shown the critical importance of supply assurance and reliability to manufacturers of adhesives and sealants." — Howard Hubert, Maroon Group

HOW DID THE PANDEMIC IMPACT THE INDUSTRY'S SUPPLY CHAIN?

Dorairaj: COVID clearly disrupted supply chains, especially where there's a long chain. As a result, we expect to see stronger regional/local supply chains vs. interregional supply. We also anticipate security of supply becoming a key factor in raw material supplier selection going forward. The additional costs and uncertainty of taking material from point A to point B will become an increasingly important part of the business equation.

Generally, we've seen tighter inventory control and lead time adjustments across the industry. Demand reduction in durables was somewhat compensated for by increased demand in consumables. Businesses have adjusted manufacturing operations to support increased demand in a COVID-constrained environment while tightly managing cash flows.

Agile supply chains that can adapt quickly to rapid demand changes are the most successful in the current environment. Making sure everyone stays supplied and minimizing disruptions in the value chain have been the highest priorities. Firms have taken advantage of what they learned from COVID and have optimized their supply chains and operations to be more robust.

Hubert: Very much a "tale of two cities"—critical products saw exponential demand over a very short timeframe, and other products saw significant loss of demand based on the end market response to the pandemic. As we know from more than 40 years servicing the adhesives and sealants markets, security of supply is, and always will be, an essential attribute of the value chain. This dictates that the ability to meet changing market demands—at times dramatic—reaffirm the importance of assurance and reliability of supply. As raw material manufacturers meet the challenges within complex supply chains, COVID reduced workforces, and onsite personnel restrictions, there is more of an emphasis on distribution to accept a larger portion of the responsibility for keeping the supply chain intact and viable.

Popovski: Construction was largely deemed essential in the early stages of COVID-19 shutdowns. Even though work was allowed to continue, however, modified protocols and access to client sites caused disruptions to productivity. Schedules were even further extended because in northern regions, climate is a limiting factor of construction output. Work lost in the summertime cannot simply be pushed to year end. Disruptions such as these impact the demand for adhesives and sealants, and we anticipate that residual effects of COVID-19 will last into 2021. However, despite the challenges presented by the pandemic, we have seen recovery in the construction space in 2020 and are prepared for what the next year will bring.

de Quatrebarbes: In the second quarter of 2020, we had to face a demand for hot-melt plasticizer that was almost twice as high as the traditional demand. Thanks to the company's fast reaction, we were able to ensure continuity of supply. This required a formidable capacity to adapt, particularly for our production. I must say that I have found the same willingness among our adhesive manufacturers to meet this higher demand.

Rezai: In general, all components of the industry supply chain were deemed essential. Thus, any delays and disruptions were chiefly attributed to labor restraints and workforce limitations, as well as trade restrictions and declining overall consumption. However, the adhesive and sealants supply chain did promptly respond to the challenges with optimization measures designed to reverse the anomalies caused by COVID-19 to mitigate further delays and disruptions.

> "Firms have taken advantage of what they learned from COVID and have optimized their supply chains and operations to be more robust." — Mahendra Dorairaj, Eastman

HAVE YOU SEEN CHANGING DEMAND FROM ADHESIVES AND SEALANTS MANUFACTURERS THAT TARGET SPECIFIC END-USE SECTORS OR INDUSTRIES?

Hubert: There has been a definite shift in the demand of products for industrial use to those designated for the consumer markets. We've experienced sustained increase in demand for materials going into end-use packaging for prepared foods, general packaging, medical and PPE, as well as increases in items that feed into durable goods. As a result, we're doing a lot of work supporting the growing needs in these areas, working with our principal suppliers and applications labs on new formulations in collaboration with our customers while always seeing quite a bit of interest in innovation. As you would expect, we experienced an exponential increase in demand for ingredients and packaging solutions for sanitization, cleaners, and disinfection, which we were able to successfully meet.

Popovski: Extended time in the home environment, coupled with more free time, catalyzed a surge in around-the-house projects. The do-it-yourself (DIY) spike has had far-reaching effects in the adhesives and sealants industry, especially in the building and construction space.

de Quatrebarbes: The coronavirus crisis has already led to some of the sharpest declines in recent times in demand for certain types of adhesive, mostly in the automotive and industrial areas, but we see some signs of recovery. We have seen also accelerating growth for others, such as tapes used in packaging for e-commerce shipments, which are emerging as lifelines in this new world.

Rezai: Adhesive and sealant end markets are experiencing varying levels of demand. Packaging, hygiene, and consumer/DIY are performing better than other sectors. Specifically, the DIY sector is benefiting from stay-at-home orders—home improvement projects are escalating and thus DIY products have benefitted.

Packaging is also experiencing strong demand, with significant increases in everything from single-serve to microwavable foods, as well as food and beverage packages and containers, flexible packaging, pet food packaging, and any end-of-line case and carton packaging. This trend is expected to continue due to consumer behavior and the resulting rise in e-commerce and online orders (e-commerce increased by around 37% in the third quarter of 2020, compared to the same quarter in 2019).

> "The coronavirus crisis has already led to some of the sharpest declines in recent times in demand for certain types of adhesive, mostly in the automotive and industrial areas, but we see some signs of recovery." — Ghislain de Quatrebarbes, Nynas

HOW HAS COVID-19 IMPACTED SUSTAINABILITY EFFORTS IN THE INDUSTRY AND WITH YOUR COMPANY?

Dorairaj: R&D organizations have evolved and adapted to remote environments to ensure long-term innovation isn't completely overwhelmed by short-term operational challenges. Coming out of COVID, firms that continued to invest in innovation despite the crisis will outperform those that didn't. We've doubled down on our innovation programs with specific focus on consumer safety, high performance, and sustainability in adhesives. Ultimately, the design of raw materials is driven by sustainability of end products (e.g., diapers, cars, end-use packaging). This has driven changes in the design and composition of finished goods.

Adhesive materials must adapt and still perform without adversely affecting the sustainability of the finished good. The adhesive can't be the weak link. It must be durable enough to sustain in-use exposure while enabling recycling processes after life. Likewise, polyolefin adhesives that enable the use of recyclable olefin substrates can make the whole solution recyclable. We're energized by these challenges, which are driving some of the top innovations in our growth platforms. Examples include our continued investment in developing and launching low-odor, low-VOC, low-SOI, and improved color tackifiers, as well as high-performance thermoplastic polyolefin polymers for hot-melt adhesives.

At a corporate level, we've committed to innovating for a sustainable future, mitigating climate change and mainstreaming circularity as outlined through our sustainability report, "A Better Circle." To help mainstream circularity, we plan to recycle more than 500 million lbs of plastic waste annually by 2030 via molecular recycling technologies, with a commitment to recycle 250 million lbs annually by 2025. And we plan to catalyze improvement of the recycling system by continuing to expand capabilities to recycle more complex products and by participating in initiatives and collaborations to drive increased collection.

Hubert: Maroon issued our first Sustainability Report in 2020. While the timing was unusual (due to the pandemic), our commitment to sustainability initiatives was born years before COVID-19. We saw this commitment as an essential aspect of being a responsible steward of the industry, an employer of choice, and an organization of the future. The detrimental challenges of COVID-19 only reinforced our resolve to our sustainability efforts as these implemented initiatives helped our company succeed through the pandemic, ensuring our sustained success. Maroon has been Ecovadis certified for years, and our Sustainability Report was the continued commitment to this initiative. We see this level of engagement as being important to our customers and our principal suppliers because they tell us so.

Popovski: Sustainability has been a long-standing core value to Covestro. Our goal is to completely align production and product range, as well as all areas in the long term to the circular concept.

de Quatrebarbes: Covid-19 has had a strong psychological impact. I noted that demand for adhesives that are more respectful of the health of consumers but also of the environment is still as strong as ever.

Rezai: Sustainability is still a focus, but sustaining the enterprise and livelihoods moved to the forefront temporarily. As mentioned, new material investigation has stalled due to understaffed laboratories. Our technical arm, CQTI, had an increase in sustainability-related projects, some of them triggered by lab shutdowns.

> "Our goal is to completely align production and product range, as well as all areas in the long term to the circular concept." — Cassie Popovski, Covestro

WHAT IS YOUR COMPANY'S OUTLOOK FOR THE FUTURE?

Dorairaj: In the next year, we will continue our commitment to long-term innovations, learning from COVID and adjusting business models to be nimble in the post-COVID world. A&S could drive sustainability by enabling chemical and mechanical recycling. Brands have made bold sustainability commitments that are driving the whole value chain to follow. Design for circularity will mean more integrated value chain innovation. Raw material suppliers, adhesive formulators, film manufacturers, food packaging converters, and brands will increasingly work together to develop sustainable solutions. We anticipate and are excited about more joint value chain collaboration and innovation. To respond to trends and drivers in end-use markets, A&S must minimize SOIs, VOCs, chemicals of concerns, and hazardous materials. We foresee increased regulation for consumer safety driven by consumer awareness, nongovernmental organizations, and influencers, leading to material innovations.

In the long term, we expect innovation driven not only by regulation but also by code of conduct, sustainability, circularity, and renewable material commitments from brands that necessitate cleaner and sustainable adhesives.

