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ECOLUBE™: THE PFAS-FREE FUTURE OF HIGH-PERFORMANCE LUBRICATED POLYMERS

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INTRODUCTION

The polymer industry finds itself at a pivotal point, with environmental responsibility and regulatory compliance emerging as central considerations in material development. For many years, per- and polyfluoroalkyl substances, or PFAS, have been widely used in the production of lubricated polymers. These compounds are valued for their resistance to heat, chemicals, friction, and have become integral to applications including complex gear trains and medical devices.

However the environmental persistence of PFAS and increasing concerns about potential health risks have led to a tightening of regulations worldwide. These changes have prompted many organizations to search for alternatives that maintain the performance benefits of PFAS without their environmental drawbacks.

In response, Americhem has introduced EcoLube™ and EcoLube™ MD; a line of PFAS-free internally lubricated compounds. Designed to offer comparable tribological and mechanical performance, the EcoLube™ family seeks to provide a viable option for manufacturers facing evolving environmental regulations.

Key Terms Related to PFAS and Fluropolymers

PFAS: Per-and-Poly-fluroalkyl substances. A broad class of chemicals (includes PTFE.) containing carbon chains and fluorine, 'forever chemicals'.

Fluoropolymer: Long chain polymers containing fluorine, including PTFE, PVDF, ETFE, PFA and others.

C6, C8, C12, C14: A common way of describing PFAS, by the length of the carbon chain.

PFCA: Perfluoroalkyl Carboxylic Acids, a broad category of PFAS, that include PFOS, PFOA and PFHxS.

PFOS: Perfluorooctanesulfonic acid, a C8 chemical that was widely used in PTFE.

PFOA: Perfluorooctanoic acid – another C8 chemical used in the manufacture of PTFE, and the target of many current and future proposed regulations.

PFHxS: Perfluorohexanesulfonic Acid – a C6 chemical often toted as a more stable building block for PTFE and other PFAS, but still subject to new regulations.

THE PFAS PROBLEM:

