ASI ADHESIVES & SEALANTS INDUSTRY
A bnp PUBLICATION

Formulating Flexibility

- Raw Materials and Chemicals Overview
- Opportunities in Electric Vehicle Applications
- Pump Advancements

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ASI ADHESIVES & SEALANTS INDUSTRY
VOLUME 28, ISSUE 8

FEATURES

2021 Raw Materials and Chemicals Overview

The outlook for industrial demand is expected to improve, notwithstanding inflated raw material costs.

Enhanced Durability and Life Expectancy of Silane-Modified Polymer-Based Formulations

Silane-modified polymers (SMPs) are particularly suitable for formulating elastic adhesives, sealants, and coatings. How can additives help optimize performance?

Enabling Greener Formulating Innovations with Liquid Polybutadiene Technology

Liquid polybutadienes can help improve the environmental performance of a diverse range of chemical formulations.

Shaping the Future Needs of Sealant Formulators

Ingredient selection provides a fresh opportunity to drive value and underpin sealants' commercial performance with a stronger value proposition.

Seven Ways Adhesives Push EV Design Forward

Adhesives offer significant advancements in electric vehicle safety, cost, durability, and performance.

Solving Challenges in EV Batteries with Pressure-Sensitive Tapes

The electric vehicle space is an area that will provide a tremendous opportunity to converters and others working with high-performance, pressure-sensitive adhesive (PSA) tapes.

Eliminating Adhesive Buildup with Air-Operated Double-Diaphragm Pumps

Next-generation diaphragms have been designed to meet the pumping challenges inherent in the sticky and viscous materials that are the foundation of adhesive and coating manufacturing.

Solving Glue Transfer Challenges with Peristaltic Pumps

A world-renowned paper tissue manufacturer is enjoying multiple benefits following the selection of peristaltic pumps for the transfer of a glue/ink mixture used in its manufacturing process.

DEPARTMENTS

COLUMNISTS

FROM THE EDITOR

>> Susan Sutton, editor-in-chief

INNOVATIONS ABOUND

From newly developed raw materials and chemicals to finished products and high-tech applications, the adhesive and sealant industry continues to focus on innovation.

The development and production of adhesives and sealants is an exceptionally complex process. One little tweak in a formulation can make the difference between an innovative, top-selling product and a potential liability. The same additive might be the perfect solution for one formulation but wreak total havoc in another. This is why it's important to have options, and the great news is that more are being developed every day.

Articles in this issue discuss silane-modified polymers, liquid polybutadienes, clay-based rheology modifiers, and more. Could one of these materials be the key to your next major product development? Take a look and find out!

We're also covering transportation end-use applications this month, with two articles focusing on the high-growth sector of electric vehicles. "The transformation of the world's vehicles from internal combustion engines (ICEs) to electric vehicles (EVs) relies in large part on what holds the vehicles together—namely, adhesives," writes DuPont's Andreas Lutz. "A wide portfolio of adhesive solutions is helping automakers worldwide mass-produce EVs that are safer and perform better than ever."

How are adhesives evolving and helping to drive innovation in this exciting market? Lutz discusses the details in "Seven Ways Adhesives Push EV Design Forward."

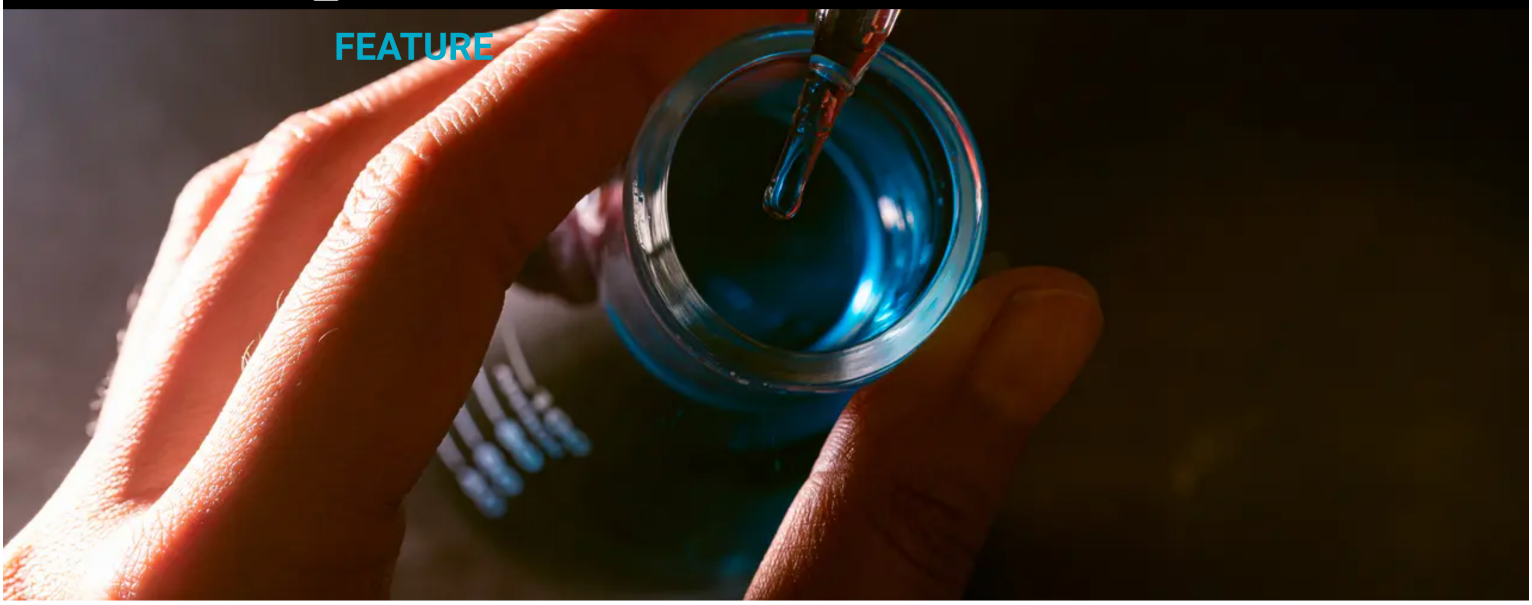
Adhesives find utility throughout the vehicle assembly process, but EV batteries raise unique challenges. In his article, Scott Krusinski of Avery Dennison Performance Tapes focuses on the battery assembly and explains how pressure-sensitive tapes can provide solutions.

"The EV space is an area that will provide tremendous opportunities for converters and others working with high-performance, pressure-sensitive adhesive (PSA) tapes," he writes. Turn to "Solving Challenges in EV Batteries with Pressure-Sensitive Tapes" to learn more.

What innovative new materials, products, or applications is your company focusing on? I'd love to hear all about it and possibly highlight your advancements in a future issue of **ASI**. Please contact me at (248) 786-1704 or suttons@bnpmedia.com to share your story.

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.

FEATURE



2021 RAW MATERIALS AND CHEMICALS OVERVIEW

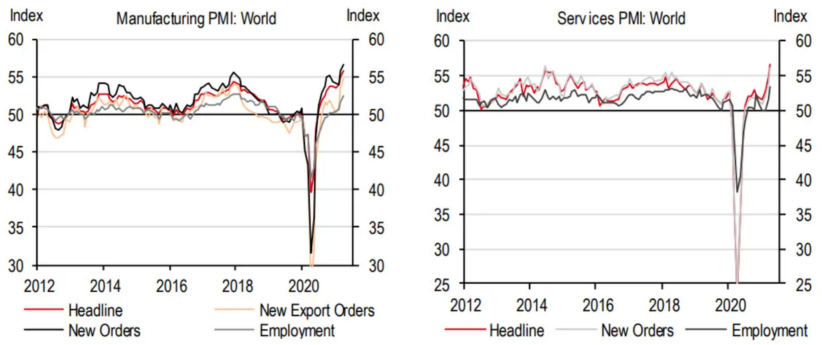
The outlook for industrial demand is expected to improve, notwithstanding inflated raw material costs.

By Michael Rezai, Senior Consultant, The ChemQuest Group

Not surprisingly, the global economic recovery is continuing more quickly in regions where COVID-19 is under control and vaccinations have been widely rolled out. After an estimated contraction of 3.3% in 2020, the global economy is projected to grow at 6% in 2021, moderating to 4.4% in 2022, according to the International Monetary Fund (IMF).

Demand for manufactured goods remains strong, with the global aggregate Purchasing Managers' Index (PMI) rising again to another decade high. Combined with persistent and widespread raw material and labor shortages, this is continuing to add to price pressures within the manufacturing sector. These appear to be being passed on, at least to a degree.

Figure 1. Purchasing Managers' Index for manufacturing and services, 2012-2020. (Source: IMF)



The U.S. economic outlook continues to strengthen, with economists boosting 2021 gross domestic product (GDP) growth forecasts encouraged by robust consumer spending and manufacturing activity. However, economists' main concern is inflation.

Global Chemical Industry

The overall chemical industry should expect demand growth driven by the construction and mobility industries. The construction industry's year-over-year output growth is estimated at 8% for 2021, with the U.S. and China expected to make massive investments in infrastructure.

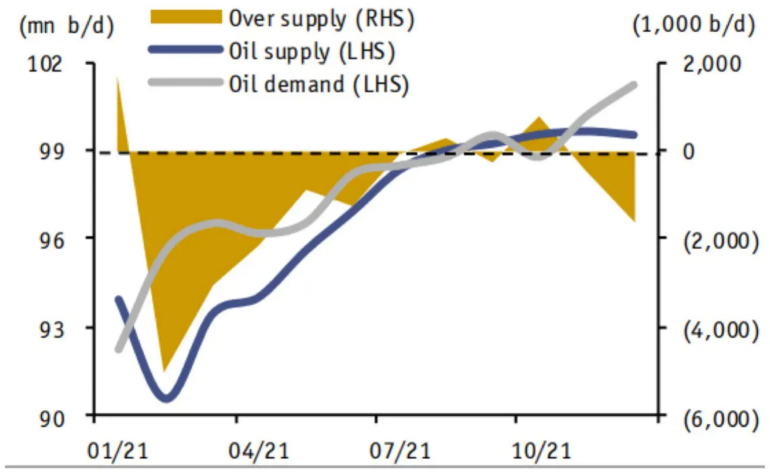
While the global auto industry is suffering from chip shortages on the supply side, it will likely see demand rebound this year thanks to sales growth on increasing outdoor activities and pent-up demand in the second half of 2021. Chemicals demand for packaging materials and hygiene products should remain strong, albeit growing at a slower pace. Even after the COVID-19 crisis subsides, these industries will benefit from pandemic-sparked shifts in consumption patterns.

