

SEPTEMBER 2026

RubberWorld¹³⁷ years

THE TECHNICAL SERVICE MAGAZINE FOR THE RUBBER INDUSTRY VOLUME 274, No. 6

**RUBBER DIVISION MEETS IN LOUISVILLE
FOR GLOBAL POLYMER SUMMIT**

**Development of polycarbonate polyols for
high performance polyurethane dispersions**

**Polyurethane spray foam and electrical wiring:
Unraveling thermal stability**

**Novel quality control approach to optimize
the mixing process of silica based gasket formulations**

**A circular future for NBR/SBR flooring:
Use of recycled ground tire rubber over fossil fillers**

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by Yoichi Hirose, Asahe Kasei. Newly developed DK031E and PCDX-249 are designed to address the issues associated with aqueous dispersions of polyurethane (PUDs) offering the potential to reduce solvent usage.

64 Polyurethane spray foam and electrical wiring: Unraveling thermal stability

by Renjith Rajan Pillai, James D. Hammon and Brent Williams, Creative Polymer Solutions. This study presents a comprehensive evaluation of the thermal and chemical stability of commonly used electrical wire components subjected to polyurethane spray foam application.

72 Optimizing the mixing process of silica based gasket formulations

by Michele Scacchi, Davide Giorgiotti and Denis Venturoli, Evercompounds S.p.A. A novel quality control approach to optimize the mixing process of a washing machine door gasket in a silica based formulation assesses the filler dispersion.



83 A circular future for NBR/SBR flooring: Minimizing fossil fillers and maximizing recycled ground tire rubber

by Christos K. Georgantopoulos, Omya International AG; and Luis Monteiro Goncalves and Michael Christensen, Genan S.A. By partially substituting virgin rubber and carbon black with ground tire rubber and other minerals, NBR/SBR flooring systems maintain mechanical performance, while reducing their carbon footprint.

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Tire contains recycled materials

As part of the EU funded ZEvRA project, Continental has developed a concept tire made from around 43% recycled materials, including recycled tall oil, steel, rubber from end-of-life tires and polyester fibers made from recycled PET bottles. The concept tire highlights the potential of innovative material approaches. It also demonstrates the need for a reliable framework when adopting recycling technologies on an industrial scale.

“Circular materials can help save resources and energy, while reducing greenhouse gas emissions. They are key to making mobility more sustainable,” said Andreas Topp, head of Platform Development and Industrialization for passenger car tires at Continental. “We have extensive experience in developing high performance materials from renewable and recycled sources. Our concept tire shows what is technically possible today, while serving as a catalyst for the innovations of tomorrow,” he added.

The project name ZEvRA stands for zero emission electric vehicles enabled by harmonized circularity. The two-year EU project is aimed at optimizing the circular economy of electric vehicles along the entire value chain. Continental is the only tire manufacturer in the consortium.

Louisville hosts GPS and Expo

This September issue of *Rubber World* arrives to you at the 2026 Global Polymer Summit (GPS), including the Rubber Division’s 210th Technical Meeting, Expo, Educational Symposium, Science & Technology Award winner presentations, networking receptions and meetups, Awards Ceremony, and many other events taking place at the Kentucky International Convention Center in Louisville, KY, September 28-30.

Jeff Bana, president and CEO of Yokohama Tire, will present the keynote address, highlighting the convergence of powerful, irreversible forces redefining the rubber industry.

Be sure to pick up your copy of the *Global Polymer Summit Daily* each day. This tabloid-sized publication is filled with important news from the conference, event schedules, special features and photos from the Expo floor.

Take advantage of this excellent opportunity to learn about the latest rubber developments and industry news, conduct business and socialize with valued customers. Please be sure to stop by the *Rubber World* booth (#1032) to say hello. *Rubber World* wishes you much success at the GPS!



Jill Rohrer

RubberWorld

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Business Briefs

Wallace establishes first African operation

Wallace Instruments (www.wallaceinstruments.com), Dorking, U.K., has established **Wallace Instruments West Africa**, a company based in Abidjan, Côte d'Ivoire, marking a significant

ACQUISITIONS, EXPANSIONS

expansion of its support for the natural rubber industry in the region. The facility will include a laboratory and training center, giving existing and prospective customers a place to see Wallace equipment in operation and access hands-on testing and technical guidance.

Continental (www.continental.com), Hanover, Germany, broke ground on its highly automated finished goods warehouse in Mount Vernon, IL. The facility, which represents an investment of approximately \$76 million, is expected to begin operations in 2027.

Olam Agri (www.olamagri.com), Singapore, has acquired **Asia Africa Rubber Industry (ASAF)**, adding 176,000 metric tons of annual rubber processing capacity in Côte d'Ivoire, Africa.

Liberty Tire Recycling (www.libertytire.com), Pittsburgh, PA, announced a major expansion of its gulf coast operations through the acquisition of **All American Tire, Colt Tire Recycling** and **Genan** (the U.S. subsidiary of **Genan A/S**). The acquisitions significantly enhance Liberty's rubber recycling capacity, tire collections and other capabilities across Texas and Louisiana.

Stockwell Elastomerics (www.stockwell.com), Philadelphia, PA, a manufacturer of custom silicone gaskets, conductive elastomer EMI shielding solutions and precision elastomeric components, announced a significant expansion of its manufacturing footprint, production capabilities and technical workforce, with a total investment of more than \$8 million. The company has acquired an additional facility adjacent to its current Philadelphia corporate campus and invested in new manufacturing equipment and engineering resources to support continued growth and better serve customers in aerospace, defense, medical devices, semiconductor manufacturing, electronics, instrumentation and other technology driven industries.

Befar Group (www.english.befar.com), Binzhou, Shandong Province, China, intends to set up a special rubber production complex in Binzhou with an investment of RMB 1.822 billion. The proposed facility will produce halobutyl rubber, said to be an important material used in tire inner liners and other products requiring low air permeability.

Fennell Tyres International (www.fennelltyres.com.au), Kewdale, Australia, part of the **Magna Tyres Group**, has acquired **Bunbury's Tyre Specialists**, strengthening its presence and service capabilities across western Australia.



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Business Briefs

Flexsys enters 6PPD research agreement

Flexsys (www.flexsys.com), Akron, OH, has entered into a cooperative research and development agreement (CRADA) with the U.S. Geological Survey (USGS) to independently

CONTRACTS, LICENSES

and thoroughly evaluate two molecules considered as an alternative to 6PPD used in tires, including their potential effects on aquatic life.

Building on Flexsys' 2023 CRADA with the U.S. Department of Agriculture's Agricultural Research Service, the testing performed under this agreement is said to be a critical step in determining the complete aquatic toxicity profile of these molecules using novel test methodologies that extend well beyond what is typical for a new chemical registration.

PUGL Technology Group LLC (www.pugltech.com), Peachtree Corners, GA, a specialty chemicals company serving the disposable glove manufacturing industry, has signed an exclusive distribution agreement with **Excelkos-Tiarco Sdn.**

Bhd. covering Malaysia, Indonesia, Thailand, Vietnam and Sri Lanka. Under the agreement, Excelkos-Tiarco will represent and sell PUGL Fusion Agent, PUGL's stearate-free release agent, together with PUD 9088, the company's polyurethane dispersion (PUD), for disposable polyurethane glove production. Excelkos-Tiarco will handle sales, technical support and customer trials for both products across the territory.

Shibaura Machine Europe LWB (www.shibaura-machine-lwb.de), Altdorf, Germany, is broadening its reach in Spain by appointing **Puebla Vendrell Engineering System S.L.** as its sales partner. This partnership will enhance the company's foothold in the Spanish market and boost the distribution of its horizontal and vertical thermoplastic injection molding machines.

Biesterfeld (www.biesterfeld.com), Hamburg, Germany, an international distributor of plastics, rubber, specialty chemicals and ingredients, and **Dymax**, an international manufacturer and supplier of light-curing materials, curing equipment and dispensing systems, have strengthened their strategic partnership. Biesterfeld will distribute Dymax's medical grade UV/LED curable adhesives, as well as UV/LED curing equipment in Belgium, the Netherlands and Luxembourg.



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Business Briefs

Alliance supports scientific regulations

The **Global Antioxidants and Light Stabilizers Alliance (GALA)** (www.gala-alliance.org), Worms, Germany, has been created to strengthen industry advocacy and support the safe

CORPORATE, FINANCIAL NEWS

and sustainable use of antioxidants (AOs) and light stabilizers (LS). Representing AOs and LS producers and stakeholders, GALA aims to provide a unified, science based voice to support policymakers, regulators and other stakeholders in making informed decisions about these important substances. GALA will begin its work by establishing three task forces covering strategically important additive families used in plastics, coatings, adhesives, rubber and other polymer applications.

Dunlop Tires North America (DTNA), a subsidiary of **Sumitomo Rubber Industries, Ltd.**, (www.dunloptires.com), Rancho Cucamonga, CA, released a statement on California replacement tire efficiency requirements. DTNA recognizes the environmental objectives behind efforts to reduce tire rolling resistance and improve vehicle efficiency. DTNA's concern is that the new rules do not fully address the complexity of tire design, since a tire is not developed around a single performance characteristic. DTNA believes California must be equally careful to ensure that improving one of those characteristics does not unintentionally compromise the performance, choices, affordability and competition that consumers depend upon from the replacement tire market.

Toyo Tire North America Manufacturing (www.toyotires.com), White, GA, has reached a major manufacturing milestone with the production of 100 million tires at its plant in White, GA. The facility has been producing tires for over 20 years, and is said to have played a vital role in supplying high quality products, supporting growth in key markets, while also contributing to the local community through job creation, economic development and long term investment.

Bridgestone Americas (www.bridgestoneamericas.com), Nashville, TN, announced the second round of support for its nationwide adaptive sports grant program. The program awards eight \$25,000 grants to school districts and nonprofit partners, expanding access to sports for students with disabilities. The \$200,000 in total funding, provided through the Bridgestone Americas Trust Fund, will directly benefit 1,439 students and 75 public schools across the United States.

Continental (www.continental.com), Hanover, Germany, conducted a study showing that fuel remains one of the largest and most volatile operating costs for truck fleets across the U.S. and Canada. The analysis found that keeping tires within the recommended pressure range improved fuel economy by 4.5%.



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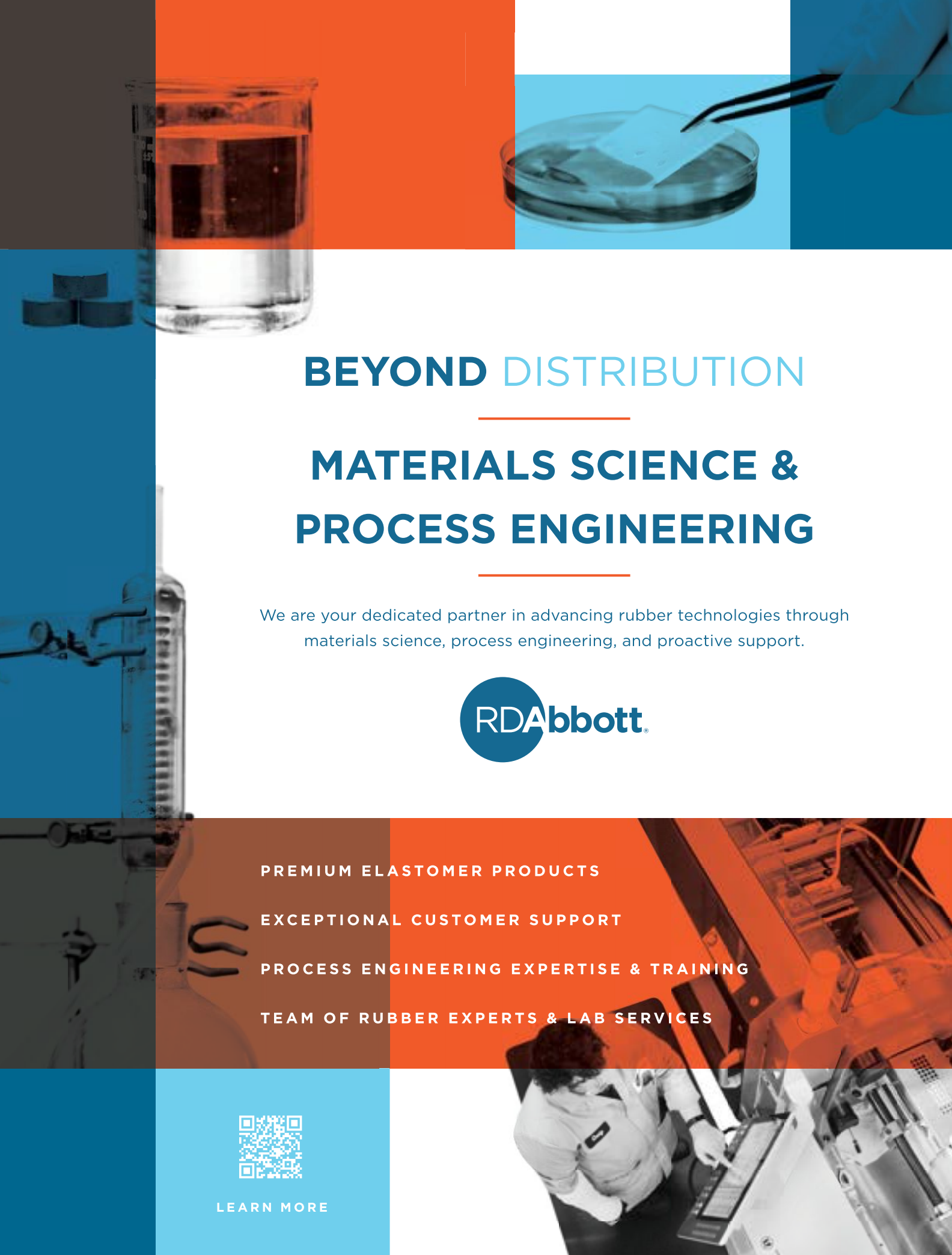
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Non-automotive belt market to grow 4%

From transferring power between rotating parts to supporting conveyor and material handling systems, non-automotive rubber transmission belts play an important role across several industries. As industrial operations become more automated and businesses look for reliable equipment that can operate under demanding conditions, the importance of durable transmission belts continues to grow.

According to Polaris Market Research, the global non-automotive rubber transmission belts market was valued at \$5,421.6 million in 2023. It is expected to grow from \$5,505.1 million in 2024 to \$7,502.6 million by 2032, registering a 3.9% compound annual growth rate (CAGR) during 2024-2032.

Transmission belts are designed to transfer rotational power and motion between pulleys and mechanical components. Manufacturing facilities use these belts in machinery and material handling systems. Agriculture relies on belt driven equipment, while mining operations use them extensively in conveyor systems. Construction, food processing, textiles and aerospace are also among the industries where specialized belt solutions are required.

One of the strongest factors supporting the market is global industrial expansion.

Industrial automation is adding another layer to this demand. Automated production lines and robotic systems require components capable of delivering consistent movement and power transmission. Improvements in rubber compounds and belt manufacturing are helping manufacturers develop products with better durability, wear resistance and load bearing capabilities.

For end users, these improvements can translate into longer operating life and fewer interruptions.

Among the different product categories, v-belts dominated the market in 2023.

Their popularity comes from their

versatility and effectiveness in power transmission. V-belts are widely used in industrial, agricultural, mining and construction applications where dependable performance is essential.

Manufacturers are also developing advanced v-belts with features such as improved heat resistance, oil resistance, durability and reduced maintenance needs. These improvements are helping v-belts remain an important choice for demanding applications.

Alongside v-belts, the market includes raw edged belts, timing belts, specialty belts and other belt types designed for specific operating requirements.

Polaris Market Research says mining is one application segment worth watching closely. Mining operations often depend on conveyor systems to move coal, ores, minerals and other bulk materials. These environments can be extremely demanding, exposing equipment to abrasive materials, heavy loads and high temperatures.

As mining companies work to improve productivity, while controlling operating costs, there is increasing interest in transmission and conveyor solutions that offer longer service life and lower maintenance requirements.

Polaris Market Research identifies the mining segment as a significant growth area during the forecast period.

Asia Pacific plays a central role in the global non-automotive rubber transmission belts industry.

The region accounted for more than 36% of the market share in 2023, making it the leading regional market. Rapid industrialization across countries such as China, India and other Asian economies is supporting demand from manufacturing, construction, agriculture, mining, textiles and logistics.

Infrastructure investments and the expansion of industrial facilities are also creating opportunities for suppliers of power transmission and material handling components.

As production capabilities expand throughout the region, manufacturers of transmission belts have opportunities to serve both established industrial companies and emerging businesses.

Despite the positive outlook, the industry is not without challenges. Rubber compounds, synthetic fibers and other materials are important inputs in belt manufacturing. Changes in raw material prices can, therefore, have a direct effect on production costs and profit margins, the report says.

Price volatility can also make inventory planning and pricing decisions more difficult. Manufacturers need to balance competitive pricing with the need to maintain product quality and invest in new technologies.

For this reason, supply chain efficiency, cost management and material innovation are likely to remain important priorities for companies operating in the market.

The future of the non-automotive rubber transmission belts market will be closely connected to the evolution of industrial machinery according to Polaris Market Research.

As industries become more automated, productive and efficiency focused, demand will increasingly favor belts that can deliver reliable performance with less maintenance. Product innovation, advanced materials, customized belt designs and improved durability could become important competitive factors.

The market's projected growth from \$5.51 billion in 2024 to \$7.50 billion by 2032 highlights the steady opportunity ahead.

Ultimately, transmission belts may not always be the most visible part of industrial equipment, but they remain essential to keeping machinery running. As industries around the world continue to expand and modernize, these seemingly simple components will continue to play a critical role in powering industrial progress, the report states.



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Silicone Rubber Growth Associates starts technical commercial advisory firm

Technical expertise, commercial perspective and added bandwidth for the silicone rubber value chain

Silicone Rubber Growth Associates LLC (SRGA), a technical commercial advisory firm focused exclusively on the silicone rubber industry, has launched a technical commercial advisory firm to help material suppliers, compounders, processors and manufacturers solve technical challenges, pursue growth opportunities and add experienced outside bandwidth when specialized support is needed.

Founded by longtime silicone industry professional David Greenwell, SRGA brings together more than 70 years of combined silicone rubber industry experience, with expertise spanning liquid silicone rubber (LSR), high consistency rubber (HCR), specialty silicone compounds, processing, application development, technical sales and market development.

Greenwell brings decades of silicone and rubber industry experience, including leadership roles with Wacker Chemical and its Solmix operations. His career has encompassed sales, business development, operations, supply chain, customer support and organizational leadership, giving him a broad perspective on both the technical and commercial requirements of the silicone rubber market.

Joining Greenwell is Ted Johnson, chief technical partner, who brings extensive technical and product development experience to SRGA. Johnson's career includes experience with FreudenbergNOK, Wacker and Elkem, where his work focused on silicone materials, product development, applications and customer technical support.

"Companies in the silicone rubber industry face challenges that often cross technical and commercial boundaries," Greenwell said. "Sometimes the issue is material selection, formulation or processing. Sometimes it is identifying the right market, customer or application. SRGA was created to bring experienced silicone industry perspective to those situations and help companies move toward practical solutions."

SRGA works with organizations throughout the silicone rubber value chain, providing support in three interconnected areas: technical guidance, commercial growth and marketing strategy.

On the technical side, SRGA assists companies with material and application strategy, processing challenges, product development and customer technical support. Its expertise includes

LSR and HCR, cure systems, compounds and additives, extrusion, molding and material performance considerations.

Commercially, SRGA helps companies identify and prioritize growth opportunities, evaluate markets and applications, strengthen customer strategies and develop practical go-to-market plans. The firm also assists technically focused companies in communicating their capabilities through sales and marketing strategy, technical content, product literature and other customer facing materials.

SRGA can also provide experienced outside bandwidth when internal technical or commercial teams are stretched, when a specialized silicone rubber issue falls outside an organization's day-to-day capabilities, or when a company wants an independent perspective before committing internal resources.

SRGA also provides selective market entry assistance to international silicone companies seeking to establish or expand their presence in North America. Support can include market and application assessment, customer targeting, technical and commercial positioning, outreach support, market feedback and, where appropriate, customer introductions.

"Our approach is practical and collaborative," Greenwell said. "We want to work alongside our clients, understand the challenges they face and help develop solutions that support meaningful technical and commercial progress."

SRGA offers both project based engagements and ongoing advisory support, allowing companies to access specialized silicone industry expertise based on their individual needs, internal resources and objectives.

Silicone Rubber Growth Associates LLC (SRGA) is a technical commercial advisory firm serving the silicone rubber industry. Based in Adrian, MI, SRGA provides more than 70 years of combined experience in silicone rubber materials, processing, applications, technical sales and market development to help companies solve technical challenges, identify growth opportunities and strengthen commercial performance.

SRGA supports clients through project based engagements and ongoing advisory work, including situations where specialized expertise or additional technical commercial bandwidth is needed.

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Silicon fortress: TSMC's Arizona buildout and the case for a domestic cleanroom glove supply chain

America is rebuilding its semiconductor manufacturing base in the Arizona desert at a scale with no modern precedent. As that buildout accelerates, it is creating a parallel, largely unaddressed question: Who supplies the cleanroom personal protective equipment (PPE) that touches every wafer along the way, and where is it made? This article makes the case that Arizona's semiconductor resurgence and the broader push for U.S. supply chain resiliency create a genuine strategic opening for American Armor Gloves (AAG), the only 100% Made in the USA manufacturer of polyurethane cleanroom gloves.

The Taiwan Semiconductor Manufacturing (TSMC) Arizona campus is now the largest greenfield foreign direct investment in U.S. history, with a recent cumulative commitment of \$265 billion, up from \$165 billion after a fresh \$100 billion pledge for at least four additional fabs at 2-nanometer and below. Fab 21 Phase 1 is already running at full production; Phase 2 is entering equipment installation months ahead of its original schedule; and two new advanced packaging facilities are under construction that will, for the first time, bring full AI chip production (wafer through packaging, onto U.S. soil.

Every one of those process steps, from extreme ultraviolet (EUV) photomask handling to chemical mechanical planarization (CMP) wet cleans to fine-pitch chip-on-wafer packaging, is executed by gowned cleanroom operators wearing gloves that sit in direct, continuous contact with a product worth hundreds of thousands to millions of dollars per lot. The glove is not incidental PPE in this environment; it is a functional component of yield. Yet the cleanroom glove market has long depended heavily on overseas manufacturing; the same offshoring dynamic that CHIPS Act policy was designed to reverse for chips themselves.

AAG is positioned to close that gap. As the only U.S. manufacturer producing a 100% polyurethane cleanroom glove domestically, and carrying independently verified, ANAB/ISO 17025 accredited electrostatic discharge (ESD) performance data, AAG offers a supply chain story that mirrors the reshoring logic driving the Arizona buildout itself: critical materials, made in America, next to the fabs they serve. The clearest near term opening is Arizona's advanced packaging buildout: new headcount and new process steps, rather than an incumbent relationship to displace.

Table 1 - semiconductor buildout

Metric	Detail
Total committed investment	\$265 billion cumulative U.S. commitment as of July 2026 (\$165 billion for the original six fab, two packaging facility, one R&D center cluster, plus a further \$100 billion announced for at least four additional fabs at 2 nm and below); the largest greenfield foreign direct investment in U.S. history
CHIPS Act direct funding	\$6.6 billion direct award (finalized November 2024) plus up to \$5 billion in proposed CHIPS program office loans, tied to project milestones
Fab 21 phase 1 (N4/N4P)	Operational since the fourth quarter of 2024; ~10,000 wafer starts/month; yield on par with Taiwan fabs; producing chips for Apple and AMD
Fab 21 phase 2 (N3)	Construction completed ahead of schedule (April 2026); equipment install begins the third quarter of 2026; volume production accelerated to 2027 (from an original 2028 target)
Fab 21 phase 3 (N2/A16)	Broke ground April 2025; targeting production by decade's end
Advanced packaging (CoWoS)	Two facilities under construction; will enable full AI chip production (wafer through packaging) on U.S. soil for the first time
Direct employment	3,500+ employed today; ~6,000 direct manufacturing jobs planned across the first three fabs; 20,000+ construction jobs; tens of thousands of indirect and supplier jobs
Broader Arizona ecosystem	70+ semiconductor related expansions since 2020, representing \$314 billion+ in investment (more than any other state); 140,000+ jobs in semiconductor relevant occupations across metro Phoenix.

Sources: TSMC Arizona public statements and 2026 North America Technology Symposium; U.S. Department of Commerce/NIST CHIPS program office; Greater Phoenix Economic Council; company and trade press reporting, July 2026.

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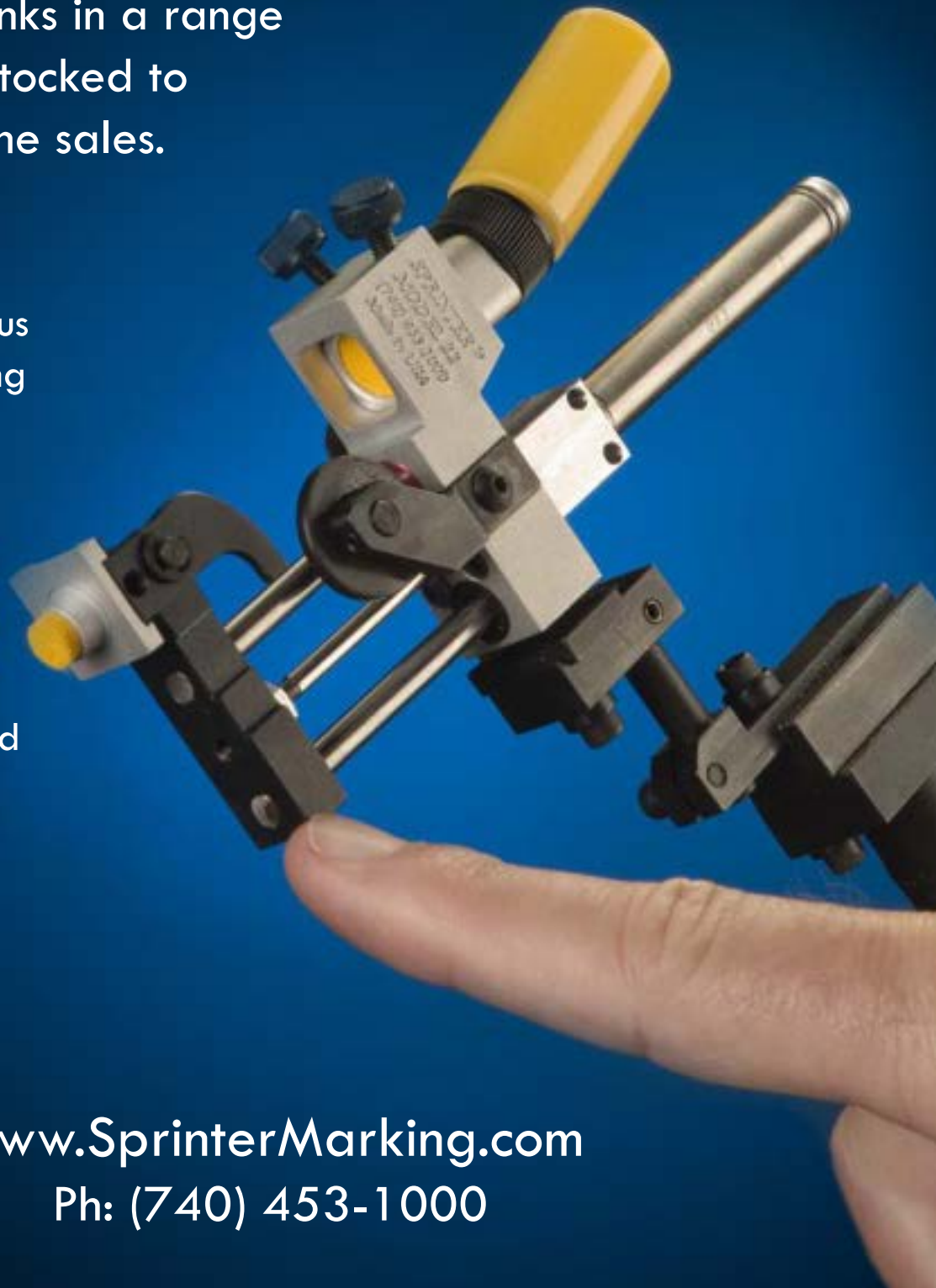
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Overview

The Arizona semiconductor buildout

Global semiconductor sales reached roughly \$627.6 billion in 2024, up 19.1% year over year, with 2025 on pace for a new record near \$697 billion; growth led almost entirely by artificial intelligence (AI) and data center demand. U.S. policy has responded with direct intervention: CHIPS Act awards to Intel (\$7.86 to 8.5 billion), TSMC Arizona (\$6.6 billion), Samsung Texas (\$4.745 billion) and Micron (~\$6.1 billion), a 25% Advanced Manufacturing Investment Credit under Section 48D and a National Semiconductor Technology Center standing up workforce, and research and development grants. NIST/Commerce projections point to more than 200% growth in U.S. wafer capacity by 2032 if announced builds are completed.

TSMC's Arizona campus is the flagship of that effort. Table 1 summarizes the current scale and pace of the buildout. The pace of acceleration is itself notable. Phase 2 construction finished ahead of schedule, and volume production moved up a full year, from 2028 to 2027, with TSMC pulling milestones forward even as it has separately pushed back the volume-production timeline for its most advanced A16 node. That is a live, moving buildout, not a static announcement; and it is scaling in a direction that consistently adds cleanroom headcount and cleanroom square footage in Arizona.

Clean room supply chain: Not a semiconductor project

A wafer fab is, functionally, a very long chain of human hands wrapped in gloves. Photolithography, wet clean and etch, CMP and, increasingly, as Arizona's packaging facilities come online, chip-on-wafer-on-substrate (CoWoS) and system-on-integrated-chip (SoIC) assembly are all gowned operator processes performed in ISO 3-6 cleanrooms. The glove is the only material in continuous, direct contact with the product at nearly every one of those steps.

The economics of getting that contact wrong are severe and well documented. A single shed particle on an EUV photomask propagates as a defect across every die on every wafer subsequently exposed with that mask. An ESD event during fine pitch interposer placement can damage an already assembled multi-die stack, destroying the cost of every wafer built into it. An analysis of six representative TSMC relevant cleanroom scenarios, mapped against actual failure modes rather than generic PPE specifications, found the severity distribution across 18 identified failure modes (table 2).

Roughly six in ten of the identified failure modes carry critical to high severity, and detection is frequently delayed, sometimes by an entire manufacturing cycle; as with photomask defects that only surface at wafer inspection, or automotive qualification data that are only found compromised at audit. That combination (high cost, delayed detection and a single point of contact [the glove] that sits at the origin of the failure) is precisely the profile that justifies treating glove selection as a yield and supply chain decision, rather than a commodity purchasing one.

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Table 2 - EUV photomask defect

Severity	Count	Estimated cost range
Critical	5 of 18 (28%)	\$100,000 to \$2 million+ per event
High	6 of 18 (33%)	\$500 to \$2 million+ per event
Medium high/medium	6 of 18 (33%)	\$500 to \$100,000+ per event
Low medium	1 of 18 (6%)	Program economics risk

Source: AAG TSMC use case failure mode model, cross-referenced against industry contamination cost data. Cleanroom shutdown costs are separately cited in industry literature at an order of magnitude of \$1.5 million per day.

The advanced packaging buildout deserves particular attention. Arizona's two CoWoS facilities represent a genuinely new category of cleanroom operation for the site: new operators, new process steps and no incumbent glove relationship already in place. That makes it the cleanest entry point for a new domestic supplier, rather than a displacement fight against an established vendor.

Resiliency gaps: Domestic fab and imported gloves

The entire rationale for the CHIPS Act (direct funding, investment tax credits, export controls on adversary nations, loan guarantees) is that concentrating the production of a critical input in a small number of overseas locations is a national vulnerability, not just a cost optimization. That logic was applied to chips. It has not yet been meaningfully applied to the PPE those chip fabs consume by the tens of millions of pairs per year. Cleanroom glove manufacturing, like most disposable glove production globally, has historically concentrated overseas, leaving fabs that are themselves reshoring production dependent on import exposed supply chains for a component that sits in direct contact with every wafer.

This is the same resiliency argument, one supply chain tier down. A semiconductor buildout justified in Washington on national security and supply chain security grounds is, at the PPE level, still largely served by the offshore manufacturing base from which that justification was meant to move away. For automotive grade qualification work in particular, where AEC-Q100 reliability testing depends on audit ready lot traceability, sourcing consumables from a domestic, traceable manufacturer is not a patriotic preference; it is a documentation requirement.