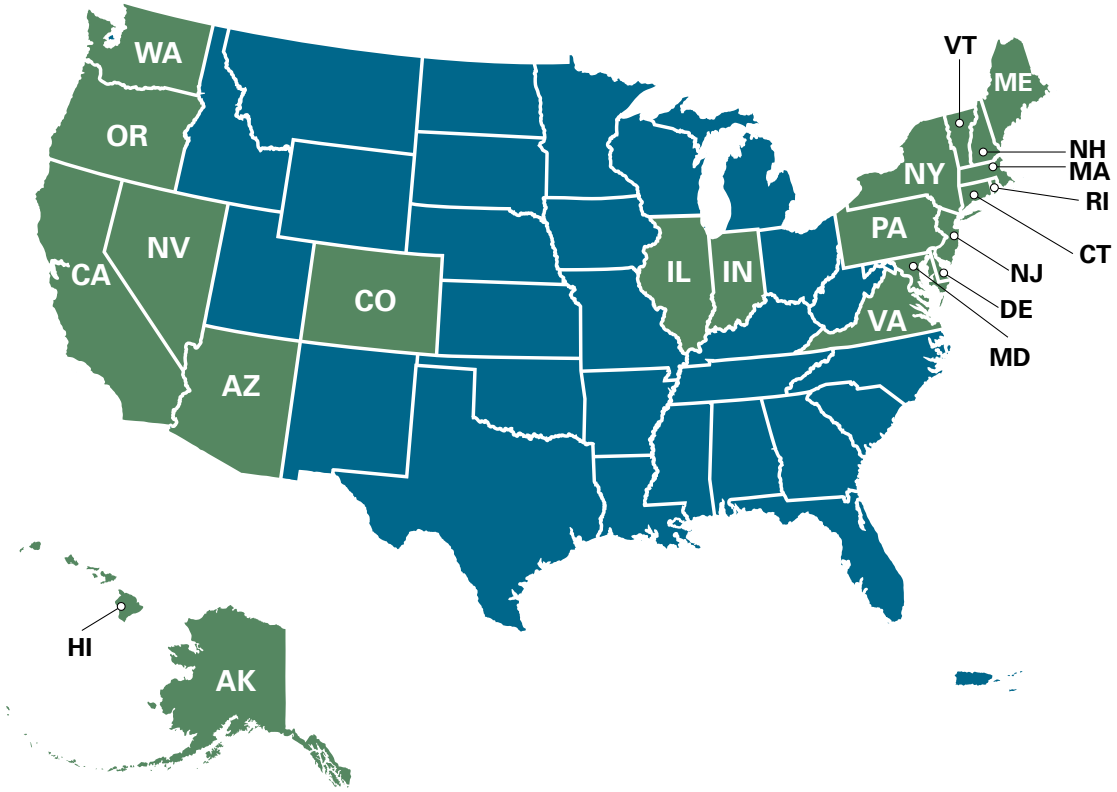
COMPLEX CHEMISTRY, GLOBAL CONSEQUENCES

NPFAS represent a large class of synthetic chemicals characterized by strong carbon-fluorine bonds, which contribute to their durability and resistance to degradation. These properties have made PFAS useful in a variety of manufacturing contexts. However, their persistence in the environment has raised significant concerns.

Regulatory efforts to limit PFAS use have gained momentum. In the United States, the Environmental Protection Agency has introduced drinking water limits for select PFAS compounds, while several states have implemented bans on PFAS in specific product categories. In the European Union, more comprehensive restrictions are under discussion, potentially affecting a broader range of PFAS and their precursors.

Although exemptions for medical applications currently exist in some jurisdictions, industry experts caution that relying on these materials is becoming increasingly risky. As chemical manufacturers phase out fluorochemical production, concerns around availability and cost have added urgency to the search for substitutes.

A recent article in Plastics News outlines the complications medical device manufacturers face under the evolving PFAS regulations. While many medical products are exempt from immediate phase-outs, the broader supply chain is still vulnerable to disruptions. The article notes that defining PFAS itself has become a regulatory challenge, with hundreds of thousands of chemicals potentially falling under the classification. Experts suggest that product obsolescence and supply volatility—rather than regulation alone—pose the most pressing concerns for medical manufacturers navigating the shift away from PFAS (Plastics News, November 2023).



States with PFAS restrictions.

These properties have made PFAS useful in a variety of manufacturing contexts. However, their persistence in the environment has raised significant concerns.

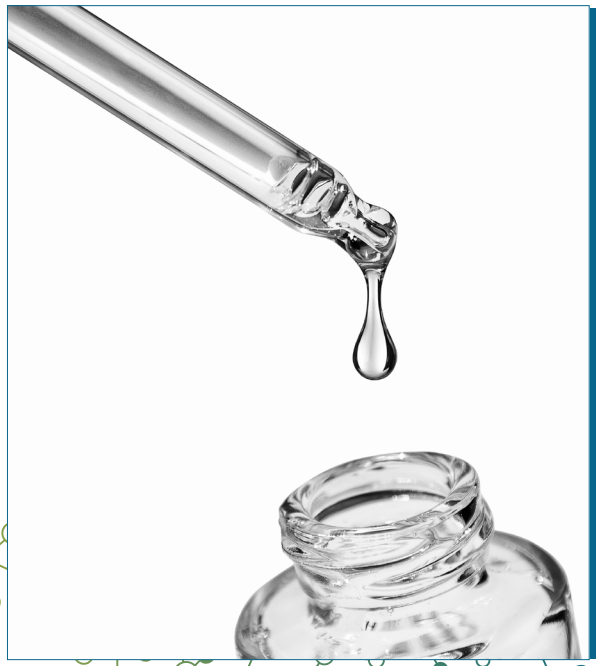
INTRODUCING ECOLUBE™:

A FUTURE-READY SOLUTION

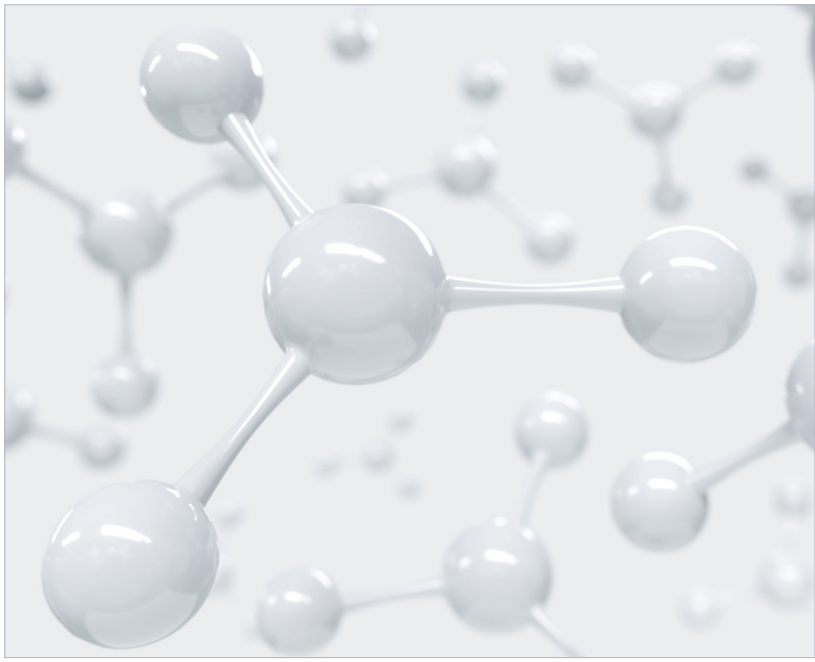
Americhem developed EcoLube™ to meet the need for PFAS-free alternatives in lubricated polymers. The line is designed to deliver tribological performance, including reduced friction and wear, without relying on fluorinated additives. EcoLube™ compounds are intended for use in plastic-on-plastic and plastic-on-metal contact surfaces and are suitable for a variety of industries, including medical, transportation and consumer goods.

To achieve its performance targets, the EcoLube™ line of compounds uses a combination of non-fluorinated technologies. These can include polymeric-based lubricants as well as solid-state lubricants. These additives contribute to properties such as thermal stability and mechanical reinforcement.

EcoLube™ and EcoLube™ MD are available in a wide range of base resins, including PA66, POM, PC, PBT, PEEK, PEI, PPSU, and TPU. This breadth of compatibility helps ensure the line can be integrated into diverse manufacturing processes.



EcoLube™ function –The line is designed to deliver tribological performance, including reduced friction and wear, without relying on fluorinated additives.



Solid State Lubricants
Non-migrating lubricants that stand up to extreme pressures, reducing frictional wear and "slip-stick" behavior in nylon bearings.

- Molybdenum Disulfide
- Graphite
- Boron Nitride

Boundary Lubricants
Migrating lubricants that reduce the coefficient of friction and wear rate by providing immediate lubrication at start-up and high speeds.

- Silicone-Based Lubricants
- PE and PP Waxes

Fiber Reinforcement
Non-traditional formulations offer shear reinforcement and wear resistance between moving or mating parts.