Crude Oil Prices

With economic activities returning to normal levels, both WTI and Brent are up around 30% so far this year, on the back of an improved demand outlook due to the successful vaccine rollout. Oil demand has been recovering in China first, followed by the U.S. and Europe, and continues to exceed supply. Conversely, global oil supply declined 6% year over year in April due to oil cuts by OPEC+ members and a production slump in the U.S.

In 2021, oil prices have advanced steadily; on June 1, Brent crude futures breached the $70/barrel ceiling and extended the rise the next day. Pricing is expected to hold strong near term through the 2021 second quarter. However, WTI is expected to slow down to ~$59/bbl in the second half of the year, as petroleum supply disruption in Texas since February is expected to normalize (relieving supply pressure) and OPEC+ normalizes its production level.

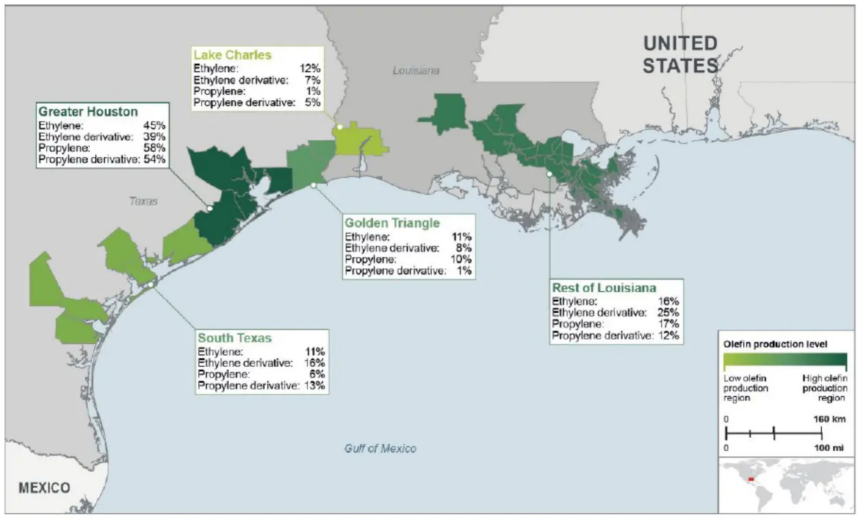
Figure 2. Global oil supply and demand, 2012. (Source: EIA)



Winter Storm Uri

As Winter Storm Uri hit the Texas-Louisiana area in February, several sites shut down or ran at reduced rates in the chemical industry. Nearly 78% of U.S. ethylene supply had been impacted, shutting down almost every propylene production unit in Texas and several in Louisiana (the Lake Charles area). The industry's recovery is generally approaching completion, though pricing for raw materials is still inflated.

Figure 3. Production loss (%) in U.S. Gulf Coast light olefins corridors. (Source: IHS)



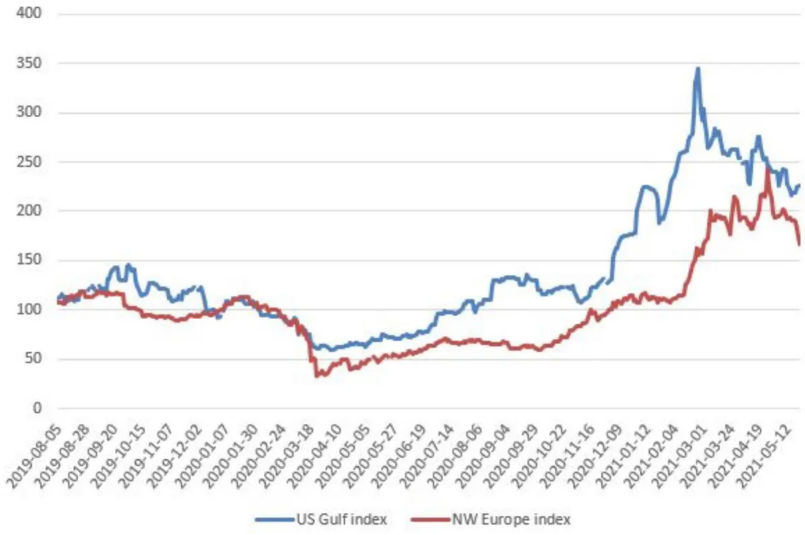
Raw Material Prices

The ICIS Petrochemical Index tracks chemical prices in important value chains and regions. Petrochemical prices that have been up across all regions have recently softened.

The index tracks the movement of prices for the 12 major petrochemicals and polymers: ethylene, propylene, butadiene, benzene, toluene, paraxylene (PX), polyethylene (PE), polypropylene (PP), styrene, polystyrene (PS), methanol, and

benzene, toluene, paraxylene (PX), polyethylene (PE), polypropylene (PP), styrene, polystyrene (PS), methanol, and polyvinyl chloride (PVC), with the regional indexes weighted by capacity. The IPEX values are related to a January 2000 base of 100.

Figure 4. ICIS spot price indexes, August 2019-May 2021. (Source: ICIS)



Ethylene

As production issues related to Winter Storm Uri were largely resolved by the end of March, ethylene chain fundamentals remained tight in April on strong demand. Effects from the storm linger as the market continues to work through the impacts of lost production, which pressured already-tight markets and planned maintenance.

In addition, with strong packaging demand and new derivative capacity startups, ethylene contract prices moved higher for the fifth consecutive month in April (47.25 c/lb). On a brighter note, as supply disruptions end, real underlying supply and demand are likely to become more balanced, reducing the pressure on price inflation.

Lastly, while the rest of the world looks to Asia to consume excess ethylene, Asian demand will heavily rely on global control of COVID-19. This is particularly true with surges in other regions that pressure derivative export volumes.

Propylene

Propylene prices settled down 19% in April to 57.0 c/lb and 55.5 c/lb for chemical-grade (CG) and polymer-grade (PG) propylene, respectively. Supply conditions improved as U.S. propylene capacity came back online following widespread outages in late February due to Winter Storm Uri.

Propylene prices remain well above their three- and five-year averages (41 and 40 c/lb, respectively, for chemical-grade propylene), due to rebounding downstream demand, higher oil prices, and low inventories.

Vinyl Acetate Monomer

Vinyl acetate monomer (VAM) prices have increased significantly amid a global supply shortage. News of additional outages and strong downstream demand (adhesives being one of the primary determiners driving demand) are leading to expectations of further pricing increases.

Wacker Chemie's chief finance officer called the more than doubling of VAM prices "crazy" on a recent earnings call. Unfortunately, continued export strength and robust construction sector demand are anticipated to keep prices elevated.

Butadiene

Global butadiene demand is expected to continue to recover throughout 2021, in line with increasing downstream tire and vehicle production. Asia is a key player in the global butadiene (BD) market, accounting for more than 62% of global consumption. It is also the world's largest BD producer, churning out nearly 59% of global output.

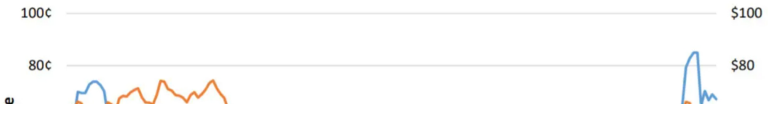
CFR China butadiene price was up recently, with the butadiene-naphtha price spread being pushed up to a five-week high. However, sources have indicated that this price increase may be limited amid increasing supplies from China, as China has been accelerating butadiene exports in line with rising production capacities.

In the U.S., market participants see continued strength in pricing through the second half of 2021 due to the ongoing curtailment of supplies following TPC Group's explosion at its butadiene unit at Port Neches, Texas. There will be many challenges for butadiene supply, and the U.S. will need to compensate through imports as automobile demand spikes.

Styrene

Figure 5 shows styrene and oil prices since 2018. The relationship between styrene and oil prices has returned after briefly breaking down due to the winter storms in the southern U.S. that interrupted petrochemical production. Styrene experienced a sharp increase early this year (~ 30%), but has subsided and is expected to moderate until the end of 2021 (see Figure 6).

Figure 5. Styrene and oil prices, January 2018-April 2021. (Source: Bloomberg)



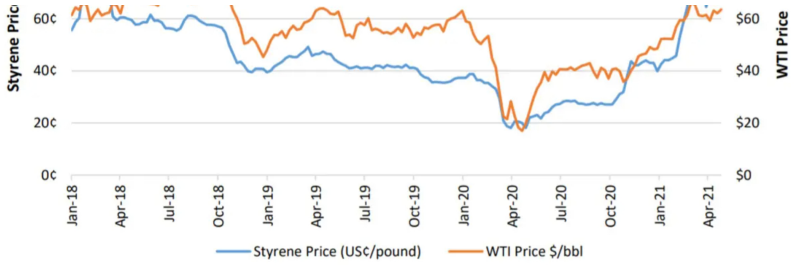
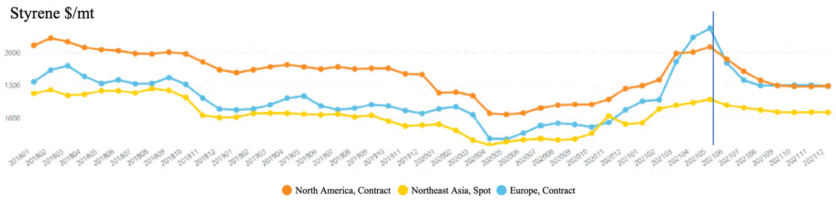


Figure 6. Styrene pricing, 2018-2021. (Source: IHS)



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FEATURE

ENHANCED DURABILITY AND LIFE EXPECTANCY OF SILANE-MODIFIED POLYMER-BASED FORMULATIONS

Silane-modified polymers (SMPs) are particularly suitable for formulating elastic adhesives, sealants, and coatings. How can additives help optimize performance?