American Armor Gloves: U.S. manufactured

AAG is the only U.S. manufacturer producing a 100% polyurethane cleanroom (CR) glove domestically and nitrile CR gloves, giving fabs a domestic option across two distinct glove chemistries, rather than a single import dependent SKU. AAG's approach to the TSMC opportunity has been to validate its claims against independent, accredited data, rather than lead

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with marketing language, which matters for a technical buyer evaluating a new supplier against process critical specifications. The strongest current claims are:

- *ESD performance, verified:* PUR CEL qualifies as static dissipative under ANSI/ESD STM15.1, confirmed by ANAB/ISO 17025 accredited third party testing (Electro-Tech Systems, April 2026). In use resistance is only weakly humidity dependent (5.75 MΩ at 12% RH versus 4.96 MΩ at 50% RH) because the glove hydrates against the hand once worn, directly relevant to EUV photomask handling and CoWoS/SoIC packaging: the two scenarios where ESD risk is most severe.
- *Non-volatile residue (NVR), verified:* PUR CEL's $\leq 0.05\%$ by weight ceiling is roughly 70x tighter than the leading nitrile competitor's published specification, a genuine, independently checkable advantage.
- *Film thickness and breathability, verified:* PUR CEL is thinner than the leading nitrile competitor at every measurement point on the hand, and its polyurethane chemistry carries substantially higher moisture-vapor transmission, relevant to operator comfort and error rates over the long, high cycle time shifts common in fan out and specialty packaging.
- Chemical resistance to fab specific process chemistries (HF, sulfuric/peroxide, CMP slurry) and sustained flex ESD stability over a full wear session remain open validation items, not yet claimed as proven. AAG has flagged these internally as the priority items for third party testing ahead of direct technical conversations with fab customers.

That last point is deliberate. A comparison document that only shows wins is not one a technical buyer at a fab this sophisticated will trust, and AAG's internal evaluation process has been built to surface unfavorable findings, such as tensile retention and permeation testing gaps versus the incumbent nitrile specification, alongside the favorable ones. For an investor or press audience, that discipline is itself part of the pitch: AAG is building the kind of evidence file a fab's own quality organization would expect to see, rather than one built to survive only a first read.

New opportunity

Three factors converge to make this a live window, rather than a speculative one. First, the buildout is accelerating on a compressed timeline; Phase 2 production moved up a year, and the July 2026 announcement of \$100 billion for four additional fabs means Arizona's cleanroom headcount will keep scaling for years, not quarters. Second, the advanced packaging facilities represent genuinely new cleanroom operations with no incumbent glove contract to displace. Third, the same CHIPS Act and Section 48D policy environment that funded the fabs has normalized domestic sourcing preferences as a legitimate, non-cost

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criterion in supplier selection; a case AAG does not have to make from scratch.

For investors and industry observers, the underlying thesis is straightforward: the United States is spending a quarter trillion dollars to reshore the most strategically sensitive manufacturing process in the world, and it is doing so through a supply chain that, one tier down, still runs largely through imported PPE. A domestic, independently validated, 100% Made in the USA cleanroom glove manufacturer sitting adjacent to that buildout is a direct beneficiary of the same resiliency logic driving the investment; not a tangential one.

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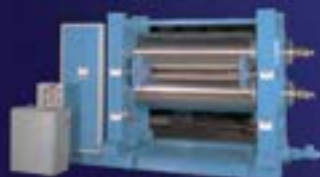
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India's rubber sector examined

The All India Rubber Industries Association (AIRIA) is a not for profit organization, located in Mumbai, India, serving the rubber industry and trade with the objectives of safeguarding and promoting interests of the rubber sector in India. AIRIA was established in 1945, and as the leading organization for the industry, it works to advance its interests and facilitate cooperation, growth, innovation and development within the sector. The following interview with newly appointed president, Anay Gupta, explores the current state of the rubber industry in India.

From supply shortages to price spikes, how would you assess the current state of India's rubber ecosystem?

India's rubber ecosystem remains fundamentally strong from the demand perspective, but it is operating under significant raw material pressure. In 2024-25, India produced 8.75 lakh tonnes of natural rubber, while domestic consumption stood at 14.10 lakh tonnes. This created a production-consumption gap of approximately 5.35 lakh tonnes.

To bridge this gap, natural rubber imports increased by 11.8%, from 4.93 lakh tonnes in 2023-24 to 5.51 lakh tonnes in 2024-25. These imports were valued at around ₹9,021 crore. Domestic production increased by only 2.1%, which was not sufficient to keep pace with the country's structural demand.

Prices have also moved sharply. The average RSS-4 price at Kottayam increased from approximately ₹155.72 per kg in 2023-24 to ₹199.85 per kg in 2024-25, an increase of about 28%. As of July 9, the Rubber Board's reference price for RSS-4 at Kottayam was approximately ₹274 per kg. The Government of Kerala provides a guaranteed support price of ₹250 per kg for natural rubber under its Rubber Production Incentive Scheme, which was recently announced. The scheme subsidizes farmers for the difference between this benchmark rate and the daily market price notified by the Rubber Board.

Therefore, the present situation is not a demand crisis; it is a supply, cost and competitiveness challenge. India has a large manufacturing base and growing demand from the automotive, infrastructure, healthcare, engineering and consumer product sectors. The immediate priority must be to ensure adequate raw material availability at prices that remain viable for growers, as well as manufacturers.

India's natural rubber consumption continues to outpace domestic production. What are the key reasons behind this supply-demand gap?

The principal reason is that demand has grown faster than domestic production capacity. Between 2015-16 and 2024-25, natural rubber consumption increased from approximately 9.94 lakh tonnes to 14.10 lakh tonnes, representing growth of about 42%. During the same period, domestic production increased from 5.62 lakh tonnes to 8.75 lakh tonnes. Although the produc-

tion recovery has been encouraging, it has not been adequate to eliminate the gap.

There are also structural issues on the production side:

- Rubber trees have a long gestation period, normally requiring several years before commercial tapping begins.
- A considerable portion of the planted area is either immature, old, uneconomic or not being tapped regularly.
- During 2024-25, India had a total rubber plantation area of approximately 9.39 lakh hectares, of which 7.56 lakh hectares were tappable. However, only about 5.83 lakh hectares (77.2% of the tappable area) were tapped and contributed to natural rubber production.
- Labor shortages, rising tapping costs, climate variability, excessive rainfall and disease incidence affect the number of tapping days and overall productivity.
- Small and fragmented holdings make mechanization, quality control and aggregation more difficult.

India's average yield improved to approximately 1,500 kg per hectare of tapped area in 2024-25, but it was still below the levels of over 1,629 kg per hectare achieved during 2013-14. This shows that the solution is not limited to increasing acreage; India must also improve productivity from existing plantations and maximum use of available area.

How are recent price fluctuations in natural rubber impacting manufacturers, particularly micro, small and medium enterprises (MSMEs) and downstream industries?

The impact is particularly severe on MSMEs because raw material constitutes a substantial proportion of the manufacturing cost of most rubber products. When natural rubber prices rise sharply, a company's working capital requirement increases almost immediately. However, the manufacturer may not be able to revise selling prices at the same speed.

Many MSMEs supply rubber components to automobile companies, railways, defense establishments, engineering companies and other large buyers under annual contracts or pre-agreed prices. A manufacturer may, therefore, face a sharp increase in raw material cost, while the final product price remains fixed for several months.

The pressure is not confined to natural rubber. Manufacturers are also exposed to fluctuations in synthetic rubber, carbon black, rubber chemicals, processing oils, energy, freight and finance costs. For labor intensive units, increases in wages and compliance costs add another layer of pressure.

This can result in:

- Compression of already narrow operating margins
- Increased working capital borrowing
- Reduced ability to hold adequate inventory
- Delayed investment in machinery, technology and product development



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Perspective

- Difficulty in competing against lower priced imported finished rubber products
- Closure of micro and small units that work on small margins

The industry supports remunerative prices for growers because sustained domestic production is essential. At the same time, abnormal volatility is harmful to both growers and manufacturers. The objective should be a transparent and reasonably stable market, rather than artificially low prices.

With rising geopolitical tensions and trade uncertainties, how should India respond to growing volatility in global natural rubber markets?

India should treat natural rubber as a strategically important industrial raw material. The country currently imports close to 39% of its annual natural rubber consumption, based on 2024-25 figures. Moreover, 87.7% of imports during the year were in the form of technically specified rubber, indicating significant dependence on overseas supplies for particular industrial grades.

India's import sources are diversified to some extent, but concentration remains visible. In 2024-25, Côte d'Ivoire accounted for 25.9% of India's natural rubber imports, followed

by Indonesia at 21.5%, Vietnam at 20.7%, Malaysia at 12.8% and Thailand at 12.6%. The top five countries, therefore, supplied more than 93% of India's imports. Most of the MSME units switched to alternative raw material matching grades of synthetic rubber.

A balanced response should include:

- Diversification of import sources and shipping routes
- Better real time monitoring of production, stocks, consumption, imports and prices
- Development of appropriate strategic or buffer stock mechanisms for critical grades
- Long term supply arrangements with reliable producing countries
- Faster testing and customs clearance of imported raw material
- Greater domestic production of technically specified and consistent quality rubber
- A trade policy that protects domestic producers without creating raw material shortages for manufacturers

The policy framework must maintain a balance between grower remuneration, industrial availability and the competitiveness of downstream manufacturers.

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What steps can India take to reduce import dependence and strengthen domestic rubber production in the long term?

India requires a two-track strategy: improving productivity in existing plantations and expanding cultivation in suitable new areas.

The first priority should be to bring more of the tappable area into regular production. In 2024-25, nearly 1.73 lakh hectares of tappable area did not contribute to production. Even a partial activation of this area could produce meaningful additional supply without waiting for newly planted trees to mature. Further difference of 1.83 lakh hectares between total available area and tappable area must be brought under plantation to bridge the gap.

The following measures would help:

- Replanting old and low yielding trees with high yielding, climate resilient clones
- Financial assistance during the immature period following replanting
- Support for rain guarding, disease control and improved agronomic practices
- Promotion of self-tapping, group tapping and trained tapping teams

- Mechanization and development of low frequency tapping systems
- Expansion of collection centers and group processing facilities
- Assured access to quality planting material
- Better farm-gate price information and transparent marketing
- Promotion of technically specified rubber and graded rubber
- Affordable credit and insurance support for small growers

Import dependence cannot be eliminated completely in the near term because the industry requires both volume and specific grades. However, India can progressively reduce the gap and ensure that imports function as a supplementary source, rather than the principal response to every domestic shortage.

Do you see expansion of rubber cultivation in non-traditional regions as a viable solution to address future supply challenges?

Yes, expansion in non-traditional regions is a viable and necessary part of the long term solution, particularly in the northeast and selected areas of West Bengal, Odisha, Maharashtra, Karnataka and other climatically suitable regions.



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Perspective

The Inroad project aims to develop an additional 2 lakh hectares of rubber plantations in the northeast and West Bengal, while also improving quality, productivity, training and skill development across the natural rubber value chain. However, acreage expansion must be scientifically planned. Rubber cannot simply be planted wherever land is available. The selection must consider rainfall distribution, temperature, soil, altitude, wind exposure, water availability and future climate risks. Plantation expansion should also avoid ecologically sensitive areas, and should not displace essential food crops or natural forests.

Another important point is that planting alone will not solve the problem. New production regions require an entire supporting ecosystem comprising nurseries, extension services, trained tappers, collection centers, roads, processing facilities, testing laboratories and reliable market linkages.

Since rubber has a long gestation period, plantations established today will contribute materially only after several years. Therefore, expansion must be combined with immediate productivity improvement in existing producing areas.

What role can technology, research and development, and sustainable farming practices play in improving productivity and

resilience across the rubber value chain?

Technology and research will be central to India's ability to produce more rubber from limited land and labor resources.

At the plantation level, priority areas include:

- High yielding and disease resistant clones
- Climate resilient planting material
- Improved rain guarding systems
- Low frequency and controlled tapping techniques
- Mechanized or assisted tapping tools
- Digital monitoring of tree health, disease and yield
- Satellite and geospatial mapping of plantation areas
- Weather based advisories for growers
- Soil and leaf analysis for precise nutrient management

At the processing level, India needs greater investment in quality consistency, traceability, energy efficient drying, technically specified rubber, effluent treatment and value addition. Traceability will become increasingly important as international customers seek proof regarding the origin and sustainability of agricultural commodities.

Sustainable cultivation should focus on soil conservation, water management, responsible chemical use, biodiversity protection and intercropping during the immature period. These



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Perspective

practices can reduce environmental risk, while giving growers supplementary income before rubber trees become tappable.

Research and development must also extend beyond plantations. Industry, research institutions and universities should work together on advanced compounds, recycling, devulcanization, circular use of rubber waste, lower emission processing and high performance products for EVs, defense, railways, healthcare and infrastructure.

How can policymakers, industry stakeholders and growers work together to build a more competitive and self-reliant rubber ecosystem?

The rubber value chain should be approached as an integrated ecosystem, rather than as separate grower, processor and manufacturing segments. A policy that supports one part of the chain, while weakening another, will not produce sustainable results.

The Indian tire industry, in collaboration with the Rubber Board, is actively promoting natural rubber cultivation in northeast India. Leading tire manufacturers such as Apollo, CEAT, JK Tyre and MRF have contributed over ₹1,100 crore under a public-private partnership initiative to develop ap-

proximately 2,00,000 hectares of natural rubber plantations across the region.

A permanent coordination mechanism involving the central government, state governments, Rubber Board, growers, processors, manufacturers, research institutions and industry associations would help align production planning with future demand.

The immediate areas of cooperation should include:

- A five to ten year national natural rubber production roadmap
- District level mapping of tappable, untapped, immature and senile plantations
- Regular publication of transparent production, stock, import and consumption data
- Joint grower-industry programs for quality improvement
- Long term procurement and price discovery mechanisms
- Regional processing and testing infrastructure
- Skill development for tappers and plantation workers
- Research funding linked to measurable industry outcomes
- Easier finances for growers, processors and MSME manufacturers
- A calibrated import policy based on actual domestic

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Perspective

availability and industry requirements

Growers need stable income and access to markets. Processors need adequate volumes and consistent quality. Manufacturers need timely availability at competitive prices. Public policy must seek a workable balance among all three.

Looking ahead, what is the outlook for India's rubber industry over the next five years, and what key trends should stakeholders watch closely?

The five-year outlook remains positive, but the industry's growth will depend on how effectively India manages raw material availability, technology adoption and global competitiveness.

Demand is likely to remain supported by automotive production, replacement tires, electric mobility, infrastructure, railways, defense, healthcare, construction, industrial equipment and consumer goods. The automotive tire sector alone accounted for 67.1% of India's natural rubber consumption in 2024-25, demonstrating the close relationship between rubber demand and the mobility sector.

At the same time, stakeholders should closely monitor the following trends:

- The pace at which newly planted areas in the northeast enter production
- Productivity improvement in existing plantations
- Availability of trained tapping labor
- Climate related disruption in India and major producing countries
- Global natural rubber supply deficits and price volatility
- Crude oil movements and their impact on synthetic rubber and other petrochemical inputs
- Traceability, sustainability and environmental compliance requirements
- Recycling, circularity and regulation of end-of-life rubber products
- The shift towards specialized compounds for EVs and advanced mobility
- Competition from imported finished rubber goods

India has the potential to emerge not only as a major consumer, but also as a global manufacturing hub for high value rubber products. Achieving that potential will require a coordinated effort to increase domestic production, improve quality, protect MSME competitiveness and invest in technology, skills and export oriented value addition.



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Patent News

Golf ball

U.S. patent: 12,616,878

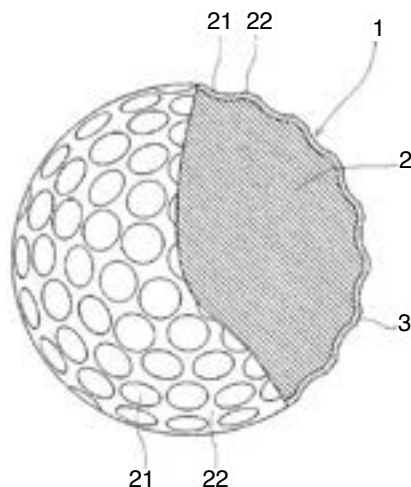
Issued: May 5, 2026

Inventors: Takumi Kaneko, Hikaru Nagakura, Takehiko Hyodo, Kazuyoshi Shiga, Yuko Kujirai and Hiroaki Tanaka

Assigned: Sumitomo Rubber Industries

Key statement: An object of the present disclosure is to provide a golf ball having lowered resilience while maintaining the hardness of the golf ball. The present disclosure provides a golf ball comprising a constituent member, wherein at least a part of the constituent member is formed from a cured product of a rubber composition containing (a) a base rubber, (b) a co-crosslinking agent and (c) a crosslinking initiator, (a) the base rubber con-

tains (a1) a natural rubber and a grafting ratio of (b) the co-crosslinking agent in the cured product of the rubber composition ranges from 40 mass % to 80 mass %.



Sulfur containing unsaturated hydrocarbon polymer and method for production thereof, additive for rubber, rubber composition and tire

U.S. patent: 12,617,878

Issued: May 5, 2026

Inventors: Keisuke Chino, Yusuke Matsuo and Makoto Ashiura

Assigned: Eneos Materials

Key statement: Provided is a sulfur containing unsaturated hydrocarbon polymer which can improve wet grip performance and fuel efficiency of a tire in a well balanced manner by being blended into a rubber composition for a tire. A sulfur containing unsaturated hydrocarbon polymer of the present invention is a reaction product obtained by reacting sulfur with an unsaturated bond in a polymer of an unsaturated hydrocarbon.

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Patent News

Pneumatic vehicle tire having a reinforcing layer with steel monofilaments

U.S. patent: 12,623,491

Issued: May 12, 2026

Inventors: Daniel De Castro Pinho, Mihail Catana, Thomas Kramer and Michael Schunack

Assigned: Continental

Key statement: A pneumatic vehicle tire having a strength member ply comprising steel monofilaments having a cross-sectional area of 98 mm² to 125 mm² per meter of strength member ply, the steel has a carbon content of at least 0.86% by weight. To improve rolling resistance the monofilaments have a brass coating having a copper content of 61% by weight to 70% by weight and a zinc content of 30% by weight to 39% by weight, in that the monofilaments have a linear density of 92 g/100 m to 105 g/100 m

and the monofilaments each have a tensile density Td of 34 MPa/(g/100 m) to 39 MPa/(g/100 m). The strength member ply has an areal strength AS of 109 Nmm² to 166 Nmm² and the rubber material has a breaking elongation of 300% to 450%.

System and method for generating tire rubber asphalt

U.S. patent: 12,624,210

Issued: May 12, 2026

Inventors: Joseph Randall Bruns and Hashem Hashemi

Assigned: Asphalt Sciences

Key statement: A method and system for generating a rapid digestion process ("RDP") product are described. The method includes receiving a bitumen compound and first heating the bitumen compound to 320°F to 420°F. The method then proceeds to add tire rub-

ber to the bitumen compound. The bitumen compound and the tire rubber are mixed for 5 minutes to 360 minutes during a second heating to 525°F to 700°F. Further, sulfur is added to the mixture of tire rubber and bitumen compound. These steps generate the RDP product. The RDP product is then cooled for transfer to a storage vessel.

System and method for modifying and enhancing tire rubber bitumen

U.S. patent: 12,623,964

Issued: May 12, 2026

Inventors: Joseph Randall Bruns and Hashem Hashemi

Assigned: Asphalt Sciences

Key statement: A method and system for generating a modified and enhanced dissolved tire rubber bitumen compound are described. The method includes receiving a rapid digestion

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Patent News

digestion process ("RDP") compound, a bitumen compound and a sulfur crosslinking agent. First heating the RDP compound, the bitumen compound and the sulfur crosslinking agent to 320°F to 420°F with mixing for 3 to 5 hours. The method then proceeds to add SBC to the RDP compound, the bitumen compound and the sulfur crosslinking agent. The RDP compound, the bitumen compound, the sulfur crosslinking agent and the SBC are second heated to 320°F to 420°F with mixing for 15 minutes to 120 minutes.

Rubber composition, vulcanized object obtained from said rubber composition and vulcanized molded object obtained

from said rubber composition

U.S. patent: 12,624,196

Issued: May 12, 2026

Inventor: Atsunori Kondo

Assigned: Denka

Key statement: A rubber composition, by which a vulcanizate having excellent vulcanization speed, abrasion resistance and low temperature rise can be obtained, is provided. A rubber composition including 100 parts by mass of a chloroprene based rubber, 20 to 80 parts by mass of silica, 1 part by mass or more and less than 20 parts by mass of a hydrate and 0.3 to 1.4 parts by mass of an organic peroxide, wherein the rubber composition includes 0.5 to 15 parts by mass of a silane coupling agent having a double

bond in a structure of the silane coupling agent with respect to 100 parts by mass of the silica.

Sterilization method for medical rubber part

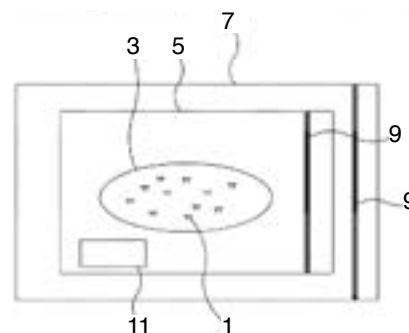
U.S. patent: 12,622,985

Issued: May 12, 2026

Inventors: Yogun Kida, Kei Tajima, Kazuki Nojiri, Yuichiro Matsutani and Shumpei Morita

Assigned: Sumitomo Rubber Industries

Key statement: A sterilization method for a medical rubber part is a sterilization method for a medical rubber part that can include a body made from an elastic material and that can include an inactive resin film stacked on at least a portion of a surface of the body, where the sterilization method can include irradiating a packaging article with gamma ray, the packaging article accommodating a plurality of the medical rubber parts and having an oxygen concentration not higher than 5%.



Adhesive composition for tire cord, tire cord and tire

U.S. patent: 12,623,490

Issued: May 12, 2026

Inventors: Sung Gyu Lee, Il Chung, Ok Hwa Jeon and Min Ho Lee

Assigned: Kolon Industries

Key statement: This invention relates to an adhesive composition for a tire cord, a tire cord including an adhesive layer formed from the adhesive composition and a tire including the tire cord. According to the present disclosure, an environment-friendly adhesive composition for a tire cord that can not only improve adhesive strength between tire rubber and a

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Patent News

tire cord, but can also improve strength of a tire cord is provided.

Rubber composition for an inner liner for pneumatic vehicle tires

U.S. patent: 12,624,197

Issued: May 12, 2026

Inventors: Bernhard Schwaiger, Tobias Wittmann, Jacob Podschun and Alexander Stücker

Assigned: Suncoal Industries

Key statement: The invention relates to a rubber composition comprising a rubber component that comprises at least one halobutyl rubber selected from the group consisting of bromobutyl rubber and chlorobutyl rubber; and a filler component that comprises at least one filler F1 which has a ^{14}C content in the range of 0.20 to 0.45 Bq/g of carbon; a carbon content in the range of 60 wt. % to 85 wt. % relative to the ash-free and water-free filler; an STSA surface area in the range of 10 m²/g of filler to 50 m²/g of filler; and acidic hydroxyl

groups on its surface; and wherein the proportion of halobutyl rubber in the rubber composition is 70 to 100 phr. The invention further relates to a vulcanizable and a vulcanized rubber composition based on the aforementioned rubber composition, a kit of parts for preparing the vulcanizable rubber composition and methods for preparing the rubber composition and the vulcanizable rubber composition. Furthermore, the invention relates to a method for further processing the vulcanizable rubber composition, wherein webs are formed which are suitable, when cut to size, for use as inner liners in a method for manufacturing a pneumatic tire. The invention also relates to the use of the aforementioned hydrothermally carbonized lignin for the preparation of rubber compositions for inner liners.

Rubber composition, processing method thereof and rubber product using the same

U.S. patent: 12,624,198

Issued: May 12, 2026

Inventors: Tao Xu, Zhi Sheng Fu and An Yang Wu

Assigned: Hangzhou Xinglu Technologies

Key statement: The present invention discloses a rubber composition, a processing method thereof and rubber product reinforced with silica using the same. The rubber composition comprises a rubber matrix and essential components, wherein, based on 100 parts by weight of the rubber matrix, the rubber matrix comprises, a branched polyethylene with a content represented as A, in which $0 < A \leq 100$ and an EPM and an EPDM with a total content represented as B, in which $0 \leq B < 100$; and the essential components comprise 1-10 parts of a crosslinking agent and 15-80 parts of silica. The rubber composition can be used for producing high voltage insulating sheath rubber, high temperature resistant conveyor belt, waterproof coil, rubber particles for plastic track surface layer, rubber plug, rubber roller, inner tube, tire tread, tire sidewall and inner rubber layer of air conditioner hose.

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Rubber composition and tire

U.S. patent: 12,630,696

Issued: May 19, 2026

Inventor: Yoshihisa Inoue

Assigned: Asahi Kasei Kabushiki Kaisha

Key statement: The present invention provides a rubber composition, containing 10 parts by mass or more and 90 parts by mass or less of a rubber-like polymer having an iodine value of 10 to 200 (g/100 g), a content of an ethylene structure of 3% by mass or more, a content of an aromatic vinyl monomer block of less than 10% by mass and a content of a conjugated diene monomer unit of 2% by mass or more; 10 parts by mass or more and 90 parts by mass or less of a natural rubber; and 20 parts by mass or more and 80 parts by mass or less of a silica based inorganic filler and a carbon black, with respect to 100 parts by mass of a total amount of a rubber component.



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Patent News

Sidewall structure of tire

U.S. patent: 12,636,915

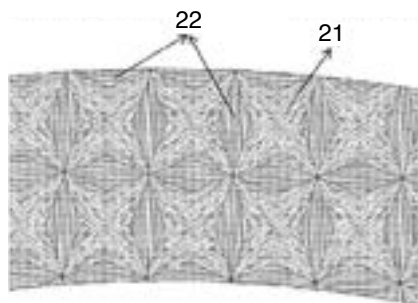
Issued: May 26, 2026

Inventor: Zongtao Sun

Assigned: Qingdao Aufine Tyre

Key statement: Provided is a sidewall structure of a tire, belonging to the technical field of sidewall structures. The sidewall structure of the tire includes a tire, a side surface of the tire is designed with multiple knurling lines which are formed on a sidewall of the tire by a knurling engraving process. The knurling lines are composed of sparse knurling lines and dense knurling lines which are alternately arranged on the sidewall of the tire. The knurling lines are composed of radial protrusions distributed in an array and the knurling lines and the tire are integrally formed. The sparse knurling lines and the dense knurling

lines are composed of a plurality of knurling lines which are arranged in parallel to form non-closed polygonal patterns, respectively, and the sparse knurling lines and the dense knurling lines are connected and combined to form a new polygonal pattern on the sidewall of the tire.



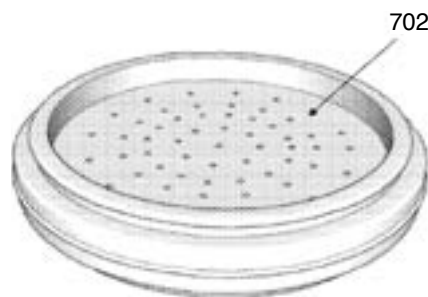
Tire interconnect adapter and system

U.S. patent: 12,643,710

Issued: June 2, 2026

Inventor: Carlos Rosa

Key statement: A tire interconnect adapter mechanism for securely coupling two tires (used or new) into a continuous structure in both mechanical terms (either horizontally, vertically or any other suitable angle), as well as in pneumatic/hydraulic terms, so that through the successive connection of tires, a water or other suitable fluid tank may be created. In other applications, animal shelters may also be created.



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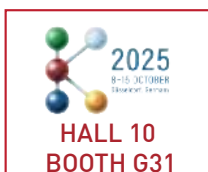
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Patent News

Desulfurized rubber, rubber composition, rubber composition for tire, tire, hose, belt, crawler

U.S. patent: 12,643,960

Issued: June 2, 2026

Inventors: Masayuki Taniguchi and Takumi Toda

Assigned: Bridgestone

Key statement: Provided is a desulfurized rubber capable of producing a crosslinked rubber having an excellent mechanical strength. The desulfurized rubber contains a solvent-soluble rubber component A having a weight-average molecular weight of more than 260,000 and less than 600,000, and a solvent-insoluble rubber component B, wherein the content ratio of the rubber component B is less than 45% by mass of the total mass of the content a of the rubber component A and the content b of the rubber component B.

Elastomer composition, sealing material and method for producing sealing material

U.S. patent: 12,643,999

Issued: June 2, 2026

Inventors: Masanori Okazaki and Souichirou Yamauchi

Assigned: Valqua

Key statement: One embodiment of the present invention relates to an elastomer composition, a sealing material or a method for producing a sealing material, in which the elastomer composition includes a crosslinkable fluoroelastomer (A) [provided that the elastomer (A) is a compound having no hydrosilyl group] and a composition (B) that contains at least one ethylenically unsaturated bond-containing compound selected from compounds having a perfluoro skeleton having an ethylenically unsaturated bond [provided that the compounds are compounds other than the elastomer (A)] and

compounds having a siloxane skeleton having an ethylenically unsaturated bond, the composition (B) having a minimum torque (ML) at 60°C of 0.5 kgf-cm or more as measured with a Curelasterometer.

Biodegradable soft elastomers for regenerative engineering

U.S. patent: 12,642,889

Issued: June 2, 2026

Inventors: Guillermo A. Ameer, Arun K. Sharma, Xinlong Wang and Matthew I. Bury

Assigned: Northwestern University and Ann and Robert H. Lurie Children's Hospital of Chicago

Key statement: Provided herein are materials and methods related to scaffolds and uses thereof. In some embodiments, provided herein are poly (octamethylene-octanol citrates) (POOC) scaffolds with native mechanical properties that are comparable to urinary bladder tissue. In some embodiments, provided herein are methods for the synthesis of POOC scaffolds with native mechanical properties that are comparable to urinary bladder tissue by including octanol in the polycondensation synthesis of POC. In some embodiments, provided herein are methods of use of the disclosed scaffolds, including for urinary bladder tissue regeneration.

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Synthesis of isoprene butadiene copolymer rubbers

U.S. patent: 12,649,811

Issued: June 9, 2026

Inventor: Thomas Franklin Spilker

Assigned: G-3 Chickadee Purchaser

Key statement: It has been unexpectedly found that certain neodymium catalyst systems can be used to copolymerize isoprene and 1,3-butadiene to produce random isoprene-butadiene copolymer rubbers which are not tapered. These random isoprene-butadiene copolymer rubbers have properties which are beneficial for use in rubber formulations for manufacturing a wide variety of rubber products, such as tires, hoses, conveyor belts, power transmission belts and shoe soles. These random isoprene-butadiene rub-

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Patent News

bers are synthesized by copolymerizing (a) isoprene monomer or a substituted isoprene monomer and (b) 1,3-butadiene monomer in the presence of a neodymium catalyst system, wherein the neodymium catalyst system is prepared by (1) reacting a neodymium carboxylate with an organoaluminum compound in the presence of a conjugated diolefin monomer to produce neodymium-aluminum catalyst component and (2) subsequently reacting the neodymium-aluminum catalyst component with an alkyl aluminum chloride to produce the neodymium catalyst system.

Method of milling rubber composition having graphene and liquid rubber

U.S. patent: 12,649,832

Issued: June 9, 2026

Inventor: Frederic Vautard

Assigned: Michelin

Key statement: An improved rubber

composition and method to create the improved rubber composition is achieved by milling reduced graphene oxide ("RGO") in liquid rubber to induce a reduction of bulk density of the reduced graphene oxide while maintaining dispersibility in rubber without using a solvent based process resulting in an industrially scalable process and an improved rubber composition.

Combined structure of lens and soft elastomer

U.S. patent: 12,656,627

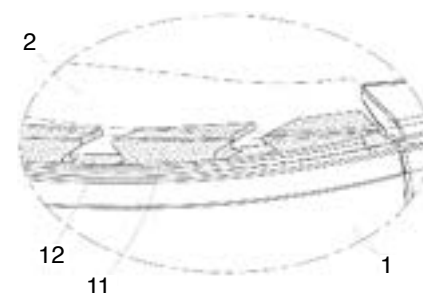
Issued: June 16, 2026

Inventor: Pin-Tsung Huang

Assigned: Ourad Safety

Key statement: A combined structure of a lens and a soft elastomer is disclosed. The lens has an upper edge that includes a combining portion, wherein the combining portion has at least one surface formed as a roughened surface. The elastomer is integrated with the

combining portion as a unity through an over-molding process. By roughening the surface of the combining portion, enhanced engaging force and all-around combination between the elastomer and the combining portion can be achieved. The combined structure prevents the elastomer and the lens from separation and thereby enhances industrial safety.



Method for manufacturing asphalt comprising rubber from end-of-life tires

U.S. patent: 12,668,686

Issued: June 30, 2026

Inventors: Luca Lelio, Massimo Losa and Pietro Leandri

Assigned: Bridgestone Europe

Key statement: A method for producing asphalt comprising a heat treatment step, wherein the rubber granules deriving from an end-of-life tire granulation process are subjected to a temperature of between 80°C and 300°C for a period of time necessary in order to obtain rubber granules with a density of between 1.0 and 1.5 g/cm³; and a mixing step wherein the rubber granules from the heat treatment step are mixed with stone aggregate and bitumen in order to obtain asphalt.