Hubert: We're incredibly optimistic and enthusiastic about the future—both short- and mid-term. The challenges of COVID-19 allowed our company and employees to grow in the face of very real risk and uncertainty, reinforced our culture, and stretched our teams to deliver for our customers and principals. We've adapted well and learned a lot from COVID, as our experience has encouraged our company to implement process and operational changes we've evaluated over the years with very positive results in every aspect of our business model. We've embraced new ways to assess risk and develop mitigation strategies, as well as learning to conduct business in a virtual environment, acknowledging that you don't have to fly across the country (or the ocean) to collaborate with a partner. Building on our sustainability initiatives, our business is stronger than ever, more efficient and focused on our goals, independent of the extent of the effect (or duration) of the pandemic. We're prepared for the future and a clear focus on our business plan with the confidence we flourished through the worst health care crisis in more than 100 years.

Popovski: Despite the challenges presented this year, Covestro is excited for the future. In order to maintain collaborations internally and externally, Covestro had to adjust its methods of operations and communication. Digitalization was rapidly accelerated to enable meaningful interactions across the value chain. The lessons learned will have far-reaching effects as we incorporate these new habits into post-pandemic life. We're hopeful that our increased digitalization will lead to more frequent and meaningful partnerships with our customers as we solve the unmet needs of the industry.

de Quatrebarbes: In the short/medium term, Nynas continues to work with its adhesive customers firstly to adjust production capacity and thus continue to ensure a response to the increasing demand for the hygiene, tape, and packaging markets. Nynas is also mobilizing its technical and industrial capacity to continue to innovate. We are preparing a new, even purer plasticizer to meet the ever-increasing consumer demand for eco-friendly products.

Rezai: We expect adhesives to recover nicely due to an improving macro backdrop (assuming the COVID-19 vaccine rollout becomes widespread) and pick-up in industrial output to meet pent-up demand, as vaccinated workers resume more typical face-to-face activity levels in the workplace (albeit with added health and safety precautions). With respect to major end markets for adhesives, robust growth is expected in 2021, including: autos, with OEM builds expected to be up 14%; U.S. housing to see new builds up 5% and existing home sales up nearly 10%; electronics/semiconductors to enjoy volume growth of mid-teens in 2021; and lastly, even aerospace is likely to start improving off the bottom in late 2021.

That said, long-term economic growth may be curtailed below the historical average due to the impact of increased indebtedness globally on GDP growth and tougher Made in America rules mandated by executive order in January 2020. In short, current market dynamics are pulling demand forward to the near-term, very likely at the expense of future growth prospects, unless G20 leaders enact comprehensive debt restructuring and reinforce a global financial safety net to mitigate pandemic-induced debt, as outlined in the G-20 Leaders' Summit, Virtual Meeting minutes.[1]

For more information, visit these companies online at https://chemquest.com, www.covestro.com, www.eastman.com, www.maroongroupllc.com, and www.nynas.com.

1. "Group of Twenty G-20 Surveillance Note," International Monetary Fund, G-20 Leaders' Summit, Virtual Meeting, November 21-22, 2020, www.imf.org/external/np/g20/pdf/2020/111920.pdf.

Photo courtesy of matejmo / iStock / Getty Images Plus

2021 RAW MATERIALS, CHEMICALS, POLYMERS, AND ADDITIVES HANDBOOK

As a manufacturer or formulator of adhesives, sealants, or coatings, you may turn to hundreds of different ingredients to perfect your end products. Our annual *Raw Materials,Chemicals, Polymers, and Additives Handbook* purchasing guide is designed to help you find sources for these materials.

We invite you to reference the supplier* logos below, and click or tap them to learn more about each company's offerings. Plus, be sure to visit (and bookmark!) our easy-to-use online directory at www.adhesivesmag.com/materialshandbook.

*Supplier logos represent paid advertising. If you are a materials supplier and would like to receive information regarding your company's inclusion online and in future editions, contact AnnaMarie McCann at mccanna@bnpmedia.com or (610) 436-4220, ext. 8518.

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2021 RAW MATERIALS, CHEMICALS, POLYMERS, AND ADDITIVES HANDBOOK

Materials Descriptions

We have compiled descriptions and usage information for hundreds of raw materials, chemicals, polymers, and additives that are used in the production of adhesives, sealants, and coatings. To find sources for these materials, reference the advertisers throughout this issue and be sure to visit our easy-to-use online *Raw Materials, Chemicals, Polymers, and Additives Handbook* at www.adhesivesmag.com/materialshandbook.

Materials in this issue are divided into five major categories: Additives and Chemical Specialties; Oils and Fatty Acids; Resins and Base Polymers; Pigments and Dyes, Dry/Dispersions, and Extenders; and Solvents. Click or tap the name of the category you need, and navigate among the descriptions using the Back and More buttons at the bottom of each page. Additives and Chemical Specialties begins below.

Products are listed alphabetically under each major category, and descriptions provide details on specific materials. We invite you to reference the supplier* mini-ads throughout these sections, and click or tap them to learn more about each company's offerings.

*Supplier mini-ads represent paid advertising. If you are a materials supplier and would like to receive information regarding your company's inclusion in the online *Raw Materials, Chemicals, Polymers, and Additives Handbook* or with mini-ads in future editions of **ASI**, contact AnnaMarie McCann at mccanna@bnpmedia.com or (610) 436-4220, ext. 8518.

ADDITIVES AND CHEMICAL SPECIALTIES

Accelerating and Vulcanizing Agents

Vulcanizing agents are used to crosslink rubber compounds. The most commonly used material is elemental sulfur, although peroxides are used with some elastomer types. Accelerators are used to speed up the vulcanization process and improve the properties of the vulcanized material—many different types are available depending on the specific elastomer and vulcanizing agents, including amine-aldehydes, thiazoles, guanidines, sulfenamides, dithiocarbamates, and xanthates.

Accelerating and Vulcanizing Agents, Abrasives

Materials used as accelerating and vulcanizing agents.

Accelerating and Vulcanizing Agents, Dithiocarbamates

A chemical used as an accelerating and vulcanizing agent.

Accelerating and Vulcanizing Agents, Sulfur

A readily available raw material. Chemically and physically compatible with traditional interior and exterior glues.

Accelerating and Vulcanizing Agents, Thiazoles

Thiazoles are additives used as accelerating and vulcanizing agents.

Accelerating and Vulcanizing Agents, Thiuram Sulfides

Chemical used to accelerate and vulcanize.

Accelerating and Vulcanizing Agents, Zinc Oxides

Additives used to improve holding power.

Additives

An additive is a material used to change, or prevent or minimize changes in properties in a formulation.

Adhesion Promoters

Adhesion promoters are usually acid-modified or hydroxyl monomers. Their dual functionality helps formulators increase adhesion and lower viscosity. Depending on the application, polyester oligomers and specialty resins may also function as adhesion promoters.

Adhesion promoters crosslink on the surface, which may be glass, plastic, or another substrate. The surface material plays a critical role in product selection because different materials require specific adhesion promoters in order to achieve optimal results. The adhesion promoter's reactive sites must be adaptable to reacting with the surface material. Dual-functionality monomers are often used as adhesion promoters for this reason because they help activate many surface materials and make them more responsive. Additionally, acid esters are often used because they provide a proton or neutron that can be linked on the surface.

Although adhesion promoters are used across a wide range of adhesives applications, they are most often found in laminating adhesives.

Adhesion Promoters, Adhesive Bonding Primers

An agent used to increase fixture times.

Adhesion Promoters, Alpha Methylstyrene Polymers

Alpha methylstyrene (AMS) is a chemical intermediate that is used in the synthesis of specialty polymers and copolymers.

Adhesion Promoters, Hydrogenated Resins

Materials that promote tack and enhance adhesion.

Adhesion Promoters, Pentaerythritol Esters

Rosin esters used to aid adhesion in a formulation.

Adhesion Promoters, Phenolic Resins

Phenolic resins are a type of synthetic thermosetting resin invented by Leo Baekeland, Ph.D., in 1907. The material was originally called Bakelite. The resins are used in the production of molded products such as billiard balls and laboratory countertops, and as adhesives and coatings.

Adhesion Promoters, Resorcinol

A crystalline compound originally obtained from galbanum resin.

Adhesion Promoters, Silane

When added to adhesives, silanes can provide improvement in adhesion by reducing moisture attack at the interface. This results in improved moisture, temperature, and chemicals resistance.

Adhesion Promoters, Silicone

Silicone anti-foams are typically formulations of dimethylpolysiloxane fluids and silica. They are chemically inert and insoluble in most foaming systems. This enables them to retain their activity over a long period of time.

Anti-Foaming Agents

Anti-foams are used in water-based systems to minimize the generation of foam, particularly during high-shear mixing operations. Anti-foams are usually immiscible with water, and very small amounts are usually very effective. Defoamers are additives that, when added to a liquid, break foam.

Anti-Foaming Agents, Non-Silicone

These are materials for applications where silicone is deemed undesirable. They are typically based on polyalkylene/polyethylene glycols and refined hydrocarbon oils.

Anti-Foaming Agents, Silicone

Most anti-foams are based on simple hydrocarbons or silicone fluids. The latter often function most effectively in parts-per-million concentrations. (See also Anti-Foaming Agents.)

Antioxidants

Antioxidants are compounds that inhibit chemical reactions with oxygen. Oxidation reactions may involve highly reactive molecules called free radicals. Free radicals are molecules that have lost an electron and try to replace it by reacting with other molecules. This causes the substance to break down. Metals often catalyze reactions with oxygen. Antioxidants inhibit these changes by reacting with the free radicals before they can react with oxygen (free radical scavenging) or by reacting with the metals.

Antioxidants, Phenolic

Many antioxidants are phenolic compounds. Phenolic antioxidants are excellent hydrogen donors and are widely used to stabilize polymers. (See also Antioxidants.)