By Benno Blickenstorfer, Global Business Development Manager Adhesives & Sealants, SONGWON Industrial Group

Adhesives and sealants are part of our daily lives, although they are often invisible. They ensure that our food is packaged and promoted safely, that our houses are wind- and waterproof, and that our communication and mobility needs are served in safe and efficient ways. Thousands of everyday items, such as mobile phones, washing machines, personal hygiene products, shoes, clothing, building products, batteries, automobiles, rail cars, ships, and even airplanes, are nowadays only possible thanks to high-performance adhesives and sealants.

Silane-modified polymers (SMPs) are particularly suitable for formulating elastic adhesives, sealants, and coatings. These systems were first introduced in the late 1980s and are based on polymer backbone structures terminated with silyl groups. Market systems are mostly designed as 1-part (1-K) products that cure through a polycondensation reaction using moisture in the ambient air or substrate to harden. 2-K systems are less frequent but essential when bonding substrates such as metals, plastics, glass, or other non-porous materials. SMP-based systems emit small quantities of methanol or ethanol, depending on the silane used, and attain the typical strength of elastomeric material.

SMP-based adhesives, sealants, and coatings are gaining in popularity. They have shown stronger growth than competitive silicone or polyurethane chemistries for elastic systems over the past few years, and this trend is expected to continue.[1] The main reasons behind this acceptance include their freedom from solvents and isocyanate, their versatility as regards to formulation, and the rising number of available raw materials.

The most important application areas for SMP-based systems include: the building, construction, and roofing industries; glass bonding in all types of vehicles; bonding of side panels in trailers and trucks; fixation of solar panels; and assembly operations. SMP-based products with long-term stability and durability also extend the lifetime of adhesively bonded, sealed, or coated goods. Optimized selection and use of additives are therefore of particular importance.

Formulations and Stabilization

Application areas, end-use performance, and specifications define the mechanical characteristics for the product. Experienced formulators can choose from a wide range of available materials and combine parameters such as polymer types (linear, branched), molecular weight, type and location of silane group, degree of functionality, degree of filler or pigmentation, degree of plasticization, rheology additives, adhesion promotors, moisture scavengers, and catalysts, as well as antioxidants and light stabilizers.[2]

Product literature supplied by SMP raw material manufacturers typically offers starting-point formulations that provide a certain set of mechanical attributes, such as tensile properties, hardness, and processing viscosity, for some application areas or compositions. Table 1 lists general quantity ranges of component categories for filled opaque and transparent systems.

Table 1. General composition of SMP-based adhesives/sealants.

Component	Filled/Opaque Systems	Transparent Systems
Silane-modified polymers (SMP)	20-35%	45-65%
Filler/pigments	40-60%	-
Rheology modifier (e.g., fumed silica)	0-5%	10-30%
Plasticizer	10-30 %	15-40%
Adhesion promotor/moisture scavenger	3-6%	3-6%
Catalyst	0.1-1%	0.1-1%
Antioxidants/light stabilizers	1-3% (based on SMP content)	1-3% (based on SMP content)

When it comes to long-term protection against thermal or light-induced degradation, the composition and quantity of the antioxidant/light stabilizer package deserves special attention. Antioxidants (AOs) prevent thermally induced degradation of polymers during processing and under end-use conditions. They trap oxygen-centered radicals and stabilize or deactivate them, interrupting the auto-oxidation process.[3]

UV absorbers (UVAs) act as light filters and transform absorbed radiation energy into harmless heat. They are more efficient on thicker materials. In practice, this means that lower material layers are better protected than surfaces. Hindered amine light stabilizers (HALS) act on the oxygen-exposed surface of materials. In the presence of oxygen, peroxides, or hydroperoxides, HALS form nitroxyl radicals that trap carbon-centered alkyl radicals and convert them into inactive alcohol or ketone derivatives. The cyclic stabilization process of HALS provides exceptionally long-term protection and durability.[4]

How is the durability performance of SMP-based products influenced and affected by different stabilizer packages? An application project sheds light on the behavior of different stabilizing additive combinations.

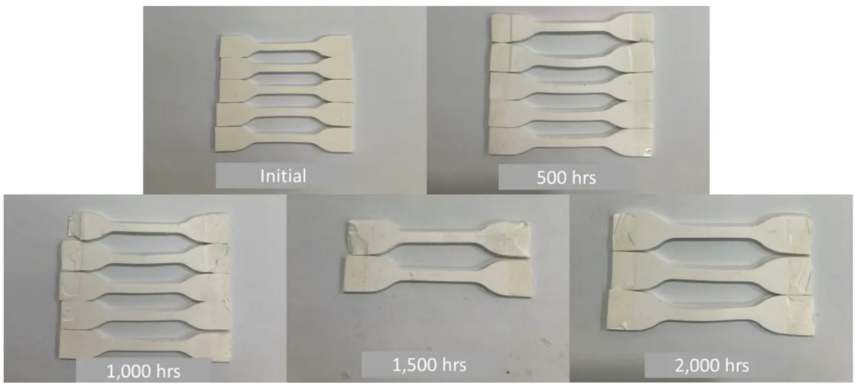
Testing Methodology

Four different SMP-based test formulations (two filled and two transparent) were tested with various additive packages. Various types of AOs, UVAs, and HALS were applied in different ratios (add-on ranging from 1-2%), based on polymer content. In all, 15 additive packages were used to prepare 21 formulations.

The mixed systems were poured into 3-mm-thick sheets and fully cured over three weeks under ambient conditions. ISO 37 type 2 dumbbell specimens were cut and exposed in an Atlas Ci 4000 weatherometer in accordance with ASTM G155 Cycle 1 standard practice. This method specifies exposure to a 0.35W/m2*nm (at 340 nm) Xenon arc light, 102-min irradiation at 63°C black-panel temperature, followed by 18-min water spray under light exposure.

Samples were removed from the test chamber after 500, 1,000, 1,500, and 2,000 hrs and tested for color change and Shore A hardness. The specimen series that were fully intact after 2,000 hrs were further subjected to tensile strength testing in accordance with ISO 37:2017 (see Figure 1).

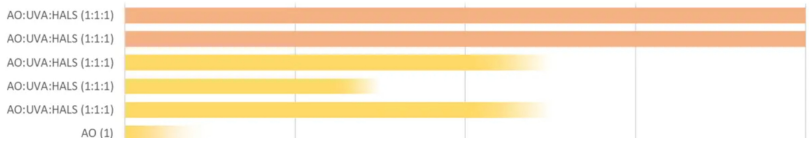
Figure 1. Opaque formulation samples at different stages of artificial weathering.

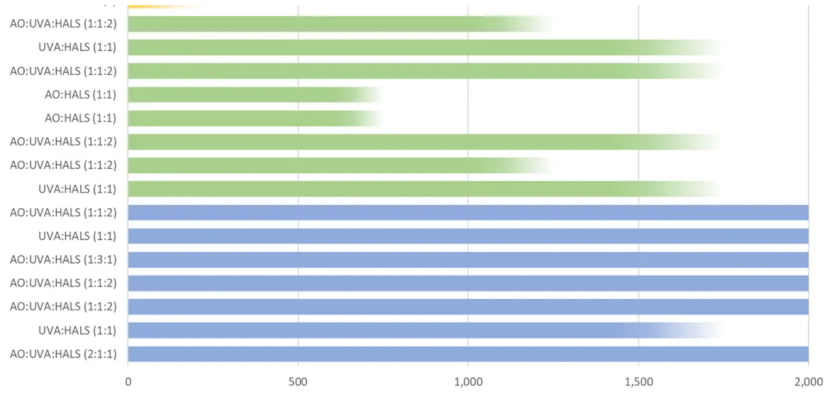


Results

Each color in Figure 2 represents a different base formulation that was modified with a stabilizer combination. The columns that retained the color right up to 2,000 hrs indicate that the samples remained intact for the full duration of the aging cycle.

Figure 2. Failure point of specimens after ASTM G155 Cycle 1 weathering. Each color denotes a different base formulation.

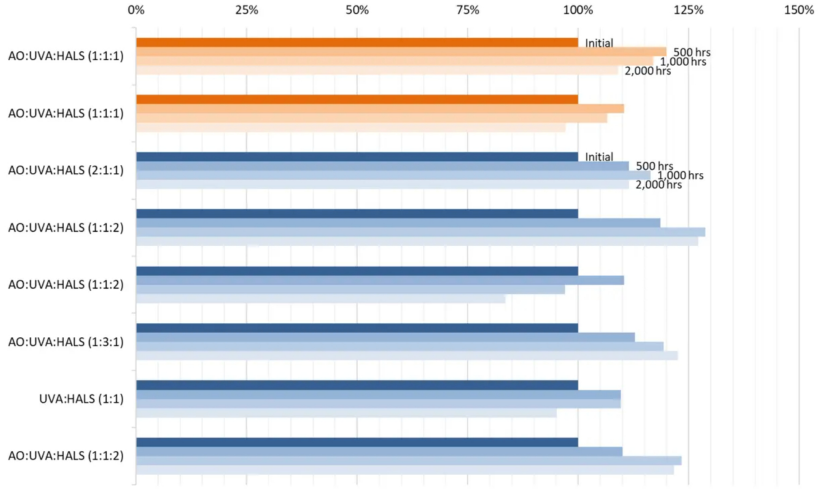




The yellow and green formulations failed to complete the cycle: the lowest stabilizer add-on was 1% and the highest 1.6%, based on polymer content. An increase in additive content can also improve durability; however, optimization of the package appears the more practical solution. Most specimens that keep their integrity over the testing period contain AOs, UVAs, and HALS; only one composition achieved sufficient stabilization with just UVAs and HALS.