3D printable one-part carbon particle elastomer ink for applications such as health monitoring

U.S. patent: 12,655,309

Issued: June 16, 2026

Inventors: Andy Shar, Philip Glass and Daeha Joung

Assigned: Virginia Commonwealth University

Key statement: 3D printable inks are disclosed which include one-part room temperature vulcanized (RTV) silicone and

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carbon particles such as carbon nanotubes (CNTs). Butyl acetate may be used as a solvent to disperse the CNTs in the silicone in the ink precursor. The one-part nature of the inks (i) enables to print without prior mixing and cures under ambient conditions; (ii) allows directly dispensing 100 µm resolution printability

on nonpolar and polar substrates; and (iii) forms both self-supporting and high aspect ratio structures, key aspects in additive biomanufacturing that eliminate the need for sacrificial layers; and (iv) lends efficient, reproducible and highly sensitive responses to various tensile and compressive stimuli. The high electrical

and thermal conductivity of the CNT-silicone composite is further extended to facilitate use as a flexible and stretchable heating element, with applications in body temperature regulation, water distillation, and a dual temperature sensor and Joule heating source, for example.

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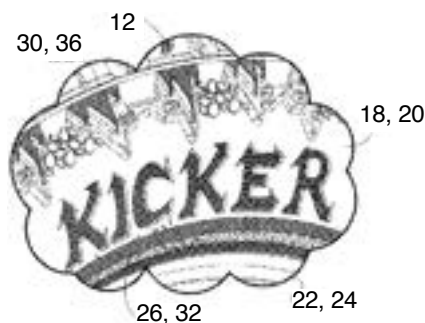
U.S. patent: 12,661,935

Issued: June 23, 2026

Inventor: Antonio Rafael Gonzalez

Assigned: Tire Group International

Key statement: A pneumatic tire assembly includes: a tread portion including one or more traction features; a first sidewall portion coupled to the tread portion; and a first bead portion coupled to the first sidewall portion; wherein the first sidewall portion includes multiangle first tread traction features positioned proximate the tread portion.



Elastomer composition, sealing material and method for producing sealing material

U.S. patent: 12,655,282

Issued: June 16, 2026

Inventors: Masanori Okazaki, Naoki Osumi and Masamune Noguchi

Assigned: Valqua

Key statement: One embodiment of the present invention relates to an elastomer composition, a sealing material or a method for producing a sealing material, in which the elastomer composition includes a crosslinkable fluoroelastomer (A) other than a perfluoroelastomer, an ethylenically unsaturated bond-containing compound (B), a crosslinking agent (C) and a crosslinking aid (D), the ethylen-

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ically unsaturated bond-containing compound (B) contains at least one selected from compounds having a perfluoro skeleton having an ethylenically unsaturated bond and compounds having a siloxane skeleton having an ethylenically unsaturated bond, and a mass ratio of a content of the crosslinking aid (D) to the crosslinking agent (C) is 5 or more.

Thermoplastic elastomer silicone composition

U.S. patent: 12,655,294

Issued: June 16, 2026

Inventors: Sebastien Merzlic, Philippe Blondel, Florent Abgrall, Karine Loyer, Damien Rauline and Sebastien-Jun Mougner

Assigned: Arkema France

Key statement: A composition including: (A) a copolymer having rigid

blocks and flexible blocks (TPE), (B) a non-crosslinked polysiloxane silicone, preferably a non-crosslinked polyorganosiloxane, (C) a compatibilizer, improving the compatibility between the TPE and the silicone, the compatibilizer (C) being chosen from a polyolefin or a mixture of polyolefins, and optionally (D) an additive.

Rubber composition, rubber product and tire

U.S. patent: 12,649,847

Issued: June 9, 2026

Inventors: Claudia Aurisicchio, Alessandra Calzetta and Raffaele Di Ronza

Assigned: Bridgestone Europe

Key statement: The present invention provides rubber compositions suitable for tire manufacture comprising a functionalized polymer and a functionalized silica.

Wheel and tire assembly, method of manufacture and use thereof

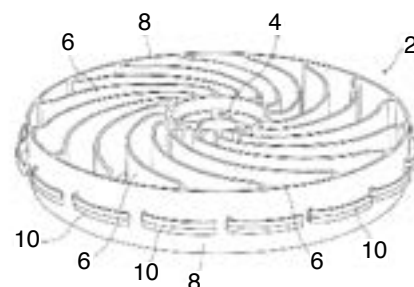
U.S. patent: 12,661,931

Issued: June 23, 2026

Inventor: Michael Andrews

Assigned: Kenda Manufacturing GB

Key statement: A wheel assembly incorporating a non-pneumatic tire, said assembly including first inner web or rib members and one or more second outer web or rib members. The web or rib members comprise flexible or resilient material where the first inner web members are less flexible or substantially more rigid than the second outer web members.



Rubber composition for golf ball

U.S. patent: 12,674,045

Issued: July 7, 2026

Inventor: Jun Shindo

Assigned: Bridgestone Sports

Key statement: A rubber composition for golf balls includes (a) a base rubber, relative amounts of (b) a co-crosslinking agent which is an α,β -unsaturated carboxylic acid and/or a metal salt thereof and of (c) an organic peroxide that together satisfy a specific condition, and (d) a specific amount of a moisture-providing agent, the latter being a substance which includes on the structure thereof a water constituent other than free water and eliminates moisture under heating or a substance which thermally decomposes under heating, releasing a water constituent. When the hardness difference in the internal hardness profile of a golf ball core made of the composition is large, the ball exhibits a low spin rate on shots, improving the flight performance of the ball, and the durability of the ball to cracking is enhanced.

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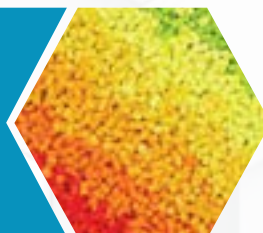


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Development of polycarbonate polyols for high performance polyurethane dispersions

by Yoichi Hirose, Asahi Kasei

Polycarbonate diols (PCDs) are diols with carbonate units, and they enable increased durability to polyurethanes (PUs) due to high cohesion energy of carbonate units (refs. 1 and 2). PCDs are therefore mainly used in high end applications requiring high durability, such as synthetic leather for automotive, soft feel paint for automotive interior parts, mobile phone coatings and so on. There are two types of PCDs: solid type and liquid type. The liquid PCDs offer both flexibility and durability compared to the solid homo type PCD of 1,6-hexanediol, which is widely used in general (ref. 3).

In recent years, the goal of achieving a sustainable society has become an important issue, and various methods are being explored to help achieve that goal. The main approaches of urethanes have included using bio-based raw materials, recycling PUs and reducing solvents used in synthesis of PUs. In water systematization, PUDs are one of the solutions.

PUDs are aqueous dispersions of polyurethane that offer the potential to reduce solvent usage compared to conventional solvent based PUs. However, the introduction of hydrophilic groups necessary for water dispersion compromises the water resistance of PUDs relative to solvent based PUs. Furthermore, dimethylolpropionic acid (DMPA), a commonly used hydrophilic diol, has been observed to increase the rigidity of PUs, thereby potentially reducing their suitability for textile applications.

Moreover, there is a need for high solid content in PUDs, which can reduce the time and energy required for curing. However, this also presents challenges, such as increased viscosity and compromised dispersion stability. This article describes the DK031E and PCDX-249 products, designed to address the issues associated with PUDs.

Experimental

Materials

DK031E and PCDX-249, developed by Asahi Kasei, were used. The structure and composition were not disclosed. For solid homo PCD with 1,6-hexanediol, T6002 from Asahi Kasei was used. PTMG (Mn: 2000, commercially available) was also used.

Synthesis of PUDs and their films

The polyurethane dispersions (PUDs) were prepared from polyols, 2,2-dimethylolpropionic acid (DMPA: Tokyo Chemical Industry Ltd., Japan), isophorone diisocyanate (IPDI: Fujifilm Wako Pure Chemical, Japan), triethylamine (TEA: Fujifilm Wako Pure Chemical, Japan) and ethylenediamine (EDA: Fujifilm Wako Pure Chemical, Japan) by the prepolymer method. The synthesis was performed using a base composition of polyol/DMPA/IPDI/TEA/EDA = 1/1/3/1/0.5 (molar ratio). When reducing DMPA, the synthesis was performed by decreasing the amount of DMPA to the specified equivalent amount.

The internal atmosphere of a 1 L separable flask to which a

stirrer, thermometer, reflux condenser, nitrogen blowing tube and a dropping funnel were attached was then purged with nitrogen. Polyol, DMPA, 100 ppm of DBTDL as a catalyst and MEK (methyl ethyl ketone: Fujifilm Wako Pure Chemical, Japan) were added to the flask and stirred at 200 rpm for 15 minutes under reflux at 90°C. Subsequently, IPDI was added with a syringe and the mixture stirred under reflux at 90°C until NCO% reached 3.5% by mass to obtain a solution of a terminal isocyanate group-containing urethane prepolymer in MEK. The NCO% is the ratio of the mass of an isocyanate group to the total mass of the starting materials used in the prepolymer step.

The resulting urethane prepolymer solution was cooled to 35°C, and TEA added with stirring at 500 rpm. Subsequently, while the solution was kept at 35°C and stirring at 500 rpm was continued, pure water was added dropwise at a rate of 10 mL/minute to obtain an emulsion (emulsified liquid).

While the emulsion was kept at 35°C and the stirring at 500 rpm was continued, EDA was added for chain extension reaction. Additionally, MEK was distilled under reduced pressure by the heating of the solution after the chain extension reaction to obtain an aqueous polyurethane solution.

The resulting water based polyurethanes were each coated onto polypropylene boards with molds attached to achieve a dry film thickness of 300 μ m, dried overnight and baked at 80°C for three hours to obtain films for evaluation of properties. The film thicknesses were both 300 $\pm$ 30 μ m. The obtained films were evaluated, respectively, by the following methods:

- **Average particle size:** The average particle size of aqueous polyurethane was measured using the NanoTrack UPA, manufactured by Nikkiso, Ltd.
- **Water absorption:** PUD film was soaked in water for one day at 23°C. Swelling ratio was calculated by the formula: Swelling ratio (%): $(W_2 - W_1)/W_1 \times 100$; W_1 = weight before an exam; W_2 = weight after an exam.
- **Mechanical properties (SS curves):** The resulting film was cut into 10 x 1 cm pieces and pulled at 20 mm between chucks and at a speed of 100 mm/second using a tensile testing machine manufactured by A&D Company, and SS curves were obtained. Measurements were performed at two levels: 23°C (r.t.) °C.
- **Heat and hydrolysis resistance:** The tensile strength at break of the films was obtained by the method described in the mechanical properties sections, and the films subjected to an additional test at 85°C and 85% relative humidity for 10 days was measured. The stress retention rate before and after the heat and hydrolysis resistance test was calculated according to the following formula: $[(\text{tensile strength after heat and hydrolysis resistance test}) / (\text{tensile strength before heat and hydrolysis resistance test})] \times 100$.
- **Chemical resistance (oleic acid):** PUD film was soaked in oleic acid for seven days at 23°C. Swelling ratio was

Table 1 - average particle size of PUDs

Polyol	DMPA (eq.)		
	1	0.5	0.25
DK031E	30 nm	40 nm	110 nm
PCDX-249	35 nm	145 nm	Not dispersed
T6002	150 nm	Not dispersed	Not dispersed
PTMG	70 nm	Not dispersed	Not dispersed
DK031E/T6002 = 1/1	40 nm	90 nm	Not dispersed

calculated by the formula: Swelling ratio (%): $(W_2 - W_1) / W_1 * 100$; W_1 = weight before an exam; W_2 = weight after an exam.

- *Viscosity*: The viscosity of the PUD was measured using the Visco QC 300R manufactured by Anton Paar.

Results and discussion

Water dispersibility

Table 1 shows the average particle size of PUDs obtained from each polyol: DK031E, PCDX-249, T6002, PTMG and a blend of DK031E and T6002 (1/1: wt%). Compared to typical polyols such as T6002 and PTMG, the particle size of PUDs using DK031E and PCDX-249 tended to be smaller. Utilizing this high water dispersibility, a 75% reduction in DMPA was possible with DK031E, and a 50% reduction with PCDX-249. This effect was also effective in blends, as a 50% reduction in DMPA was possible even when blending DK031E and T6002. This result is believed to be due to the high water dispersibility derived from the unique hydrophilic structure of DK031E and PCDX-249.

In the following sections, water resistance, oleic acid resis-

Table 2 - comparison of 100% modulus and breaking point of PUDs

Polyol	DMPA (eq.)	100% modulus (MPa)	Breaking point (MPa)
DK031E	1	5.9	55.5
	0.25	3.2	38.5
PCDX-249	1	2.5	23.8
	0.5	1.4	16.2
T6002	1	5.8	53.5
PTMG	1	2.0	26.4

Table 3 - solid content, particle size, viscosity of PUDs

Polyol	DMPA	Solid content (average particle size/viscosity)		
		30%	40%	50%
DK031E	1 eq.	30 nm/ 5-10 mPa·s	29 nm/ 120 mPa·s	x
	0.25 eq.	110 nm/ 5-10 mPa·s	-	110 nm/ 690 mPa·s
T6002	1 eq.	150 nm/ 10-30 mPa·s	90 nm/ 140 mPa·s	x

tance and flexibility were evaluated to confirm the benefits of reducing DMPA.

Water absorption

By reducing the amount of DMPA using DK031E and PCDX-249, it was possible to lower the water absorption of PUDs and minimize changes in appearance due to water absorption.

Figure 1 shows the results of the water absorption test of PUDs synthesized using various polyols and DMPA amounts. At the same amount of DMPA, DK031E and PCDX-249 exhibited inferior water resistance compared to T6002. However, by reducing the amount of DMPA, the water resistance significantly improved, resulting in better water resistance than T6002. This is believed to be due to the reduced hydrophilicity of polyurethane as a result of DMPA reduction.

Figure 2 shows the appearance of PUD films after the water absorption test. While all films with the same amount of DMPA became cloudy, reducing the DMPA amount allowed the films to maintain a transparent appearance, even after the water absorption test.

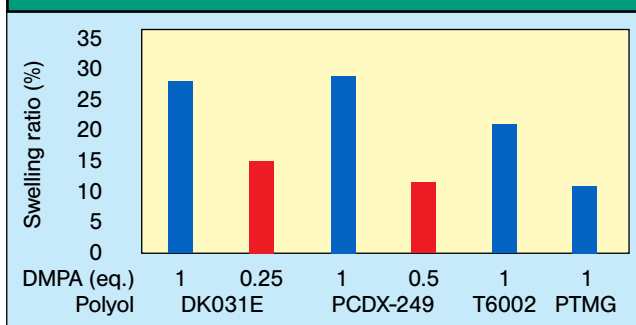
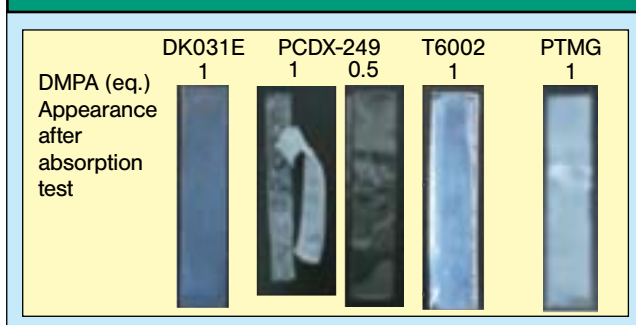
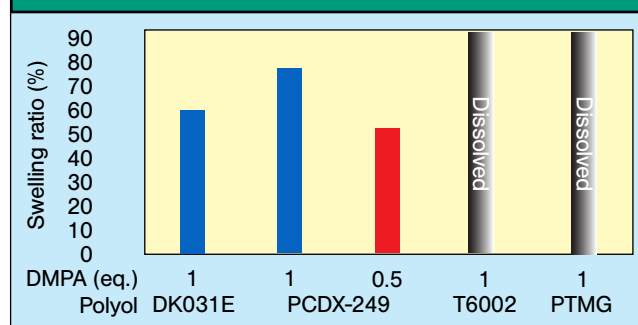
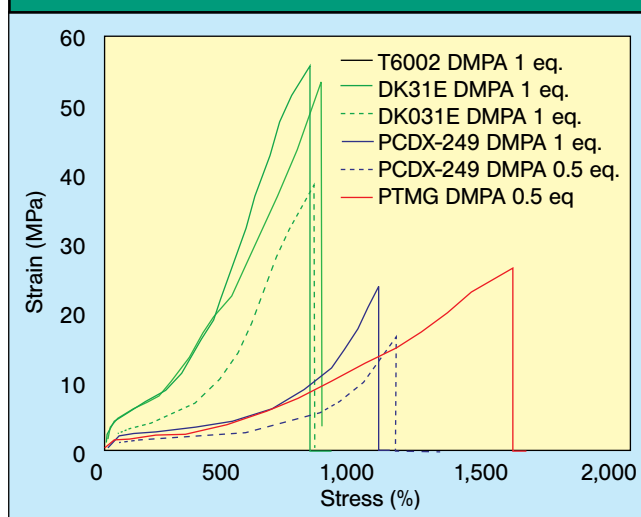
Figure 1 - water absorption of PUDs**Figure 2 - appearance of PUD films after water absorption test****Figure 3 - oleic acid resistance of PUD films**

Table 4 - property of the PUDs

Polyol	DMPA (eq.)	Water absorption (%)	Oleic acid absorption (%)	100% modulus (%)	Maximum solid content (%)
DK031E	0.25	15	-	3.2	50
			(62: DMPA = 1 eq.)		
PCDX-249	0.5	12	53	1.4	-
T6002	1	21	Dissolved	5.8	40
PTMG	1	11	Dissolved	2.0	-

Figure 4 - stress strain curves of PUD films



Oleic acid resistance

DK031E and PCDX-249 also exhibit good chemical resistance, and further improvements in chemical resistance were possible by reducing the amount of DMPA. Figure 3 shows the results of the oleic acid resistance test of PUDs synthesized using various polyols and DMPA amounts. The oleic acid resistance test is commonly evaluated for synthetic leather applications. PUDs using T6002 and PTMG dissolved after the test, whereas PUDs using DK031E and PCDX-249 maintained their shape. Additionally, reducing the amount of DMPA further suppressed swelling.

Flexibility

Next, to evaluate the flexibility of PU, the stress-strain curves of PUD films were obtained. By reducing DMPA using DK031E and PCDX-249, it was possible to form highly flexible coatings. Figure 4 shows the stress-strain curves at room temperature of PUDs synthesized using various polyols and DMPA amounts.

DK031E and PCDX-249 were able to lower the 100% modulus, an indicator of flexibility, by reducing DMPA. Particularly, PCDX-249 achieved a lower 100% modulus compared to PUDs using PTMG, which is known as a flexible polyol (table 2).

Solid content

Finally, the maximum solid content of PUDs was confirmed. Increasing the solid content of PUDs is beneficial, as it can reduce the energy costs associated with baking and transportation. Table 3 shows the solid content of PUDs synthesized using various polyols and DMPA amounts, as well as the particle size and viscosity at those solid contents. Both DK031E and T6002 had a maximum solid content of 40%. However, by reducing the amount of DMPA, DK031E was able to increase the solid content to 50%. This is believed to be due to the unique hydrophilic structure of DK031E, which stabilizes the dispersion and prevents particle aggregation, even at high solid content.

Conclusion

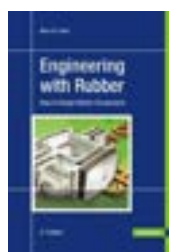
This article reported on DK031E and PCDX-249, which were developed for PUDs to address the challenges of:

- Reducing DMPA
- Increasing solid content

These PCDs have higher water dispersibility compared to general purpose PCDs, enabling the reduction of DMPA. This resolved issues related to water resistance, chemical resistance and flexibility in PUDs (table 4). Additionally, using DK031E allowed for an increase in solid content, successfully synthesizing PUDs with a 50% concentration. It is believed that the newly developed DK031E and PCDX-249 can address the limitations of conventional PUDs and contribute to their enhanced functionality.

References

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3. T. Masubuchi, *Material Stage*, 10 (2011).



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Polyurethane spray foam and electrical wiring: Unraveling thermal stability

by Renjith Rajan Pillai, James D. Hammon and Brent Williams, Creative Polymer Solutions

Polyurethane (PU) foams have garnered widespread attention in the construction industry owing to their superior thermal insulation properties, structural versatility and ease of application (ref. 1). These foams are synthesized through the exothermic reaction of isocyanates (Part A) with polyols (Part B), forming a highly crosslinked cellular polymeric structure. Based on their cellular morphology and physical characteristics, PU foams are broadly categorized into open cell and closed cell systems. Open cell foams are lightweight and vapor permeable, offering excellent acoustic dampening and thermal insulation in interior applications. In contrast, closed cell foams are denser, exhibit low water absorption and provide higher thermal resistance (R-value), making them suitable for exterior walls, roofing systems and environments requiring moisture barriers and enhanced structural integrity (refs. 2 and 3).

Over the past two decades, PU foam based insulation systems have witnessed substantial growth in both residential and commercial construction sectors due to their excellent thermal and acoustic properties, cost effectiveness, ease of installation and energy efficiency benefits. This expansion has been driven by increasingly stringent building energy codes, heightened awareness of energy conservation and the global shift toward sustainable construction materials. According to recent market analyses, the global PU foam market has experienced a consistent compound annual growth rate (CAGR), with projections indicating a market value exceeding \$80 billion by the year 2030 (figure 1). This trend is further reinforced by the foam's compatibility with diverse substrates, rapid application techniques and long term cost saving potential through reduced energy consumption (refs. 4 and 5).

Despite their well established performance benefits, the deployment of PU foams in direct contact with critical building

infrastructure components, such as electrical wiring, has raised safety concerns among stakeholders, including builders, regulatory bodies and end users. One of the primary apprehensions relates to the thermal stability of electrical wires when encapsulated within or surrounded by PU foam during and after application. Given the exothermic nature of the PU curing process, the potential risk of thermal degradation of wire insulation and jacketing materials warrants systematic investigation. Electrical conductors used in building applications are typically rated for continuous operation within defined thermal limits, as specified by governing safety codes and standards, such as National Electrical Code (NEC), UL 83 (for thermoplastic insulated wires) and IEC 60228 (for conductor requirements). Direct exposure of the electrical wire insulation or jacket material to a highly reactive monomeric species and elevated temperatures during foam curing may pose risks of chemical or thermal degradation, embrittlement or loss of dielectric strength in the insulation layer. Such degradation, if left unaddressed, could lead to compromised electrical performance, increased fire risk or long term reliability issues in building systems. The safety of electrical wires-PU foam interactions remained a question among users. It is critical to develop a scientific understanding of the thermal effects of PU foam on common electrical wiring materials. Addressing this knowledge gap is not only necessary to ensure compliance with safety regulations, but also to promote evidence based practices in spray foam insulation applications. Moreover, resolving such concerns through empirical data is essential for preserving consumer confidence and preventing misinformation that could hinder the adoption of PU foam technologies.

In this study, a comprehensive investigation into the thermal stability of electrical wires subjected to spray PU foam application under realistic construction conditions is presented. The primary objective was to evaluate whether standard electrical wiring materials, when embedded in wall panels and encapsulated with PU foam, exhibit any measurable thermal or physical degradation. Both open cell and closed cell PU foams were assessed, given their differing thermal conductivity, density and reaction kinetics. The wires used in the study conformed to standard residential electrical specifications.

Experimental

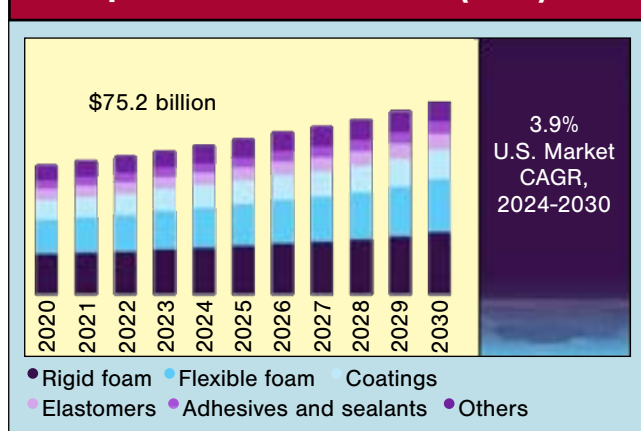
Materials

The electrical wire selected for this study was the Southwire Romex SIMpull indoor copper NM-B cable (14/2 with ground, rated for 600 volts), a commonly utilized wiring type in both residential and commercial installations. To monitor the thermal behavior during spray foam application, a Fluke 54 II B digital thermometer was employed. The wall panel assemblies used in the experimental setup were procured from Uline.

Spray foam application

Experimental wall assemblies were constructed with electrical

Figure 1 - U.S. polyurethane market size by product from 2020 to 2030 (ref. 6)



wires embedded in configurations representative of typical in-wall installations. PU foams were applied using standard industry spraying methods, with key variables, including ambient temperature, foam rise time and application thickness, precisely controlled to replicate real world conditions. The exothermic temperature profile during foam application was recorded using a digital thermometer in conjunction with thermocouples strategically positioned near the wires, inside the wires and within the foam core to monitor peak temperatures and the duration of thermal exposure. After the foam had fully cured, the wires were carefully extracted and subjected to comprehensive analysis to evaluate any potential alterations in the chemical or physical characteristics of the insulation and jacket materials.

Characterization

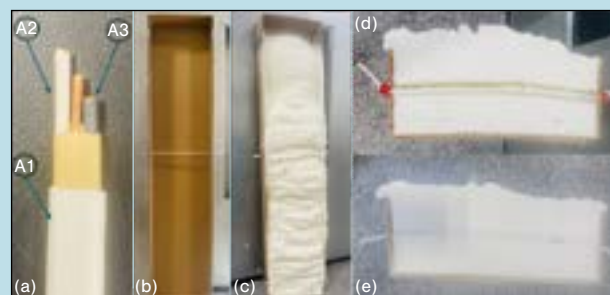
Characterization techniques encompassed a combination of analytical, spectroscopic and microscopic approaches to comprehensively evaluate the thermal and structural integrity of the electrical wire components. Initial assessments began with visual inspection to identify any observable signs of thermal distress, such as discoloration, surface cracking or warping. Fourier transform infrared (FTIR) spectroscopy was conducted to detect potential chemical modifications in the polymeric structure of the outer jacket following exposure to PU foam. To evaluate changes in thermal behavior, differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA) were employed to determine shifts in melting temperature (T_m) and decomposition temperature (T_d), respectively. Furthermore, ultra high resolution 3D microscopy was used to investigate the surface morphology of the inner wall of the outer jacket, with quantitative surface roughness measurements providing insight into any microstructural alterations induced by heat exposure. This high resolution imaging allowed for precise assessment of subtle changes that would indicate polymer chain rearrangement. All analyses were performed in parallel with unexposed control samples to distinguish PU foam induced effects from baseline material characteristics.

This study aims to generate a comprehensive dataset that elucidates the thermal and structural implications of embedding electrical wiring within PU spray foam environments. The findings presented herein are expected to be of relevance to foam formulators, electrical component manufacturers, insulation contractors, safety inspectors and building design professionals. The thermal interaction between PU foams and electrical wiring is a critical area of investigation that has implications for both safety and performance in modern building systems. As PU foams continue to proliferate in construction applications, it is essential to ensure that their integration with electrical infrastructure does not compromise long term reliability or violate safety margins. This study represents a foundational step toward addressing this need through methodical experimentation and scientific analysis.

Results and discussion

The structural configuration of the electrical wire includes an outer jacket made of polyvinyl chloride (PVC), followed by a kraft paper binder layer. Encapsulated within this binder are the

Figure 2 - (a) A1 white outer jacket, A2 white insulation, A3 black insulation; (b) wall panel with electrical wire placed 2.5" from the bottom; (c) after open cell spray foam; and electrical wire at the middle of the (d) open cell foam; (e) closed cell foam



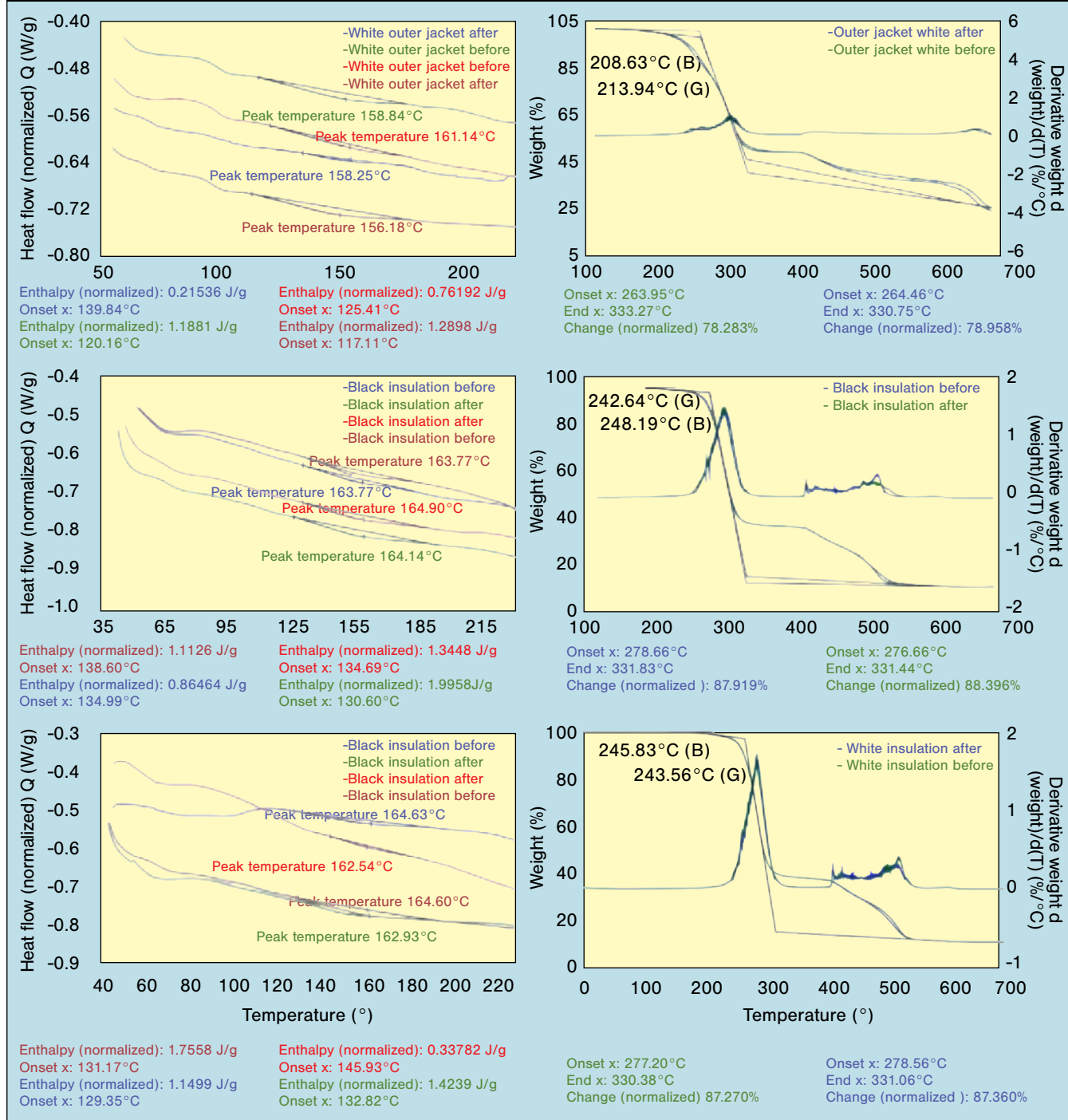
ground and copper conductors. Each conductor was individually insulated and further enclosed by an additional transparent jacket to ensure safe and efficient electrical transmission (figure 2). The jacketing and insulation components of the electrical wire were carefully evaluated following the spray foam application to identify any alterations in their chemical, thermal or material properties, thereby ensuring thermal stability. Visual inspection of the wire post-extraction from the foam revealed no significant alterations, apart from residual foam adhering to the outer surface. The assessment began with DSC and TGA. The melting (T_m) and degradation (T_d) temperatures of the jacketing and insulation materials were analyzed both before and after the spray foam application (figures 3a and 3b). No notable variations were observed in the thermal behavior of any of the tested components (table 1). The application of spray foam did not affect either the T_m or T_d of the materials. In cases where the temperature generated during foam application or curing approaches exceeds the T_m of a material, thermal energy can disrupt intermolecular interactions, leading to chain scission, crosslinking or oxidation. Such changes may result in polymer chain reorganization and, consequently, altered material properties. Extended exposure to elevated temperatures can also cleave covalent bonds or trigger secondary reactions.