Antioxidants, Phosphite

Phosphite antioxidants are high-performance solid antioxidants. They offer processing stability, color stability, and protection properties for thermoplastic polymers (polypropylene, high-density polyethylene, low-density polyethylene, polycarbonate, etc.). They produce excellent effects when used with phenolic antioxidants and contribute significantly in achieving color stability during compounding. (See also Antioxidants.)

Anti-Settling Agents

Anti-settling agents are additives used to prevent or retard pigment settling and to maintain uniform consistency during storage and application.

Anti-Skinning Agents

Anti-skinning agents are added to materials to prevent or retard the processes of oxidation or polymerization, which result in the formation of an insoluble skin on the surface of the material.

Anti-Static Chemicals

Surface treatment compound used to reduce or eliminate buildup of static electricity.

Anti-Tack Agents

Materials designed to eliminate adhesion.

Catalysts

Catalysts, preferably called "initiators" in the adhesives and sealants industry, are used to cure or crosslink monomers and polymers. Typical types include organic peroxides and hydroperoxides, sulfur compounds used in rubber vulcanization, and UV initiators used in adhesives and coatings.

Colloidal Stabilizers

The adsorption of homopolymers and block copolymers at solid-liquid interfaces is crucial for controlling the colloidal stability and, hence, the rheology of concentrated suspensions used in many applications, including adhesives, ceramics for electronic and structural purposes, paint, pharmaceutical products, and paper coatings. Block copolymers that form self-assembled brush layers have proven to be particularly effective colloidal stabilizers.

Colloidal Stabilizers, Cellulose Ethers

Polymers produced by the chemical modification of cellulose.

Colloidal Stabilizers, Soaps

Colloidal in nature, soaps act through adsorption or emulsification.

Corrosion Inhibitors

A corrosion inhibitor is a material that provides physical protection against corrosive attack or reduces the open-circuit potential difference between local anodes and cathodes. Examples of corrosion inhibitors include hexamine, phenylenediamine, dimethylethanolamine, sodium nitrite, and others.

Crosslinking and Curing Agents

Crosslinking improves three basic properties of the adhesive: it provides a higher temperature resistance, it provides improved shear resistance, and it increases solvent resistance. All of these stem from the same cause—reduction of mobility of the polymer. An added benefit to crosslinking, which is not readily apparent, is that the product is less prone to oxidation, which increases working life. The degree of crosslinking can be manipulated by the quantity of crosslinking agent used. A crosslinked polymer is often referred to as "having been cured."[2]

Crosslinking and Curing Agents, Epoxy Curing Agents

Epoxies can be formulated as one-component or two-component systems. One-component systems are heat-cured and usually use dicyandiamide (DiCy) as a curing agent. Two-component epoxies are more common, and a range of curing agents is available. The cure kinetics and the glass-transition temperature (Tg) of the cured resin are dependent on the molecular structure of the curing agent. Curing agents include aliphatic amines, amidoamines, aromatic amines, cycloaliphatic amines, imidazoles, polyamides, anhydrides, polysulfides, and boron trifluoride adducts. (See also Crosslinking and Curing Agents.)

Crosslinking and Curing Agents, Hexamine

Hexamine (hexamethylenetetramine) is a heterocyclic organic compound with the molecular formula $(CH_2)6N_4$. It is prepared by the reaction of formaldehyde and ammonia, which yields crystalline hexamine. Hexamine is used as a crosslinking agent for hardening phenol formaldehyde resins and for vulcanizing rubber.

Crosslinking and Curing Agents, Melamine Formaldehyde Resins

Hard, thermosetting plastic material made by polymerization of melamine and formaldehyde.

Crosslinking and Curing Agents ,Silane

Silane crosslinking technology can allow for higher extrusion speed. Compared to traditional crosslinking processes that involve organic peroxide, no crosslinking occurs inside the extruder, even at high temperatures.

Crosslinking and Curing Agents, Silicone

Crosslinkers or curing agents used in silicone formulations typically contain R-Si-X3 or Si-X4, where R can be amethyl, vinyl, or phenyl group, and X can be acetoxy, alkoxy, enoxy, or oxime groups. (Source: www.honeywell.com)

led to a liquid, breaks foam. This is in contrast to antifoam, which prevents foam

Defoamers, Castor Oil

Insoluble material used to knockdown foam.

Defoamers, Pine Oil

Pine oil is an essential oil generated by the steam distillation of needles, twigs, and cones from a variety of species of pine trees.

Defoamers, Silicone Oils

Silicone-based defoamers are polymers with silicon backbones; they can be delivered as an oil or a water-based emulsion.

Defoamers, Stearic Acid

A saturated fatty acid with an 18 carbon chain, stearic acid is a waxy solid.

Dispensing Agents

Dispensing agents are chemicals that aid in the dispersion and stabilization of pigments and other finely divided solid particles.

Dispersing Agents

Dispersing agents are chemical compounds that, when added to a colloidal suspension, tend to make the particles more disperse. (See also Introduction to Fillers, as well as Surfactants and Dispersing Agents.)

Driers

A drier is a compound that catalyzes or accelerates the drying (curing) of a coating or adhesive, or the crosslinking of polymers or drying oils. Driers are not the same as curing agents, which chemically react with functional groups in the polymer. Driers are catalytic in nature and do not chemically react with the polymeric material.

Driers, Cobalt

Common oxidative drier with a deep blue/purple color.

Driers, Water Dispersible

Water-dispersible driers are designed for use in water-based systems.

Elastomers

Any of various polymers having the elastic properties of natural rubber.

2021 RAW MATERIALS, CHEMICALS, POLYMERS, AND ADDITIVES HANDBOOK

MATERIALS DESCRIPTIONS APPENDIX

Acknowledgement

ASI greatlyappreciates the help of those who contributed to the preparation of the materials descriptions and are cited in the following appendix.

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ADHESIVES IN SUSTAINABLE CONSUMER GOODS

Adhesive manufacturers must support consumer brands as they pursue their sustainability goals.

By Susan McNichols, Sourcing Analyst, H.B. Fuller

The International Panel on Climate Change (IPCC) released a report in 2018 summarizing the effects of a 1.5°C warming of the planet. The report stated that the Earth is on track to warm 1.5°C by 2040 if we don't take action.[1] The study indicates the planet will experience increased natural disasters and significant and potentially irreversible damage to our societies, economies, and the natural world if the Earth warms to this extent. IPCC states that in order to prevent this warming of the planet, the world must reduce greenhouse gas (GHG) emissions by 50% by 2030 and achieve net-zero emissions by 2050.

Many consumer-packaged goods (CPG) brands are taking seriously their role in combatting climate change by setting aggressive 2025 and 2030 sustainability goals. Company sustainability goals are twofold: reducing manufacturing and shipping GHG emission output, and ensuring goods are packaged and disposed of in a way that causes the least harm possible to the environment.

The Science Based Targets Initiative verifies that companies' GHG reduction targets are aligned with the IPCC recommendations. To date, more than 1,000 companies are participating in the Science Based Targets Initiative, including many CPG brands and their suppliers (e.g., adhesive manufacturers).[2]

GUIDING LEGISLATION

Europe has been a world sustainability leader. The EU Green Deal, formed in December 2019, sets ambitious targets for the entire continent, ultimately resulting in climate neutrality by 2050. The Green Deal takes a holistic approach to addressing sustainability with the following priorities: clean energy supply, protecting and restoring the natural environment, sustainable use of resources, sustainable transport, transitioning to a circular economy, zero pollution, and sustainable food systems.[3]

The rest of the world is following suit and putting regulations into place. For example, China is committed to carbon neutrality by 2060.[4] Many countries, including France, the Netherlands, and Norway, have announced support to move to electric cars.[5] In the U.S., California will ban gasoline-powered cars by 2035. Large vehicle manufacturers, such as Ford Motors and Honda, have publicly supported California's ban, which is in direct opposition to the automotive industry's stance two decades ago when many in the industry actively lobbied against electric cars.[6] When you combine legislation with corporate commitment, environmental change happens.

CPG BRANDS AND SUSTAINABLE PACKAGING

As science and global legislation guides us toward a sustainable future, many CPG brands are embracing aggressive sustainability goals. For example, P&G is a leading consumer brand that is seeking to be carbon neutral by 2030. Today, 88% of the company's packaging is composed of recycled materials. P&G created the Pampers Pure brand; unlike many diapers, this line is free of harmful chemicals, fragrances, lotions, and preservatives called parabens and allergens.[7] P&G understands that consumers are increasingly concerned about the ingredients going into their products and are willing to pay more for those that are natural and safe.

Apple, one of the world's most recognized brands, is carbon neutral today. Apple's goal is to have all its products made from recycled materials and have zero carbon footprint by 2030.[8] Some say this is impossible, but Apple embraces the challenge and recognizes that its ambitious goals will shape other companies' efforts to follow in its footsteps.

In the apparel industry, Patagonia has been a sustainability leader for many years. The company promotes the circular economy through its Worn Wear Platform, which provides used clothing a new life and a new home. Interestingly, Patagonia also has a repair program where employees travel across the U.S. to consumers' homes to repair their broken items and extend the products' lifespan. Patagonia is also focused on the circularity of its products. On average, Patagonia goods are made of 68% recycled material. In addition to offering 100% organically grown cotton, the company strives to do even better by using regenerative organic cotton.[9] This type of cotton is grown in soil that scientists have evaluated and determined is healthy, which helps reduce carbon levels in the atmosphere. The certification also takes into account animal welfare and farmworker fairness.