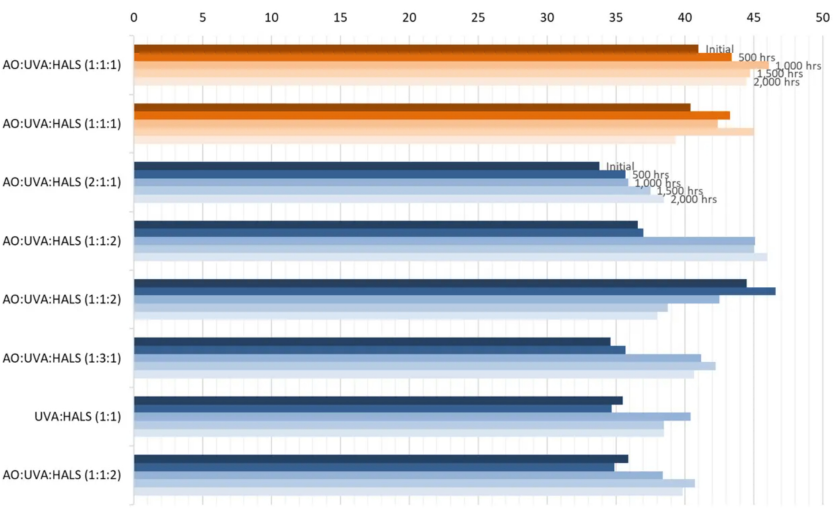
The red color-coded results are those obtained from a transparent SMP system, while the blue ones denote an opaque formulation. Figure 3 illustrates the relative change of tensile stress at 100% elongation vs. the initial value. Most systems reveal an increase at the first measuring point. The increase slows but remains above or on a par with the initial value. Only one additive package showed a distinct decrease (to 85%), as compared with the base value.

Figure 3. Relative change of tensile stress at 100% during exposure to artificial weathering, shown in decreasing color intensity.



Higher tensile strength is generally connected with an increase in product hardness. This is confirmed by the Shore A values in Figure 4. Here, too, the same stabilizer package reveals a significant reduction in Shore A values, while all the other packages demonstrate the contrary. An increase in tensile strength and hardness typically also indicates a reduction in the elasticity of a system. To achieve the best mechanical performance of the product during end use, therefore, it is important to balance these characteristics.

Figure 4. Shore A hardness development during exposure to artificial weathering, shown in decreasing color intensity.

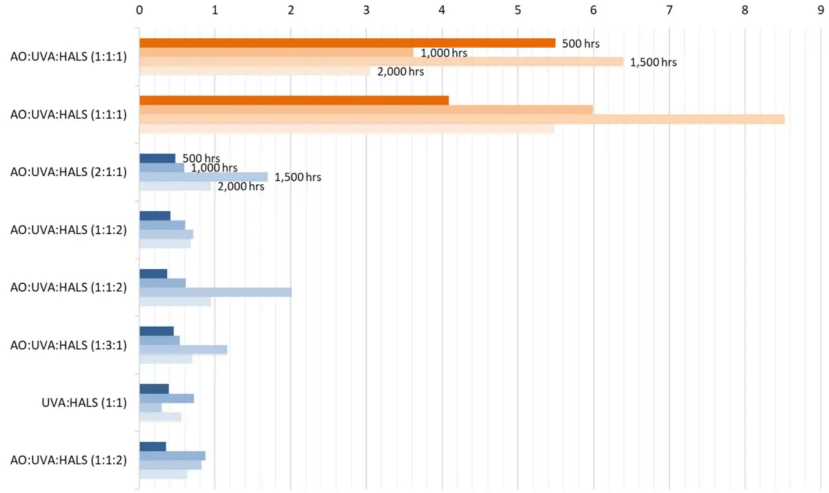


In many applications, a color change of the coating, adhesive, or sealant is the first sign of degradation and alteration of properties. Filled and pigmented opaque systems are naturally less prone to yellowing and color change than transparent

ones.

The results in Figure 5 show minimal ΔE values on the blue color-coded opaque specimens. Some of the specimens show a peak ΔE value at 1,500 hrs. The reason for this is not apparent and might need further investigation.

Figure 5. ΔE color change during exposure to artificial weathering, shown in decreasing color intensity.



The least discoloration (a ΔE of less than 0.8) was found with the package containing a particular UVA/HALS combination and no AO. The red color-coded transparent specimens showed distinct yellowing and high ΔE values over time. Improving this behavior is desirable for transparent cartridge packaging materials and for applications involving glass. In practice, some yellowing can be offset with slight blue tinting of the SMP product.

Summary, Conclusion, and Outlook

The results demonstrate that aging performance depends strongly on the SMP base formulation. Adapted stabilizer packages improve the longevity of properties to some extent but also indicate the need for newer solutions.

The study provides valuable insights into factors influencing the stabilization of SMP systems. These are key to addressing industry needs such as further increase of durability, improved processing, and regulatory aspects, as well as cost optimization in use vs. performance.

For more information, email coatings@songwon.com or visit www.songwon.com.

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Images courtesy of SONGWON.

FEATURE

ENABLING GREENER FORMULATING INNOVATIONS WITH LIQUID POLYBUTADIENE TECHNOLOGY

Liquid polybutadienes can help improve the environmental performance of a diverse range of chemical formulations.

By Doug Thompson, Global Sales and Marketing Manager, and Malcolm McInnes, Global Technical Services Manager, Lithene Business Unit, Synthomer

The chemical industry continues to strive for greener innovation, and liquid polybutadiene technology* can provide innovative solutions for today's challenges. High-performance liquid polybutadiene chemistry serves a range of sectors, including automotive sealing and sound damping, rubber compounding, and coating additives.

Liquid polybutadienes can help improve the environmental performance of a diverse range of chemical formulations, many of these within transportation markets. Having a positive impact on sustainability and the environment can take many forms, including the reduction of harmful emissions, lower CO_2 from manufacturing processes or vehicles in use, less hazardous materials in manufacturing operations, and making products more durable and extending their life.

Sustainable Benefits in Automotive

Liquid polybutadienes have been used for many years as the functional base in automotive body-shop flexible gap fillers, semi-structural adhesives, and acoustic deadeners. In addition to providing formulators with a range of performance characteristics, from flexibility to adhesive strength, the acoustic damping properties of liquid polybutadienes can extend to the paint shop application of liquid-applied spray dampers.

A traditional approach to sound damping in automotive has been to use filled and plasticized bitumen sheets, placed in contact with the bodyshell during final assembly. However, this method is labor intensive and does not readily permit spot application of the damping material where it is really needed on the bodyshell. These sheets also add unnecessary weight to the vehicle and consume additional materials.

In contrast, a spray-applied acoustic damper based on liquid polybutadiene can be spot applied precisely onto the bodyshell in the assembly line and with automated equipment. The liquid damper is cured in the paint shop oven during assembly, so it reduces emissions over the service life by adding less weight than bitumen sheets while also requiring no additional energy demand to cure.

With increasing focus on reducing the use of hazardous materials in both industrial and domestic environments, the non-hazardous nature of liquid polybutadienes is a further potential benefit for formulators. Sulphur vulcanization of automotive body shop materials is a well-established and versatile technology, but the development of alternative cure systems based on peroxide can reduce the number of components in the formulation that attract specific hazard labelling. Liquid polybutadienes can play an important role in such formulations by acting as plasticizers, crosslinking additives, and direct-to-metal adhesion promoters without contributing to emissions or additional chemical hazards.

Conserving materials and saving energy are key goals in sustainable manufacturing, and they are often achieved by designing products with a longer service life. In the automotive industry, improvements in bodyshell corrosion protection have enabled longer corrosion warranties to be provided, helping to extend the life of the vehicle.

While primer coatings applied in the e-coat bath provide effective metal protection, adhesives, sealants, and dampers required as part of body shell construction are applied directly to bare metal, usually before the removal of anti-corrosive oils. Any failure in the bonding of these compounds allows a route for corrosion to access the unprotected metal surface beneath.

Body shop products based on liquid polybutadienes coupled with maleic anhydride functional polybutadienes play an important part in this protective function. The hydrophobic

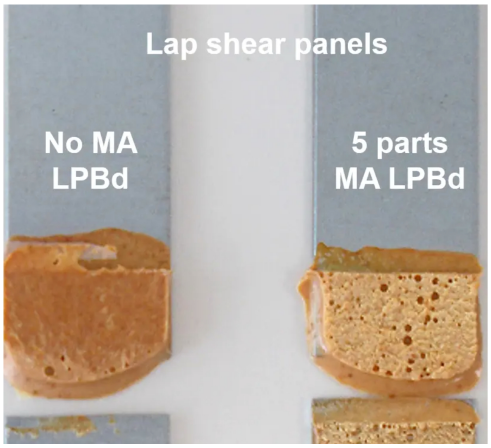

Figure 1. Lap shear tests contrast sealant cured with (right) and without (left) maleic anhydride-containing liquid polybutadiene.

properties ensure the compound is not washed off prior to the e-coat primer application, and the polar maleic anhydride adhesion promoters ensure good adhesion direct to oiled, bare metal surfaces. This develops a strong, impermeable, and durable bonding of the body shop adhesives and sealants once vulcanized, preventing a route for the onset of corrosion.

Non-Hazardous Modifiers for Rubbers

Beyond direct automotive assembly, liquid polybutadienes play an important part in auxiliary components based on rubber. While largely unseen, these polymers are formulated in a diverse range of rubber components, from engine mounts, cooling hoses, drive belts, and oil seals to the tires' tread compounds. Many auxiliary chemicals are regularly used in rubber compounds to enhance properties, but many carry hazard classifications and are potentially harmful to health or damaging if released to the environment.

Liquid polybutadiene polymers perform a wide range of functions as rubber modifiers, co-curing during the vulcanization process to increase the compound's crosslink density. This can improve a range of properties, from better compression set in engine mounts and gaskets to lower T_g to enhance wet grip in winter tire tread. In reinforced belts and hoses, where bonding of the rubber matrix to a textile or metal cord reinforcement is critical for durability, the polar maleic anhydride groups on certain liquid polybutadiene grades provides a significant improvement to the bond strength between rubber and reinforcement.

While these functional properties are obviously of great value to achieve a given specified performance, the use of these liquid polymers also provides sustainability and environmental benefits. During compounding, liquid polybutadienes can help reduce mix viscosity and shorten mix cycle times, providing an energy-saving potential. They can also, in part, replace some of the process oils used in many rubbers. Importantly, thanks to their reactive structures, they are chemically bound into the rubber matrix after cure. While acting as reactive plasticizers during processing and preventing embrittlement over service life, this also means that they cannot leach out into the environment during or even beyond their service life.

For more information, visit www.synthomer.com/lithene.