Given that the jacket and insulation materials of the electrical

Table 1 - melting and degradation temperatures of various components of the electrical wire before and after the application of spray foam

Type of material	T_m ($^{\circ}\text{C}$)	T_d ($^{\circ}\text{C}$)
White outer jacket before	159.9 ± 1.15	213.94
White outer jacket after	157.2 ± 1.04	208.63
Black insulation before	163.3 ± 0.50	248.19
Black insulation after	164.5 ± 0.38	242.64
White insulation before	162.7 ± 0.20	243.56
White insulation after	164.6 ± 0.02	245.83
Transparent jacket black before	220.6 ± 0.03	315.63
Transparent jacket black after	220.2 ± 0.03	311.38
Transparent jacket white before	221.3 ± 0.81	315.14
Transparent jacket white after	221.2 ± 0.15	307.72

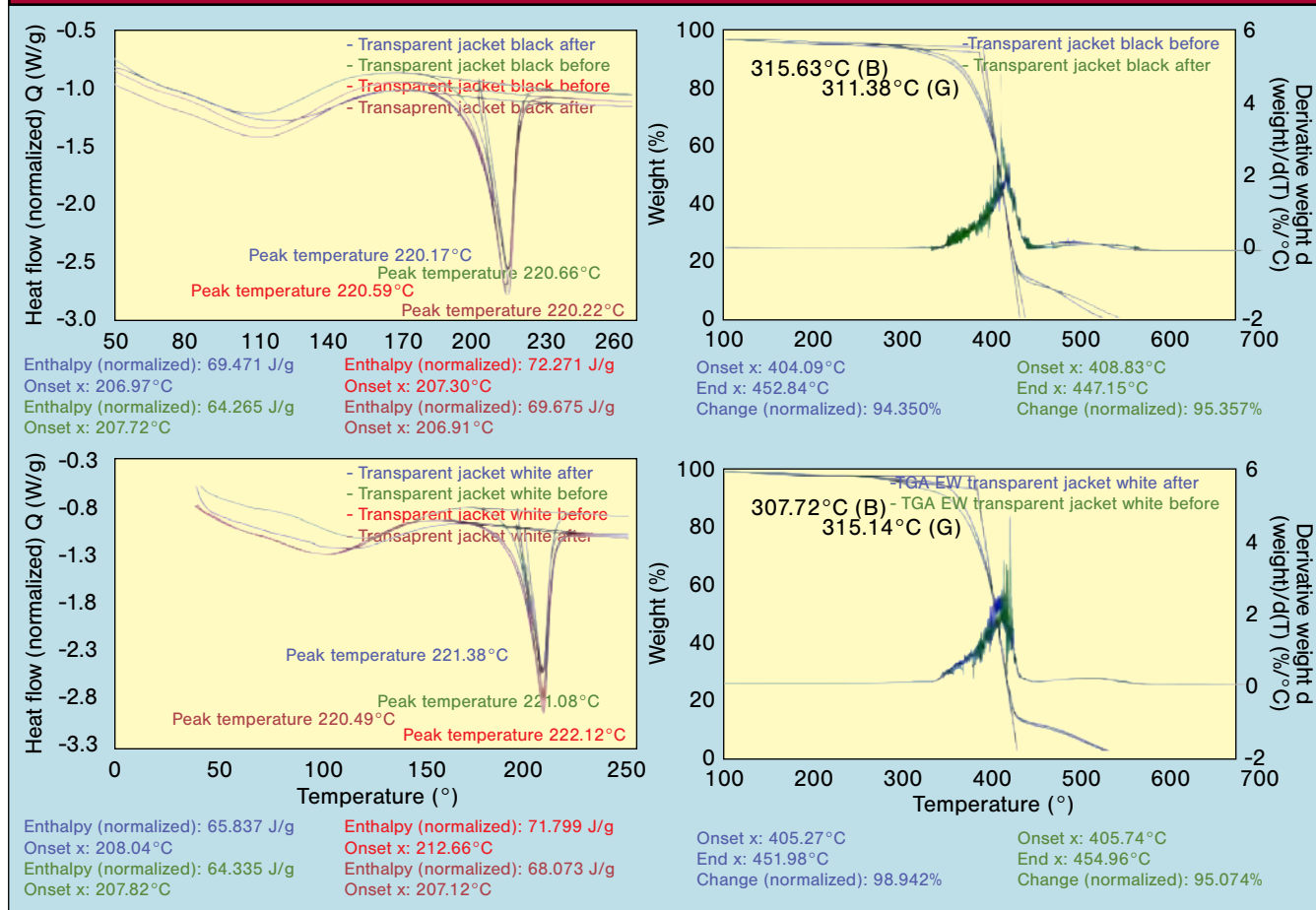
Figure 3a - DSC and TGA profiles of the insulation and jacketing materials from the electrical wire before and after spray foam application



wire exhibited no signs of thermal degradation during spray foam application or curing, it was essential to characterize the heat generation profile of both open cell and closed cell PU foams. To simulate practical application conditions, the electrical wire was placed at the mid-plane of the wall panel, positioned approximately 2.5" above the base prior to foam spraying. Temperature measurements were taken at this central location to capture the peak exothermic behavior during foam expansion and curing. Additionally, temperatures were monitored

in the immediate vicinity of the wire to assess the effective thermal exposure, which is typically expected to be slightly lower than the core foam temperature due to heat dissipation. Reflecting commercial spray practices, closed cell PU foam was applied in one continuous 5" lift, as well as in two sequential 2.5" lifts; while a single lift was used for open cell foam due to its significantly lower heat output. For open cell foam, the peak temperature in the foam bulk reached 107°C, with a corresponding temperature of 79°C near the wire (figure 4), both well

Figure 3b - DSC and TGA profiles of the transparent jackets of the insulation materials from the electrical wire before and after spray foam application



below the melting and degradation thresholds of the jacket and insulation materials. In contrast, a single 5" lift of closed cell foam generated a peak temperature of approximately 185°C in the core, 131°C near the wire and 121°C inside the electrical wire. When applied in two 2.5" lifts, the closed cell foam generated maximum temperatures of 126°C and 138°C in the core, 79°C and 92°C near wire and 65°C and 95°C inside the wire during the first and second lifts, respectively. In every scenario, the effective temperature experienced near and inside the jacket of the wire remained safely below the thermal failure limits of the insulation and jacket materials. Based on the DSC analysis, the white outer jacket material exhibited the lowest Tm among all tested components, measured at 158.6°C ± 1.8°C. This value remains significantly higher than the maximum temperature recorded near the electrical wire during both open cell (79°C) and closed cell (131.3°C) PU foam application. Taken together, these results confirm that the thermal loads generated during the application of both open cell and closed cell PU foams do not compromise the integrity of the electrical wire, corroborating the findings from DSC and TGA measurements, and validating the material's thermal resilience.

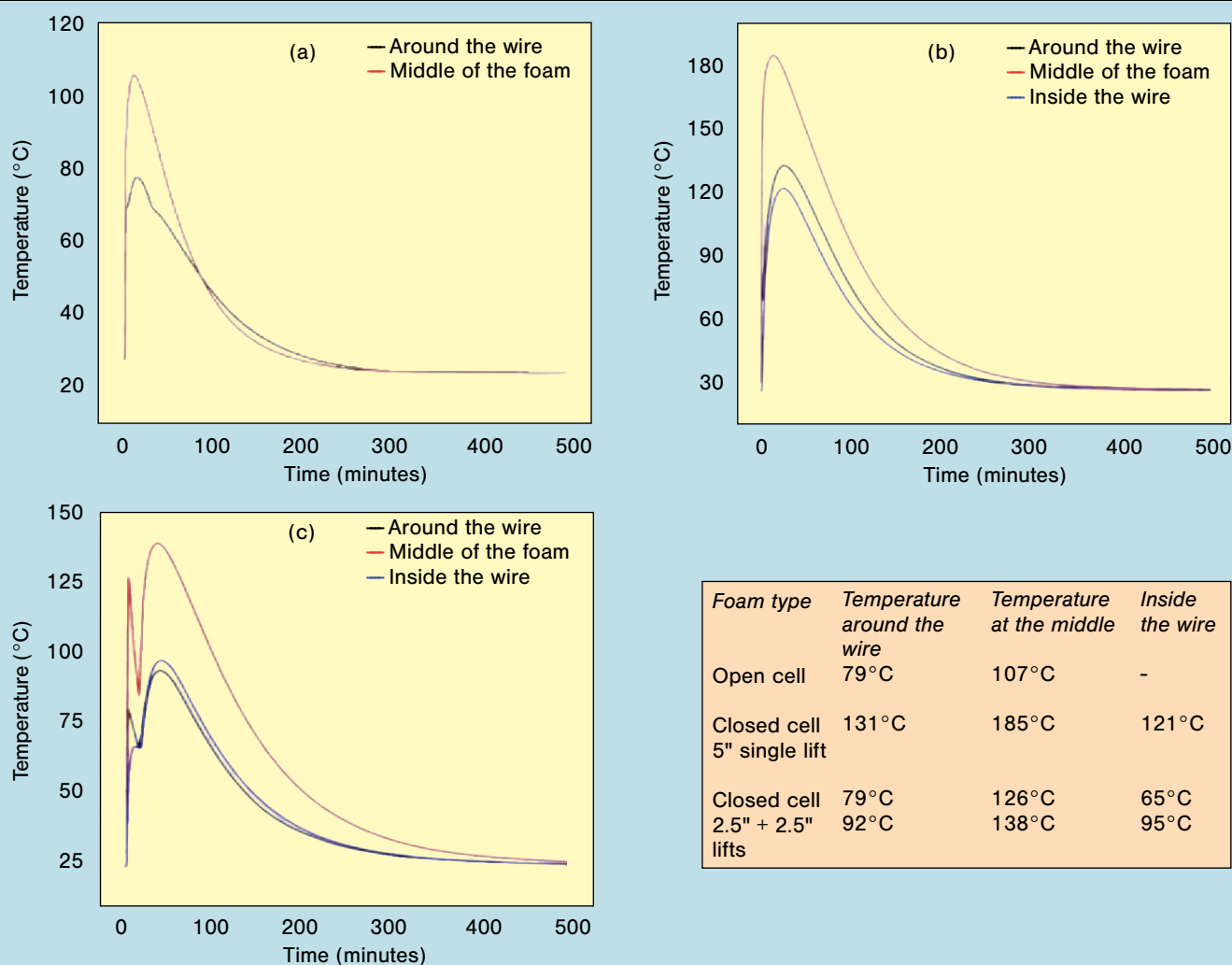
In addition to thermal properties, the chemical integrity of polymeric materials plays a critical role in evaluating their thermal stability under different processing conditions. Elevated

temperatures can induce chemical transformations in polymers, such as chain scission, crosslinking or oxidative degradation. To assess potential chemical alterations resulting from spray foam application, FTIR spectroscopy was performed on the outer jacketing of the electrical wire, both prior to and following the

Table 2 - melting (Tm) and degradation (Td) temperatures of different components of commercially available electrical wires

Type of electrical wires	Tm (°C)	Td (°C)
8-3 NM W/G wire, black		
1. Black jacket	153.12	223.34
2. White insulation	220.45	366.06
3. Transparent jacket (IN)	211.01	267.03
18/2 brown solid CU CL2 thermostat wire		
1. Brown jacket	182.35	246.52
2. Red insulation	160.86	260.22
3. White insulation	162.13	252.06
Gauge green stranded copper THHN wire		
1. Green insulation	167.64	257.59
2. Transparent jacket	220.24	374.13
6 gauge red stranded copper THHN wire		
1. Red insulation	200.12	248.75
2. Red jacket	220.28	363.29

Figure 4 - exothermic temperature profiles of (a) open cell foam; (b) closed cell foam applied in a single 5" lift; (c) closed cell foam applied in two successive 2.5" lifts; and summarized numerical temperature data



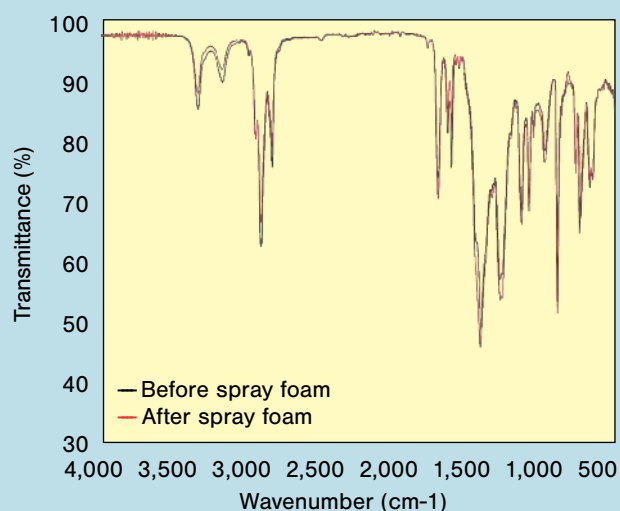
spray foam application (figure 5). As the outer jacket is in direct contact with the applied foam, and thus subject to the highest localized thermal exposure during foam application and curing, it serves as a sensitive indicator of heat induced chemical changes. The FTIR spectra revealed no discernible differences in characteristic absorption bands before and after treatment, indicating the absence of chemical degradation or modification. This suggests that the thermal load imparted by the spray foam process remained well below the threshold necessary to disrupt the chemical structure of the jacket material. These findings reinforce the conclusions drawn from DSC and TGA analyses, collectively confirming that the jacketing material retains its thermal and chemical stability following exposure to spray foam application.

To complement the thermal and spectroscopic analyses, ultra high resolution 3D microscopic imaging was employed to evaluate the inner surface morphology of the electrical wire's outer jacket. Quantitative surface roughness analysis was performed to identify any microstructural changes potentially in-

duced by thermal exposure during PU foam application (figure 6). Such exposure, if sufficient, could affect the polymer matrix that would typically manifest as chain rearrangements or degradation, resulting in measurable alterations in surface topography. However, comparative examination of 3D image data revealed no appreciable differences in morphology between unexposed and exposed samples. The measured surface roughness values were $10.3 \mu\text{m} \pm 2.19 \mu\text{m}$ for the unexposed jacket, $10.73 \mu\text{m} \pm 2.26 \mu\text{m}$ for the open cell exposed sample and $10.06 \mu\text{m} \pm 0.9 \mu\text{m}$ for the closed cell exposed sample. These minimal variations strongly suggest that the outer jacket, the component with the lowest thermal threshold within the wire system, retains its morphological stability under both open cell and closed cell spray foam conditions. Consequently, this structural integrity suggests that all other internal components of the wire, which possess higher thermal thresholds, are likewise unaffected, affirming the overall thermal resilience of the electrical wire system in such insulation environments.

Considering the wide range of electrical wires available on

Figure 5 - FTIR spectra of the electrical wire's outer white jacket, comparing samples before and after the application of closed cell spray foam



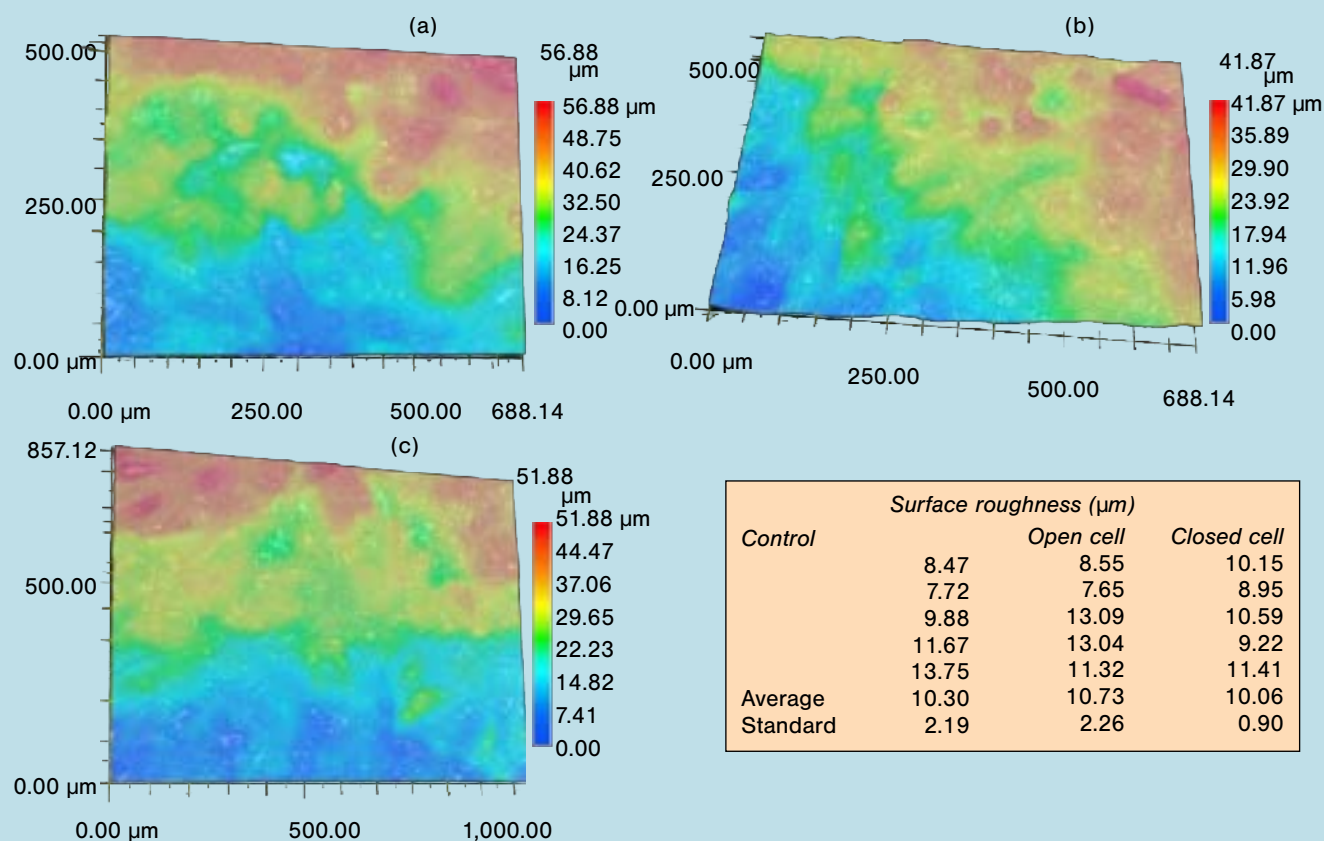
the market, four more types of electrical wires have been examined (table 2). A comprehensive examination was performed on

all these, and investigators were not able to find any form of thermal damage in any of the electrical wire components attempted.

Conclusion

This study presents a comprehensive thermal and structural stability assessment of a widely used electrical wire system subjected to PU spray foam applications. Both outer jacketing and inner insulation layers, including the transparent sub-jackets, were evaluated before and after exposure to open cell and closed cell PU foams under simulated real world installation conditions. By replicating field scale spray procedures and embedding wires within wall assemblies, investigators ensured that the results closely reflected actual application environments. Thermal analysis using DSC and TGA revealed no significant alteration in the melting or degradation temperatures of any wire component post-application. Notably, the outermost jacket exhibited the lowest T_m at $159.9^\circ\text{C} \pm 1.15^\circ\text{C}$, while the peak temperatures recorded near the embedded wire were 79°C for open cell and 131.3°C for closed cell PU foams; well below the critical thermal limits. The maximum exothermic exposure from closed cell foam remained at least 30°C below the T_m of the most thermally sensitive component, which is the outer jacket; affirming that the wire remains thermally stable under standard PU foam application and curing conditions. Furthermore, T_d

Figure 6 - ultra high resolution 3D microscopic images of the inner wall of the electrical wire jacket (a) without spray foam; (b) after open cell spray foam; (c) after closed cell spray foam; and the table of all the samples with their surface roughness data



values for all components were at least twice the maximum effective temperatures measured around the wire, effectively ruling out any risk of thermal degradation. Spectroscopic analysis via FTIR and surface morphology evaluation using ultra high resolution 3D microscopy corroborated the absence of chemical or structural changes, further validating the wire's resilience. Surface roughness analysis of the inner wall of the outer jacket showed no significant deviations before and after foam exposure, confirming that the jacket's microstructure remained unaltered by the thermal load. Collectively, these findings provide strong evidence that the electrical wire tested in this study maintains its integrity and performance when exposed to the thermal conditions generated during PU foam applications. The results not only address industry concerns regarding wire-foam compatibility, but also support the continued safe use of PU spray foams in residential and commercial settings involving embedded electrical wiring systems.

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Novel quality control approach to optimize the mixing process of washing machine door gaskets in silica based formulations: New tool for assessing filler dispersion

by Michele Scacchi, Davide Giorgietti and Denis Venturoli, Evercompunds S.p.A.

Silica is one of the most common reinforcing fillers used in the rubber industry, second only to carbon black (CB) filler. In addition to the tire industry, silica reinforced rubbers are commonly used in shoe soles, conveyor belts, rolls, hoses and numerous other rubber products. In this study, silica filled EPDM compounds for washing machine door gasket applications are examined. Regardless of the application, the mixing of silica filled compounds is more complicated than CB filled compounds. As reported in the literature, due to the presence of hydrophilic Si-OH groups on the silica surface, silica is not compatible with the non-polar diene elastomers. To achieve a sufficient degree of filler dispersion, the silica must be hydrophobated by means of silane. In other words, a chemical reaction called silanization takes place during mixing concomitantly with the filler dispersions and the addition to other ingredients. On one hand, high shear forces are required for mechanical dispersion and generation of new filler surfaces; on the other hand, an isothermal condition over a sufficient period of time is necessary to complete the silanization reaction (ref. 1). Therefore, to achieve a compromise between these contradictory conditions, an optimum temperature control must be reached in the mixing process. Typically, the silanization reaction may not exceed 160°C (ref. 1) and the optimum operating temperature window is between 140°C and 155°C.

Therefore, although the silanization reaction is crucial to improve the compatibility between silica and the rubber matrix, only a limited percentage of all silanol groups on the silica surface reacts with the silane, as reported by Blume et al. (ref. 2).

The dispersion of silica fillers, in a similar way to CB, is often divided into two main stages: macro dispersion and micro dispersion. Macro dispersion is defined as the dispersion of so-called agglomerates, in the case of CB, and clusters for silica, and the typical size range is between 2 and 100 mm. Micro dispersion is instead considered the dispersion of agglomerates of CB or clusters of silica with size smaller than 2 mm. Despite both dispersions being important, micro dispersion is considered the most critical to achieve the higher level of reinforcement. Typically, the micro dispersion in silica filled rubber compounds is the dispersion process resulting from the breaking of the silica network to various extents, and the redistribution of the resulting micro clusters in the rubber matrix.

For silica filled compounds, Blume and Uhrlandt (ref. 3) proposed a model to describe the mechanism of micro dispersion, according to which the micro dispersion of silica occurs regardless of the size of the silica clusters, and therefore the

macro and micro dispersions are not linked as in the case of CB fillers.

Moreover, the micro dispersion of silica fillers cannot be measured and quantified with the conventional techniques (ref. 4). Light optical microscopy techniques are limited only to macro dispersion. The assessment of electron microscopy investigations (ref. 5), regardless of the technique used, transmission or scanning mode, can be subjected to significant arbitrariness because of the extremely small volume elements that are investigated. For these reasons, these advanced techniques are not suitable for quality control purposes because a great number of samples should be examined to obtain a reliable “index” of the degree of micro dispersion.

Also, for the compound examined in this work which is designed for a silica door gasket, the assessment of the filler dispersion in the rubber matrix is a crucial aspect to avoid issues in the final product. In fact, for this specific application, a poor dispersion of silica in the EPDM matrix can cause loss of mechanical properties and a reduction of the product's life cycle.

There are several rheometric techniques that can be used to evaluate the macro and micro dispersion of filled rubber compounds in the uncured and in the cured stages (refs. 4, 6 and 7).

As the Payne effect (refs. 8, 9 and 10) is well known as an alternative technique to electron microscopy, it also provides an indirect measurement of degrees of micro and macro dispersion of filled rubber compounds, just by looking at the typical strain dependent behavior of the storage modulus, G' . This approach provides an interpretation of the disruption of filler-filler and filler-matrix interactions under deformation. In other words, the Payne effect phenomenon reflects the progressive breakdown and reformation of the filler network. For silica reinforced compounds, due to the high amount of silanol groups on their surface, and consequently a strong filler-filler network in the rubber matrix, the typical Payne effect persists until approximately 10% strain (refs. 4, 11, 12 and 13).

The Payne effect was converted in a quick, simple to perform standard test method (ASTM Standard D8059, Test Method for Rubber Compounds, Measurements of Unvulcanized Dynamic Strain Softening [Payne Effect] Using Sealed Cavity Rotorless Shear Rheometer) (ref. 14), and it is currently the most popular approach used to qualitatively assess the macro and micro dispersion of silica.

Despite the above mentioned benefits, the strain dependence of G' by strain amplitude sweep is not capable of describing the non-linear behavior of rubber compounds, as shown in the next section. To overcome this limitation, in this study, FT rheology (ref. 15) was applied, adopting the same approach presented in recent works (refs. 16 and 17) to detect the filler-rubber interac-

tions of uncured compounds. A sensitive non-linearity index (NLI) was introduced, capable of detecting the nonlinear contribution due to polymer-filler interactions, tracking not only the onset of the Payne effect, but also describing the strain dependent behaviors related to filler network breakdown and polymer chain stretching. This approach was validated by analyzing the door gasket compound in the cured stage with a scanning electron microscope (SEM), and the correlation between the results obtained by this analysis and the outcomes delivered by the NLI parameter were checked.

FT rheology: Generalized elastic modulus and new non-linearity index

As mentioned before, the main limitation of the Payne effect approach is that in the non-linear regime, the storage modulus from the first harmonic is not capable of describing the non-linear behavior of filled rubber compounds. In fact, according to the model proposed by Payne and the ASTM Standard D8059, the Payne effect is measured as the difference between $G'_0 - G'_\infty$, $\Delta G'$, where G'_0 is the maximum value of G' , while G'_∞ is the minimum value of G' in the strain sweep measurement. Theoretically, the lower the value of the $\Delta G'$ (so called dynamic stress softening), the better the macro and micro dispersion of silica in the rubber matrix. However, in the nonlinear viscoelastic regime, this approach is not ade-

quate to characterize the nonlinear response of the tested materials, because in this regime, the sinusoidal shear stress becomes distorted and the elastic modulus is no longer strain dependent (figure 1).

In other words, as strain amplitude increases, a significant deviation from linearity appears, and the shear stress response can be described only by considering all odd higher harmonic contributions of the overall signal (figure 2).

Therefore, the appearance of these harmonics means that the material's response is no longer an ideal sinus wave, marking the transition to nonlinear viscoelasticity.

In an oscillatory shear flow by applying the input strain to the sample:

$$\gamma(t) = \gamma_0 \sin(\omega t) \quad (1)$$

the resulting shear stress response of the material, according to the Fourier transform analysis, can be described as Fourier series using the trigonometric representation of a periodic function of sine and cosine terms:

$$\tau(t) = \gamma(t) \sum_{k=1}^{\infty} [G'_k \sin(k\omega t) + G''_k \cos(k\omega t)] \quad (2)$$

Since the strain applied $\gamma(t)$ is an odd function of time $\gamma(-t) =$

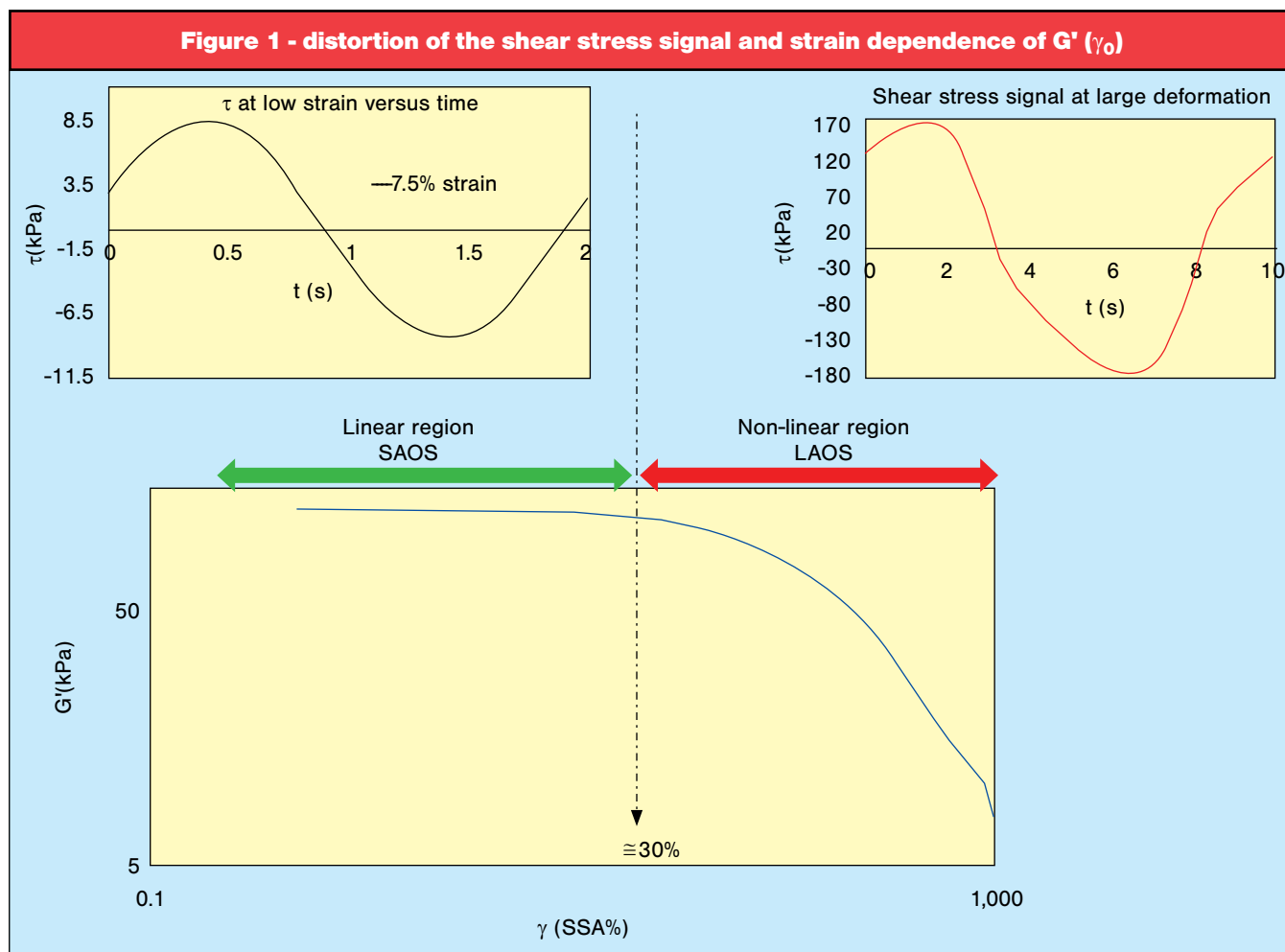
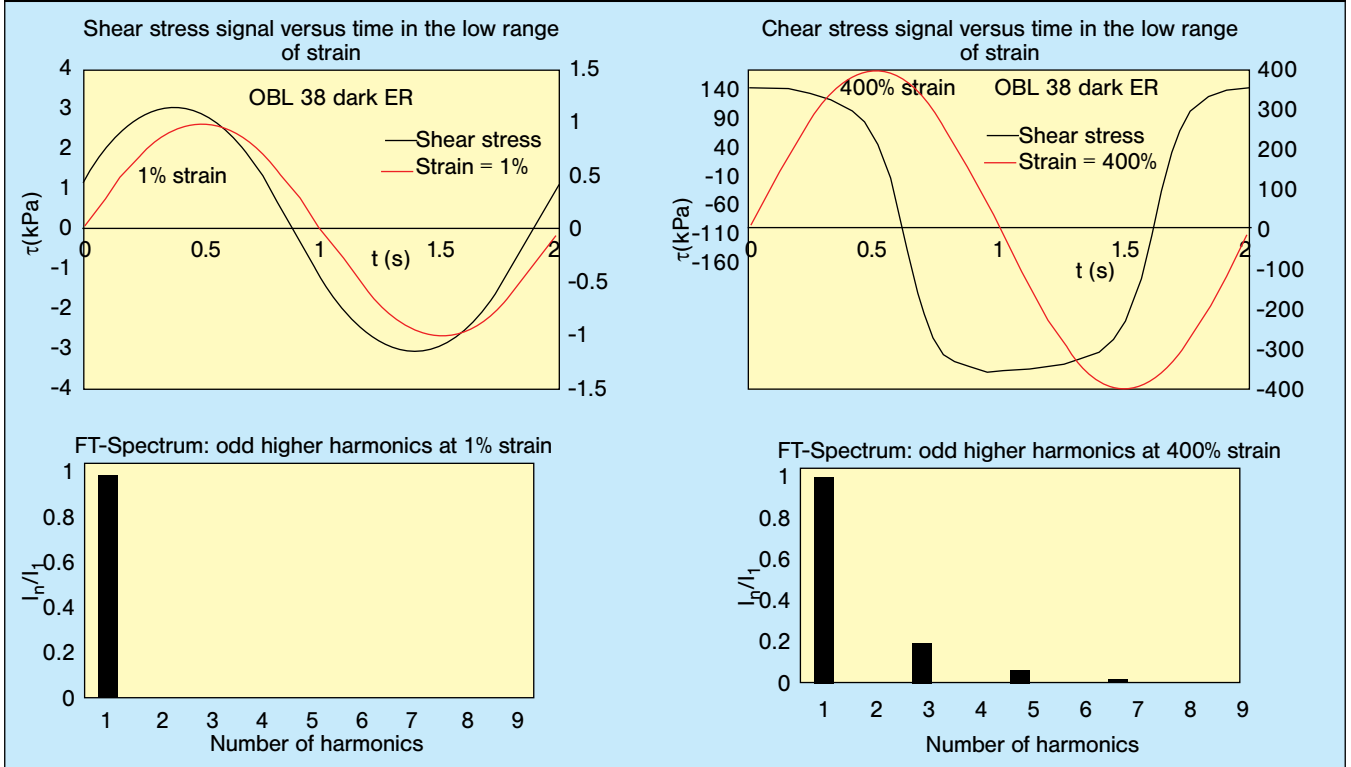


Figure 2 - distortion of the shear stress of OBL 38 Dark and intensity of harmonics in the linear and nonlinear regime



$-\gamma(t)$, consequently the corresponding stress component, $\tau_E(t)$ is also an odd function of time and is defined as the elastic component.