All in all, CPG brands' focus on sustainability will help our society meet IPCC goals to reduce GHG emissions by 50% by 2030—whether that focus is on using more bio-based or recyclable materials or extending the lifespan of products.

ADHESIVES AND SUSTAINABILITY

As legislation and consumers demand more sustainable products, CPG brands are beginning to scrutinize (in some cases for the first time) how all their product components, including adhesives, support their sustainability goals. Many CPG brands simply don't know how their sustainability goals impact their adhesive needs. At this point in time, adhesive manufacturers must support CPG brands in three ways as they pursue their sustainability goals: carbon footprint reduction, circular product design, and supporting the well-being of people.

Carbon Footprint

In the past, CPG brands have focused carbon footprint reduction on internal efficiencies and energy usage (also known as Scope 1 and 2 emissions). Today, CPG brands are moving beyond Scope 1 and 2 and highlighting on Scope 3. Scope 3 is defined as reducing GHG emissions throughout a product's entire value chain—from raw material extraction to post-consumer disposal.

As evidence of this, many customers are beginning to request carbon emissions data on their invoices. Adhesive manufacturers should thus actively measure and report CO_2 emissions, and ultimately increase their utilization of lifecycle analysis creation through the ISO 14044 Environmental Management Life Cycle Assessment certification. Adhesive industry suppliers will need to educate their employees on carbon footprint and lifecycle analysis, as well as commit to providing customers with transparent data.

Circular Economy

The term *circular economy* means that instead of manufacturing products in a linear fashion, brands need to design their products with a waste-out approach. Adhesive manufacturers need to have in-depth knowledge of the circularity of materials, and they need to develop innovative formulas and application processes to support this circularity.

Consumers are guiding the specific circular approach that CPG brands are pursuing—whether that's creating recyclable goods, reusable goods, or compostable end products. The circular economy may require adhesive manufacturers to use new raw materials that are repulpable or bio-based instead of those that are derived from petroleum. In the electronics industry, adhesive R&D teams may need to develop stronger adhesives to greatly expand the lifespan of finished goods.

Adhesive manufacturers may also need to understand and invest in third-party testing, such as ASTM D6868-19 or D6400 industrial compostability test methods, and Fibre Box Association Voluntary Standard for Repulpability and Recyclability Test Method. Adhesive industry suppliers must explore new materials that may be repulpable, compostable, and/or bio-based.

Well-Being of People

The last area of sustainability involves ensuring that products are safe for consumers. For example, CPG brands must consider the volatile organic compound (VOC) content in their products, as breathing in VOCs is ultimately harmful to the end consumer.

Consumer perception is also very important. For example, one baby-care trend is that mothers want their babies to wear diapers that are free of chemicals and are made from natural substrates such as cotton. In another example of sustainable packaging trends, CPG brands are looking to eliminate polyethylene coatings on packaging—and, indeed, plastic packaging all together. Adhesive manufacturers may be tasked to bond to new materials such as cotton instead of nonwovens, paper instead of plastic, recycled plastic instead of virgin, or uncoated paper instead of coated paper.

MEETING THE CHALLENGE

How does the adhesive industry create products that meet end customers' current sustainability targets—reduce carbon footprint, support circular design, and promise the well-being of people? How do we find ways to measure success without many adhesive industry standards to guide adhesive development and benchmark against? Can the industry come together with CPG brands to create and further define industry standards?

Adhesive manufacturers must be committed to the conversation and to helping achieve a 50% reduction in GHG by 2030 per IPCC guidelines. The industry needs to focus on developing adhesives that help customers create sustainable consumer goods by, for example: extending the durability of electronic goods, helping reduce material usage in disposable diapers, creating paper straws, enabling beer bottles to be efficiently recycled and commercially reused, and reducing packaging material consumption to improve carbon footprint.

For more information, contact the author at (651) 236-5070 or susan.mcnichols@hbfuller.com, or visit www.hbfuller.com.

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EXPLORING RENEWABLE CARBON-BASED RAW MATERIALS

Producers of adhesives and sealants can reduce their carbon footprints by turning to materials based on renewable carbon sources, but obstacles remain.

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

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As consumers around the world increasingly focus on ways they can help alleviate climate change, manufacturers (and their suppliers) are exploring myriad options for making their processes and products more sustainable—and thus more attractive to these eco-conscious end users. Suppliers of adhesives and sealants are certainly no exception. Common approaches in our industry include replacing petroleum-based raw materials with bio-based alternatives, improving a product's recyclability or compostability, and developing solutions to help industries attain climate-related legislative requirements (e.g., lightweight structural adhesives for the automotive sector), among many others.

Michael Costello

"The term renewable carbon was designed to take into account the good carbon that we should be using in order to replace fossil fuel carbon, which is what we want to eliminate, of course."

The term *carbon footprint* is generally used to identify the amount of greenhouse gas (GHG) emissions, including carbon dioxide (CO_2) and other materials, that an entity produces. We all have a carbon footprint, as individuals, companies, and even the industry as a whole. It is important to keep in mind that carbon is not the enemy, in and of itself. As one of Earth's most common elements, carbon is fairly ubiquitous in the chemical industry, certainly in organic chemistry. The key is to explore more sustainable options for our carbon use.

RENEWABLE CARBON

Finding ways to reduce GHG emissions levels equates to a smaller carbon footprint, which ultimately results in less negative impact on the climate. The concept of *renewable carbon* (simply put, carbon derived from renewable sources) is particularly exciting because it offers multiple avenues for GHG emissions reductions.

Renewable carbon can come from three main sources, explains Michael Costello, group director of Environment, Social and Governance for Stahl: biomass and bio-based raw materials, carbon capture (CO_2 that is captured during a process and converted to a usable raw material), and recycled materials such as plastics. Though the chemical sector has identified these sources as viable options to replace traditional petroleum-based materials, much development work remains to be done.

"In many cases, we do have some alternatives. Those are the materials that we are working hard on and using," Costello says. "But there's still so much to do because some of the raw materials that we and all chemical companies use just don't have those alternatives ready or they are not developed. And even if they are developed, they're not yet scaled up to a size that can be properly sourced."

TAKING THE INITIATIVE

The chemical sector is taking action to identify and develop sustainable, renewable carbon-based solutions. In September 2020, the Germany-based nova-Institute brought together 11 chemical companies to create the Renewable Carbon Initiative (RCI). The founding companies include: Beiersdorf (Germany), Cosun Beet Co. (The Netherlands), Covestro (Germany), Henkel (Germany), LanzaTech (U.S.), Lenzing (Austria), NESTE (Finland), SHV Energy (The Netherlands), Stahl (The Netherlands), Unilever (UK), and UPM (Finland).

The initiative's stated goal "is to support and speed up the transition from fossil carbon to renewable carbon for all organic chemicals and materials." According to the RCI, it will take a three-pronged approach by:

- Building cross-industry platforms that illustrate practical use in specific applications
- Promoting changes in legislation, taxation, and regulation
- Increasing awareness and understanding

"It's an awareness initiative, to explain what renewable carbon is, to explain to the world that, yes, we can get our chemical raw materials from sources which do not deplete fossil fuels," Costello explains. "But we need to accelerate that research so that the change can happen faster, because we're running out of time."

As awareness grows along the supply chain and more companies join initiatives like the RCI, development projects and new opportunities will expand apace. In turn, the resulting renewable raw materials options will enable adhesives and sealants producers to reduce their carbon footprint and offer customers more eco-friendly options that will help appeal to consumers while reducing or even eliminating negative environmental impacts.

"This is about a fundamental change in the chemical industry," said Michael Carus, CEO of nova-Institute and head of the RCI, when the initiative was launched. "Just as the energy industry is being converted to renewable energies, so renewable carbon will become the new foundation of the future chemical and material industry. The initiative starts today and will be visibly present from now on. We want to accelerate the change."

To learn more, visit www.renewable-carbon-initiative.com and www.stahl.com.

Photo courtesy of A stockphoto / iStock / Getty Images Plus

PRETREATMENT SOLUTIONS FOR IMPROVING ADHESION IN ELECTRONICS APPLICATIONS

Blown ion plasma and flame plasma are effective and repeatable treatment methods that take the guesswork out of electronics manufacturing bonding processes.

By Wilson Lee, Director of Business Development, Enercon Industries

We rely on electronics for almost every aspect of our daily lives. With the advent of compact components and circuitry, it is difficult to think of many products that do not incorporate electronics in some fashion. What you might not think about is how fragile these electronics can be and how they can become easily damaged or degraded by environmental conditions.

It is imperative that manufacturers protect these electronics. Moisture, corrosion, contamination, static, and mechanical shock can damage or destroy electronic circuits. To prevent damage, electronics such as printed circuit boards (PCBs) are typically protected with coatings. Additional protection methods include potting for critical electrical components and placing electronic components in housings that provide waterproof seals.

A coating provides a protective layer to the outside of a PCB; popular coatings include epoxy, silicone, and polyurethane. Potting applications generally involve an electrical component in a plastic or metal housing. The housing is filled with an epoxy resin that hardens and encapsulates the electronics. Other housings are sealed with adhesives that provide a waterproof seal between similar or different materials.

Almost every industry uses one or both methods in some form to protect their electronic components. Aerospace and automotive manufacturers have been the early adapters of these technologies, but thousands of applications are found in marine, electrical equipment, instrumentation, data communications, and consumer products. Wherever electronics are used, particularly in uncontrolled environments, coating and potting are important to the durability of the product.