**The liquid polybutadiene technology discussed in this article is Synthomer's Lithene™. Images courtesy of Synthomer.*

FEATURE

SHAPING THE FUTURE NEEDS OF SEALANT FORMULATORS

Ingredient selection provides a fresh opportunity to drive value and underpin sealants' commercial performance with a stronger value proposition.

By Tony Bruce, Sales Manager-Performance Chemicals UK & Ireland, Cornelius Group

It's clear that we are entering a new age of innovation, and nowhere is this more apparent than in the performance chemical sector. As commerce reactivates following a turbulent and unpredictable year across every sector, many brands operating in the adhesive, sealant, and coating markets are looking toward the next wave of new product development.

While logistical challenges and reduced operational headcount have slowed new product development for many businesses, it's time to put the foot back on the accelerator. Naturally, in an environment that relies so heavily on performance chemicals, it's imperative that brands are able to evolve and adapt to current market conditions.

Switching Fumed Silica for Clay Alternatives

Taking a view on rheology modifiers for aqueous acrylic sealants, there is a strong and growing case for eliminating fumed silica from formulations. Used as a universal thickening agent and desiccant, the challenge for formulators is that fumed silica is not particularly simple in terms of handling. It can easily become airborne, presenting a health and safety risk.

Because of this, a switch away from fumed silica can contribute to both health and safety and corporate sustainability strategies. The great news for formulators is that alternatives are available. Hectorite clays are set to play a much bigger role over the coming year as formulators make smaller, incremental steps in reformulation.

Aqueous acrylic sealants (i.e., caulks) are traditionally used as joint fillers or grouts. Fumed silica is typically used in this application, but hectorite clays are proving a safer and easier-to-handle alternative with a number of benefits. In addition to high low-shear viscosity, hectorite clay alternatives offer strong shear thinning and low sheer stress at high shear flow, resulting in excellent extrudability.

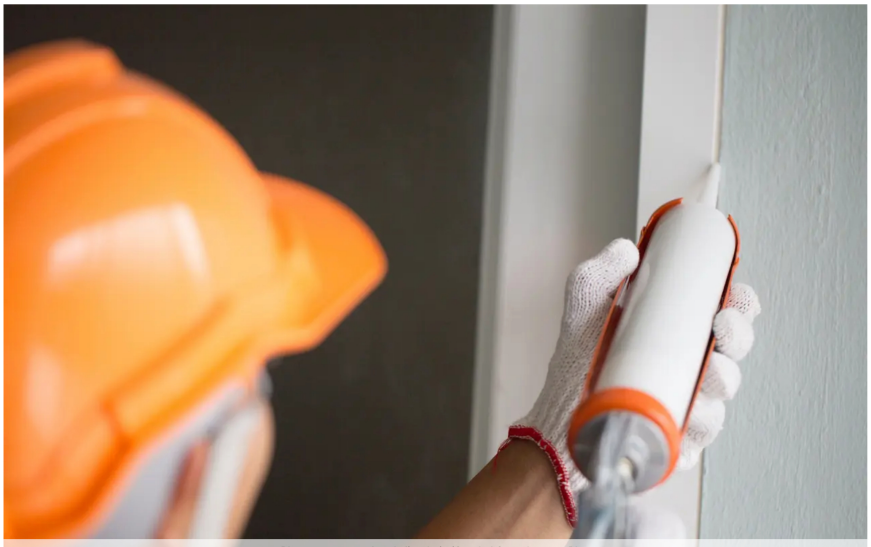

Photo courtesy of undefined via iStock / Getty Images Plus

Clay-based rheology modifiers* combine high performance and dispersibility with stability. Due to ionic substitution, the force between platelets is reduced, meaning the platelets can be separated with relative ease as water molecules diffuse in between them. As more formulators look to replace fumed silica in water-based formulations, clays provide a powerful alternative.

Volume, Volume, Volume

The sheer scale and immediacy of the COVID-19 pandemic caught businesses by surprise. While many directly consumer-facing brands found relative stability as DIY home projects became a priority and demand outstripped supply, those supplying exclusively to trade have found a much tougher time as work becomes delayed and projects postponed.

The well-documented "panic buying" phase of the pandemic put massive pressure on the performance chemical supply chain, as well as the sealant brands it serves. The challenges highlight just how vital a consistent and agile supply chain can be—from ingredient sourcing through to material handling and storage.

The changing balance between trade and consumer also points toward an evolution in how sealants are marketed. This underlines the importance of having both a B2B and B2C offering. While it's still common for brands to put sharp focus on one commercial approach (i.e., "for the trade, by the trade" or DIY-friendly ranges), the fluctuating nature of business has shown that a combined approach can be commercially protective under the right market circumstances.

Acceleration to Net Zero

The overall demand for carbon dioxide (CO_2) reduction is front of mind for every industry today. Sealant formulators are accounting for this in new product development, particularly in products set to be range mainstays or core products.

Photo courtesy of Petmal via iStock / Getty Images Plus

Brands need to be aware of a number of additional considerations. Evaluating CO_2 output and the overall "carbon cost" of a product need to account for the product's global journey, sourcing, processing energy requirements, and logistics. To create a business that's carbon neutral, formulators are moving much faster toward localized manufacturing that reduces physical transportation requirements, as well as ingredients that are minimally processed.

Organic Thixotropes

Formulators of adhesives and sealants are seeing an ever-expanding selection of options when it comes to rheology modification for new product development. One of the most compelling is organic thixotropes, usually based on diamide or castor waxes. Today's organic thixotropes, like organoclays, compare favorably to fumed silica. The latest generation of organic thixotropes is designed for efficiency and exemplary rheology.

Crucially for formulators, organic thixotropes provide a way to speed up the manufacturing process with new efficiencies. They're also particularly versatile, with stable viscosity in a low temperature range between 35-60°C. It is easy to formulate with organic thixotropes; they are also simple to extrude, with no signs of thread formation.

Commercial Potential for Antimicrobial Sealants

As a result of the global pandemic, there is a great deal more discussion on potential growth for antimicrobial sealants. These products use careful ingredient selection and more delicate formulation to build hygiene directly into the product. The building and construction sector is seeing a renaissance in post-COVID safety technology, even down to the materials used during builds.

Contractors are looking for every safety edge available, which creates more sales opportunities for products that can boast antimicrobial claims. Sealants that can neutralize potential pathogens can be a particularly attractive proposition in areas such as schools and healthcare facilities, which rely on more consistently sterile conditions.

Photo courtesy of gerenme via iStock / Getty Images Plus

Future Innovations

To condense a highly changeable market down to the essentials, sealant formulators are currently looking toward a real innovation surge and the dovetailing of several important themes. At the core, particularly as the industry recovers from a volatile year, are the heightened needs for sustainability, stability, and volume.

More than ever, ingredient choices in formulations are made strategically, with performance additives having a much more diverse role to play beyond simply modifying the characteristics of sealants. A more strident ingredient selection process provides a fresh opportunity to drive value and underpin commercial performance with a stronger value proposition.

For more information, visit www.cornelius.co.uk.

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FEATURE

SEVEN WAYS ADHESIVES PUSH EV DESIGN FORWARD

Adhesives offer significant advancements in electric vehicle safety, cost, durability, and performance.

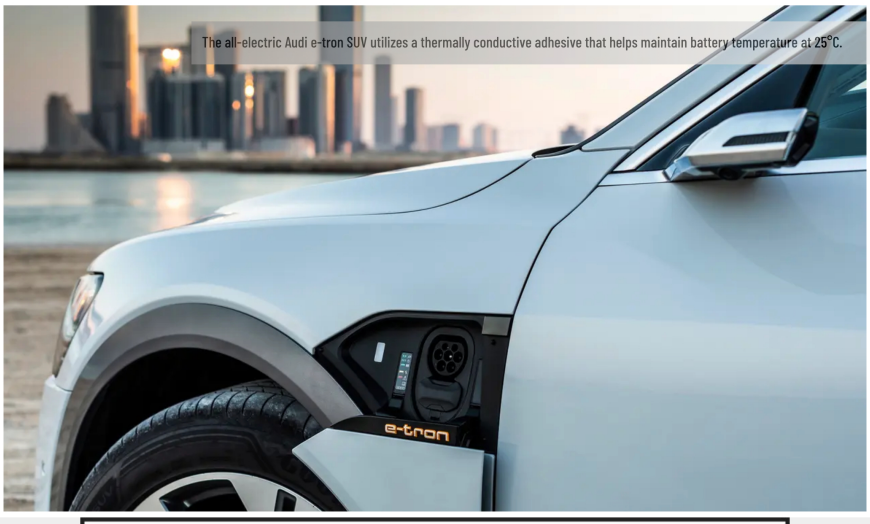
By Andreas Lutz, Ph.D., Global Technology Leader, DuPont Mobility & Materials

The transformation of the world's vehicles from internal combustion engines (ICEs) to electric vehicles (EVs) relies in large part on what holds the vehicles together—namely, adhesives. A wide portfolio of adhesive solutions is helping automakers worldwide mass-produce EVs that are safer and perform better than ever. Here are seven ways adhesives—including some that also function as a thermal interface material (TIM)—are helping advance EV design.

Thermal Management to Improve Battery Durability

One of the biggest challenges in designing batteries for plug-in hybrids and EVs is thermal management of the battery pack. Battery components must operate within a window of 15-60°C during operation and charging. Operation in extreme temperatures outside this range can strain batteries. If it's too cold, performance, efficiency, and range suffer. If it's too hot, the battery deteriorates, shortening its life and possibly creating safety issues.

Specialty adhesive and TIM formulations that are thermally conductive help maintain optimal battery temperatures during charging and operation, thus extending vehicle range and enhancing vehicle safety. A recent collaboration resulted in the application of a thermally conductive adhesive* for the all-electric Audi e-tron® SUV that maintains a battery temperature of 25°C—the sweet spot for optimum battery performance.



The all-electric Audi e-tron SUV utilizes a thermally conductive adhesive that helps maintain battery temperature at 25°C.

The thermally conductive polyurethane structural adhesive transfers heat in both directions between the battery and heat sink, even during the e-tron's super-fast 150-kW charging. The adhesive's properties also help avoid hot spots in the battery pack that could lead to thermal runaway.