Therefore, the elastic shear stress can be expressed as follows:

$$\tau_E(t) = G(\gamma(t)) \cdot \gamma(t) = \gamma(t) \sum_{k=1,3,5,\dots} G'_k \sin(k\omega t) \quad (3)$$

In the same way, cosine function, which is an even function, represents the viscous stress component and it is consequently the only function of $\dot{\gamma}$.

Then, using the approach of the generalized viscoelasticity proposed by Cho et al. (ref. 18), the shear stress equation 2 can be alternatively written as:

$$\tau(\gamma, \dot{\gamma}) = G(C) \cdot \gamma + \frac{1}{\omega} \cdot W(\dot{\gamma}) \cdot \dot{\gamma} \quad (4)$$

where $G(\gamma)$ represents the generalized elastic modulus, which depends solely on strain γ , while $W(\dot{\gamma})$ indicates the generalized viscous modulus, which only depends on the shear rate ($\dot{\gamma}$).

Note that in the linear regime, the generalized moduli $G(\gamma)$ and $W(\dot{\gamma})$ are exactly the storage modulus and the loss modulus, respectively, G' and G'' . In other words, equation 4 is independent of the viscoelastic regime applied, linear regime (small amplitude oscillatory shear [SAOS]) or highly nonlinear regime (large amplitude oscillatory shear [LAOS]), and can be used as a general equation of the generalized shear stress response of a viscoelastic material undergoing a generic oscillatory shear deformation.

tory shear deformation.

The parametric representation of $G(\gamma)$ is further obtained by adopting the approach proposed by Nichetti et al. (refs. 16 and 17): By decomposing the elastic modulus by Fourier series and using the expansion of the Chebyshev polynomials (Chebyshev polynomials of second kind) or specific forms of angle identities, the generalized elastic modulus can be written as follows:

$$G(\gamma, \gamma_0) = G'(\gamma_0) + G'_{NL}(\gamma_0) + \sum_{n=1}^{\infty} (-1)^n g_{2n+1} \left(\frac{\gamma}{\gamma_0}\right)^{2n} \quad (5)$$

The first term of equation 5, $G'(\gamma_0)$, is the classical storage modulus of the linear viscoelasticity, which is the elastic modulus from the first harmonic. The second term, $G'_{NL}(\gamma_0)$, is obtained as a linear combination of non-linear stress components such as:

$$G'_{NL}(\gamma_0) = \sum_{n=1}^{\infty} (2n+1) G'_{2n+1} \quad (6)$$

$G'_{NL}(\gamma_0)$ is independent of strain applied on the cycle, $\gamma(t)$, but depends only on the amplitude γ_0 (inter-cycle term).

The last term in equation 5 accounts for the elastic modulus change during cycle deformation, $\gamma = \gamma_0 \sin \omega t$, where the parameters g_{2n+1} are a combination of the nonlinear modulus of G'_{2n+1} and as an example:

$$g_3 = 4G'_3 + 20G'_5 + 56G'_7 + 120G'_9 + \dots + mG'_{2n+1} \quad (7)$$

This is the term that contains an explicit dependency on

$\gamma(t)$ within the cycle through even powers of γ/γ_0 (intra-cycle term).

In particular, G'_0 is defined as a generalized modulus obtained as a sum of the first two terms, $G'(\gamma_0)$ and $G'_{NL}(\gamma_0)$, as follows:

$$G' = G'(\gamma_0) = G'_{NL}(\gamma_0) \quad (8)$$

More details about the mathematical treatment used to obtain equation 5 are provided in the Appendix A of the previous paper (ref. 16).

Based on this mathematical treatment, it is possible to introduce a new nonlinearity index defined as:

$$NLI(\gamma_0) = - \frac{G'_{NL}(\gamma_0)}{G'(\gamma_0)} \quad (9)$$

NLI gives a quantitative measure of nonlinearity as the contributions of nonlinear elastic components compare to the first harmonic storage modulus. Compared to the relative intensity of the third harmonic, $I_3/I_1(\gamma_0)$ (the ratio of the third harmonic contribution to the first), the proposed nonlinearity index NLI can capture the complex interactions within polymer-filler networks and describe the nonlinear behavior of soft materials in the range of low strain values (refs. 16 and 17).

Experimental

Filled compounds

In this article, five different silica filled EPDM compounds were investigated for washing machine door gasket application. To validate the approach presented in this study, two compounds were prepared in the laboratory Farrel IM 1.5 E (1.8 l) Intermix mixer (Farrel Ltd., Rochdale, U.K.) with intermeshing rotor geometry (PES 5 rotors) and an automatically adjustable rotor speed, followed by the milling process in a laboratory two-roll mill: They were mixed with two different mixing times (1 minute and 5 minutes) to have a clear differentiation between the well dispersed and poorly dispersed experimental compound called OBL 38 Lab 5' mixing time versus OBL 38 Lab 1' mixing time.

The remaining three composite materials were compounds of regular production (OBL 38 door gasket), and were used to check the sensitivity of the NLI and the additional techniques used in this study.

As mentioned previously, one of the main critical issues of the OBL 38 door gasket compound was the dispersion of silica in the EPDM matrix. However, the use of silica is an essential requirement to obtain gray or color compounds, to improve filler reinforcement, and the tensile properties and chemical resistance.

Typically, OBL 38 door gasket is a very soft compound, characterized by hardness between 35 and 41 durometer A, that is crucial to ensure the appropriate deformability and hydraulic sealing when the washing machine door closes.

At the same time, the OBL 38 door gasket must withstand aggressive chemical environments, considerable high temperatures and continuous fatigue cycles. For this kind of application, EPDM is the appropriate raw material because it does not swell

Table 1 - door gasket compound formulation

<i>Masterbatch OBL 38 recipe</i>	
<i>Component</i>	<i>phr</i>
EPDM	100
Paraffinic oil	113
Silica and calcinate clay	90
Colors	13
Processing aid	5
Zinc oxide	5
Antioxidant	2
Silane (Si69)	2
<i>Final batch OBL 38 recipe</i>	
<i>Component</i>	<i>phr</i>
Master OBL 38	330
Curative	7.8

in water, it does not discolor and maintains good elasticity for a long time (10 years). Some details of the compound recipe are described in table 1.

Compounds of the regular production were mixed in an HF Intermix, IM 250 E (Harburg-Freudenberg Maschinenbau GmbH, Freudenberg, Germany) with intermeshing rotor geometry (PES 5 ro-

tors). The useful volume of the internal mixer is 180 l, and investigators worked with a fill factor of 0.7.

Characterization method

Rheological measurements: FT-Rheology and strain sweep protocols

All rheological measurements were conducted on the investigated materials in the uncured stage at 60°C using a Premier RPA (Alpha Technologies, Indictor Group, Hudson, OH).

An RPA (rubber process analyzer) is a torsional dynamic rheometer (refs. 19 and 20) equipped with a biconical testing die cavity with a closed rim and grooved dies which help minimize slippage and enable the testing of very stiff materials. This setup provides reproducible and reliable results for a wide range of elastomer systems under dynamic conditions. Specifically, during measurements, the RPA test cavity is closed by the action of the crosshead, with the upper and lower dies maintained under a closing force of 15.7 kN. Tests are conducted under pressurized conditions. All materials were characterized using two test protocols: large amplitude oscillatory shear (LAOS) experiments and classical amplitude strain sweep tests. Both are amplitude oscillatory shear tests, but in the LAOS experiments, investigators characterized not only the nonlinear regime, but also the small amplitude oscillatory shear/medium amplitude oscillatory shear (SAOS/MAOS) regime, covering the strain range between 0.5% to 800%. As mentioned before, these investigations were conducted at 0.5 Hz and 60°C. Additionally, for the LAOS test protocol, the RPA was equipped with a suitable software module to apply Fourier transforms, converting the complex torque data from the time domain to the frequency domain.

For this analysis, higher order harmonic contributions of torque were recorded, allowing the calculation of key nonlinear rheological parameters: the nonlinearity modulus $G'_{NL}(\gamma_0)$ and the nonlinearity index (NLI), as introduced in the previous section. The strain sweep test protocol was carried out according to the ASTM Standard D8059, at 1 Hz and 60°C to assess the uncured dynamic strain softening (Payne effect) of the examined materials.

Micro-dispersion mechanism visualized by SEM analysis

The micro-dispersion determination of silica in the matrix of OBL 38 was performed by using a Gemini SEM (Carl Zeiss IQS Deutschland GmbH, Jena, Germany) equipped with an INCAx-act energy dispersive x-ray (EDX) microanalysis system (Oxford Instruments, High Wycombe, U.K.). In these investigations, all examined cured samples were sputter coated with gold for two minutes under vacuum.

The analysis involved two distinct techniques and two different sample preparation methods. In the first stage, the surface of two production samples were scanned: one from an OBL 38 batch with excellent tensile stress strain properties, and one OBL 38 batch with tensile properties in the lower limit required by the specification.

In this phase, images were acquired exclusively through secondary electron (SE) detection to characterize the surface morphology.

Subsequently, two laboratory samples, classified as well dispersed and poorly dispersed, were examined. For these specimens, the morphology of the internal cross-section, obtained via cryogenic fracturing, was investigated. In addition to SE imaging, energy dispersive x-ray (EDX) spectroscopy was employed to analyze the characteristic x-ray emitted from the selected area; in this way, providing the elemental spectra of the examined regions, and to determine the places where the silica clusters are positioned.

Vulcanization and tensile tests

Tensile tests were performed to compare the mechanical characteristics of well dispersed and poorly dispersed OBL compound samples.

Compounds were cured for 10 minutes at 180°C. The tensile properties (i.e., moduli at different strains, reinforcement index) were determined with a Zwick tensile testing machine, model Z005 (Zwick Roell Group, Ulm, Germany) at a crosshead speed of 500 mm/minute according to ASTM Standard 412 C and ISO 37. The tearing properties were also measured, and investigators used the results of this comparison to check the effect of micro and macro dispersion on the reinforcement.

Results and discussion

Correlation between different techniques

Regarding the Payne effect and FT rheology on uncured OBL 38 compounds, the Payne effect approach was checked first to assess the macro and micro dispersion on the OBL laboratory compounds in the uncured stage: OBL 38 Lab 5' mix time versus OBL 38 Lab 1' mix time. By comparing the $\Delta G'$ measured, as previously mentioned, running a strain sweep test according to ASTM D8059 confirmed the different dispersion between the compounds having different mixing time: $\Delta G'$ of Lab HF 5' is significantly lower than $\Delta G'$ of Lab HF 1' mixing time (figure 3).

However, when the same approach was used to compare the macro and micro dispersion of OBL 38 compounds of regular production, investigators were not able to detect the different filler dispersion in the examined materials. In this case, a batch of OBL 38 standard production that exhibited high tensile stress-

Figure 3 - storage modulus versus strain amplitude by strain sweep test of the OBL 38 laboratory compounds with different mixing times

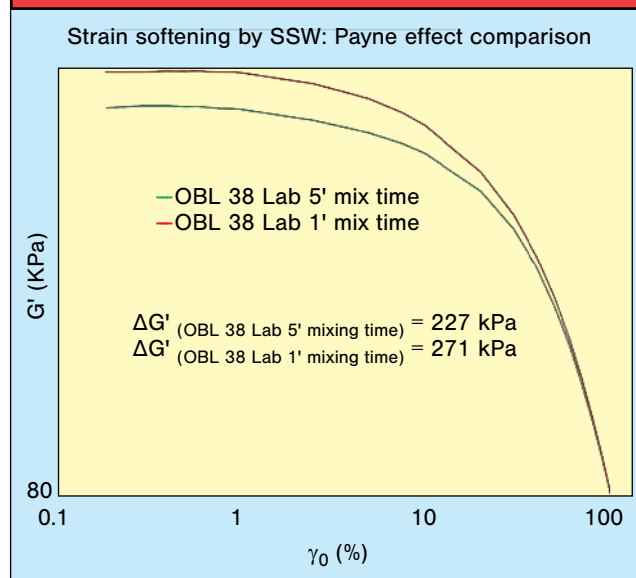
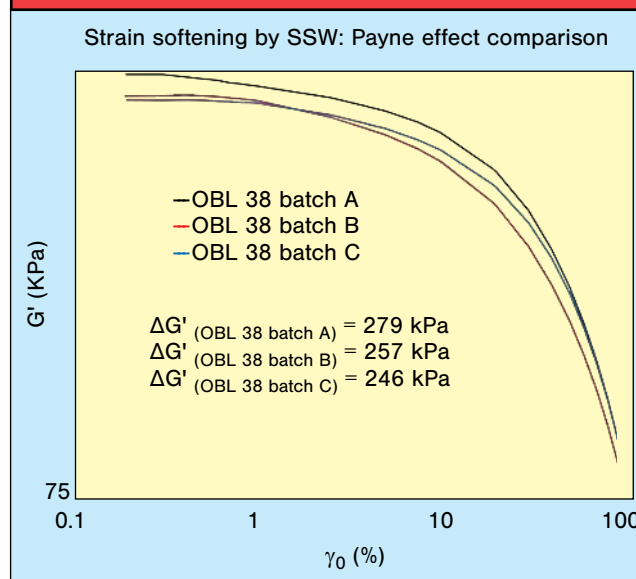


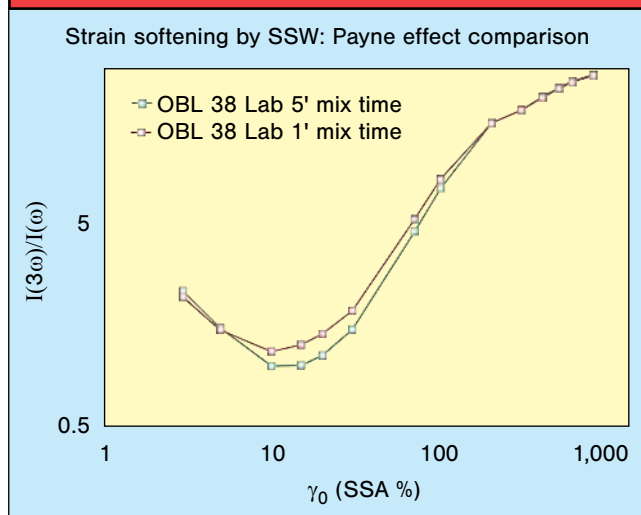
Figure 4 - Payne effect comparison between different batches of OBL 38 standard production: batch A versus batch B and batch C



strain properties (OBL 38 batch A) was compared with two batches of OBL 38 (batch B and batch C) that were still in the required tolerance range, despite having significantly lower tensile properties than batch A (figure 4).

Based on the G' reduction versus strain, the conclusion should be drawn that the two batches (B and C) have a better filler dispersion than batch A; but these results disagree with the experimental evidence. As already mentioned, the Payne effect approach presented two main limitations: Beyond the linear regime, the calculation of G' using only the first harmonic is not

Figure 5 - relative intensity of the third harmonic versus γ_0 of the examined laboratory samples: OBL 38 Lab 5' mixing time versus OBL 38 Lab 1' mixing time

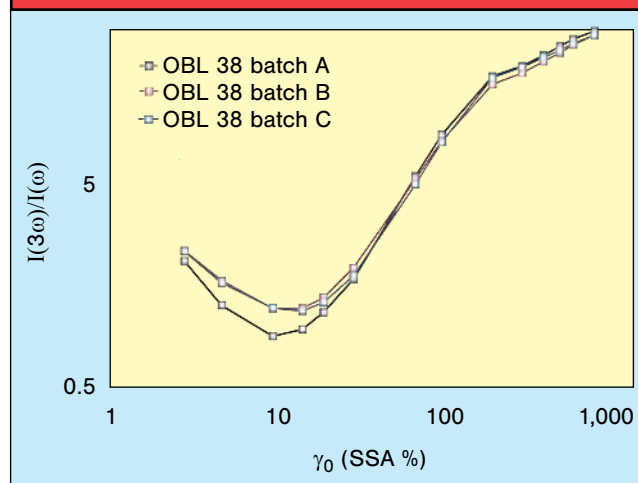


correct. Indeed, in filled rubber systems, the transition from the linear to nonlinear regime is critical and cannot be detected only by considering the strain dependent decrease of G' (refs. 21 and 22). Moreover, the Payne effect reduction is significantly affected by the overall strain history of the mixing process that the compound has undergone: The mixing regime should be comparable not only in the internal mixer, but also in the further steps (open mills, final batch).

The alternative approach used in rheology to disclose information about filler-filler/filler-polymer interactions, using the FT rheometry technique via LAOS testing, is the model developed by J.L. Leblanc (refs. 23 and 24). Leblanc et al. (refs. 12, 13 and 24) observed that the typical ratio I_3/I_1 of filled rubber compounds is not described by a simple sigma shape curve, but due to the significant content of filler in the rubber system, this function displays a local maximum located in the range between 400% and 600% strain. Despite this approach revealing information about the filler-polymer interactions, it is not sensitive enough to detect the filler-polymer interactions that occur in the low range of strains. Additionally, to minimize the contribution of noise on the odd higher harmonics, I_3/I_1 versus γ_0 was plotted (in double logarithmic scale) for strain amplitudes greater than 1%. However in this case, by comparing the relative intensity of the third harmonic versus γ_0 of the OBL laboratory compounds, it clearly appears that in the medium to high range of strain amplitudes, I_3/I_1 is not sensitive enough to differentiate the examined materials in terms of filler dispersion (figure 5).

Moreover, as already reported in the literature (refs. 12 and 25), at low strain amplitudes, $I_3/I_1(\gamma_0)$ decreases with a main slope of -1 in the logarithmic plot against γ_0 , although in this region, the nonlinear contributions should be close to zero, or at least negligible compared to the first harmonic. Therefore, in the linear regime, the trend described in figure 5 is only a consequence of the low torque transducer resolution of the instrument, and the measurements are governed by noise.

Figure 6 - relative intensity of the third harmonic versus γ_0 of OBL 38 from standard production: batch A versus batch B and batch C



The same limitations were also observed by comparing the same trends of OBL 38 compounds from regular production runs (figure 6).

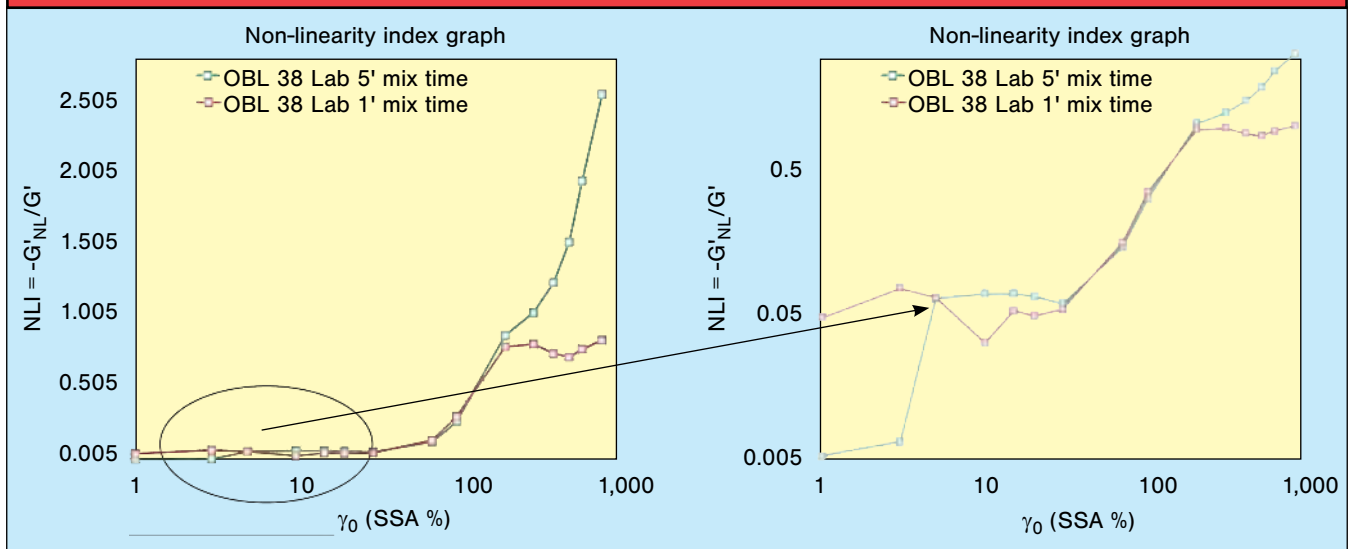
Similarly to the previous comparison, in the region below 10% of strain amplitudes, I_3/I_1 fails to describe the correct non-linear contribution due to the rubber-filler interactions; while in the medium-high range of strains, the relative intensity of the third harmonic is not capable of differentiating the OBL 38 compound samples.

Compared to the third relative harmonic, the NLI parameter introduced in the previous section is more sensitive in detecting the nonlinear contribution, and it can predict the region in which the first peak occurs. In the first comparison between OBL laboratory compounds, the NLI index allows for detection of two peaks: The first peak is in the range between 1% and 20% strain, while the second peak is in the range between 200% and 400% strain (figure 7).

As already reported in the literature, the onset of this first peak (bump) is related to the nonlinear contribution due to rubber-filler interactions. After the first bump, since the filler network is significantly destroyed and the pure elastomer behavior dominates the rest of the harmonic dependence, at higher strain amplitudes NLI further increases by increasing the strain. However, the onset of a second peak can appear, and this is probably attributed to the incomplete dispersion of the filler in the rubber matrix. Indeed, if the full dispersion of silica particles has not been achieved, this bump is the result not only of the rubber matrix, but also of the rubber-filler interphase region that remains until the strain is large enough to leave only the rubber matrix viscoelastic response. This is probably the case for the OBL laboratory (OBL 38 Lab 1' mixing time) sample that for the very short mixing time (one minute compared with the laboratory sample mixed for 5 minutes) is characterized by the incomplete dispersion of the filler.

Similarly to the trends observed for the OBL laboratory compounds just shown, for the OBL 38 compounds of the regular production, it was also possible to differentiate these materials,

Figure 7 - NLI versus strain comparison between OBL 38 laboratory compounds with different mixing times



and to assess the filler dispersion using the NLI index in the whole range of γ_0 . Also, in this case, the first peak occurs in the range between 1% and 20% strain (figure 8).

The first peak could indicate the strong interactions between the filler surface and the elastomer chains in the OBL 38 compounds. The onset of the second peak of batches B and C that occurs in the range between 200% and 300% strain could indicate that the full dispersion of the filler in the rubber matrix has not been achieved in these batches. OBL 38 batch A is instead characterized by a continuous increase of NLI, even in the high range of strain values, and it probably means that the filler is well dispersed in this batch.

Results of the SEM analysis on cured OBL 38 compounds

To confirm the reliability of the NLI outcomes shown in the

previous section, the OBL compounds were analyzed in the cured stage using the SEM technique. Figure 9 illustrates four SEM images of the two OBL 38 sample surfaces at different magnifications: 500x (images a and c) and 1,500x (images b and d). A comparative analysis of the images reveals that the surface defects in the conform OBL 38 batch A sample (images a, b) are smaller in size compared to the defects observed in the non-conform OBL 38 batch C sample (images c, d), which exhibit significantly large dimensions.

This experimental evidence highlights a clear correlation between the quality of the production batches, batch A versus batch C (OBL 38 compounds), and the resulting surface morphology. Specifically, the non-conform batches exhibit a lower degree of dispersion, leading to the occurrence of large scale (coarse) defects. It is important to note that such morphological

Figure 8 - NLI versus strain comparison between standard production: batch A versus batch B and batch C

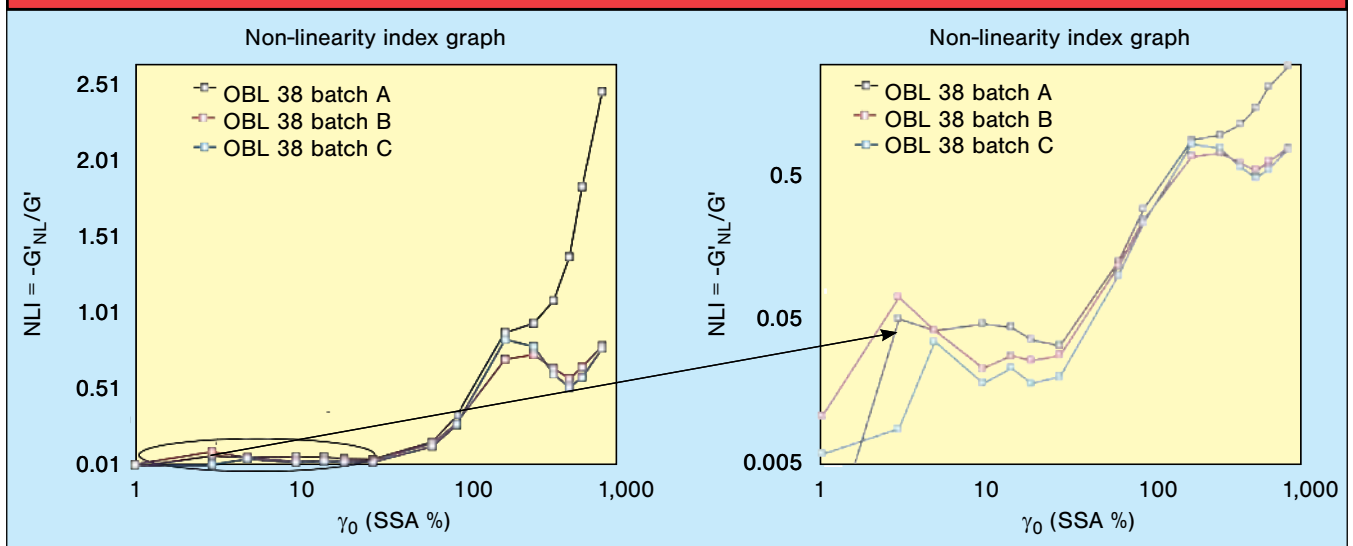
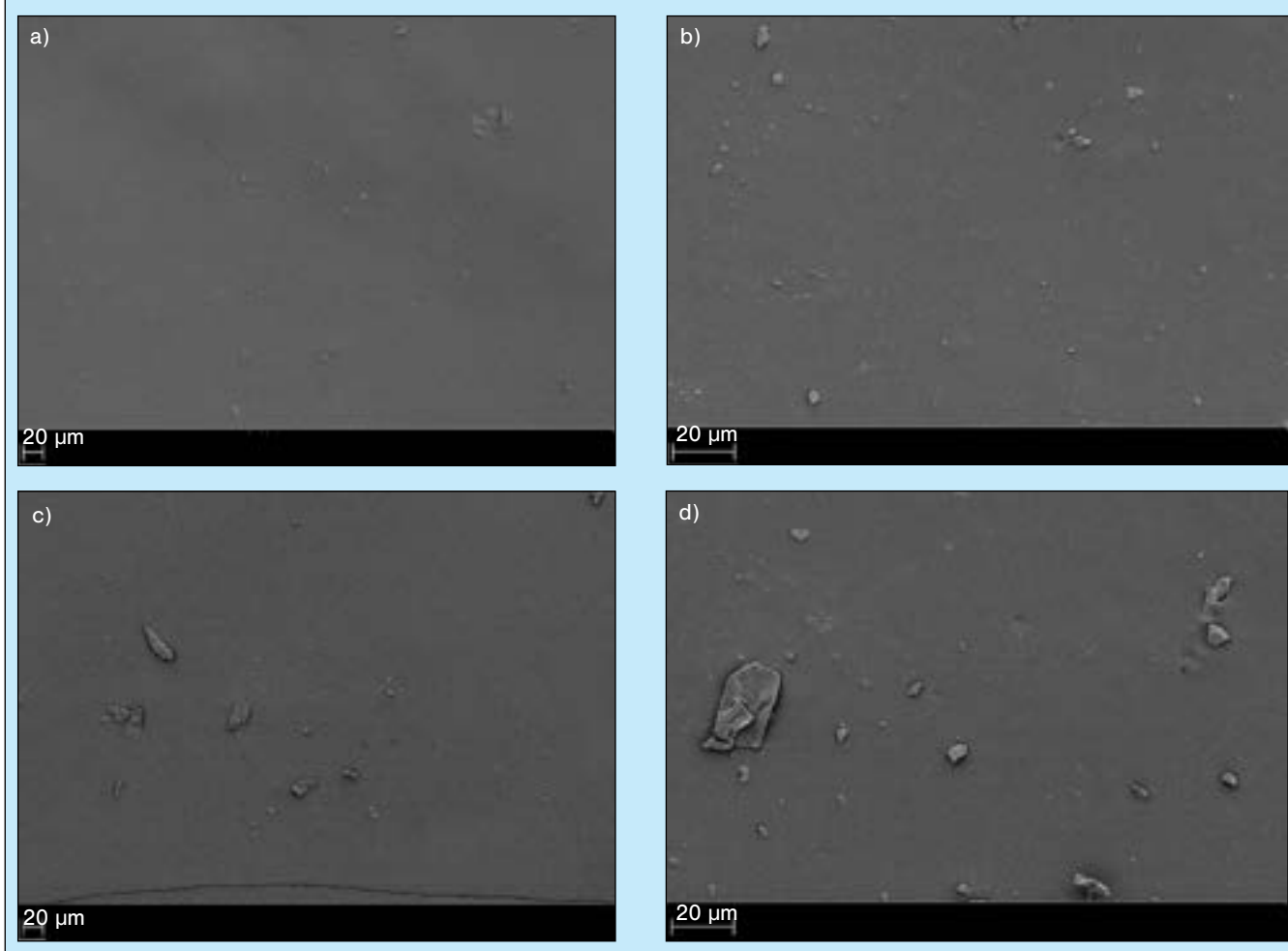


Figure 9 - SEM scans of the surfaces of cured standard production OBL 38 samples: (a and b) magnification 500x (left) and 1,500x (right) from the OBL 38 batch A; and (c and d) magnification 500x (left) and 1,500x (right) from the OBL 38 batch C



differences occurred despite the application of identical mixing protocols for both sample classes. This suggests that the quality of the dispersion is not solely dependent on the mixing process itself, but is also affected by several external variables arising/occurring at different stages of the compound production cycle.

Figure 10 shows SEM micrographs at 5,000x magnification of the internal cross-sections of the two OBL laboratory compounds, obtained through cryogenic fracturing: Image a shows the compound produced via the direct technique after 1 minute of mixing time; while image b illustrates the compound produced using the same technique after 5 minutes of mixing time.

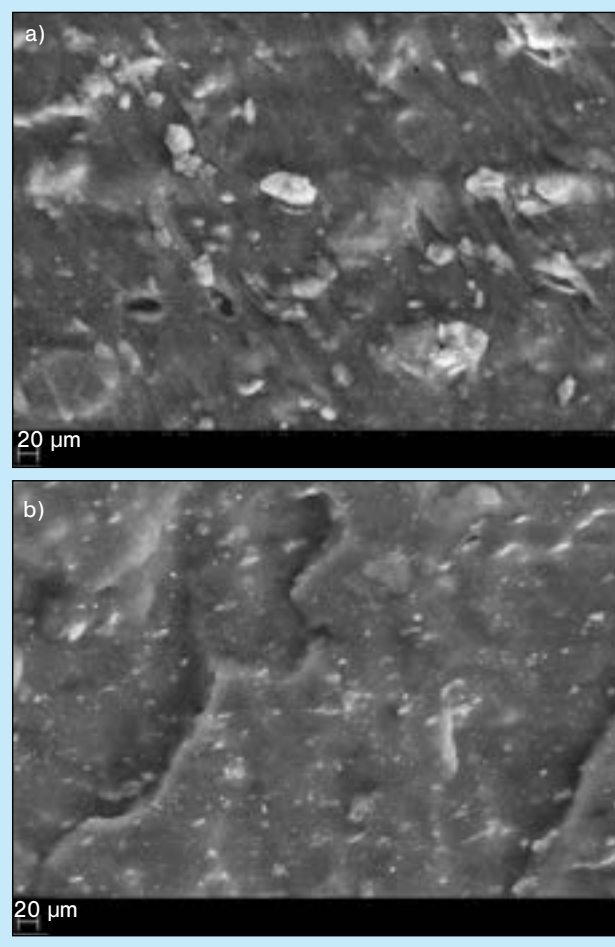
The comparison of the micrographs emphasizes the direct impact of the mixing time on the degree of dispersion in the two compounds. In figure 10, image a, the surface appears to be heterogeneous and characterized by several defects exposed, with dimensions in the micrometric range, visible in the image as bright details. Conversely, in figure 10, image b, the bright spots (white points) are significantly smaller, and the overall surface appears more homogeneous. These discrepancies between the two specimens confirm the significant influence of mixing time on the control and optimization of the filler dispersion degree.