WHY IS SURFACE ENERGY IMPORTANT?

Many manufacturers face a problem: the individual components in both electronics and printed circuit boards are made from inherently inert, low-surface-energy materials. Why does low surface energy present a problem? Low surface energy makes adhesive bonding to the product more difficult because many adhesive chemistries will not wet out on a low-energy surface, and the bonding sites available to the adhesives are insufficient. Generally speaking, the higher the surface energy of a product, the easier it is to bond, coat, paint, or print on that material.

A classic example of surface energy in everyday life is a car with a freshly waxed surface. When you wax your car, you are in effect lowering the surface energy on the body of the vehicle. Technically, you are applying a coating with a lower energy, but the example is still sound. The wax allows the cohesive forces in water molecules to pull together; the water beads up and easily rolls off the car. As the wax wears off, the car's surface—with its higher surface energy—is exposed. Water droplets then spread out and stick to the surface. Therefore, coating and potting applications need to increase surface energy to optimal levels, not decrease it.

When performing any bonding or coating application, each surface has an optimal surface energy threshold that is required to achieve the best possible bond. Surface energy is measured in a number of ways, including the common methods of dyne level and contact angle. Meeting the target threshold for surface energy does not guarantee adhesion. However, in general, higher dyne levels are better for enabling adhesion. Table 1 illustrates the starting surface energy of various materials, as well as the associated increasing dyne levels following surface treatment.

HOW IS SURFACE ENERGY INCREASED?

Traditionally, manufacturers have used wet chemistries like solvents and primers to clean and activate surfaces. While this activation does increase surface energy and the ability for coatings or potting materials to stick, it also involves several manufacturing concerns. If the solvent or primer is manually applied, tremendous process inconsistency can result; this often leads to high variability in product quality and increased failures in the field. Manual processes are also slower and may cause production bottlenecks.

Another consideration when using wet chemistries includes environmental and safety concerns related to the handling and disposing of solvents. In addition, many manufacturers prefer a cleaner process without the expense of inventorying consumable chemistries.

Today, many manufacturers are moving away from wet chemistries and opting for in-line atmospheric blown ion plasma or flame plasma to increase surface energy and prepare surfaces for bonding. These technologies clean, micro-etch, and functionalize surfaces in a consistent and repeatable process, leading to higher product quality and decreased failures.

WHAT IS BLOWN ION PLASMA?

Plasma is simply ionized gas. It is the fourth state of matter, along with solids, liquids, and gases. Blown ion plasma is created by passing a process gas past a high-voltage arc, which turns the gas into its ionized form. Most applications use compressed air, and the plasma produces oxygen, hydrogen, and nitrogen ions, as well as other hydroxyl groups. Under pressure (70-90 lbs/in^2), the air passes through a vortex and past the high-voltage arc, bombarding the surface with high-velocity ions. This process cleans, etches, and functionalizes the various surfaces that make up an electrical component or PCB.

Plasma's ability to clean surfaces occurs in multiple ways. First, it removes anything that is initially held to the surface by static charge. Plasma further cleans the surface by removing organic and some inorganic materials off the surface. These materials are leftovers from the manufacturing process and interfere with bonding a coating, adhesive, or potting formulation to the electronics or the compartment containing the electronics.

Plasma also micro-etches the surface, which increases the usable bonding surface area. This is similar to sand blasting or grit blasting, but it is measured on the nanometer scale and does not damage the surface as it etches. Increasing the usable bonding surface area can greatly increase bond strength.

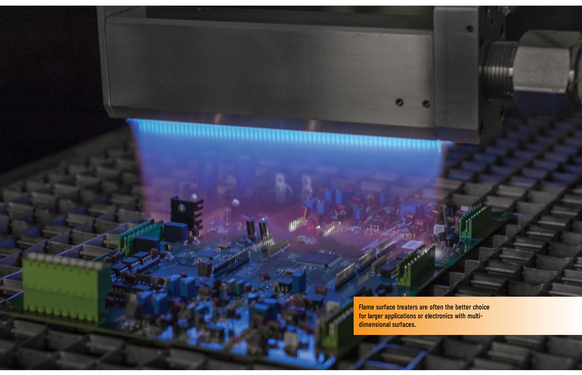
Functionalizing (sometimes called activation) of the surface is the third benefit of plasma or flame treating. Here, the ions in the plasma field actually change the outermost molecular layers of the surface, adding the hydroxyl groups mentioned previously.

After passing through the plasma field, the treated surface is transformed with increased surface energy. This enables consistent and superior bonding with coatings, adhesives, and potting formulations. The plasma does this with no damaging effects to the treated electronics. The typical single plasma nozzle treats a path from ½-2 in. wide, depending on the system, and at speeds of 100 ft/min or greater.

WHAT IS FLAME PLASMA?

Flame surface treaters perform the same function as blown ion plasma systems. The main difference is that carboxyl groups are added to the surface instead of hydroxyl groups to increase surface energy. The result, however, is the same: increased surface energy, decreased variability, and better overall surface for coating and potting.

The range of flame burners typically begins at 2 in. wide. Any burner over 16 in. wide requires a water-cooling system, but dual head systems are available if treating up to 32 in. Beyond that, multiple systems or water-cooled systems are an option.



Flame surface treaters are often the better choice for larger applications or electronics with multi-dimensional surfaces.

WHICH TECHNOLOGY IS BEST?

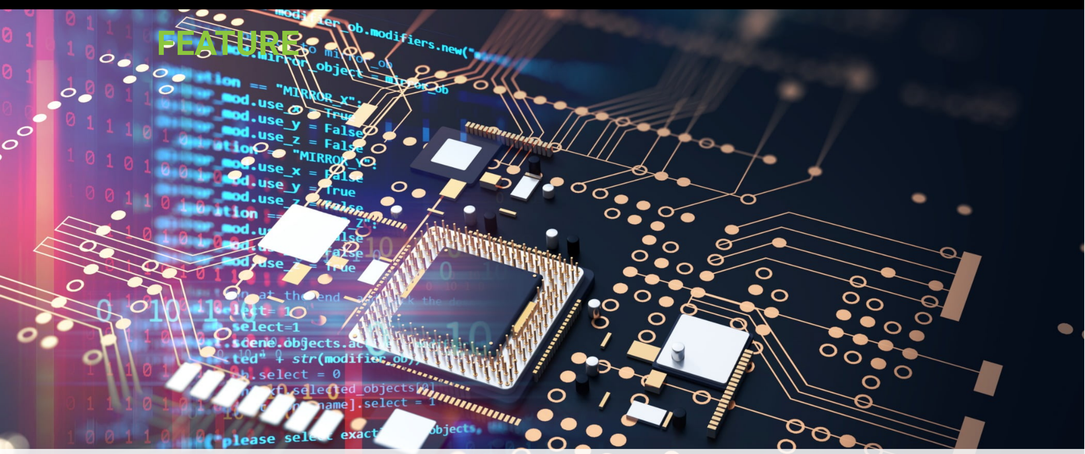
Each technology has its advantages; choosing between them involves finding the correct process for a specific application. For larger applications or electronics with multi-dimensional surfaces, flame is often the better choice. Larger burners only fractionally increase the price of the overall system, and the distance between the burner and the treat area is not as critical as it is with plasma.

For small areas or applications requiring precise treatment paths, plasma is often the best choice. Plasma has the advantage of much lower incremental costs. Without a fuel component requirement like flame plasma, air plasma systems only cost pennies per hour to operate. When using plasma, it is important to note that the treatment speed and distance to the surface are critical to getting uniform treatment. For this reason, robots, conveyors, or other material handling systems are generally used.

ELIMINATE THE GUESSWORK

Whether coating a PCB, filling an electronic housing with epoxy, bonding surfaces together, or simply printing on a material, preparing the surface for bonding has a huge effect on the overall quality and durability of the product. Having a clean, highly active, high-surface-energy material promotes manufacturing quality and efficiency while adding product durability and integrity. Blown ion plasma and flame plasma are both highly effective and repeatable treatment methods that take the guesswork out of bonding processes in electronics manufacturing.

For more information, contact the author at (262) 250-3181 or wlee@enerconmail.com, or visit www.enerconind.com.



FEATURE

EXPLORING ELECTRONICS MANUFACTURING AT IPC APEX EXPO

IPC APEX EXPO 2021's virtual platform will allow attendees, exhibitors, and speakers to easily navigate more than 100 technical conference sessions, professional development courses, and product demonstrations.

IPC APEX EXPO 2021 is being held virtually on March 8-12, 2021. "Given ongoing COVID-19 health and safety concerns and continued restrictions for large gatherings and events in California, it was not feasible to safely convene the nearly 9,000 expected participants at IPC APEX EXPO 2021," said John Mitchell, IPC president and CEO. "The event will now take place in a safe, all-virtual format."

While the event is virtual, organizers report that IPC APEX EXPO will still be the place to connect, collaborate, and learn. The event's virtual platform will allow attendees, exhibitors, and speakers to easily navigate more than 100 technical conference sessions, professional development courses, and product demonstrations, as well as schedule one-on-one meetings with exhibitors. Technical conference sessions will be available to registered attendees for replay, providing the opportunity to take advantage of education for 90 days after the event.

KEYNOTES

Each year, IPC APEX EXPO features dynamic, innovative minds to deliver keynote presentations that are both educational and entertaining. On March 10, Travis Hessman, *IndustryWeek* editor-in-chief, will present "The Great Digital Transformation."