By either transferring heat or extracting heat, the thermally conductive adhesive helps extend battery cell lifetime and driving range. The material's combination of higher modulus and elongation helps ensure that the battery and the bonded substrates can last up to 15 years (i.e., the projected life of the vehicle). This is also important because sustainability regulatory bodies suggest that some batteries may be repurposed in other vehicles or gain second lives as energy storage solutions.

Efficient thermal management between battery packs and cooling units made possible with adhesives and TIM also means longer driving ranges for EVs. This longer range frees drivers from "range anxiety," which is one of the biggest reasons consumers hesitate to embrace EVs.

Thermally conductive polyurethane material is applied between EVs' battery cells and cooling plates to help control heat by maintaining thermal conductivity over an optimal temperature range.

Adhesives Help Improve EV Safety

Foremost in every vehicle design is safety. With EVs, the massive battery pack poses a risk of fire or electrocution if it's not properly insulated and secured. Adhesive bonding is a key joining technique that provides crash durability and thermal conductivity while keeping the battery at a safe temperature.

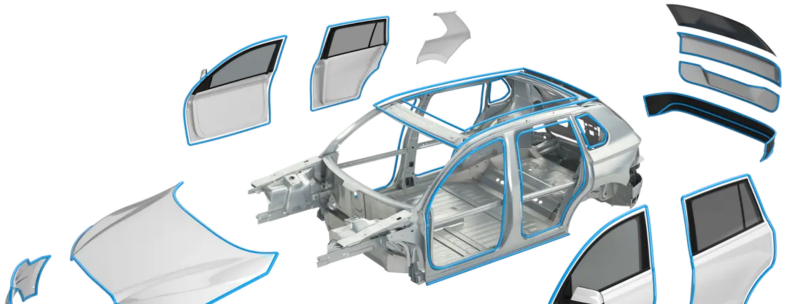
Adhesives also make auto bodies stronger. When the London EV Co. redesigned London's classic black taxis into range-extended hybrid electric vehicles, the lightweight, extruded-aluminum body was assembled with structural adhesive. The continuous bondlines of adhesive are integral to making stiffer, stronger, and more crash-durable taxis that help protect drivers and passengers.

Enhanced Acoustic and Driving Performance

Structural adhesives help improve EVs' acoustic and driving performance. To understand why, it helps to look at how EVs differ from ICEs in terms of body construction.

Structural adhesives that replace welds and mechanical fasteners create rigidity that provides better handling while reducing noise, squeaks, and vibration. Reducing road noise is especially important in these quieter running vehicles.

In newer EVs, the battery pack itself serves as the floor of the passenger compartment. Battery packs bonded with adhesives create a low center of gravity that translates into a more dynamic driving experience.



Structural and multi-material bonding adhesives add stiffness for durability and crashworthiness while also reducing vibrational energy for improved acoustics.

Ability to Bond Dissimilar Materials

Have you ever noticed how many different materials are used to build vehicles? Traditionally, the primary material for automotive structural components has been metal. The objective to reduce greenhouse gas emissions has transformed the composition of structural components, which now include the use of plastics, composites, and other materials, creating a need for a new generation of adhesives to bond a variety of substrates.

Multi-material bonding adhesives help bond dissimilar substrates, including high-strength steel, aluminum, plastics, composites, magnesium, glass, and carbon fiber. The continuous bondlines in these structures add stiffness and strength for safety while eliminating weight associated with heavier metal structures that utilize mechanical fasteners. In fact, the composite bonding adhesives used to construct the redesigned London black taxis eliminated all mechanical fasteners.

Lighter Weight Vehicles

The lighter an EV is, the longer its range. However, one of the heaviest components of an EV is the battery pack. Structural and thermally conductive adhesives for battery pack assembly can significantly reduce the number of components and reduce the battery pack weight by up to 30 kg.

Body bonding solutions also help reduce vehicle weight. High-performance adhesive solutions can contribute to achieving a fully bonded structure that is stronger and lighter than equivalent steel construction. In addition to increased safety for the occupants, the weight savings contributes to greater efficiency.

Optimized Costs

Currently, EV batteries account for one-third of the overall vehicle cost. The simpler the battery pack, the less cost required for materials and assembly. The same adhesive technologies that reduce weight also enhance battery pack assembly efficiency. By enabling manufacturers to use fewer components, structural and thermally conductive adhesives help optimize costs for battery pack design.

Advances in Sustainability

Having a great design for an EV is one thing; sustainably mass-producing and keeping those cars on the road long term is another. As EVs evolve, work is ongoing to solve the challenge of providing safe, efficient transportation for people and goods while reducing CO_2 emissions.

In addition to structural adhesives that enable lightweighting to help lower fuel consumption and increase EV range, adhesive technologies advance sustainability during production and over vehicle life. Examples include:

- A VOC-free adhesive for bonding glass to other materials that does not require the use of primers, cleaners, or activators, allowing assembly and repair facilities to reduce their VOC emissions
- An adhesive that acts as a thermally conductive bonding agent that's designed to also allow easy removal of battery modules, enabling repair, reuse, repurpose, or ultimately recycling
- An adhesive** that supports sustainability in two ways: by keeping EV batteries cool during super-fast charging and operation, which extends battery life; and by reducing the number of components needed, thus reducing the need for raw materials

Adhesive formulations can be fine-tuned based on the production process at individual OEMs while integrating circular economy practices. Variables such as viscosity, application temperature, and cure time can all be addressed with customized solutions that provide the desired performance for deliverables like conductivity, Young's modulus, and strength, as well as product lifecycle impacts.

Poised to Meet Future Needs

These seven benefit areas for using adhesives to advance EVs are just the beginning. Innovation hubs for the next generation of adhesives will accelerate the adoption and development of new technologies that will help auto manufacturers validate new concepts faster. Ultimately, these new adhesives will reduce the time it takes to get EVs to market and get more sustainable vehicles on the road.

For more information, visit www.dupont.com/mobility.

**BETAFORCE™ TC, from DuPont **Edison Award-winning BETAFORCE 2800 TC, from DuPont. All images courtesy of DuPont.*

FEATURE

SOLVING CHALLENGES IN EV BATTERIES WITH PRESSURE-SENSITIVE TAPES

The electric vehicle space is an area that will provide a tremendous opportunity to converters and others working with high-performance, pressure-sensitive adhesive (PSA) tapes.

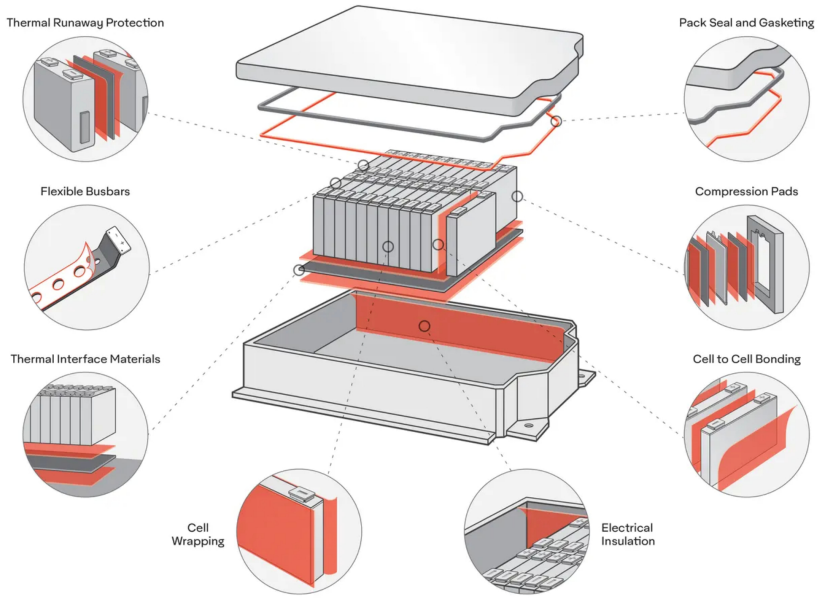
By Scott Krusinski, Product Manager for Aerospace, Automotive, and Transportation, Avery Dennison Performance Tapes

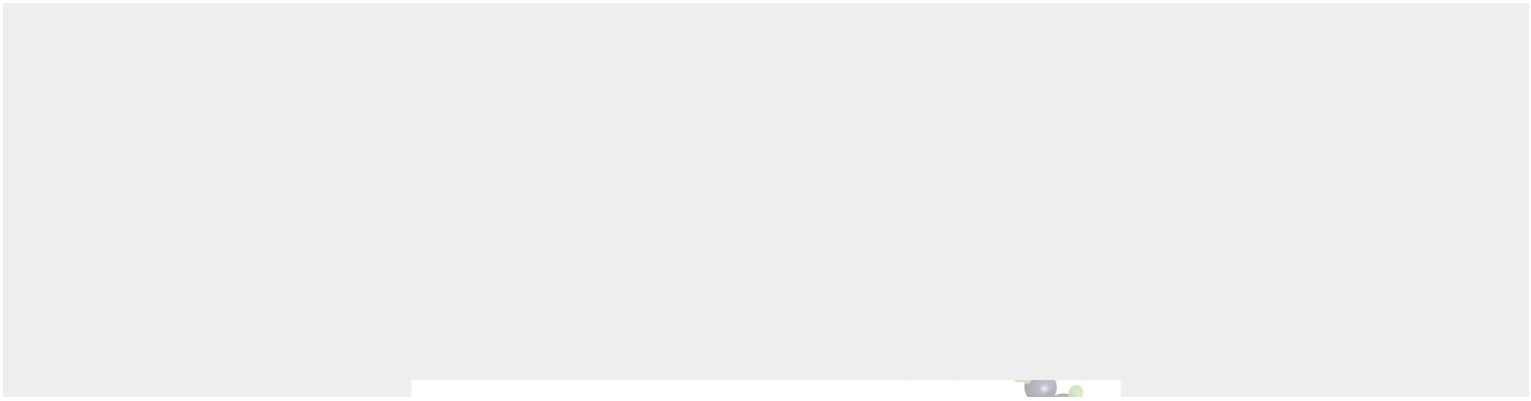
Automakers are investing heavily in electric vehicle (EV) technology and are setting long-term goals for phasing out internal combustion engines. This strategic shift is driven by government policy, long-term competitiveness, and innovations in lithium-ion technology and production that have extended the EV driving range and reduced battery pack costs.