Figure 11 displays the EDX spectra of the two OBL laboratory specimens: image a of the OBL laboratory sample after 1 minute of mixing time, and image (b) of the OBL laboratory sample after 5 minutes of mixing time. A comparative analysis of both spectra reveals the presence of characteristic Al and Si peaks, consistent with the fillers used in the formulation.

However, the spectrum of image a appears “noisier,” characterized by several relatively intense secondary peaks at approximately 1 KeV, and between 2 and 2.5 KeV. Furthermore, the intensities of the Al and Si peaks displayed in image a are significantly higher than those observed in image b. These spectral differences suggest that the area analyzed in the OBL 38 Lab 1' mix time sample (image a), contains a higher local concentration of undispersed fillers, identified as the coarse defects shown in figure 10. Conversely, the OBL 38 Lab 5' mix time sample (image b) exhibits a superior degree of dispersion with a spectrum nearly devoid of secondary peaks.

Finally, the presence of additional peaks in the spectrum a indicates that poor dispersion does not only affect the primary fillers (silica and kaolin), but likely extends to other minority additives, which remained unidentified during this specific

Figure 10 - SEM scans of the internal cross-section of the laboratory compounds obtained by cryogenic fracturing: image a a 5,000x magnification of the OBL laboratory sample using the direct technique after one minute mixing time (OBL 38 Lab 1' mix time); image b 5,000x magnification of the laboratory sample using the direct technique after five minutes mixing time (OBL 38 Lab 5' mix time)



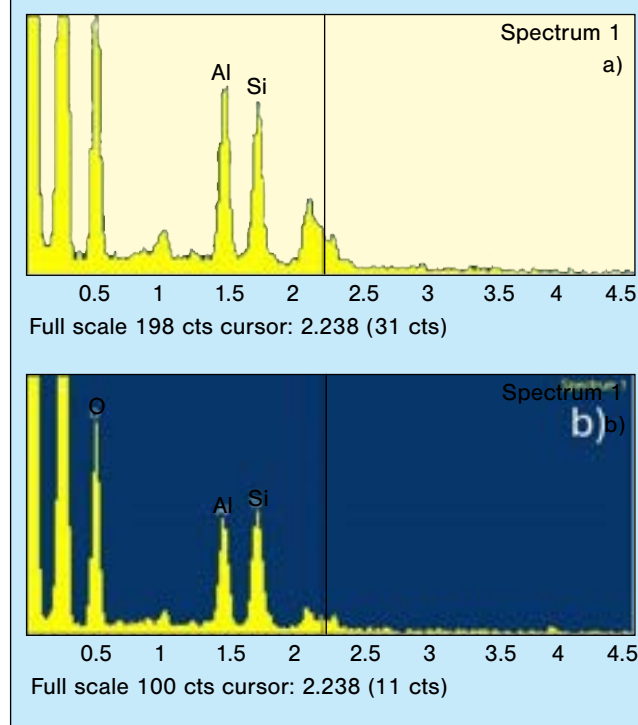
analysis. Therefore, the results obtained with the SEM analysis were in good agreement with the outcomes delivered by the NLI parameter, and this confirms the excellent correlation between the two mentioned techniques.

As expected, the investigated OBL cured samples with a higher degree of dispersion show better tensile stress-strain properties (M100, M200, M300 M200/M100, tensile strength, elongation at break), higher tear strength and a significant higher repeatability than the OBL samples characterized by the incomplete dispersion of silica: The OBL cured compounds with a higher degree of dispersion have a coefficient of variation less than 1%, while the OBL cured materials with poor dispersion have a coefficient of variation greater than 5%.

Summary and conclusions

The focus of this work was the assessment of filler dispersion of

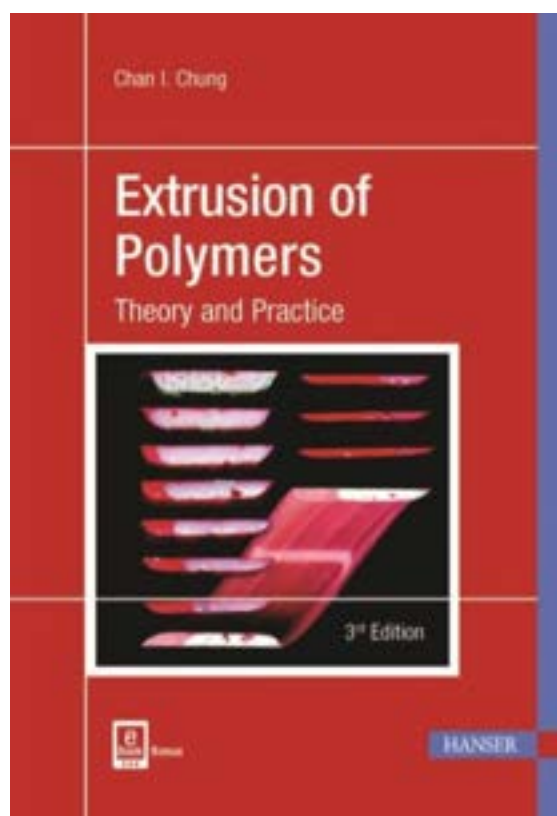
Figure 11 - SEM-EDX spectra of laboratory samples: image a obtained using the direct technique after one minute mixing time of the OBL 38 laboratory sample; image b obtained using the direct technique after five minutes mixing time of the OBL 38 laboratory sample



a washing machine door gasket compound in a silica based formulation. An inefficient dispersion of silica in a door gasket compound can determine reduction of product's life cycle and loss of mechanical properties. The objective of this study was the development of a reliable test method to check the quality of the filler dispersion of OBL 38 batches (master and final) along the mixing line. To achieve this goal, FT rheometry was used and a new nonlinearity index (NLI) was introduced, capable of detecting the nonlinear contribution due to polymer-filler interactions; tracking not only the onset of the Payne effect, but also describing the strain dependent behaviors related to filler network breakdown and polymer chain stretching. The high sensitivity of NLI is crucial to overcome the main limitations of the traditional Payne effect approach and the limits of the relative intensity of the third harmonic, resolving both low strain (filler dominated) and high strain (polymer dominated) nonlinear regimes. This approach was validated by analyzing the door gasket compound in the cured stage by SEM analysis and checking the tensile stress-strain properties. The trends delivered by the NLI parameter were in good agreement with the results of the SEM images, and this confirms the high correlation between these techniques. Therefore, considering the main benefits of the presented FT rheology approach, the NLI tool can be used to optimize the mixing process, making this parameter suitable for quality control purposes to obtain a reliable index of the degree of micro-dispersion of door gasket application.

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Booth 529



Booth 1036



Booth 836



Booth 805



Booth 1059



Booth 1112



Booth 439



Booth 752

A circular future for NBR/SBR flooring: Minimizing fossil fillers and maximizing recycled ground tire rubber

by Christos K. Georgantopoulos, Omya International AG; and Luis Monteiro Goncalves and Michael Christensen, Genan S.A.

NBR/SBR flooring applications have a broad range of application, from commercial office surfaces and high impact gym floors to durable rail crossing panels and resilient animal stable mats. The flooring applications are under growing pressure to be more cost effective and use sustainable materials. Traditional formulations relying heavily on fossil based fillers such as carbon black. Carbon black becomes increasingly more expensive, is exposed to geopolitical tensions implying an uncertain supply chain and has about 2.400 kg CO₂-eq. per ton (ref. 1). These points are driving the industry to seek alternative solutions. A key pathway toward cost reduction and CO₂ minimization is the incorporation of ground tire rubber (GTR) and partial substitution of carbon black (CB), which enables manufacturers to lower raw material costs, while increasing recycled content. By partially substituting virgin rubber and carbon black with GTR and functional minerals, NBR/SBR flooring systems maintain robust mechanical performance, while significantly reducing their carbon footprint. This shift supports the broader transition to circular materials, helping flooring producers balance performance, affordability and environmental responsibility in applications that demand long service life and high durability.

Globally in 2012, about 13.5 million metric tons (MMT) of tires were scrapped worldwide. Based on recent developments and market analysis from 2020, 30.0 MMT of tires were scrapped worldwide (ref. 2). The amount of scrapped tires globally increases with a compound annual growth rate (CARG) of about 4.0%. On average, a passenger car tire weighs about 12 kg and consists of 10 wt.% textile, 15 wt.% steel and 75 wt.% rubber compound (rubber, filler, curatives, etc.). Based on a rough estimation, 22.5 MMT of rubber compound can be retrieved from end of life tires. According to market studies for the non-tire industry in 2024, 12.5 MMT of rubber were used in technical rubber goods. This 12.5 MMT consisted of about 9.0 MMT of synthetic rubber and 3.5 MMT of natural rubber. Putting these numbers into perspective, anyone can realize that the newly made rubber for non-tire applications is almost two times smaller than the available rubber compound (rubber and additives) in the market coming from the recycling of tires. Increasingly, the recycled rubber compounds from end of life tires are finding valuable applications in the rubber and plastics industry, offering sustainable and versatile solutions across a variety of sectors.

In this article, the evolving formulation strategy for NBR/SBR flooring compounds is examined, focusing on how the flooring industry can simultaneously reduce cost and environmental impact, while maintaining mechanical performance. The investigation focuses on the substitution of neat NBR/SBR rub-

ber and the partial replacement of carbon black; two fossil based raw materials whose decreasing use directly supports both economic and sustainability targets. The benefits of combining these reductions to redesign compounds with a more efficient and circular filler system are evaluated. A key part of this transformation is the introduction of Omya's new functional mineral, Omyaprene 50 C, which enables lower CB loading, while enhancing compound functionality. Additionally, the use of Genan's 40 mesh ground tire rubber (GTR) is highlighted. This GTR not only increases the recycled content and decreases the neat rubber within the formulation, but also lowers the overall CO₂ footprint by re-integrating secondary raw materials into high volume flooring systems. Together, these elements outline a modern, more sustainable approach to NBR/SBR flooring compounds built on material efficiency, circularity, cost optimization and performance improvement.

Typical formulations and material characteristics

The investigated recipes are presented in table 1. The study evaluates five NBR/SBR flooring compound formulations designed to progressively reduce fossil based inputs, while increasing the share of functional minerals and recycled rubber. Any modification in the formulations assumes that GTR consists of 50% rubber. This leads to 100 phr of rubber in each formulation. The reference formulation contains a traditional ratio of 60 phr NBR, 40 phr SBR and a loading of 60 phr carbon black (N550) without any recycled content. Sample 1 begins the transition by lowering NBR to 55 phr and introducing 10 phr of 40 mesh GTR, while maintaining the same carbon black level. Sample 2 further reduces neat polymer, with NBR at 55 phr and SBR at 35 phr, representing a total polymer reduction of 10 phr. In addition, 20 phr of 40 mesh GTR is incorporated. Sample 3

Table 1 - investigated NBR/SBR formulations for flooring applications; assuming that GTR consists of 50% polymer, this leads to 100 phr of rubber in each formulation

Raw material	Reference	1	2	3	4	5
NBR 3345	60	55	55	55	55	55
SBR 1502	40	40	35	40	35	35
CB N 550	60	60	60	50	40	35
Omyaprene 50 C	-	-	-	10.0	20.0	10.0
GTR 40 mesh V3	-	10.0	20.0	10.0	20.0	20.0
Stearic acid			1.5			
Rubatan 184-TMQ			1.5			
Santoflex 13-6PPD			1.5			
Zinc oxide			4.9			
Antilux 654			1.0			
CBS GR			1.5			
Sulfur 99%			1.8			

Figure 1 - hardness durometer A of NBR/SBR flooring compounds showing the effect of neat polymer reduction, carbon black replacement and incorporation of Omyaprene 50 C and GTR; absolute values demonstrate the softening trend, as carbon black decreases and GTR increases, with Samples 4 and 5 falling fully within the ISO 7619-1 specification range (65 ± 5)

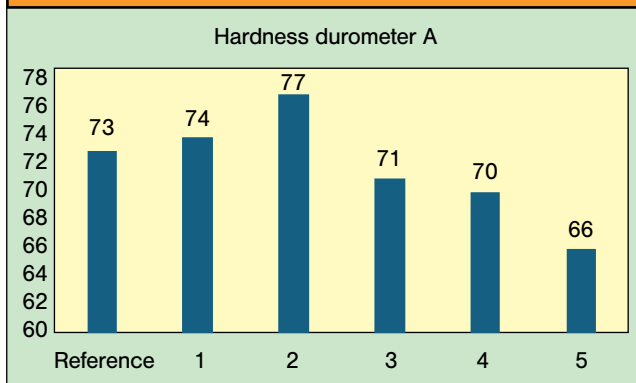
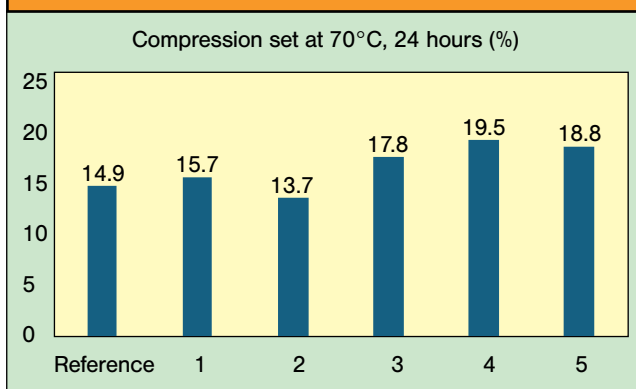


Figure 2 - compression set (%) measured after 24 hours at 70°C, illustrating the influence of reduced neat polymer content, carbon black substitution and increasing levels of GTR; the reference and Sample 2 (20 phr GTR) show the best elastic recovery, while higher than 10% GTR and lower CB levels (Samples 3-5) increase permanent deformation; all of the values are well below the 25% ISO 7619-1 specification



continues with 55 phr NBR, but replaces part of the carbon black, reducing it from 60 to 50 phr, and compensates with 10 phr of Omyaprene 50 C, together with 10 phr GTR, demonstrating a hybrid filler system. Sample 4 advances this development by combining the lowest polymer and carbon black levels to this point: NBR at 55 phr, SBR at 35 phr (again a 10 phr polymer reduction), with carbon black reduced to 40 phr and replaced by 20 phr Omyaprene 50 C plus 20 phr GTR. Finally, Sample 5 presents the most challenging and ambitious formulation, still maintaining the 10 phr polymer reduction, while significantly

lowering carbon black to 35 phr and compensating with 10 phr Omyaprene 50 C and 20 phr GTR, resulting in a high recycled load and the lowest carbon black content.

The following figures, together with their legends, illustrate how this sustainable formulation strategy succeeds in maintaining ISO 7619-1 compliant performance, while reducing carbon black, increasing recycled content and enhancing specific mechanical characteristics that are important for durable and reliable flooring applications. Specifically, the hardness results (figure 1) show an initial increase in stiffness for Samples 1 and 2, before gradually softening in Samples 3-5 as carbon black is replaced by the mineral and GTR. The compression set (figure 2) performance remains great for the reference and Sample 2,

Figure 3 - elongation at break demonstrating the transition from stiffer, highly reinforced systems (Samples 1-2) to more extensible compounds (Samples 3-5); Samples 3, 4 and 5 meet and exceed the ISO 7619-1 requirement of $\geq 250\%$, with Sample 5 showing the highest elasticity due to reduced CB and increased GTR

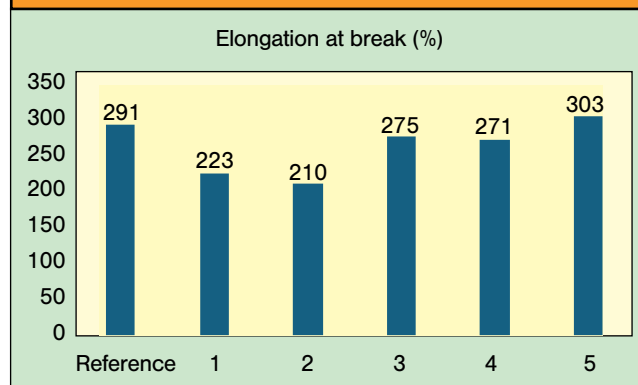


Figure 4 - tensile strength results for all formulations; despite reductions in neat polymer and reinforcing carbon black, all samples exceed the minimum requirement of 7 MPa according to ISO 7619-1; strength decreases gradually with higher GTR and lower filler reinforcement, yet remains fully compliant for flooring applications

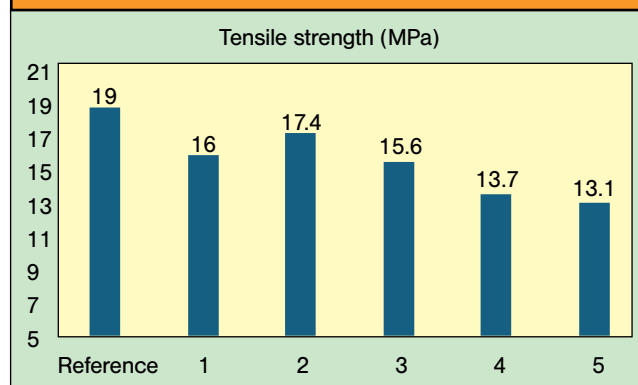


Figure 5 - 100% modulus values reflecting the compound stiffness at low strain; Samples 1-2 show increased modulus due to polymer reduction under constant reinforcement and GR content, while Samples 3-5 show a slight decrease as carbon black is replaced with Omyaprene 50 C and GTR, resulting in softer, more flexible materials

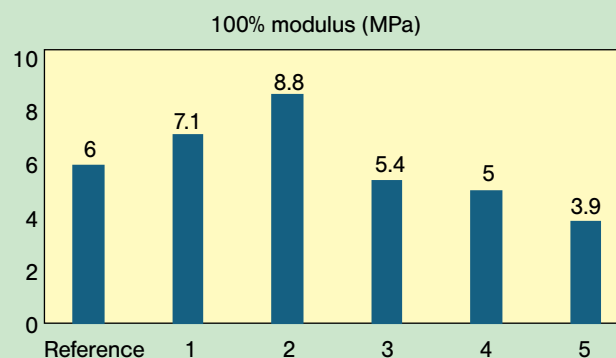


Figure 7 - maximum torque from rheometric curves showing crosslink density evolution; Sample 2 exhibits the highest torque due to reduced polymer and high CB reinforcement, while Samples 3-5 show progressively lower (even though similar to reference) torque as carbon black is replaced by Omyaprene 50 C and GTR

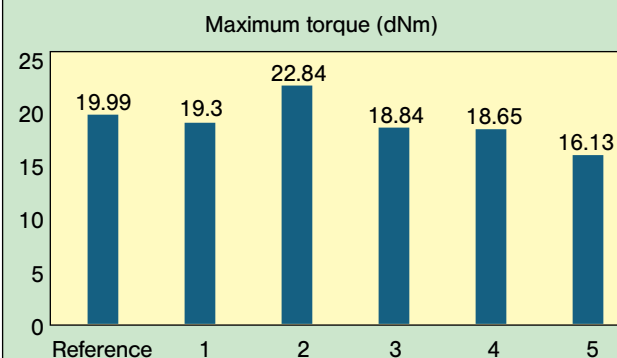


Figure 6 - tear growth resistance highlighting the ability of each compound to withstand crack propagation; 20 phr of GTR (Samples 2 and 5) show improved tear resistance due to crack-deflection effects, while formulations with lower CB (Sample 4) show slightly reduced, but still acceptable, performance

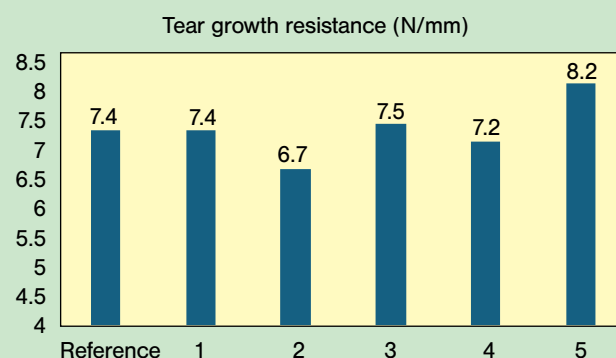
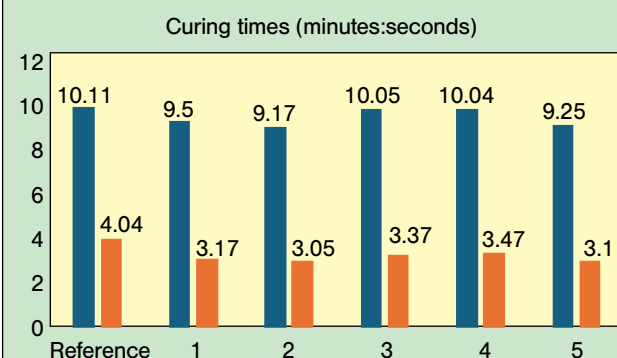


Figure 8 - curing profile comparing scorch time (t10) and optimum cure time (t90); all formulations show stable scorch safety, while t90 slightly varies, depending on reinforcement level and dilution of the polymer matrix; Omyaprene 50 C and GTR introduce slight retardation in Samples 3-5, but curing remains well within industrial processing windows



but it increases as the GTR content exceeds 10 phr. Tensile strength (figure 4) remains well above specification for all compounds, while elongation at break (figure 3) improves in Samples 3-5, demonstrating enhanced flexibility as carbon black is reduced. Modulus values (figure 5) illustrate a clear transition from highly reinforced networks in the early samples to softer, more compliant ones in the later formulations. Tear resistance (figure 6) is improved with moderate GTR levels, since it acts as a crack deflector, particularly in Sample 5. Curing profiles (figures 7 and 8) remain consistent and industrially manageable, despite changes in filler type and loading. These results outline how each formulation balances performance, elasticity, reinforcement, cost and sustainability. The following figures with

their legends provide a detailed explanation of these behaviors.

The above presented results clearly demonstrate that significant cost optimization and sustainability gains can be achieved in NBR/SBR flooring compounds without compromising mechanical performance. As carbon black is progressively reduced and partially replaced by Omyaprene 50 C, the formulations show a controlled softening, improved elasticity, maintained tensile properties at a good level, and an overall direct contribution to both cost reduction and CO₂ footprint minimization. The introduction and gradual increase of GTR further enhances the recycled content of the compounds, while simultaneously improving key properties such as elongation at break and tear resistance. Notably, samples enriched with GTR exhibit greater

flexibility and energy absorption capability, properties highly desirable in flooring materials. The combined use of Omyaprene 50 C and GTR not only reduces reliance on fossil derived fillers and polymers, but also supports a circular materials approach with measurable mechanical benefits.

Conclusions

In conclusion, the combination of the new functional mineral Omyaprene 50 C and the ground tire rubber have several advantages for the rubber flooring industry, such as:

- All sustainable formulations met or exceeded ISO 7619-1 mechanical requirements, with Samples 4 and 5 fully complying with hardness, tensile strength and elongation criteria.
- Carbon black reduction through Omyaprene 50 C proved technically successful, enabling softer, more flexible compounds, while keeping tensile strength and tear resistance at an acceptable level.
- Ground tire rubber (GTR) significantly improved elongation and tear resistance, demonstrating that recycled content can reinforce specific performance attributes, rather than weaken them. Compression set, on the other

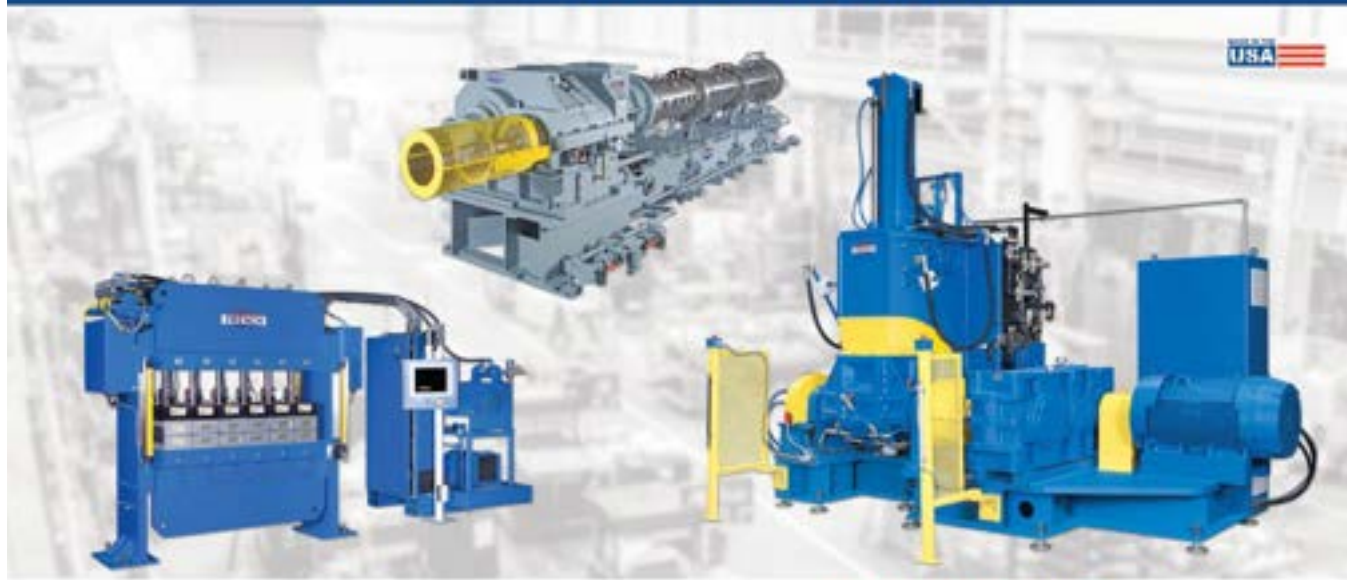
hand, is a property that needs careful formulation; see Samples 2 and 5.

- Sample 5 delivered the highest sustainability benefit, with the largest carbon black reduction and high GTR content (20 phr), while still surpassing ISO 7619-1 requirements and providing excellent elasticity and tear resistance.
- Curing behavior remained industrially stable across all samples, demonstrating that the introduction of Omyaprene 50 C and GTR does not introduce processing risks.
- Overall, the study confirms the technical feasibility of transitioning toward low carbon black, low polymer, high recycled flooring compounds without sacrificing mechanical integrity.

References

1. F. Rosner; T. Bhagde, D.S. Slaughter; V. Zorba and J. Stokes-Draut, "Techno-economic and carbon dioxide emission assessment of carbon black production," *Journal of Cleaner Production*, 436, 140224 (2024).
2. A. Rowhani and T.J. Rainey, "Scrap tire management pathways and their use as a fuel: A review," *Energies*, 9 (11), 888 (2016).

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Meetings

Louisville hosts Global Polymer Summit

The Rubber Division of the American Chemical Society (ACS) will host this year's Global Polymer Summit (GPS), featuring its 210th Technical Meeting, Educational Symposium and Expo, September 28-30 at the Kentucky International Convention Center in Louisville, KY.

This year's GPS keynote speaker will be Jeff Barna, president and CEO, Yokohama Tire. The keynote address is titled, "Collision course: The forces rewriting the tire industry." A convergence of powerful, irreversible forces, from global overcapacity and margin compression to the rise of low cost competitors, e-commerce and shifting retail dynamics, is rapidly reshaping the tire industry's foundation. The keynote

address will explore how these interconnected disruptions are redefining value across the entire supply chain, and why traditional strategies may no longer hold. Attendees will gain a clear eyed view of what lies ahead and what bold, adaptive action is required to remain relevant in an industry that will not transform gently.

The GPS Expo, including 178 exhibitors, will showcase the latest products, services and technologies from top organizations across the tire, rubber and elastomer industries. Attendees will have the opportunity to explore cutting edge innovations, meet industry leaders and network with peers. Over 100 technical, business and industry presentations and panels will be featured in five Expo theaters. Expo hours are from 10:15 a.m.

until 5 p.m. on Tuesday and Wednesday, September 29 and 30.

An Awards Banquet takes place on Monday, September 28, from 11:30 a.m. until 1:30 p.m., and the cost to attend is \$65. This event will honor the Rubber Division, ACS Science & Technology Award winners, the Harold Herzlich Distinguished Technology Achievement Medalist, *Rubber News*' Best Places to Work Honoree and *Tire Business*' Innovators in Technology, Marketing and Sustainability. In addition, the Rubber Division will announce the winners of the GPS Student Symposium, the Rubber Division, ACS Service, Best Paper and Publication Excellence Awards, and more. New 25-year industry legends will also receive their pin, and the industry longevity count-up will take place.

Science & Technology Award Winner presentations will take place on Monday, September 28, from 1:45 p.m. until 5:15 p.m., featuring presentations by the 2026 Science & Technology award winners, including the following: Charles Goodyear Medal, Gregory B. McKenna; Melvin Mooney Distinguished Technology Award, Will V. Mars; George S. Whitby



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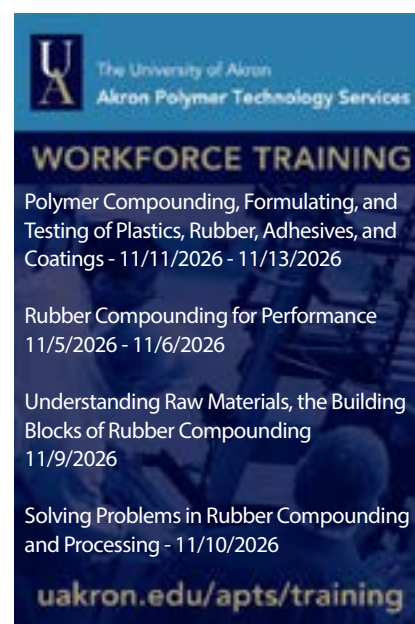
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Meetings

Rubber Group News

The **Los Angeles Rubber Group** will hold its GLTPC Scholarship Golf Outing September 21 at Glen Ivy Golf Club in Corona CA. TLARGI will hold its Oktoberfest on October 6 at the Brea Community Center in Brea, CA. TLARGI will hold a golf outing November 2 at Black Gold Golf Club in Yorba Linda, CA. Details on all of these events are available at www.tlargi.org.

The **Mexico Rubber Group** will hold the course, Rubber Compounding Part I, Chemical Reaction Mechanism, instructed by Soul Leonides, on October 16 at the Rubber Chamber Facilities in Mexico City, Mexico. The MRG will hold the course, How to Improve Rubber Compounds Part III, instructed by Jose Gazano, on November 27 at the same location. Details are available at www.rubber.org/mexico-rubber-group.

The **MidAtlantic Rubber and Plastics Group** will hold its fall technical symposium October 21 at Lehigh University's Iacocca Hall in Bethlehem, PA. Further information is available at www.marpg.org.

The **Ontario Rubber Group** will hold its Past Chair Meeting November 5 at Charcoal Steakhouse in Kitchener, Ontario, Canada. Details are available at www.rubber.org/ontario-rubber-group.

Award for Distinguished Teaching & Learning, Rigoberto Advincula; Sparks-Thomas Award, Clement Robin; Fernley Banbury Award, Gerard Nijman; and Sustainability In Elastomers Award, Rabindra Mukhopadhyay.

The WORD (Women of Rubber Division) program, to be held on Monday, September 28 from 6:30 until 8:30 p.m., and the price to attend is \$50

for Rubber Division members and \$100 for non-members. The WORD program was created to bring women of the rubber industry together and provide opportunities to gain knowledge, share, learn from each other and network. Participants will experience a powerful session exploring the paths women take from technical roles into leadership, the challenges and turning points along the way, and how

the field is being shaped by the women advancing it. It will feature an inspiring keynote, engaging breakout discussions and a dynamic panel of professionals sharing real stories, strategies and support for what is next.

Networking receptions will take place on the Expo floor on Tuesday, September 29, and Wednesday, September 30, from 4 p.m. until 5 p.m.

The annual 5K Walk/Run, sponsored by H.M. Royal, will be held on Wednesday, September 30, with check-in at 6:30 a.m. at the Marriott Hotel Lobby. The entrance fee, which goes towards student outreach initiatives, is \$25.

WTF (where to find) your people meetups will take place on the Expo floor during the GPS so that attendees can meet, connect and network with fel-



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Meetings

low attendees who share their interests and experiences. Meetups will be held for first time attendees, young professionals, industry newbies, tech nerds, students, international attendees and past chairs.