Hessman will educate participants on the processes undertaken by some of today's most successful companies, discussing what they are doing to transform a dizzying array of technologies such as connected machine-to-machine systems, machine learning, and artificial intelligence into actionable, effective digital strategies. In addition, he will cover how they achieved greater operational efficiency and launched new products faster while improving product quality across their businesses.

Guided by Hessman, participants will navigate a roadmap to digital transformation that can help move their companies from the sidelines to the heart of the factory of the future—the Industry 4.0 revolution. As chief editor of *IndustryWeek*, Hessman is in daily contact with some of the world's most successful and innovative manufacturers. These companies are immersed in real-life implementation, application, and strategies for digital transformation success. His presentation will mix these perspectives with his background as a teacher, mentor, and writer to create a powerful storytelling experience that crafts a distinct narrative to help drive real progress for the industry.

Later in the afternoon, Hessman will conduct a live, 1-hr Q&A session with attendees, who will have the opportunity to pose their own questions on digital transformation. In addition to Hessman's keynote, John Mitchell, IPC president and CEO, and Shawn DuBravac, IPC chief economist, will deliver keynotes on March 8 and 11, respectively.

LEARNING OPPORTUNITIES

With more than 100 educational offerings, IPC APEX EXPO offers many options for attendees to gain knowledge and enhance their careers. The Technical Conference will give attendees the opportunity to access the latest electronics manufacturing industry technical content and insights, with the ability to choose from three hot-topic tracks:

- Factory of the Future—sessions to help modernize facilities; topics include data analytics, connected factory, cybersecurity, and digital twin
- PCB Fabrication and Materials—sessions on microvia reliability, PCB design, reliability, and advancements
- Quality, Reliability, Assembly, Test, and Inspection—covers automotive electronics, electronics materials, assembly, coating, and printed circuit board assembly design

In addition, Professional Development courses will feature live instructors who will provide unique interactive instruction on an easy-to-use platform. These courses will cover:

- Assembly Process
- Circuit Design and Component Technologies
- Meeting Extreme Environments
- PCB Fabrication and Materials
- Quality, Reliability, Test, and Inspection

ADDITIONAL FEATURES

Attendees will also be able to experience industry innovation during daily New Product Demonstrations. These 30-min presentations will provide access new equipment, products, and services from a variety of exhibitors. In addition, the virtual platform makes it easy to connect with exhibitors and request one-on-one meetings. Rounding out the immersive experience, attendees can attend a "meet and greet" with IPC Hall of Famers and Emerging Engineers and participate in a virtual trivia event, among other activities.

"Be it in person or via an online platform, it is IPC's goal to maintain IPC APEX EXPO's position as the premier event for the electronics manufacturing industry, providing practical applications for learning—knowledge that attendees can immediately apply to their work and as well as far-reaching insights that can be applied toward implementing future technologies," said Mitchell. "Wherever in the world you may be located, IPC APEX EXPO 2021 is the place to be."

To find additional details and to register, visit www.ipcapexexpo.org.

Photo courtesy of monsitj / iStock / Getty Images Plus

OPTIMIZING EFFICIENCIES FOR HOT-MELT ADHESIVES

A Spain-based tape manufacturer has optimized its production process with the installation of a new static mixer reactor.

Shortening the time required to heat adhesives in tape manufacturing without compromising their physicochemical properties is one of the most crucial goals for businesses in this sector. When a leading European adhesive tape manufacturer needed an innovative heat exchanger to support and improve its operations, it found the solution in Sulzer's heat and mass transfer technology. The company's heat exchanger effectively reduced time-to-heat periods, speeding up the entire production line while delivering high-quality materials.

A DELICATE BALANCE

Adhesive tape manufacturing relies heavily on heat exchangers. In these machines, resin-based adhesives are heated to reach a suitable consistency at which they can be applied onto tapes as coatings. Heating such highly viscous materials requires a delicate balance between reaching the desired temperature in the fastest way and maintaining the optimal physicochemical properties of the substance. Every minute of heating time lengthens production cycles, increases energy consumption, and contributes to higher process costs. However, increasing the temperature of the adhesive too quickly can result in irreparable thermal degradation.

In the case of the Spain-based adhesive tape producer, the company saw the potential to make its manufacturing more efficient by optimizing its heating operations. To find a suitable solution, the company started to proactively look at state-of-the-art heat exchangers to replace its existing system. Working with process specialist Caperva, which collaborates with Sulzer and acts as an agent in Spain, the tape producer identified Sulzer's static mixer reactor (SMR) as a more effective alternative to its conventional heat exchanger.

The tape producer was intrigued by the SMR's large surface area, which facilitates the heat transfer process while homogenizing the temperature of the adhesives. Developed by Sulzer, the technology features an innovative design. Contrary to conventional multi-tube heat exchangers, the product to be heated passes through the SMR's shell while the heat transfer medium flows inside a fixed-tube geometry. The structure comprises bent and folded tubes, providing a static mixing effect.

The presence of a single, large channel for the liquid product maximizes the surface area per unit of volume, leading to an optimized product distribution. In addition, as the product is not split into separate flows within the various tubes, the different laminar flow layers are continuously transposed. In this way, it is possible to achieve an efficient and uniform mixing of the entire stream.

CREATING A CUSTOM DESIGN

The adhesive tape manufacturer and Sulzer had successfully collaborated in the past. When the producer wanted to ease processing challenges associated with mixing and blending colors, Sulzer had provided a static mixer that addresses these issues and offers high-quality color blends. Based on the positive collaboration, the adhesive tape producer again enlisted the company's help.

In order to provide a customized SMR design, Sulzer's engineers began to look at the specific process requirements. To do so, they conducted an extensive investigation on throughput and the availability and type of heating media, as well as differences in adhesive temperature and viscosity at input and output to determine a realistic heating profile.

The adhesive to be processed was calculated to have an average density, specific heat capacity, and thermal conductivity of 730 kg/m^3, 2,400 J/kg K, and 0.15 W/m K, respectively. The SMR would use water as the heat transfer medium to increase the temperature of the material from 20°C to 45°C, entering the equipment at a flowrate of 3,200 kg/h and viscosity of 200 Pa·s. Modifying the temperature of such a viscous substance is particularly challenging for conventional heat exchangers, but the structure of the SMR effectively supports these applications.

In the static mixer reactor, the adhesive passes through the unit's shell while the heat transfer medium flows inside a fixed-tube geometry that provides a static mixing effect for uniform and efficient heating and mixing.

This data and other key parameters, such as pressure drops, were key for Sulzer's team to define the ideal length and diameter of the SMR. For example, large diameters generally reduce pressure drop differences. The manufacturer was also able to provide large volumes of highly accurate existing process data, which enabled Sulzer to conduct simulations that would closely match the real-world application.

POSITIVE RESULTS

As a result of these studies, Sulzer's engineers concluded that the SMR would need to be particularly large, at 3.2 m in length and with an exchanger surface area of 20.7 m^2, to support the high throughput and temperature difference expected within the application. The modelling conducted by Sulzer's engineers, supported by data from the producer, was able to accurately predict how resins and adhesives would react during the process.

After successful testing and installation, the SMR is now fully operational and has enabled the adhesive tape manufacturer to reach its process intensification goals. Even more, the solution exceeded initial expectations, allowing the manufacturer to reach 48°C with its hot melt, rather than 45°C. Finally, as the SMR has no moving parts and the mixing effect is gentle (without any shear force), the system can be used to manage solvents such as hexane, which is utilized by the adhesive tape manufacturer.

"The customer is very happy with the SMR," said José Corbacho, sales manager at Caperva. "The project has been a great success and has allowed them to optimize their production process and reduce maintenance activities. At the same time, the resource efficiency of their manufacturing has been improved by reducing the volume of waste generated. Looking at the positive results of this project, Sulzer is planning to further support the growth of this customer by installing two more SMRs that will further increase their yield."

For more information, email dorota.zoldosova@sulzer.com or visit www.sulzer.com.

FREEWEBINAR

Labs of the Future: How Software is Powering Modern R&D Labs

March 18, 2021 at 2:00 pm EDT

Each year, materials R&D teams must innovate faster and faster, but the software these teams use have not kept up. Data is siloed in different parts of the organization and collaborating involves phone calls to do something as simple as sharing a formulation between teams in different sites. This webinar will discuss what a modern data platform looks like, that enables cross-team collaboration and easy analysis of existing data.

1. What a modern software stack looks like for R&D, and how that compares to the traditional ELN / LIMS / Excel solution that has been used for the past 30 years
2. The challenges organizations will face when modernizing their infrastructure
3. How an R&D solution should fit within other tools in the organization, such as ERP and Regulatory systems

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Will Tashman
Chief Revenue Officer
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IMPROVING EFFICIENCY AND SUSTAINABILITY IN COMPOSITES BONDING

A new system comprising a curing oven, regenerative thermal oxidizer (RTO), and secondary and tertiary heat exchangers can help reduce operating costs while ensuring the safe removal of volatile organic compounds during composite bonding processes.

By Tasha Jamaluddin, Managing Director, Epcon Industrial Systems

Among all chemical curing techniques, convection and radiant thermal curing represent the most widely used applications for adhesives and sealants. During the curing process, adhesives and sealants usually pass through two physical transformations—evaporation and condensation—while being applied to other materials.