At the same time, more drivers are rethinking internal combustion engines in favor of electric motors powered by state-of-the-art battery packs. Lithium-ion batteries enabled the earliest EVs, and they remain the most common power supply for the latest models coming off of today's assembly lines.

The EV space is an area that will provide tremendous opportunities for converters and others working with high-performance, pressure-sensitive adhesive (PSA) tapes. EV batteries provide a range of applications for converted, pressure-sensitive materials that enable those packs to be more efficient, safer, and easier to assemble.

Figure 1. EV batteries provide a range of applications for converted, pressure-sensitive materials.





Pressure-sensitive materials are suited for providing solutions for some of the most frustrating challenges that have faced OEMs and battery pack manufacturers as they have raced to improve their technologies. The major issues include reducing flammability, boosting dielectric strength, and protecting battery pack materials.

Acrylic- and silicone-based adhesives with flame-retardant* properties allow composites and other materials to meet UL® 94 V-0 and additional flame requirements. To address dielectric strength, single- and double-coated tapes incorporate dielectric films. OEMs and pack manufacturers should seek out materials and adhesives that are tested for breakdown voltage and dielectric strength requirements using GB/T 1408.1-2016 and ASTM D3755 test methods. To help protect pack materials, single- and double-coated tapes provide dimensional stability. In addition, easy-release liners can help protect delicate materials during assembly.

The converting and tape industry is poised to expand with continued EV growth. Various pressure-sensitive tape technologies can help solve the industry's challenges with specific EV battery applications that converters can employ.

Cell-to-Cell Bonding

PSAs offer a quick and strong way to provide structural integrity in an EV battery pack. The use of pressure-sensitive tapes to bond pouch and/or prismatic cells together in EV battery pack assemblies offers key benefits:

- PSAs require no cure time, with immediate strength; they can act as an assembly aid and bonding solution, unlike liquid-applied products
- There is no need for mixing nozzles or pot life concerns, as PSAs feature single-component functionality
- Flame-retardant and dielectric tapes are available when there are flame or electrical requirements

Thermal Runaway Protection

Various materials are dedicated to preventing thermal runaway events, in which a domino effect of fire spreads from cell to cell in the battery pack. EV and battery manufacturers have strict requirements to protect against thermal runaway events and rely on mica, ceramic fibers, and other materials for protecting cells and passengers. Many solutions are available for bonding these materials to cells, modules, and pack structures:

- Flame-retardant adhesives that enable composites and materials to meet UL® 94 V-0 and other flame requirements
- Single- and double-coated film tapes for fiber encapsulation and dielectric strength
- Easy-release liners for preventing the cohesive failure of delicate, fibrous-based materials

Flexible Busbars

Flexible, printed circuits require electrical insulation and flame resistance. Busbars offer flexibility, safety, and cost effectiveness in EV battery applications. Adhesives are used to protect these flexible, printed circuits, and the bonds provide electrical insulation and flame retardancy.

Thermal Interface Materials

Thermal interface materials (TIMs) facilitate the transfer of heat between components in EV battery assemblies. Multiple adhesive solutions for TIMs bonded to either heat sinks or chiller plate materials assist with battery cell and battery module cooling. These include:

- High wet-out adhesives to lower thermal impedance between TIMs and the heat source
- Silicone-based PSAs offer excellent adhesion to silicone TIMs
- Acrylic-based PSAs offer first-rate adhesion to non-silicone-based TIMs
- Flame-retardant adhesives, tested in accordance with UL® 94 V-0, are also available

Electrical Insulation

Electrical insulation and cell wrapping are critical for protecting specific sensitive components in EV batteries. The best solution involves single- and double-coated tapes incorporating dielectric films for electrical insulation in EV batteries.

Double-coated tapes can be combined with other materials, such as compression pads, to achieve electrical insulation. Single-coated tapes can be applied to rigid materials like aluminum chill plates and other metal structures.

Compression Padding

Compression padding materials protect individual cells from damage caused by impact, movement, or swelling. Pressure-sensitive tapes are used to bond compression pad foam that protects EV battery cells.

Individual prismatic and pouch cells in EV battery packs need protection from impact and movement. Pouch cells can also swell during charging and discharging. To help prevent damage, EV battery manufacturers place foams backed with pressure-sensitive tape between each cell. The use of pressure-sensitive tapes for cell cushioning offers some key benefits:

- Requires no cure time and provides immediate strength; can act as an assembly aid and bonding solution, unlike liquid-applied products
- Full coverage adhesion between the metalized polyester pouch cell and cushion foam
- Flame-retardant and dielectric tapes are available when there are flame or electrical requirements

Pack Seal and Gasketing

Creating a tight seal for components is critical in the construction of EV battery assemblies. Heat-activated acrylic foam tapes help maintain a watertight seal between the casing and rubber gaskets. Acrylic foam tapes offer the following features:

- High durability and strength for demanding environments, shock absorption, and dynamic resistance
- Acrylic foam core enables gap filling between rigid components
- A continuous bondline helps seal out unwanted intrusion and reduces the need for fasteners

Collaborative Effort

Pressure-sensitive tapes are easy for converters, OEMs, and pack manufacturers to apply/assemble, and they provide a slim profile and a continuous bond across a large surface area. They are also generally lighter than mechanical fastening systems, which is a critical property as the automotive industry looks for ways to reduce battery pack and overall vehicle weight.

As electric vehicles and EV batteries continue to evolve, unknown needs and trials will develop. OEMs, tier suppliers, and converters will need to work together closely to understand the engineering challenges and design requirements to develop effective and reliable solutions.

For more information, visit https://tapes.averydennison.com/evbattery.

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FEATURE

ELIMINATING ADHESIVE BUILDUP WITH AIR-OPERATED DOUBLE-DIAPHRAGM PUMPS

Next-generation diaphragms have been designed to meet the pumping challenges inherent in the sticky and viscous materials that are the foundation of adhesive and coating manufacturing.

By Erik Solfelt, Diaphragm Pump Product Director, Wilden®

It's simple: without adhesives, the world would literally fall apart. They are utilized in almost every industry in the world and in the manufacture of millions of unique products, with the highest concentration in the packaging, automotive, electronics, building and construction, home goods, textiles, and transportation markets.

A key component in the adhesive production chain is the pumps that are used to transfer raw materials and finished products. The adhesive manufacturing process typically involves a roster of solvents, catalysts, and resins combined together in order to create the finished adhesive product.

As a result, the pumps that are used to facilitate the adhesive production process must be versatile, reliable, and robust enough to handle liquids of many different types and structures, including those that may be corrosive, abrasive, or hazardous. Positive displacement air-operated double-diaphragm (AODD) pumps—especially those that are outfitted with next-generation diaphragm technologies—possess the operational and compatibility capabilities for use in the manufacture of the adhesives that help keep the world in one piece.

The Challenge

One of the main challenges in manufacturing adhesives—whether the process is water based, solvent based or hot melt—is the fact that they are sticky, viscous liquids. In other words, the "adhesiveness" of adhesives can make them particularly difficult to produce.

This can be a truly visceral challenge for operators and maintenance teams, as chemical adhesives (along with some technically non-adhesive products such as latex coatings) often form a buildup, known as "skins," on the pump's internal passages and components. This buildup is particularly common on the outer piston of traditional diaphragm designs, which require an inner and outer piston to hold the diaphragm in place. The outer piston inherently has added surface area and space for buildup to occur.

A new integral piston diaphragm (IPD) reduces the risk that damaging product buildup will occur in AODD pumps.

This buildup can cause problems in several ways:

- Slough off into the product stream, where the bits of hardened adhesive clog filters, pipes, etc.
- Slough off and get stuck in the pump itself, which will minimally reduce overall performance and potentially cause the pump to stall; smaller internal clearances related to the buildup can lead to premature wear
- Remain attached to the outer piston, with the growing buildup damaging the pump's liquid chamber

These buildup issues result in increased maintenance, cleaning, and repair of wear components. In AODD pumps, this means the balls, seats, and diaphragms that are integral to the pumping process are affected. In addition, increased downtime can result when the pump needs to be taken offline for cleaning and maintenance. This makes meeting strict production schedules much more difficult.

Operators and maintenance teams often take the brunt of the true challenge when removing adhesive buildup from process equipment and pumps. In many cases, the only way to remove the buildup is with the use of a hammer and chisel. In facilities where the use of hazardous materials means the operation must be entirely explosion proof, no power tools can be used. As a result, the hammer-and-chisel method is often the only method available for adhesive buildup removal.

This is not only personally frustrating for whoever is charged with removing the buildup. In the worst-case scenario, the only possible outcome may be to simply replace the old pump with a new one, which can harm the operation from a financial perspective.

The ultimate downside to adhesive manufacture, no matter the pump technology being used, is the fact that all of the operation-hampering scenarios that result from product buildup will eventually combine to result in pump failure. In addition to excessive replacement costs, product leakage can compromise operational safety, as well as the safety of site personnel, surrounding communities, and the environment.

The Solution

A new diaphragm* has been designed to combat the deleterious effects that adhesive buildup can have on the operation and reliability of traditional two-piece AODD pump diaphragm designs. This diaphragm features a one-piece integral piston diaphragm (IPD) design that encases the outer piston within the diaphragm material**. The material, which reduces the potential for any product buildup to occur during normal operation, also benefits the operator through its excellent flex life, high chemical and abrasion resistance, and durability. These properties lead to longer service life, as well as lower maintenance and replacement costs.

In effect, the design of the new diaphragm takes the stickiness, high viscosity, and product buildup concerns that are common in the transfer of adhesives and makes them irrelevant. This also serves to make them easier to clean than traditional diaphragm models, therefore saving time and money by enhancing the speed of product changeovers. Finally, the IPD design eliminates a potential leak point around the outer piston and the failure-causing abrasion points at the outer piston, extending diaphragm life.