The Global Polymer Summit offers opportunities designed specifically for young professionals so they can learn, connect and thrive in the industry. The Aspiring Leaders Discussion Panel and young professionals meetups are tailored to help emerging leaders gain knowledge, build community and advance their careers.

This year's Educational Symposium, sponsored by Parker Lord, will include the following courses:

Compounding Fluoroelastomers, instructed by William Stahl, will be held on Tuesday, September 29, from 8:30 a.m. until 12:30 p.m. Fluoroelastomers are a specialized class of synthetic elas-

tomers recognized for their exceptional resistance to heat chemicals and aggressive fluids when compared with conventional hydrocarbon based elastomers. They are selected for applications where performance requirements exceed the limits of other elastomeric materials. This course provides a technically focused examination of fluoroelastomer chemistry properties, processing behavior and end use performance. Participants will gain a deeper understanding of material selection, formulation considerations and manufacturing challenges, along with current regulatory considerations, including the evolving impact of PFAS on fluoroelastomer materials and applications.

Rubber Vulcanization and Curing Chemistry, instructed by Paul Merda, will be held on Tuesday, September 29, from 8:30 a.m. until 12:30 p.m. This course

gives an overview of the chemistry behind rubber vulcanization, but focuses on how different types of curatives and accelerators affect rubber properties, such as crosslink density, tensile, modulus, compression set, heat resistance, etc. Topics covered will include basic principles of sulfur vulcanization, cure mechanism and chemical structures of curatives and accelerators; vulcanization effects on rubber properties (including crosslink density and crosslink type); regulatory concerns with curatives (including non-nitrosamine cure systems); and non-sulfur cure systems (peroxide, resins, diamine, etc.).

Developments in Tire Materials Science and Engineering, instructed by Brendan Rodgers, will be held on Tuesday, September 29, from 8:30 a.m. until 12:30 p.m. This course provides an overview of challenges tire technologists

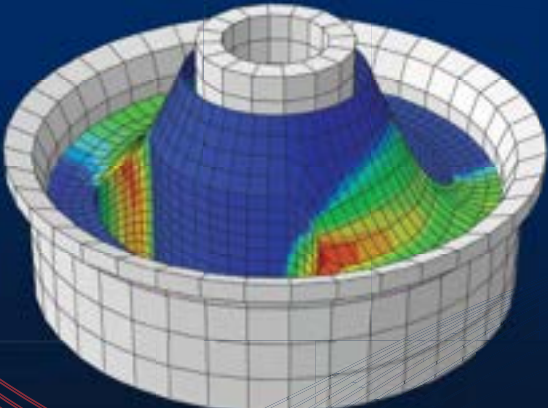
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will face over the next five to 10 years. Discussion topics include sustainability; the tire performance envelope, including rolling resistance and durability; design and construction; EV tires and the critical role of the innerliner; applied modeling techniques; manufacturing; and will conclude with a discussion on the changing regulatory environment. The global tire industry continues to be in a growth phase, so awareness of the range of challenges and future needs is of great importance. The course will provide a perspective for the industry, with much of the core highlighted technology being equally applicable to the industrial rubber products sector.

Rubber Extrusion Technology, instructed by Richard D. Strong, will be held on Tuesday, September 29, from 8:30 a.m. until 12:30 p.m. This course was designed for rubber industry employees who currently extrude rubber and wish to expand their knowledge of the process, or those wishing to gain insights into these processes and how they can be used. The course will offer an overview of the variety of commercially viable rubber extrusion processes, and will examine their strengths and weaknesses. A more in-depth look at the three most common rubber extrusion processes (liquid curing media [LCM], better known as the salt bath process; hot air vulcanization [HAV]; and microwave/hot air vulcanization) will be presented. The emphasis will be on practical knowledge that can be utilized in production. In all areas, specific safety concerns will be highlighted and addressed.

Silicone Rubber Foundations, instructed by Todd Kamyszek, will be held on Tuesday, September 29, from 1 p.m. until 5 p.m. Silicone rubber is used in applications across a wide range of markets and industries. Silicone polymers possess unmatched versatility, giving the compounder and user multiple forms and methods to crosslink the polymers into rubber materials. Silicones are famed for having the widest service temperature range of any rubber material. This course is designed to provide participants with

a thorough understanding of silicone's engineering characteristics. It will take attendees from creating silicone from sand through formulating the compound, along with the various methods by which silicone can be fabricated into useful articles. The course will cover the differences between high consistency rubber, liquid silicone rubber and room temperature curing systems. It is suitable for individuals who have various degrees of knowledge in silicone materials and applications.

Introduction to Elastomer Durability, instructed by Will V. Mars, will be held on Tuesday, September 29, from 1 p.m. until 5 p.m. This course covers the basics of elastomer durability in two parts. Part I gives an overview of crack behavior, an introduction to the concept of fatigue threshold in elastomers and practical guidance on how to use this material parameter to develop highly durable rubber products. Part II reviews the physical principles that govern rubber's strength and durability, and provides an on-ramp to navigating the many aspects of durability in elastomeric materials development and product design.

Foundations of Elastomer Technology, instructed by Sam Porter, will be held on Tuesday, September 29, from 1 p.m. until 5 p.m. Course attendees will quickly learn a wide range of information about elastomers (rubber) and be able to apply the knowledge to communicate with others, regardless of their education or experience. No in-depth chemistry or math are required. Attendees will learn the difference between saturated and unsaturated polymers, and will be able to identify glass transition temperatures of elastomers and thermoplastics; match the correct compound for specific applications; choose testing methods to classify rubber characteristics; evaluate different manufacturing methods for suitability; and interpret common specifications.

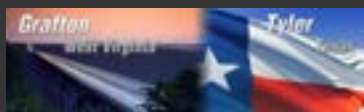
Essential Rubber Testing: What the Data Tell You will be held on Wednesday, September 30, from 8:30 a.m. until 12:30 p.m. This course is designed for non-technical professionals, as well as techni-

cal individuals who are new to the rubber industry. Centered on clear explanations of common rubber tests and practical examples of how to interpret and apply test data, the course builds foundational understanding of rubber testing methods used in quality control, process evaluation and troubleshooting.

Non-Tire Specialty Elastomers, instructed by Brad Sellers and Joshua L. Guillems, will be held on Wednesday, September 30, from 8:30 a.m. until 12:30 p.m. This course provides a focused overview of major elastomer families used across industrial, automotive, consumer and specialty applications. Participants will examine the fundamental chemistry, performance characteristics and processing considerations that define each material, along with the environments where they deliver the greatest value.

The Rubber Initiative: Next Generation Executive Leadership, instructed by Matthew Thornton and Michael Clayton, will be held on Wednesday, September 30, from 8:30 a.m. until 12:30 p.m. The rubber industry promotes its best technical people into management and rarely prepares them for the shift. This full-day workshop closes that gap. Two operators who have run businesses in the industry teach it, with every framework tested under real pressure. Attendees will work on their own business alongside industry peers and leave with four practical templates and a 90-day action plan. The four working sessions will include: formulating a sustainable business (turn supply, regulatory and customer pressure into competitive advantage); next generation leadership (make the shifts from technical expert to leader, including how to lead with AI in the room); leading innovation and research and development (back the winners, cut the projects draining the laboratory and speed commercialization); strategy into rhythm (choose where to win, then build the weekly rhythm that delivers it). A closing session pulls all four into one personalized 90-day plan.

Developing a Rubber Molding Process, instructed by Sam Porter, will be held on Wednesday, September 30, from



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1 p.m. until 5 p.m. The heart of every molding business is understanding how to set up and control a robust process and to do it well. Time spent understanding and developing the detailed manufacturing steps for a business will save time and headaches down the line. The most important process to understand is how the hidden property of cure is influenced by all other variables. Mastering the cure is essential, but it is only part of the story.

Solving Real World Industry Problems with the Alpha RPA, instructed by Unal Yilmazoglu, will take place on Wednesday, September 30, from 1 p.m. until 4 p.m. The rubber process analyzer (RPA) has become an essential tool for evaluating elastomer materials throughout the manufacturing process. This interactive course provides technicians, engineers and laboratory professionals with a practical understanding of Alpha Technologies' Premier RPA and its application to real world rubber testing challenges. Participants will learn how to leverage the RPA to characterize raw elastomers, evaluate mixed compounds, improve cure analysis and predict final product performance. Through industry relevant examples and testing strategies, attendees will gain valuable insights into maximizing the capabilities of their RPA and transforming test data into actionable information for product development, quality control and process optimization.

Further information on the Educational Symposium, including locations, registration costs and available Continuing Education Units, is available from the Rubber Division at www.rubber.org.

The 210th Technical Meeting will include the following presentations:

Monday, September 28 Advancements in Tire Materials and Compounding

Carbon black and carbon nanotube composites to increase rubber compound properties, *Brendan Rodgers*

From rubber to composite: Short fiber reinforcement in elastomer compounds, *Vishal Chaurasia*

Crosslinking reaction of specialty

rubbers using 1,2-polybutadiene and 1,2-epoxidized polybutadiene, *Hiroki Hashimoto*

Effect of liquid rubber on performance of low Tg SSBR and resin tire formulations, *Erich Klein*

Development of peroxide-cured latex rubber with self-healing effect, *Meg Buenavides*

Novelty in Payne effect reduction: Using organic peroxides for reactive compounding in NR/carbon black compounds, *Aniruddha Palsule* and *Rowan Appelman*

Sustainable Nzerosil silicas from renewable rice husk biomass, *Anthony Lin*

Monday, September 28 Contributed Session

New insights into resins behavior: Influence of resin softening point on in-rubber properties of carbon black filled SBR compounds, *Pilar Bernal Ortega*

Role of resin hydroxyl content and silane functionality in non-covalent silica-rubber coupling, *Abel Cardoso Gonzaga Neto*

Can we make a rubber compound fully sustainable? *Anke Blume*

The Role of ZnO, stearic acid and DPG in modern sulfur cured high vinyl SSBR compounds, *Fabian Grunert*

Understanding the property deterioration of recycled ground rubber containing vulcanizates, *Stefan Frosch*

Monday, September 28 Thermodynamics and Glass Transition of Polymers and Rubber: A Symposium in Honor of Gregory McKenna

Building on the past: the Gough-Joule effect and solid state refrigeration, *Gregory B. McKenna*

Agile processing of guayule biomass for market responsive latex, resin and rubber, *Julie Kornfield*

Celebrating the 2026 Charles Goodyear Medalist Gregory B. McKenna: Friendship and collaboration, *Judit E. Puskas*

Establishing performance durability testing, *Christopher C. White*

Rheology of ionomers, *Robert Weiss*

From glass transition to heterogeneous integration: Advanced packaging through the lens of polymer physics, *Ran Tao*

Tg and crystallization kinetics in natural rubber, *Sindee Simon*

Monday, September 28 Sustainable Fillers and Raw Materials for Rubber

Omyaprene 50 C: Partial replacement of carbon black in technical rubber goods, *Christos Georgantopoulos*

Cardanol as a sustainable rubber processing aid, *Douglas Rhubright*

Carbon nanotube overview: A high performance filler for elastomers, *August Krupp*

Lifecycle analysis tools for advanced material choices, *Jan Boomsma*

Preparation of natural rubber with island-nanomatrix structural network, *Seiichi Kawahara*

Circular polymer solutions beyond sustainability: Engineering performance at industrial scale, *Tiago Monteiro*

New proposed standards for sustainable fillers used in the rubber industry, *John Dick*

Monday, September 28 Sustainability and Circularity in Tires

Can we make a rubber compound fully sustainable? *Anke Blume*

Understanding the property deterioration of recycled ground rubber containing vulcanizates, *Stefan Frosch*

Monday, September 28 Characterization and Testing for Rubber Compounds

Fatigue, fracture and viscoelastic properties of NBR and HNBR elastomers for downhole sealing applications, *Orkid Ramekaj*

A multi-step rheological approach for investigating molecular topology of EPDM rubbers, *Umay Ince*

RPA and DMA study of filler reinforcement and crack growth in SBR compounds, *Unal C. Yilmazoglu*



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Meetings

Monday, September 28

Student Presentations

Fatigue, fracture and viscoelastic properties of NBR and HNBR elastomers for downhole sealing applications, *Orkid Ramekaj*

A multi-step rheological approach for investigating molecular topology of EPDM rubbers, *Umay Ince*

Monday, September 28

Science & Technology Awards

The Charles Goodyear Medal address: Interrogating rubber physics, from rheology to swelling and the approach to the glass transition, *Gregory B. McKenna*

Fatigue testing and analysis for right the first time engineering, *Will V. Mars*

Advanced manufacturing and high performance polymers with AI/ML workflows, *Rigoberto Advincula*

Linking structure to performance in elastomers: New insights from network topology, *Clement Robin*

Rheological aspects in the extrusion of rubber compounds, *Gerard Nijman*

Decarbonizing the tire and rubber industry through sustainable elastomers, green reinforcements and waste derived materials, *Rabindra Mukhopadhyay*

Tuesday, September 29

Characterization and Testing for Rubber Compounds

When standards are not enough: Developing innovative tests to solve unique problems, *Nate Tuckerman*

Adhesion behavior between different 3D printed rubber compounds for footwear applications, *Haley Dobbyn*

Linear-nonlinear dichotomy of the Payne effect for particle filled rubber: Recent measurements that further reveal the rheological complexity, *Chris Robertson*

Effect of carbon black on oil migration kinetics in SBR vulcanizate, *Jun Sawada*

Novel advances of zinc oxide activated vulcanization, *Yuko Ikeda*

Integrated multi-technique characterization of carbon black and rubber compounds using advanced analytical instrumentation, *Christoph Pielen*

Tuesday, September 29

Modeling and Simulation in Elastomer and Polymer Materials

Multiscale modeling of polymeric materials in hydrogen service, *Wenbin Kuang*

Investigation of solid particle and liquid droplet impact damage of a polychloroprene, *Yannic Gagnon*

From coupling agents to failure: The role of interfacial crosslinks in filled elastomers, *Harshad Bhapkar*

Influence of carbon black on local deformation modes in elastomers, *Sarah Pedroni*

Design of elastomer monomers with generative machine learning, *Croix Laconsay*

Physics informed FEM of elastomers for soft robotics, *Zhiyi Cao*

Tuesday, October 29

New Commercial Developments

VMI's high performance batch-off system with closed air circulation feature, *Jan ter Harmsel*

High silica EV tread compound development: Improving dynamic properties and durability with biobased NaugaShield Bio-TR 30 resin, *John Kounavis*

Enhancing service life and sustainability: NaugaShield Bio-TR 30 biobased resin for various compounds and other high severity applications, *Julian Maldonado*

SureMix TKO: Advancing sustainability and tire performance without compromise, *Gabriel Short*

New developmental EPDM for automotive sponge weatherseal, *Xi Chen*

Choice of intelligent carbon black material for designing efficient anti-vibration rubber parts, *Ram Chandra C. Ghosh*

A novel ultra-high molecular weight EPDM rubber with VNB for use in high-temperature resistant EPDM compounds, *Mark F. Welker*

Vistalon 8509 EPDM rubber: A new EPDM for automotive weather seals, *Steven Haas*

How can a new processing aid improve mixing efficiency? *Mayu Si*

The next generation of Chemlok adhesives, *Paul Wheeler*

Chemlok water based adhesives, *David Sheffield*

Tuesday, September 29

Recovered Carbon and End-of-Life Tires

Bridgestone's approach to advancing circularity: Enabling rCB adoption, *Giorgia Martino*

The application challenge: Sustainable carbon blacks progressing on performance, *Joshua L. Williams*

The year in carbon black and rCB 2026, *Paul A. Ita*

Scaling rCB: Barriers, performance and the path to commercial adoption, *Denise Kennedy* (moderator), *Karmena Anyfantaki* (panelist), *Pieter ter Haar* and *Tony Wibbeler* (panelist)

The U.S. tire pyrolysis market: Insights from the 2025 U.S. ELT Management Report and 10th Tire Recycling Conference, *Amelia Chucholowski*

rCB industry status quo, trends, and market outlook, *Andreas Kyriakou*

Rubber based performance protocol for recovered carbon black, *Dave Abdallah, Jr.*

Tire pyrolysis oil update, *Shane Perl*

Open innovation and collaboration crucial to accelerate circular economy, *Enrico Koggel*

Tuesday, September 29

Student Presentations

Influence of carbon black on local deformation modes in elastomers, *Sarah Pedroni*

Tuesday, September 29

Advancements in Tire Materials and Compounding

Reinforcement control in SSBR for next-gen tire performance, *Radoslaw Kozak*

Migration of plasticizer and its liquid polybutadiene substitutes in tire tread formulations, *Sankar R. Vaikuntam*

Low Tg, high molecular weight SSBR for improved tire tread performance, *Paul Smith*



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 - Cure Rates
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Meetings

The effect of low hysteresis carbon blacks on tire compound properties, *Lashan M. Hendavitharanage De Silva*

Tuesday, September 29

Addressing Environmental Risk: The PFAS Transition

Advancing high performance solutions in an evolving fluoropolymer landscape, *Bret Neese*

Addressing energy sector performance demands with NFS and PFAS-free elastomers for low temperature and rapid gas decompression applications, *Thomas Webber*

Technical validation of PFAS surfactant-free fluoroelastomers for critical energy applications, *Jay Yun*

Tuesday, September 29

Business and Industry Focus

Harold Herzlich Distinguished

Technology Achievement Medalist presentation, *Kanwar Bharat Singh*

From algorithms to action: How AI is transforming the tire industry, *Don Heelis, Ian Coke, Mike Cioffi and Rob Montasser*

Enabling the next generation of polymer technologies: The PIC innovation pilot facility, *Marshall Moore*

Synthetic rubber feedstocks: Surviving the turmoil, positioning for success, *William Hyde*

Meeting the EV challenge: The next generation of tire technology, *Ian Coke, Joshua L. Williams, K.C. Jensen and Rikki G. Lamba*

When expertise walks out the door: Protecting intellectual capital in the rubber industry, *Emily Q. Rosenthal-Kim*

Customer ease of doing business, *Patrick Trujillo*

Aspiring leaders discussion panel,

Kylie Knipp, Shawn T. Morgan, Unal C. Yilmazoglu and William Washer

Tuesday, September 29

Poster Session

Enhanced shape memory properties of thermally crosslinked polystyrene-polybutadiene block copolymers, *Adrineel Roy*

Mapping domestic natural rubber potential: Site suitability assessment and processing facility network planning for guayule and rubber dandelion across the continental U.S., *Sandeep Dhakal*

Carbon footprint mitigation in SBR compounds through the synergistic use of active zinc oxide and devulcanized ground tire rubber, *Marzieh Shabani*

Characterization and crystallization of a natural source of trans-1,4-polyisoprene, *Katelynne Doherty*

Fingerprinting the latex particle using



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Meetings

AFM imaging and nanoindentation, *Utathya Raybarman*

In a pinch: Efficient guayule stem bark removal without disrupting bark structure, *Siddharth Premnath*

Investigating the mechanism for nanoparticle release from automotive tire tread, *HongSik Eom*

Kinetics of crystallization for hevea and guayule natural rubber, *Aaron Cross*

Leveraging rubber process analyzer testing to guide material selection for 3D printing of thermoset rubbers, *Aerin Hardcastle*

Mechanistic investigation of plastic nanoparticles' endocytosis and fate in mouse neuroblastoma cells, *Fiorela Metrailler*

Zwitterionic cyanoacrylates: Toward biocompatible adhesives for wet surfaces, *Mothana Al-Omari*

Wednesday, September 30

Silicone and Liquid Silicone Rubber Developments

Interfacial self-assembly of graphene networks at 1 vol% enables piezoresistive and electrothermal silicone foams, *Brenden Ferland*

Room temperature liquid metal composites in synthetic rubber, *Amanda Koh*

Umix: An advanced mixing technology to produce HTV silicone compounds, *Karsten Fischer*

Wednesday, September 30

Student Presentations

Interfacial self-assembly of graphene networks at 1 vol% enables piezoresistive and electrothermal silicone foams, *Brenden Ferland*

Natural rubber latex: From conventional ammoniated systems to acidic environment processing, *Hector Arroyave Miranda*

On fingerprinting natural and synthetic rubber latices: Linear, nonlinear and steady-shear rheology, *Shuang Jin*

Predicting root biomass in rubber dandelion from time-series multispectral UAS imagery: Spectral, textural and canopy features for non-destructive phenotyping, *Sandeep Dhakal*

Selective ultrasonic-chemical devulcanization of end-of-life tires for high performance rubber recycling, *Marzieh Shabani*

Wednesday, September 30

Sustainability and Circularity in Tires

Sustainable mobility 2030 and beyond: Strategic role of the tire and rubber industry, *Rabindra Mukhopadhyay*

Devulcanized rubber case studies, *Jon Visaisouk*

Devulcanization of waste EPDM rubber from energy industry, *Anil K. Bhowmick*

Using calibrated rubber standards to understand the environmental impacts of tires, *Nick Molden*

Devulcanization of waste tire rubber by sustainable agents, *Anil K. Bhowmick*

Silastic SST 8860: A next-generation self-sealing silicone for high volume tire manufacturing and circularity, *Timothy Morley*

Wednesday, September 30

Contributed Session

Novel devulcanization technologies for ground vulcanized rubber materials, *Sunny Jacob*

Branched multi-walled carbon nanotubes: Enabling high performance polymers at ultra-low loadings, *Jay Hewitt*

Using calibrated rubber standards to understand the environmental impacts of tires, *Nick Molden*

Selective ultrasonic-chemical devulcanization of end-of-life tires for high performance rubber recycling, *Marzieh Shabani*

Wednesday, September 30

Recovered Carbon and End-of-Life Tires

From scrap tire to industrial conveyor belts: How rCB is earning its place in demanding industrial applications, *Susann Geithner*

Demonstrating coating enabled performance stability in regenerated carbon: Insights from rC Regen CGX 1000, *Mark J. Pender*

Keys to consistency: Running a qual-

ity management system and quality control lab for rCB, *Nate Murphy*

A hybrid method for producing high performance carbon black using recovered carbon black (rCB) and pyrolysis-derived oils, *Harikrishna Mynampati*

Preserving reinforcement: The critical role of carbon black morphology in recovered carbon black production, *Carl Pro*

Engineering recovered carbon black: Bridging the performance gap from pyrolysis to specification driven applications, *Vitaly Khushidman*

Scaling tire pyrolysis in challenging markets: Deployment, standardization and risk mitigation, *Aashish Gaurav*

Beyond the reactor: Why technology integration determines the success of rCB projects, *Jesse Klinkhamer*

Dense phase conveying for recovered carbon black: Designing reliable, clean and scalable material handling systems, *Don Davis*

From end-of-life tires to circular raw materials: The Polimix Ambiental experience in recovering carbon black, pyrolysis oil and steel, *Marcelo Wasem*

Wednesday, September 30

New Commercial Developments

Numerical analysis of a parallel counter rotating twin screw extruder for elastomers, *Georgia Sharp*

Replacing antimony trioxide in halogenated rubber: High-efficiency flame retardant solution for critical applications, *Matthew Kamm*

Polybutadiene coagents and the effects of their microstructure on EPDM, *Megan Casey*

A new semi-crystalline, high molecular weight EPDM for improved compound performance, *Bhavesh Shah*

Natural rubber latex: From conventional ammoniated systems to acidic environment processing, *Hector Arroyave Miranda*

Flexible and durable conductive elastomers for advanced antistatic applications, *Ali Vahidifar*

The material science of release film and its impact on improving performance, uptime and quality, *Neil Weisensel*

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Meetings

Wednesday, September 30 Sustainable Solutions and Elastomer Processing

Preventative maintenance, material savings and operational excellence opportunities in calender roll grinds, *Caroline Roberts*

Sustainable solutions in elastomer processing: Strategic reuse and rebuilding of rubber internal mixers, *Brian Howard*

High performance rubber compounds: Benefits of fine mesh straining and gear pump technology, *Bill Bisson*

Optimization of part cure time and processing for large compression molded products, *Ricardo Betancourt*

Wednesday, September 30 Materials for Harsh Environments

Elastomeric material selection for challenging sealing applications using in-situ, quantitative and comparative testing, *Preston Weintraub*

Extrusion behaviors of o-rings in

cycling high pressure hydrogen combined with thermal environments, *Nalini Menon*

Breakthrough high temperature, high wear resistant stripper rubber sealing material development for 150°C, 140 MPa coil tubing applications, *Jiaxiang Ren*

Should elemental sulfur be considered on the degradation of FEPM elastomer sealing materials in HPHT sour environments? *Jiaxiang Ren*

Wednesday, September 30 Natural Rubber Developments and Domestic Natural Rubber Supply

On fingerprinting natural and Synthetic rubber latices: Linear, nonlinear and steady shear rheology, *Shuang Jin*

Predicting root biomass in rubber dandelion from time-series multispectral UAS imagery: Spectral, textural and canopy features for non-destructive phenotyping, *Sandeep Dhakal*

Agronomic foundations for *Taraxacum kok-saghyz* as a domestic

natural rubber crop: Baseline management and stand establishment studies, *Osler Orteiz*

Unique properties and performance of guayule rubber and latex, *Katrina Cornish*

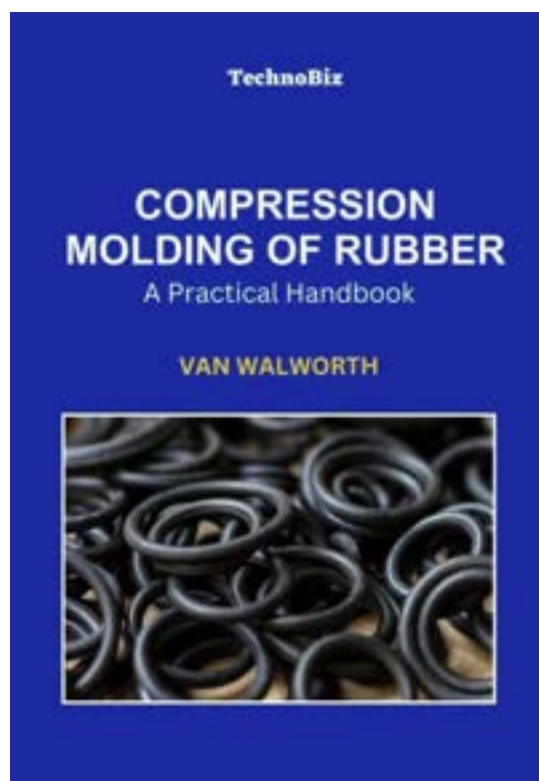
Biodegradation of natural rubber films, *Colleen McMahan*

Wednesday, September 30 Poster Session

Investigating the mechanism for nanoparticle release from automotive tire tread, *HongSik Eom*

Further information on the 2026 Global Polymer Summit, including registration details, is available from the Rubber Division, ACS at (330) 595-5531; www.rubber.org.

On-site registration hours are Sunday, September 27 from 8 a.m. until 5 p.m.; Monday, September 28 from 7:30 a.m. until 6 p.m.; Tuesday, September 29 from 8 a.m. until 5 p.m.; and Wednesday, September 30 from 7:30 a.m. until 5 p.m.



Compression Molding of Rubber – A Practical Handbook

“Compression Molding of Rubber – A Practical Handbook” is the second book by Van T. Walworth, building upon rubber industry technology and know-how. This book focuses specifically on the technical aspects Van considers to be fundamental principles of compression molding of rubber products. Some of the information presented in this book will be obvious and well known to many rubber molding practitioners, while at the same time, much of the content discussed in this book will not necessarily be considered basic, or even obvious, to those skilled in compression molding technology. From Van’s point of view, compression molding has not been replaced by transfer molding or injection molding, but rather, the process of molding rubber products has been expanded from compression molding to include transfer and injection molding. Compression molding remains the most widely used process in the world of rubber molding. Advancements in transfer molding and the installation of thousands of injection presses are somewhat offset by the ever-increasing market demand for rubber products. As a result, compression molding remains a vibrant, valuable, and necessary molding process in the rubber industry, and yet may also be the most widely underutilized rubber molding process.

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Calendar



Future Meetings/Expos

2026

Louisville September 28-30

2027

Cleveland September 27-29

www.rubber.org

Ontario Rubber Group, golf tournament, Royal Ontario Golf Club, Milton, Ontario, Canada, www.rubber.org/event/ontario-rubber-group-golf-tournament-2/ - September 18.

Los Angeles Rubber Group, Scholarship Golf Outing, Glen Ivy Club, Corona, CA, www.tlargo.org - September 21.

The Tire Society, 57th Tire Mechanics Short Course, University of Akron, Akron, OH, www.tiresociety.org - September 21-24.

Messe Dusseldorf North America, ColombiaPlast International Plastics and Rubber Trade Fair, Bogota, Colombia, www.colombiaplast.org - September 21-25.

Nova-Institut GmbH, Renewable Materials Conference, Siegburg/Cologne, Germany, www.nova-institut.eu - September 22-24.

Society of Plastics Engineers (SPE), Thermoplastic Elastomers (TPEs): From Fundamental Insights to Contemporary Technologies workshop, Danbury, CT, www.4spe.org - September 23-25.

R.D. Abbott, Thermax N990CG: A Low PAH Thermal Black for Food Contact Applications webinar, <https://rdabbott.com/news/2026-sept-webinar/> - September 24.

University of Akron, Akron Polymer Training Services, Understanding Dynamic Properties of Rubber and Rubber Products online course, www.uakron.edu/apts/ - September 24-25.

Rubber Division, American Chemical Society, Global Polymer Summit, Kentucky International Convention Center, Louisville, KY, www.rubber.org - September 28-30.

October

University of Akron, Akron Polymer Training Services, Applications of FTIR in Polymers Processing and Product Development online course, www.uakron.edu/apts/ - October 2.

University of Akron, Akron Polymer Training Services, Rubber and Plastics Failure Analysis: Physical and Chemical Analysis Techniques online course, www.uakron.edu/apts/ - October 2.

Center for the Polyurethane Industry (CPI), American Chemistry Council (ACC), 2026 Polyurethanes Technical Conference, Orlando, FL, www.american-chemistry.com - October 5-7.

Los Angeles Rubber Group, Oktoberfest, Brea Community Center, Brea, CA, www.tlargo.org - October 6.

R.D. Abbott, Chemlok Overview, Best Practices and Troubleshooting training, Buena Park, CA, <https://rdabbott.com/news/chemlok-training-ca2026/> - October 7.

University of Akron, Akron Polymer Training Services, Rubber Technician Training, National Polymer Innovation Center, Akron, OH, www.uakron.edu/apts/ - October 7-9.

University of Akron, Akron Polymer Training Services, Aircraft Tire Design Process online course, www.uakron.edu/apts/ - October 8.

R.D. Abbott, Chemlok Academy Two-Day Training, Parker Lord, Erie, PA, <https://rdabbott.com/news/pl-chemlok-training-oct2026/> - October 13-14.

University of Akron, Akron Polymer Training Services, RPA Testing of Rubber Processability and Dynamic Properties online course, www.uakron.edu/apts/ - October 13-14.

University of Akron, Akron Polymer Training Services, Rheological Theories and their Direct Applications in the Polymer Industry online course, www.uakron.edu/apts/ - October 14-16.

Mexico Rubber Group, Rubber Compounding Part I: Chemical Reaction Mechanism course, Rubber Chamber Facilities, Mexico City, Mexico, www.rubber.org/mexico-rubber-group - October 16.

Association of Modified Asphalt Producers, 2026 AMAP Annual Conference and Workshop, Hilton Boston Park Plaza, Boston, MA, www.modifiedasphalt.org - October 19-21.

MidAtlantic Rubber and Plastics Group, Fall Technical Symposium, Lehigh University, Bethlehem, PA, www.marpg.org - October 21.

Society of Plastics Engineers, Injection Molding Division, SPE Injection Molding Innovation Summit, Cleveland, OH, www.4spe.org - October 22.

University of Akron, Akron Polymer Training Services, An Introduction to Commodity and Specialty Polymer Materials, Markets and Fabrication Processes online course, www.uakron.edu/apts/ - October 26-28.

Association of Rubber Products Manufacturers, Seals Product Design and Manufacturing Training, Metro Plastics Technologies Training Center, Noblesville, IN, www.arpminc.org - October 26-30.

TechnoBiz, Indonesia Rubber Expo 2026, Bogor, Indonesia, <https://events.technobiz.org> - October 27-29.

Shibaura Machine LWB, Next-Level Molding Days, European Competence Center, Altdorf, Germany, <https://www.shibaura-machine-lwb.de/en/next-level-molding-days-2/> - October 28-29.

Latin American Rubber Association, IV Rubber Technology Symposium - Guadalajara 2026, Expo Guadalajara, Guadalajara, Jalisco, Mexico, www.simposiocaucho.com - October 28-30.

November

Los Angeles Rubber Group, golf outing, Black Gold Golf Club, Yorba Linda, CA, www.tlargo.org - November 2.

University of Akron, Akron Polymer Training Services, Tire Safety and Durability course, National Polymer Innovation Center, Akron, OH, www.uakron.edu/apts/ - November 3.