In addition to physical changes, the specific temperatures cause chemical changes in adhesives and sealants at a molecular level, where polymer chains' crosslinking occurs. Crosslinking represents the final step of polymerization, which optimizes the tensile strength of the material and solidifies the adhesive bonds in the curing process. Achieving this critical threshold requires not only predetermined temperature ranges but also humidity levels, pressure, and retention times.

CURING IN COMPOSITE APPLICATIONS

Thermal curing of adhesives and sealants is used in unlimited industrial and product manufacturing processes. The composites materials industry has been gaining significant attention in recent years. The use of composites, especially in the automotive and aerospace industries, is rising due to a tendency to decrease the weight of cars and airplanes and reduce greenhouse gas emissions. The composite materials in these industries must meet specific tensile strengths and load-bearing properties, making the material durable under extremely high temperatures and pressures.

Three composite bonding methods that include adhesive application (e.g., secondary bonding, co-bonding, and co-curing with the adhesive) mostly differ in curing schedule, but they all present heat-cure methods. In all cases, the adhesive composition must be precisely designed to meet requirements under a broad range of conditions, which is why high-performance nanomaterial reinforcements are common in adhesives for composite materials.

In the curing process, during the phase transformation of epoxy resins, polyurethane, phenol-formaldehyde resins, and other organic compounds, significant toxic volatile organic compound (VOC) emissions are produced. Due to strict governmental regulations, air pollution control equipment must be in place to keep these VOCs from evaporating into the atmosphere and causing negative impacts on the environment and harm to human health. However, treating this VOC-rich flue gas is complex, as it is contaminated with a wide range of compounds with different properties. Consequently, the VOCs' complete absorption from the flue gas is hardly feasible and extremely expensive since multiple liquid absorbents would be needed. In addition, those gases would then need to be desorbed from the liquid in the second treatment stage and then disposed of as toxic waste.

Therefore, the most efficient method of VOC treatment is oxidation under high temperatures, converting VOCs entirely into water and carbon dioxide. The oxidation occurs in combustion chambers at temperatures determined in correspondence with present volatile compounds, their concentration in the flue gas stream, and, consequently, the lower explosion level (LEL) of the flue gas. However, the thermal treatment of VOCs requires high operating temperatures of up to 1,500-1,600°F for 99%+ VOC removal, causing a significant increase in the plant's variable costs and significantly increasing energy demands.

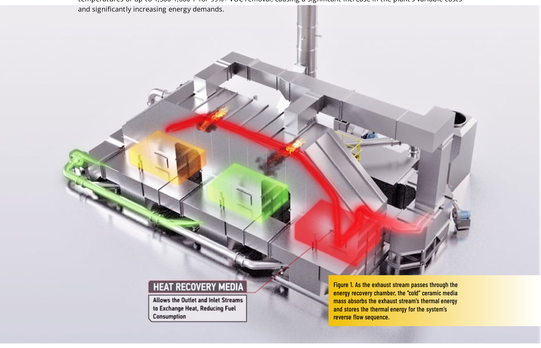

Figure 1. As the exhaust stream passes through the energy recovery chamber, the "cold" ceramic media mass absorbs the exhaust stream's thermal energy and stores the thermal energy for the system's reverse flow sequence.

A NEW SOLUTION

After adhesives and sealants are applied, the bonding process occurs in curing ovens where temperatures are often greater than 200°F and with retention times in the range of 15 min to 24 hrs or longer, which is the case with some epoxy adhesives. For optimal and uniform bonds, it is essential to control the following process parameters accurately: temperature, atmospheric pressure, and retention time of each process stage. This requires real-time control with custom-made software due to multiple transitions of process temperatures that should be executed in the shortest periods.

A patented solution has been developed for the composites industry to address these key operating challenges. The system, which comprises a composite curing oven, regenerative thermal oxidizer (RTO), and secondary and tertiary heat exchangers, ensures 95%+ heat recovery efficiency and 99%+ VOC destruction rate efficiency (DRE).

The RTO comprises three combustion chambers where flue gas enters alternately, designed for 1.0-sec or more residence time. After the flue gas temperature has been elevated in the RTO combustion chamber, the oxidized process exhaust stream then passes through a second energy recovery chamber. During this time, a third energy recovery chamber is being purged. As the exhaust stream passes through the energy recovery chamber, the "cold" ceramic media mass absorbs the exhaust stream's thermal energy and stores the thermal energy for the system's reverse flow sequence (see Figure 1).

Once the first chamber's thermal energy has been depleted through the incoming primary process exhaust stream's absorption, the flow through the system is switched. This results in the incoming VOC-laden process exhaust being directed through the previous absorption chamber saturated with thermal energy. The oxidized exhaust stream goes through the previously purged chamber. By using this airflow reversal method through the ceramic media beds, a minimal supply of heat from the burners is needed to ensure the incoming exhaust stream meets the system's minimum operating temperature. The ceramic media beds' shape and sizing ensure a 95%+ heat recovery efficiency.

Based on process parameters such as volume flow, flue gas VOC concentration, and lower explosive limit, the regenerative thermal oxidizer can be sized and designed specifically to meet all requirements. The system is supplied with burners with more than a 20:1 turndown ratio and combustion air fans controlled via variable-frequency drive (VFD). These features are essential for manufacturers with multiple production lines that have different working parameters or, alternatively, one production line whose operational functions may vary significantly, which is often the case with curing processes.

Regardless of the flue gas stream temperature and volume flow changes, the combustion chamber's set temperature will be achieved by automated combustion air and natural gas flow adjustment, meeting the desired excess air ratio and combustion efficiency at all times. The combustion chambers' temperatures depend on the nature of the adhesive and sealants involved. They often may be up to 1,500-1,600°F to enable the complete oxidation of the VOCs, leaving a tremendous latitude to use the exhaust stream as the heat source for plant processes.

The oxidized process exhaust air stream then exits the ceramic bed and enters an outlet manifold that supplies the treated air stream to the secondary heat exchanger. This secondary heat exchanger then transfers heat indirectly from the "clean" RTO outlet exhaust to a secondary process stream that supplies hot air to the curing oven (see Figure 2). This significantly reduces the required heat to be supplied by the oven burners, reducing gas usage and oven burner-generated NO_x emissions. In many installations, this allows the burners on the ovens to be turned off or removed from service.

Since there are two requirements for air entering the curing oven (pressure and temperature), it is important to control the process air flow with a variable-frequency drive in real time. Suppose the oxidized exhaust stream's temperature is too elevated. In that case, its flow is reduced by stream separation into one stream that passes through the second heat exchanger, and another bypass stream is sent back to the RTO inlet.

On one side, this regulation of the exhaust stream volume flow allows the maintenance of the desired secondary process stream temperature. On the other side, the mixing of a hot bypass stream with the RTO inlet stream significantly reduces fuel and combustion air requirements to maintain combustion chamber operating temperature. Another case is where the fresh air temperature requirements are higher than feasible at the heat exchanger outlet. In this event, the booster burner at the exchanger outlet provides additional heat by controlled gas combustion according to the specified temperature.

The last step of the oxidized air treatment is entering the tertiary heat exchanger fluidly connected to a water source conduit, a coil, and a heated water outlet conduit. The air-to-water heat exchanger recovers a significant portion of the remaining waste heat in the exhaust air stream by preheating the circulating water in the economizer coil. The heat absorbed by water may be sufficient in phenol-formaldehyde adhesive production, where phenol, formaldehyde, water, and catalyst should be heated to around160°F. The heated water is often used to heat the adhesives or sealants batches indirectly.

This system provides an optimal solution for the 99%+ removal of VOCs from the flue gas while simultaneously generating thermal energy for the curing ovens and raising the water temperature necessary for heating adhesives or sealants in chemical solutions. In this way, process heating and gas treatment units are integrated into one process unit and controlled remotely.

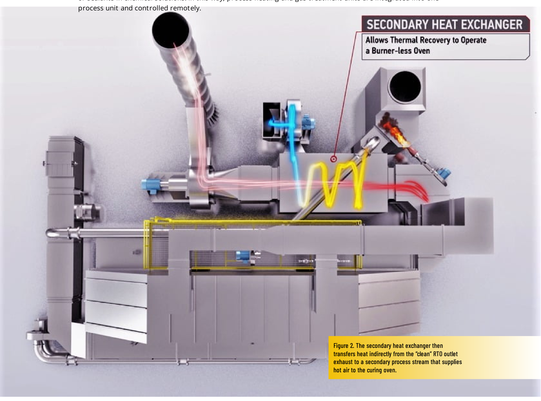

Figure 2. The secondary heat exchanger then transfers heat indirectly from the "clean" RTO outlet exhaust to a secondary process stream that supplies hot air to the curing oven.

CUSTOM CONTROLS

Accurate control of the curing process is highly demanding due to the need for multiple sessions with different retention times, operating pressures, and temperatures. A custom control system enables users to achieve a wide range of controlled variables' set values while always maintaining maximum heat efficiency. The human interface allows a user to define target values of:

- Combustion temperature in chambers, securing complete and continuous VOC removal
- Air process stream temperature and volume flow, subsequently suppling the specified heat and pressure to the curing ovens for various steps of the curing process
- Water temperature for a chemical solution or indirect heating purposes

The user may define the production process' algorithm with the set values of controlled variables in up to 11 different steps. The system's dynamic state between steps is minimal due to specially tuned programmable logic controllers (PLCs) that enable short settling time and fast achievement of a set point in a particular range that the customer specifies. The connected software enables users to define the set values in every process step a priori instead of manually entering the values during the process.