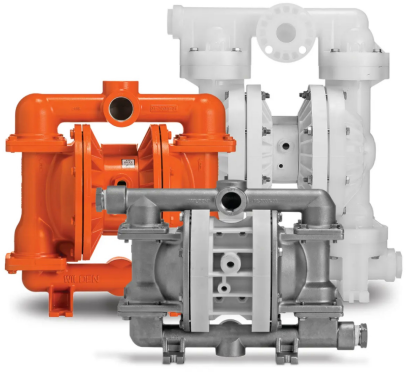
What further differentiates the new diaphragm from other IPD designs on the market is that it utilizes full-length shafts, which provide the same performance as the standard diaphragms. Other IPDs also require a shorter stroke, which gives them reduced flow and reduced suction-lift capabilities. This reduction is exacerbated when handling a highly viscous fluid, which makes it more difficult and time consuming to get the product into and then out of the pump.

The diaphragms' construction material makes them 50% less expensive than PTFE-laminate models. They are compatible with many bolted metal and plastic pump models at operating temperatures ranging from -40 to 225°F.

Improved Processes

The world wouldn't function properly without adhesives, and adhesives producers can't function without the proper pumping technology. AODD pumps have proven to be a leading choice in adhesive manufacturing applications. Their capabilities are enhanced further through the benefits that the new diaphragms can offer, specifically as they relate to eliminating product internal buildup. While there is no guarantee that product buildup will be eliminated completely, the design of these IPDs greatly reduces the chance of potential buildup when compared to other IPD designs.

The lack of product buildup also eliminates a major headache for operators, who no longer need to worry that their AODD pumps will become fouled or that any part of the buildup may slough off into the product stream. The result is an upgraded AODD pump that is easier to use and maintain. This creates a safer, more efficient, and more reliable production process for some of the world's most important products.



The use of next-generation IPDs can improve the performance, safety, and reliability of metal and plastic bolted AODD pumps.

For more information, visit www.wildenpump.com.

**The Chem-Fuse Diaphragm **Typically Wil-flex™, which is constructed of Santoprene® Images courtesy of Wilden.*

CASE STUDY

SOLVING GLUE TRANSFER CHALLENGES WITH PERISTALTIC PUMPS

A world-renowned paper tissue manufacturer is enjoying multiple benefits following the selection of peristaltic pumps for the transfer of a glue/ink mixture used in its manufacturing process.

By Simon Hooton, Technical Product Manager, North Ridge Pumps Ltd.

Peristaltic glue pumps have the ability to self-prime and transfer high-viscosity fluids while featuring a seal-less design.

Careful consideration must be taken with pump selection when handling the transfer of glues. Depending on the type, these adhesives can be highly viscous and often harden and solidify when exposed to air. Glues are typically either water or solvent based; in this instance, the former is relevant.

Polyvinyl acetate (PVA) is a common example of water-based glue, comprising natural or synthetic soluble polymers that are added to water to form the liquid. This type of product only works if the applied surface is permeable (e.g., wood and paper). The glue sets once the water has evaporated from the surface; the bond can then be broken easily with the reapplication of water. These glues are popular as they are low in cost and environmentally friendly.

Process Background

A world-renowned paper tissue manufacturer was having difficulty with the existing pumps that it used for the transfer of a glue/ink mixture used for various processes in its manufacturing plant. The company had previously purchased a peristaltic pump from North Ridge Pumps for an ink application and wanted to replace other pumps with the same technology.

The company has a large holding tank that contains the mixture, along with smaller day tanks located throughout the plant next to different machinery, dependent on the process. The purpose of the unit is to fill the smaller tanks on demand and to ensure they never fall below a minimum level that could cause production to stop. For this company, 1 hr of downtime equates to around £3,000 (approximately $4,200) of lost revenue, so it was crucial that the solution selected would be reliable and quick to maintain if a fault occurs.

While the average flow rate required to meet demand is 500 L/hr for this company, the production manager wanted the ability to increase flow up to 900 L/hr if demand increased, an ability they did not previously have. The glue mix is viscous, so the pumps needed to be capable of handling the high viscosity while self-priming from the feed tank. The capability to clean the pumps easily was also a must, as it is crucial to avoid the product setting within the unit after production has completed.

Hose pumps can dry run indefinitely, which allows all the product to be emptied completely from the hose without the potential to cause the damage that can be encountered in mechanically sealed designs.

Non-Clogging, Low-Maintenance Solution

Peristaltic glue pumps have the ability to self-prime and transfer high-viscosity fluids while featuring a seal-less design. The only component that encounters the fluid is the internal rubber hose, which is easily cleaned by flushing through warm water after demand has finished.

The absence of a mechanical seal, balls, and valves found in other pump designs ensures the pumps do not become clogged. The ability to reverse the flow is also a helpful feature, if somehow a clog does occur. Hose pumps can dry run indefinitely, which allows all the product to be emptied completely from the hose without the potential to cause the damage that can be encountered in mechanically sealed designs.

The tissue manufacturer chose to install two peristaltic hose pumps with built-in variable speed drives, which allow the flow rate to be altered by simply rotating a potentiometer dial located on the motor. Having the inverter directly mounted on the motor negates the need to install an external local inverter, something that the customer wanted to avoid.

The installation also included emergency stop buttons on the pump motors so that the glue pumps can be stopped without having to reach a control panel. In addition, reverse switches allow flow to be reversed if required (e.g., if too much product has been transferred or a blockage occurs).

The final feature for both pumps is a hose leakage detector. If the internal hose has ruptured, the sensor sends a signal to the control panel to warn the operator. This allows the fault to be detected early and for maintenance to be performed quickly before production loss occurs, minimizing downtime and ultimately saving costs.

To complete the installation, a spare hose and lubricant were supplied. As the hose is the only wearing part, the number of spare parts required on site is quite low. Simply replacing the hose and applying the grease is all that is required to get the pumps operational again after a rupture.

Lower Costs, Higher Efficiencies

The tissue manufacturer has saved over £30,000 (~ $42,000) in lost production output since the peristaltic pumps have been installed. “Since we changed the design of our ink and glue transfer pump, we have reduced the time taken to service the pump to 1/5th of what we previously did, the number of spares kept on stock has reduced by around 90% and overall we are operating far more efficiently, finding we experience far fewer emergencies,” the company’s plant maintenance engineer said.

For more information, visit www.northridgepumps.com.

Images courtesy of North Ridge.

WHAT'S NEW

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PHOSEON TECHNOLOGY

Near-Infrared LED Lamps

FireJet™ and FireEdge™ NIR Explorer near-infrared lamps reportedly offer technology advances for curable adhesives, 3D printing, and pinning on low migration applications. According to the company, the near-infrared LED lamps provide customers with a small form factor, instant on/off, and lower power consumption compared to traditional NIR lamps.

"Phoseon's cutting edge NIR LED systems are ideal for novel NIR curable adhesives and R&D on such applications," said Simon Reissmann, technical marketing engineer. "Further, this technology has shown potential in pinning and improving print quality on water-based and hybrid inks (low migration) in inkjet printing before the final curing stage."

www.phoseon.com

CHARLESS ROSS & SON CO.

Vacuum-Rated Double-Cone Tumble Blenders

The model DCB double-cone tumble blender is designed for large-scale yet intimate blending of free-flowing solids in a full suite of laboratory, pilot, and production sizes. In a highly repeatable process, according to the company, minor and micro ingredients are thoroughly distributed throughout the batch more gently than in the more common V-shaped geometry without damaging fragile or sensitive components.

Rated for vacuum up to 29.5"Hg, the jacketed 75-cu-ft model DCB-75 double-cone tumble blender shown here reportedly heats and dries product with superior efficiency as it is being blended. Other features include gas purging capability, a 16-in. pneumatically operated discharge valve, five-passage rotary union, explosion-proof brake motor, and PLC controls.

www.mixers.com

Pads with StayX reportedly remove cleanly from fabrics and have a stable peel performance across temperatures. The adhesive performance is not affected by the presence of perfume. Most notable for consumer satisfaction, pads with StayX adhesive technology stay in place during typical movements of life, ensuring a comfortable and reliable experience for consumers.

www.bostik.com

DELO AND INFOTECH

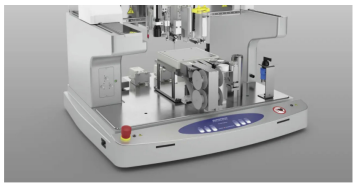
3D Printing System

DELO has collaborated with Infotech on a 3D printing system that features a dispensing unit that can be equipped with up to three different dispensing valves. Depending on the properties of the printing media and the structures to be dispensed, users can choose from a variety of established dispensing valves, like jet

valves, time-pressure valves, or screw dispensing systems. Each valve sits on a separate vertical axis.

Since the dispensing heads can be operated in parallel, it is possible to combine different liquid materials in one printing process. Linear axes and integrated real-time control ensure maximum dispensing precision.

www.delo-adhesives.com



ASK DR. DAVE

DEALING WITH DIFFERING COEFFICIENTS OF THERMAL EXPANSION

We are using epoxy adhesives to bond steel substrates that are exposed periodically to both 150°C and as low as 0°C. Our problem is in maintaining adhesion to the two steel surfaces at such divergent temperatures because of the response of materials to thermal conditions when going through heating and cooling cycles. Do you have any suggestions?

Differences in thermal expansion coefficients between substrates and adhesives can cause big problems in many applications. In extreme cases, I have seen epoxies used to bond glass to stainless steel, and the glass has cracked on heat-curing the adhesives.

Adhesives generally have thermal expansion coefficients some 4-10 times higher than metals. This can create large stresses in the joints on temperature cycling, and often these stresses will cause debonding from the surfaces.

The solution to the problem usually involves a complete joint redesign to eliminate the stress buildup (this sounds unlikely to happen in your situation), modifying the thermal expansion coefficient of the adhesive, or making the adhesive more flexible so the stresses can be dissipated. High levels (30-60%) of, for example, a silica filler that has a very low thermal expansion coefficient will bring your adhesive much closer to the expansion coefficient of the steel. Some epoxy adhesives are highly filled and have low thermal expansion coefficients.

The other approach is to make your adhesive much more flexible by incorporating elastomers. Maximizing adhesion to the surfaces is obviously important in sealing as well, and make sure you incorporate suitable adhesion promoters into the adhesive or use a primer on the metal before bonding.

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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Cotronics also supplies high-temperature epoxy and ceramic adhesives, epoxy and ceramic potting compounds, putties, castable ceramics, machinable ceramics, repair materials, and a full line of insulation products. Materials are designed to be the answer for any high-temperature application in the electrical, structural, or industrial industries.

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