University of Akron, Akron Polymer Training Services, Rubber Compounding and Process Troubleshooting online course, www.uakron.edu/apts/ - November 4.

Ontario Rubber Group, past chair meeting, Charcoal Steakhouse, Kitchener, Ontario, Canada, www.rubber.org/ontario-rubber-group - November 5.

University of Akron, Akron Polymer Training Services, Rubber Compounding for Performance online course, www.uakron.edu/apts/ - November 5-6.

University of Akron, Akron Polymer Training Services, Structure/Property Relationships in Polyurethanes online course, www.uakron.edu/apts/ - November 5-6.

University of Akron, Akron Polymer Training Services, Understanding Raw Materials: The Building Blocks of Rubber Compounding online course, www.uakron.edu/apts/ - November 9.

University of Akron, Akron Polymer Training Services, Solving Problems in Rubber Compounding and Processing online course, www.uakron.edu/apts/ - November 10.

University of Akron, Akron Polymer Training Services, Compounding, Formulating and Testing of Plastics Rubber, Adhesives and Coatings online course, www.uakron.edu/apts/ - November 11-13.

Messe Düsseldorf Asia, Plastics & Rubber Indonesia, JIExpo Kemayoran, Jakarta, Indonesia, www.plasticsandrubberindonesia.com - November 17-20.

Mexico Rubber Group, How to Improve Rubber Compounds III course, Rubber Chamber Facilities, Mexico City, Mexico, www.rubber.org/mexico-rubber-group - November 27.

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Processing additive for improved mixing

A car door sill, as part of the lower body and rocker panel assembly, reinforces cabin rigidity and side impact protection. It also serves as a sealing surface for weatherstripping, aiding to block water, wind and road noise.

Thermoplastic elastomers (TPEs) are gaining traction for car door sill components due to their high impact and scratch resistance, said to ensure long term durability without cracking.

This global manufacturer of high performance TPE compounds and customized material solutions offers the FG/SF/AP series developed for the Asia-Pacific automotive market. Developed specifically for vehicle interiors, this series is said to meet stringent requirements for high quality surface finishes.

The FG/SF/AP series demonstrates excellent PP bond-



ing (adhesion to polypropylene), making it an ideal material for 2K injection molding, automotive overmolding applications and insert molding of automotive components, according to the company. The series is said to support reliable multi-material designs, while delivering optimized flow properties and smooth demolding for efficient processing of complex part geometries. These processing advantages help improve manufacturing productivity, reduce cycle times and maintain long term durability, according to the firm. With low VOC and odor emissions, the FG/SF/AP series also meets the stringent air quality requirements for modern automotive interior applications. The TPE series is also said to offer excellent surface replication. (Kraiburg TPE)

www.kraiburg-tpe.com

PU adhesives, sealants

Adhesives, sealants and potting compounds based on polyurethane, epoxy resin and silicone have been developed for applications such as humidifiers in PEM fuel cells which need to withstand high levels of humidity, as well as exposure to heat and chemicals. In addition to gas-tightness and hydrolysis resistance, these materials also feature ion purity and low VOC content, which are essential for reliably protecting the sensitive fuel cell membrane. Moreover, the 2K systems are highly durable and offer individually adaptable parameters for both semi- and fully automated manufacturing processes, according to the company. (Wevo-Chemie GmbH)

www.wevo-chemie.com

Thermoplastic polyurethane

This company along with BASF have co-developed a modular concept seat for purpose built vehicles (PBV), showcasing how the advanced material solution of Elastollan thermoplastic polyurethane (TPU) processed with supercritical fluid (SCF) injection foaming technology can support customizable and sustainable seating solutions for automotive interiors. The modular concept seat features a headrest and armrest made with the advanced material solution



for the first time. First introduced to the footwear industry, this material is now being applied to automotive interiors. It allows tier suppliers and OEMs to create lightweight, abrasion resistant components with a soft touch feel and premium look, according to the companies. (Hyundai Transys)

www.hyundai-transys.com

TPU specialties for cables

Thermoplastic polyurethane (TPU) is applied in adhesives, compounding, additive manufacturing, and molded and extruded parts. Estane ZHF 87HP8 TPU is designed for thin cables with enhanced mechanical and flame properties to meet the needs of cable manufacturers regarding compliance with UL 1581 (passes Sec. 1061 cable flame test for small diameters) and IEC 50363 and EC 60332-1-2 regulations. The portfolio for hot melts and adhesive extrusion solutions has evolved with the latest additions: Pearlbond ECO 590 HMS TPU, Pearlbond 360 TPU and Pearlbond 920L TPU are said to provide unparalleled process versatility for manufacturers. Estane D91T86 TPU is said to be moving beyond molded specialty parts to high performance films and other extruded parts that demand excellent weatherability and superior UV resistance compared to aromatic TPU. (Lubrizol)

www.lubrizol.com



Recycling of PU waste

This company in partnership with Gruppo Fiori provides a novel process that enables recovery of polyurethane waste from end-of-life vehicles without disassembly. Valued for comfort, safety and fuel efficiency, polyurethane foam is said to be an essential part of automotive interiors. Traditional recycling of vehicles requires disassembly of automotive components. This innovation eliminates this step, producing a simplified recovery for PU waste stream with the purity needed to enable depolymerization (chemical recycling). (Dow)

www.dow.com

Millable PU rubber

This manufacturer of millable urethane rubber has published an article that explains how to mix its Millathane millable polyurethanes. These strong and abrasion resistant elastomers can be processed using conventional rubber equipment, but achieving consistent, high quality results is said to require a controlled and well structured approach to mixing. A three-step approach starts with a controlled mill environment. The compound is built in stages. Temperature is managed before final additions. The best way to begin is to band Millathane on a mill to create a uniform base, according to the firm. Once the base polymer is masticated, processing ingredients are added in a controlled sequence. Before adding curatives, however, mixers should allow the compound to cool. Temperature control is critical during each step. By properly performing each step, compounders can achieve consistent physical properties, improved processing behavior and reliable end use performance, according to the company. Millathane millable polyurethane is said to be the polymer of choice for the most demanding applications that require superior abrasion resistance and mechanical strength, as well as oil and ozone resistance. *(TSE Industries)*

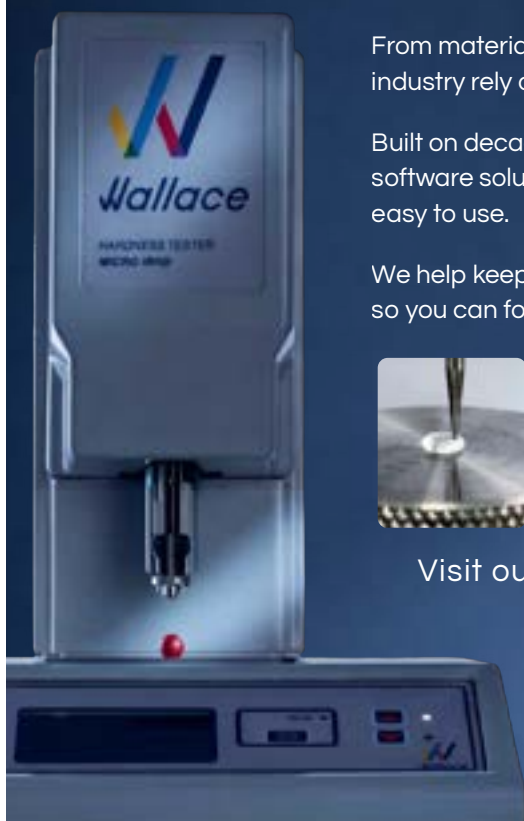
www.tseind.com

Thermoplastic elastomers

While innovation in the field of dentistry has accelerated multifold in recent years, traditional dental film is said to remain a staple in diagnostic dentistry. Dental experts rely on dental film to detect hidden cavities, assess bone loss and identify deep rooted dental issues. Dental films are flexible, moisture resistant packets used in dental imaging. Thermoplastic elastomers (TPEs) can be used in dental film components, such as the outer packet, because they are said to provide a comfortable and biocompatible casing that protects the imaging components from moisture, while remaining durable. This global manufacturer of thermoplastic elastomers and customized material solutions is said to offer medical grade TPE compounds suitable for a wide range of medical devices and dental components, with soft touch properties, flexible mechanical performance and processing versatility. The company's high performance TPE materials are designed to be safe, hygienic and biocompatible. They are sterilizable and free from animal derived ingredients, latex, PVC and heavy metals. Selected medical grade materials are said to comply with key safety standards and extraction testing requirements. *(Kraiburg TPE)*

www.kraiburg-tpe.com

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Thermoplastic polyurethane

This company along with Wacoal are extending their co-creation into automotive interior applications with an armrest concept model that highlights the potential of advanced 3D fiber based manufacturing and the company's material solutions for lightweight, comfort focused interior components with enhanced design freedom. Melooop is a proprietary three-dimensional fiber molding technology. Using a melt blown non-woven process, it forms and layers fibers simultaneously, enabling complex 3D structures to be created in a single step without adhesives or multi-layer assembly. This integrated approach reduces manufacturing steps and minimizes material usage and waste. Elastollan TPU enables the Melooop process by combining thermoplastic processability with elastomeric performance, allowing the formation of 3D-fiber structures that deliver both flexibility and structural integrity, while supporting the mono-material designs that can simplify product design and manufacturing. (BASF)



www.basf.com

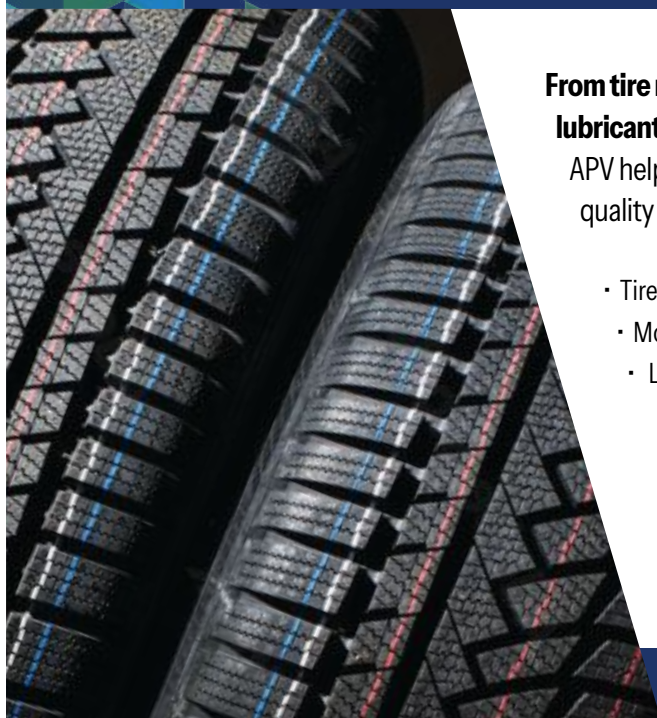
Polyols for PU dispersions

Focused on renewable carbon, this company has unveiled polyols technology for high performance polyurethane dispersions (PUDs) based on captured CO₂. Paint and coatings brands that opt for PUDs made with the company's renewable carbon technology can enhance product performance and make bolder environmental claims, while mitigating supply chain risks related to sourcing hydrocarbons, according to the firm. Called polycarbonate ether (PCE) polyols, this technology is said to create strong substrate adhesion, durability and resistance to environmental factors (e.g., UV and water) similar to or better than incumbent technologies. PCE polyols are a direct replacement for polyether polyols, polytetramethylene glycols (PTMEG) and polycarbonate glycol (PC). They are colorless, odorless, and are said to offer the added benefit of allowing formulators to fine tune properties by adjusting the amount of CO₂ incorporated at the molecular level. Designed to support companies with Scope 3 climate targets, PCE polyols have a carbon footprint up to 30% lower than standard polyols. They can be used alone or in combination with recycled and bio-based polyols to make fossil-free formulations. (Econic Technologies)

www.econic-technologies.com

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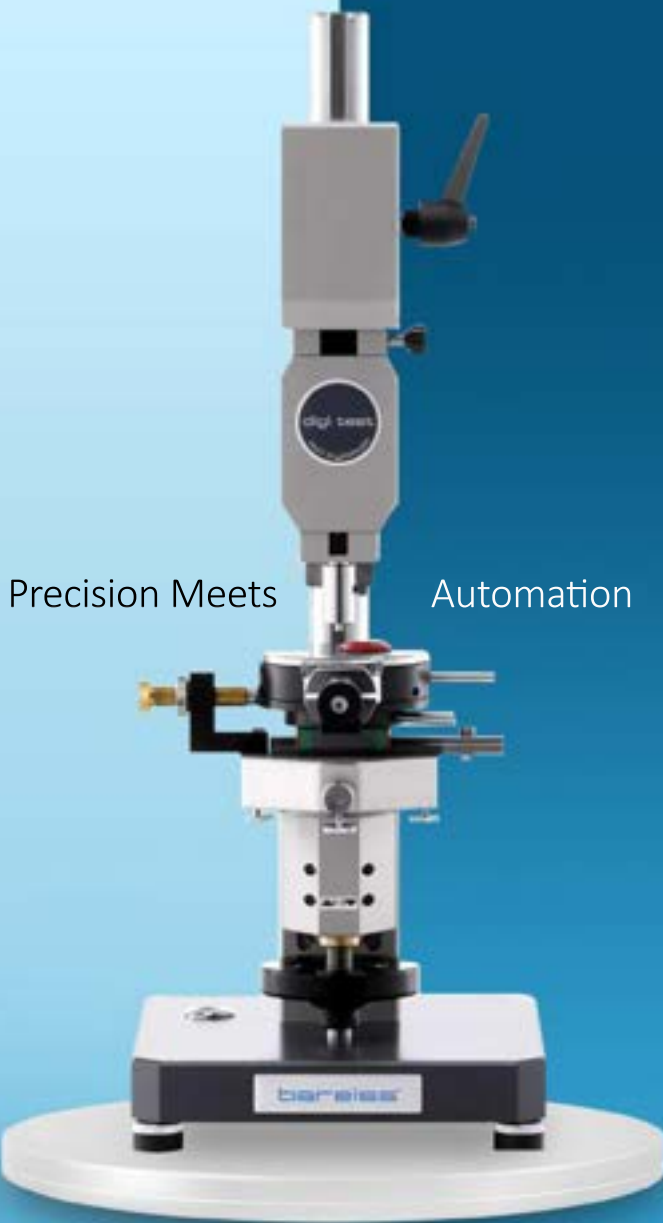


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Customized TPE solutions

This global manufacturer of thermoplastic elastomer compounds and customized TPE solutions for various industries offers the Thermolast K series, said to be a top tier material with recycling advantages. The series is said to feature optimized mechanical properties and high elasticity to maintain the integrity of container closure systems, ensuring consistent opening and closing performance over repeated use. The material is said to provide excellent adhesion to polypropylene (PP), allowing efficient multi-component injection molding and secure integration with rigid cap structures. The Thermolast K series offers full colorability, allowing brands to achieve strong visual differentiation and premium packaging designs. These TPE compounds are suitable for in-process recycling. They are also certified by Cyclos HTP as compatible with HDPE and PP recycling streams, creating opportunities for more resource efficient production. (*Kraiburg TPE*)



www.kraiburg-tpe.com

Polyurethane circularity

This company in collaboration with Steitz Secura has developed a breakthrough polyurethane (PU) solution said to help improve the circularity of safety footwear. Together, the two companies have created a Daltoped polyurethane midsole system that can incorporate recycled content without compromising performance, said to set a new benchmark in protective footwear production. Polyurethane plays a vital role in enhancing comfort and protection in safety shoes, but managing the scrap generated during production can be a challenge, according to the firm. Utilizing its extensive footwear innovation capabilities, this latest solution is said to transform this challenge into an opportunity. Together with safety shoe manufacturer Steitz Secura and an external partner, the company is said to have pioneered a way to introduce recycled PU into new shoe components using the innovative Daltoped PU system, which requires no changes to existing processing or chemistry workflows. Crucially, the approach also successfully introduces recycled PU into new shoe components, while maintaining performance on a par with virgin materials, according to the company. (*Huntsman*)

www.huntsman.com



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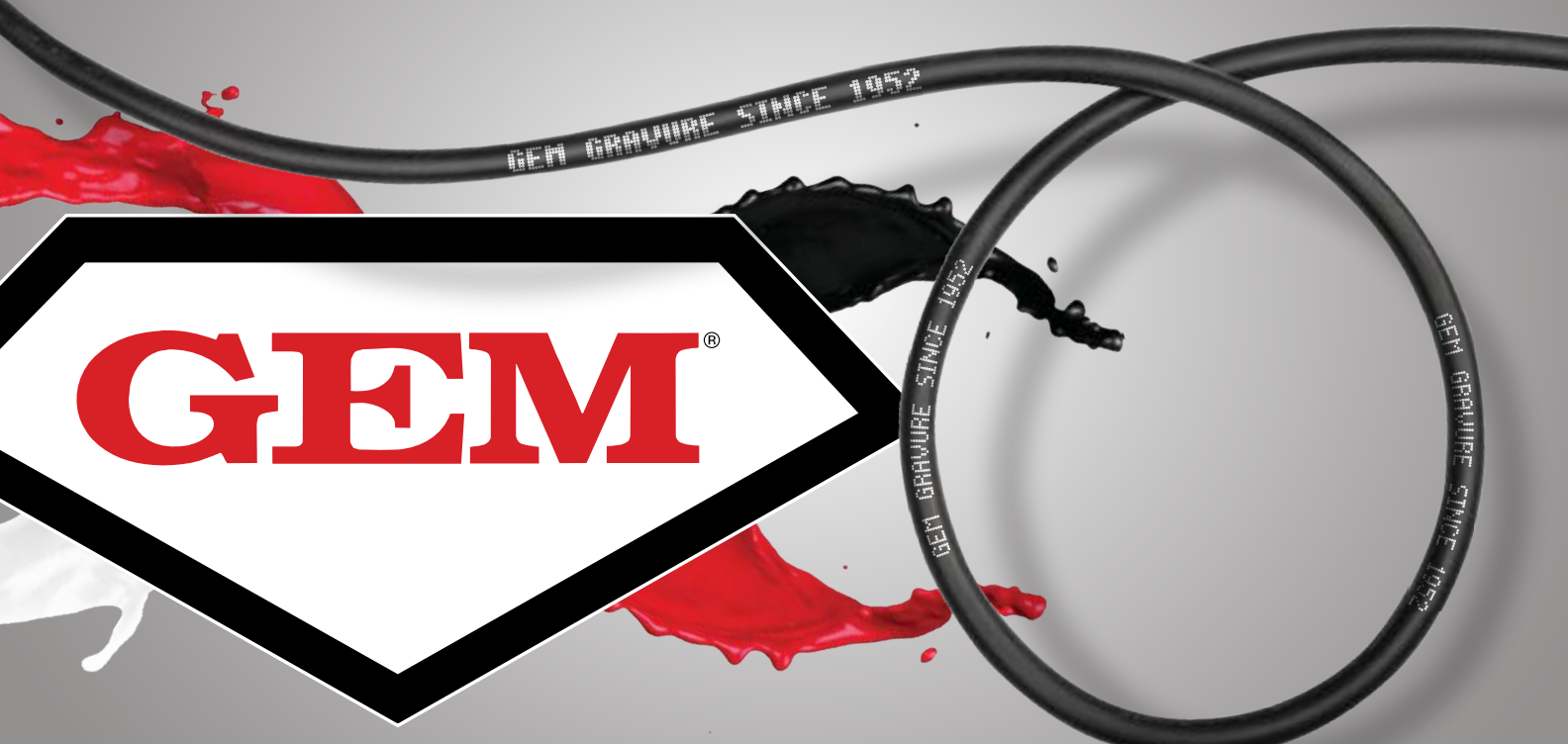


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Batch-off solution

Closed air circulation on the company's batch-offs is said to significantly improve working conditions, as the air used to cool the rubber only circulates in the cooling rack, powered by integrated



air treatment units. This keeps polluted air separate from the rest of the plant, improving the ambient environment for the people working there. In addition to

the benefits for employees, the closed air circulation system also allows customers to reuse the air until its temperature has reached the point where it is too warm to remove heat from the rubber cooling in the batch-off. Reusing air can lead to reduced energy costs. Advantages are said to include an improved working environment, potentially reduced costs and improved sustainability. (VMI)

www.vmi-group.com

Servo mini cutter system

The company's servo mini cutter system is a high torque servo driven tabletop cutter, said to be ideal for medical applications such as PVC tubing for IV sets, polyurethane tubing for venous catheters and feeding tubes, silicone for drainage tubes, nylon impregnated silicone tubing, and more. It can feed, measure and then cut up to 3/4" (19 mm) O.D. at rates up to 1,000 cuts per minute with the servo-controlled accuracy demanded by medical products manufacturers (material hardness, wall thickness and construction may limit maximum size). This compact automated cutter is said to feature the power of a large cutting system, but fits in a small footprint and is easy to program for automatic operations, making it ideal for test laboratories, cleanroom environments and on the production floor, according to the company. The firm's accurate and reliable servo technology can hold tight tolerances on cut lengths from 0.01" to 9999.99". In addition to medical tubing, it is said to be ideal for silicone tubing, rubber hose, plastic tubing, various small profiles of plastic and rubber, and more. The feeder servo is electronically linked to the cutter servo to provide accurate control of cut lengths. (Versa Machinery)

www.versamachinery.com



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Rubber World Industry Links



French Oil Mill Machinery Company (www.frenchoil.com) is an ISO certified, fourth generation family owned U.S. company that custom designs, manufactures and supports hydraulic press systems for molding rubber and composite materials, industrial rubber mixers, screw presses for synthetic rubber processing and for the separation of liquids from solids, and oilseed equipment. For for than 120 years, French Oil Mill Machinery has partnered with its stakeholders in over 80 countries to provide products with superior value and service that improve customers' productivity and reduce overall production

costs. French's 225,000 sq. ft. corporate office and manufacturing facility are located in Piqua, OH.

French owns the brand TMP, A Division of French, which supplies hydraulic presses to the composite, lamination and rubber industries, in addition to their technically advanced composite, plastic and rubber mixing systems. French is also the parent company of FOM (Shangai) Company, Ltd., a wholly foreign-owned enterprise in Shanghai, China, serving the domestic Chinese polymer processing and oilseed markets.

French designs, manufactures and supports an array of equipment used in rubber component manufacturing, from mixing to rubber molding and curing. The Rubber Mixer Group offers tilt style intensive mixers, from 5 to 110 liters, for all types of rubber and plastic compounds. The Hydraulic Press Group manufactures and supports hydraulic presses, from 5 to 3,000 tons, with various platen sizes, for compression, transfer, lamination or vacuum molding. Presses can be equipped with or retrofitted with French's Isobar and Isoplaten thermal solutions, and the company's advanced microprocessor based recipe and data collection control systems. In addition, French's Polymer Group produces dewatering and drying screw presses for all types of synthetic rubber and thermoplastic production, upstream of the mixing and molding processes.

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Digital microscopy

This global provider of ergonomic optical inspection and metrology solutions has launched the EVO Cam Aura digital microscope platform. The EVO Cam Aura is said to deliver a new standard in digital inspection with enhanced imaging, workflow integration and reporting capabilities. Designed for industrial inspection, quality control and laboratory applications, the EVO Cam Aura builds on the success of the EVO Cam II, introducing ultra high definition 4K imaging, together with an intelligent inspection software platform that streamlines imaging, measurement, analysis and reporting into a single workflow, according to the company. Engineered for manufacturers facing increasingly complex products and tighter quality requirements, EVO Cam Aura is said to deliver sharper images, faster setup, greater inspection consistency and comprehensive digital documentation, all without requiring a connected PC, according to the firm. (*Vision Engineering Ltd.*)



www.visioneng.com

Intelligent manufacturing

This AI powered manufacturing technology company formed a partnership with eMaint, the computerized maintenance management system and enterprise asset management software from Fluke. Together, the companies are helping manufacturers connect maintenance, quality, safety and operations through integrated workflows that accelerate issue resolution, improve compliance and increase operational performance. As manufacturers continue to modernize their operations, disconnected maintenance, quality and operational systems often create delays, increase compliance risk and limit cross-functional visibility. The Intellect and eMaint partnership addresses these challenges by connecting every stage of the operational lifecycle across both systems. The partnership combines eMaint's maintenance and asset management capabilities with the IntellectIQ platform. The result is said to be a connected workflow that extends maintenance intelligence across the organization. Operators, quality managers, production leaders, safety professionals and maintenance technicians can collaborate through integrated workflows that connect issue detection, maintenance execution, corrective actions, compliance and continuous improvement. (*Intellect*)

www.intellect.com

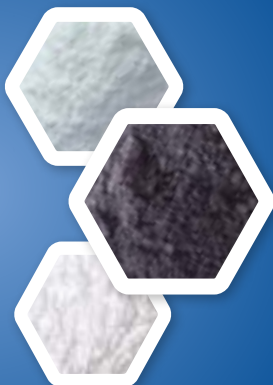


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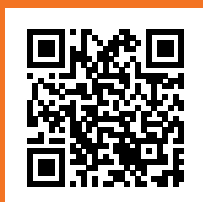


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www.vanderbiltchemicals.com

Rubber compounding

This independent custom rubber compounder operates two manufacturing facilities in Sakarya, Turkey, with an annual mixing capacity of 150,000 metric tons. The company supplies major tire manufacturers, as well as customers across a broad range of technical rubber applications, including industrial products, transportation, construction, energy and specialty elastomer markets. Increasing material complexity, shorter product development cycles and the growing use of renewable and recycled raw materials are said to be driving manufacturers to seek partners that combine formulation expertise with scalable manufacturing and technical support. Advanced automation, complete batch traceability and rigorous process control enable the company to manufacture highly consistent compounds, while protecting the confidentiality of customer formulations. The company is said to be a long term development partner for customers in both tire and technical rubber markets, supplying custom compounds, retread compounds, calendered rubber materials and specialized elastomer formulations for demanding applications. (DRC/Doctors of Rubber Compounding)

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An 80 liter tilt body internal mixing line at the company's facility was designed for specialty and lower volume compounds where process control, changeover discipline and finishing flexibility matter more than maximum throughput. An 80 liter mixer produces approximately 125-150 pound batches, depending on the compound's specific gravity. A 250 horsepower drive and rotor speeds up to 50 rpm give the line enough torque for demanding polymers. The line is said to be well suited for specialty and lower volume compounds, color sensitive materials, NBR, HNBR and other technical elastomers, higher value compounds that benefit from tighter process control, programs requiring frequent or deliberate changeovers and production trials at a meaningful batch size. This is said to give manufacturers another production option for work that does not fit neatly on a high volume line. Different polymers, fillers, oils and cure systems require different charging sequences and temperature limits. Ingredient timing can influence filler dispersion, oil incorporation, final viscosity and scorch risk. The firm is said to provide flexible ingredient charging, recipe control and adjustable temperature settings. (*American Phoenix*)

www.apimix.net

Carbon black replacement

Omyaprene 50 C is a functional filler designed to partially replace carbon black while maintaining the mechanical and processing performance of rubber compounds. Featuring a proprietary surface treatment that chemically interacts with the rubber matrix, Omyaprene 50 C enables up to 50% replacement of carbon black in rubber formulations. EPDM/NBR/SBR rubber compounds testing demonstrated that tensile strength, tear resistance, hardness and compression set performance can be maintained at significantly reduced carbon black loadings. The technology is also said to support excellent processing, delivering lower mixing torque, while maintaining comparable scorch and cure behavior under standard processing conditions. By combining reinforcement, processability, cost optimization and a low carbon footprint, Omyaprene 50 C is said to give formulators a practical alternative to conventional filler systems for automotive, sealing, antivibration and other rubber applications. (*Omya Specialty Materials*)



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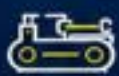
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People in the News

Toyo Tire makes executive appointments

Toyo Tire announced the following executive appointments at Toyo Tire Holdings of Americas (TTHA) and Nitto Tire U.S.A. (NTU), effective October 1. **Keiko Brockel** will be appointed president and chief executive officer of TTHA, becoming the first woman and first American to hold this position. **Angelo Naval** will be promoted to president and chief executive officer of NTU.

MANAGEMENT

Matt Futrelle was appointed associate vice president, TBR, for Dunlop Tires North America.

Arnold van Woerkum was appointed chief financial officer for Magna Tyres Group.

Lorie Adams joined Zochem as the company's human resources partner.

Atlanta Gear Works named **Randy Hand** director of field services.

TECHNICAL

Aravind Kadhambariyil has joined Endurica Europe as a staff engineer. With a Ph.D. in mechanical engineering

from the University of Luxembourg, his research has focused on the development of advanced computational methods for analyzing aging and reliability of rubber components. Kadhambariyil has also developed advanced thermal aging models for EPDM.

RETIREES

Paul DiCaprio, former president of Specialty Silicone Products (SSP), has retired after a 21-year career with the company and overseeing several expansions.



Keiko Brockel
Toyo Tire



Angelo Naval
Nitto Tire U.S.A.



Matt Futrelle
Dunlop Tires



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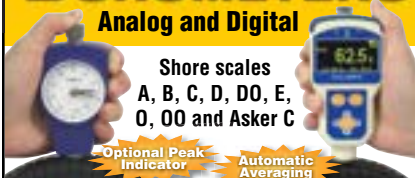
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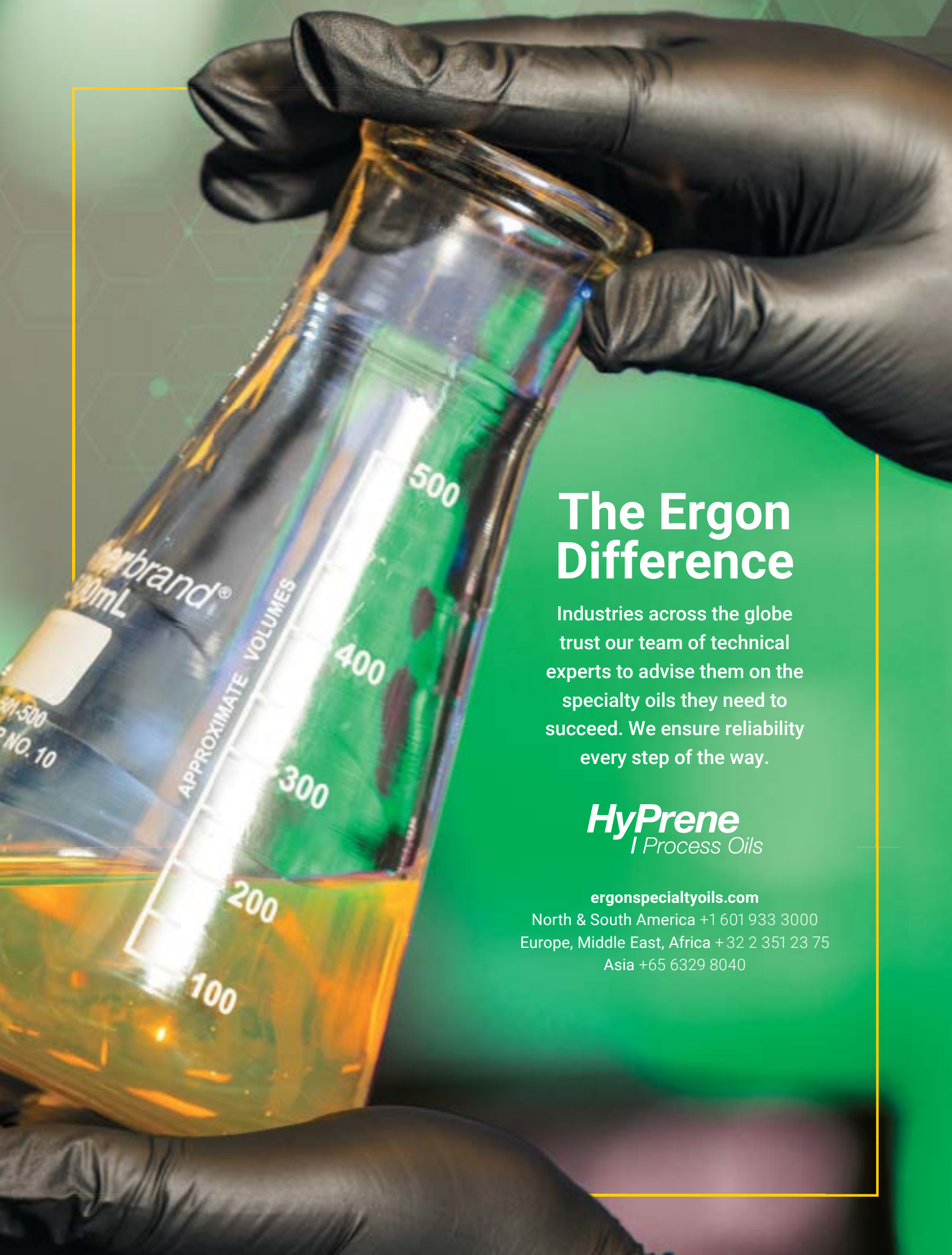
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