OPTIMAL OPERATIONS

Using this system significantly reduces a plant's operating costs in terms of natural gas and electricity demands due to its highly efficient process integration and the optimal control system. Most importantly, this integrated system is designed to ensure that the gases discharged into the atmosphere meet stringent air quality standards at all times.

For more information, visit https://epcondj.com.

FREEWEBINAR

March 24, 2021 at 2:00 pm EDT

Formulating Strong Bonding Adhesives with Silane-Modified Polymers

The need for uniquely performing adhesives is increasing as the sealant market continues to grow. We have addressed this market demand by developing unique, patent-protected properties found in silane-modified polymers. Allowing for the formulation of adhesives that possess the properties of both silicones and polyurethanes, they are isocyanate- and solvent-free. In the case of the patented -polymers, they do not require tin-catalysts for curing unlike other products in the market. Join us for this educational webinar to learn about formulating strong bonding adhesives with many substrate capabilities with silane-modified polymers.

Key webinar takeaways:

1. Introduction of silane-modified polymers
2. Explore adhesives from elastomeric to shore D hardness
3. Receive staritng point formulations to jump start developments

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SPEAKERS:

Toby Vick
Principal Chemist
Hybrids & Sealants
Wacker Chemical Corporation

Ben Creech
Marketing Manager
Hybrids & Sealants
Wacker Chemical Corporation

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HENKEL

Hot- and Cold-Sealable Coatings for PackagingApplications

The recently expanded RE range, which is "designed for recycling,"includes both hot- and cold-sealable coatings for paper. According to Henkel, the products are certified as paper-recycling compatible and allow a new range of packaging designs.

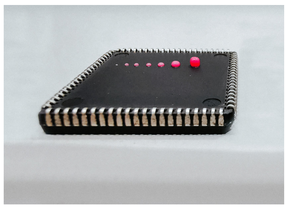
Sustainability is one of the most important factors when it comes to packaging of goods across the board. The first step when designing packaging in a recycling-friendly way that is also compatible with a circular economy starts by ensuring adhesives and coatings can accommodate alternative materials like paper for various food and non-food applications.

"The main purpose of packaging is protection—and this is still what underpins our strategy," said Alexander Bockisch, Henkel's head of global market strategy for Flexible Packaging. "The scope also includes developing adhesives and coatings that help improve recyclability and allow new packaging designs. Our two latest developments are certified recyclable and can replace plastic packaging. Both sealable coatings enable full recyclability of paper packaging in food and nonfood applications."

www.henkel.com

DELO

Die-Attach Adhesive



A new die-attach adhesive reportedly offers high strength after aging. According to tests performed in conjunction with machine integrator ASM Assembly Systems, DELO MONOPOX EG2596 can be dispensed more precisely than its predecessor. This new fluorescent adhesive is suitable for long-term use in semiconductor and surface mount technology applications.

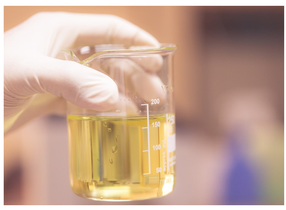
DELO MONOPOX EG2596 can be used on printed circuit boards to fix components and act as electrical insulation. It is temperature resistant and offers good dispensing properties, meeting the increasing miniaturization requirements in today's electronics.

The company reports that this heat-curing, one-component epoxy resin adhesive exhibits a 150% higher strength after seven days of storage at 85% relative air humidity and a temperature of 85°C. DELO MONOPOX EG2596 maintains strong adhesion even after typical aging tests (e.g., the MSL1 test), in accordance with JEDEC standard. When using 1x 1 mm² silicon dies, the test revealed adhesion values of 47 N on FR4 substrate and 62 N on gold.

www.delo-adhesives.com

TOYOCHEM

High-Solids Polyurethane Pressure-Sensitive Adhesives



A new Cyabine™ series of polyurethane pressure-sensitive adhesives (PSAs) reportedly features an ultra-high solids content of 99% or more. According to the company, the new adhesive composition achieves the same performance levels as conventional solvent-based PSAs while reducing solvent and volatile content to minimal levels. The adhesives are suitable for use in a wide range of industrial applications, such as protective films.

To meet the demand for lower VOC-emitting products, Toyochem reports that it has been gradually building on its lineup of high-solids adhesive compositions with high levels of non-volatile content. This new PSA product was the outcome of new technological developments in synthesis and crosslinking methods developed by Toyochem. These advances allowed the company to engineer a new high-solids system that contributes to reduced CO_2 gases during coating and drying processes for a safer, more environmentally sound work environment.

www.toyo-chem.com/en

HUNTSMAN

High-Performance Adhesive Range

The ARALDITE® 2000 Adhesive Core Range is designed to help businesses across many industries maximize productivity by covering up to 80% of all bonding needs, from assembling high-performance products to making repairs in tough conditions. The ARALDITE Adhesive Core Range comprises nine high-performance adhesives that the company reports can simplify product selection, reduce stock keeping unit (SKU) inventory, and minimize worker training.

The ARALDITE Adhesive Core Range consists of three technologies: epoxy, acrylic, and polyurethane. The adhesive products are reportedly resistant to impact, high temperatures, water, and chemicals while offering a variety of colors, open times, viscosities, and appearances.

Huntsman reports that these products enable greater innovation, performance, and sustainability, with well-proven applications across bus and truck, rail, wind, marine, and general industry. Meeting stringent industry safety standards, the range includes products with KIWA approval; Lloyd's Register approval; and conformity to HL3 requirements, ClassR1 and R7, of the Railway European Fire Protection Standard EN 45545-2.

www.huntsman.com/products/araldite2000

SONGWON

Flame-Retardant Dispersion

SONGFLAME® WB 201 solvent-free, aqueous, flame-retardant dispersion is designed especially for the coatings, adhesives, sealants, and elastomers (CASE) market and is also suitable for textile applications requiring flame-retardant properties. The benefits of the new product reportedly include easy handling for customers working with waterborne systems, as well as low viscosity and a high active content.

In keeping with its commitment to help improve sustainability throughout the value chain, SONGWON reports that it has built up the new flame-retardant synergist portfolio with a view to promoting the growth of halogen-free solutions. SONGFLAME WB 201 is the latest addition to SONGWON's water-based portfolio. Developed to meet the increased demand for environmentally acceptable additives, the new ranges combine the efficiency of conventional products with the benefits of water miscibility, low-to-zero VOC generation, and easy dosing and handling.

www.songwon.com

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ASK DR. DAVE

UNDERSTANDING TWO-COMPONENT ADHESIVES

Why do we have to use two-component adhesives and meter/mix equipment in our assembly and repair operations?

I realize that the meter/mix equipment can be a major inconvenience. Adhesives come in two forms, namely two component or one component. Two-component adhesives are mainly epoxies, reactive acrylics, or polyurethanes. Customers turn to two-component adhesives because they cure very quickly at room temperature and they can fill large gaps. However, customers often use these adhesives due to necessity rather than by choice.

Solvent- or water-based adhesives can be used, but they have obvious disadvantages such as the necessity for drying or hazards such as flammability or health hazards. Most other one-component adhesives require an external chemical or energy source to initiate curing. These one-component adhesives include: hot melts, which must be heated; reactive hot-melt urethanes, which require heat plus atmospheric moisture for curing; and heat-cured epoxies. Last but not least are UV- or visible light-cured adhesives that allow very fast curing but always require one substrate to be transparent to the radiation.

The only true one-component adhesives are silicones, polyurethanes, cyanoacrylates, and anaerobic methacrylates. Silicone and polyurethane systems rely on atmospheric moisture diffusing into the adhesive bondline from the outside; they tend to cure quite slowly for this reason.

Cyanoacrylates or anaerobics adhesives rely on surface moisture and metal surfaces, respectively, to initiate the curing and can cure very quickly. These are obviously a possible adhesive for you. They do tend to be expensive if you are bonding large areas, and they are limited to bond gaps of around 20 mils unless you use a surface primer.

Dr. Dave is a former vice president and director of Loctite Corp. (now Henkel) and has spent many years in troubleshooting adhesive and sealant problems in the adhesives, sealants, specialty rubbers, and plastics fields. Questions for publication should be directed to him at 242 Trails End, Aurora OH 44202; phone (440) 477-5164; or email DrDave242@windstream.net.

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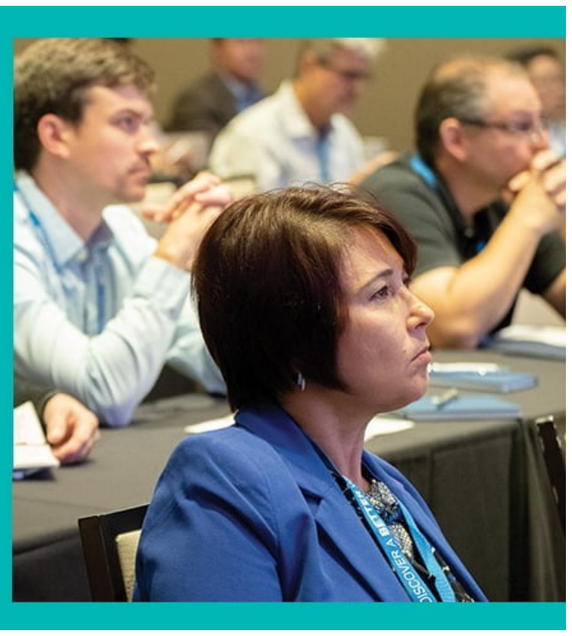

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