- Glass Fiber
- Carbon Fiber
- Aramid Fiber

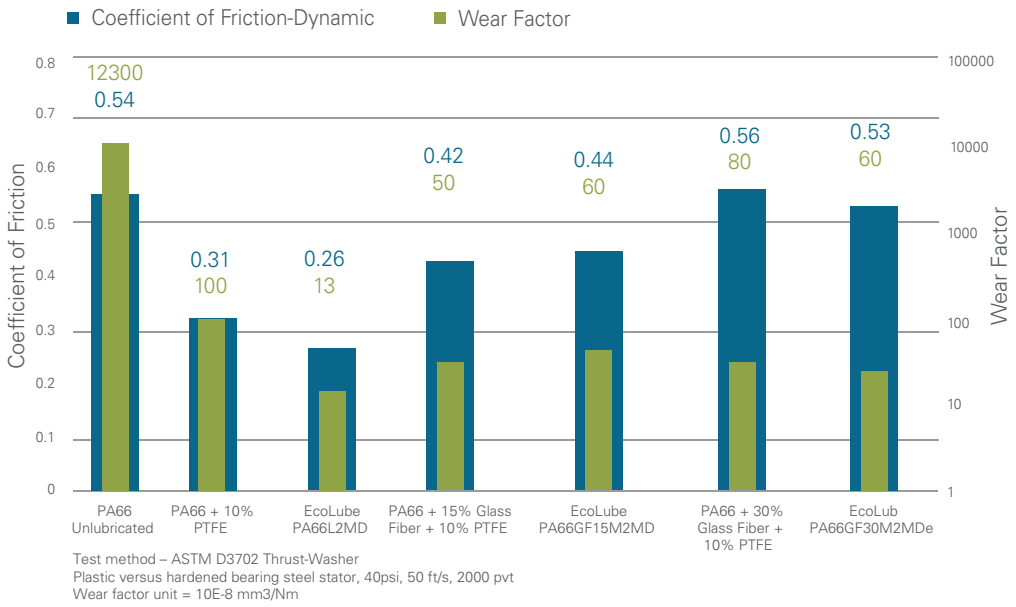
Inherently Wear-Resistant Polymers
Polymers such as POM, POK, PEEK, PAI, and certain PA, have good inherent wear resistance and may require less lubrication.

PERFORMANCE BACKED

BY RIGOROUS TESTING

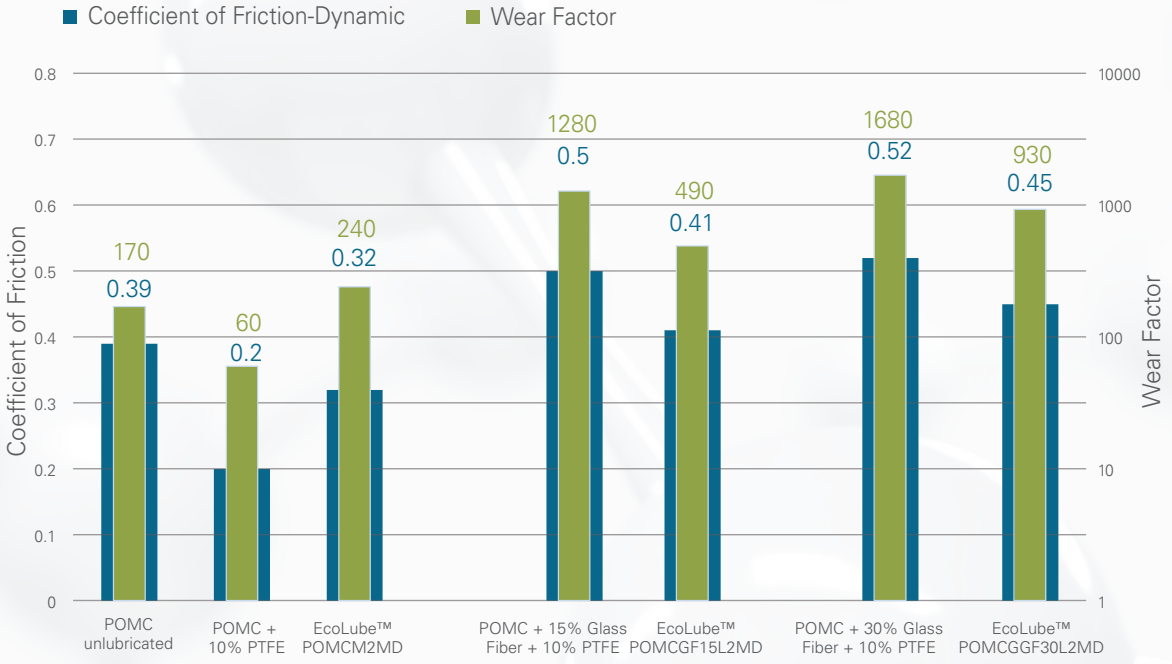
EcoLube™ compounds have been evaluated using ASTM D3702, a standardized thrust washer wear test that simulates sliding contact conditions. The testing results show that EcoLube™ materials often match or exceed the performance of PTFE-containing formulations in terms of wear factor and coefficient of friction

ECOLUBE™ MD COMPARISON TO PTFE – PA66 COMPOUNDS



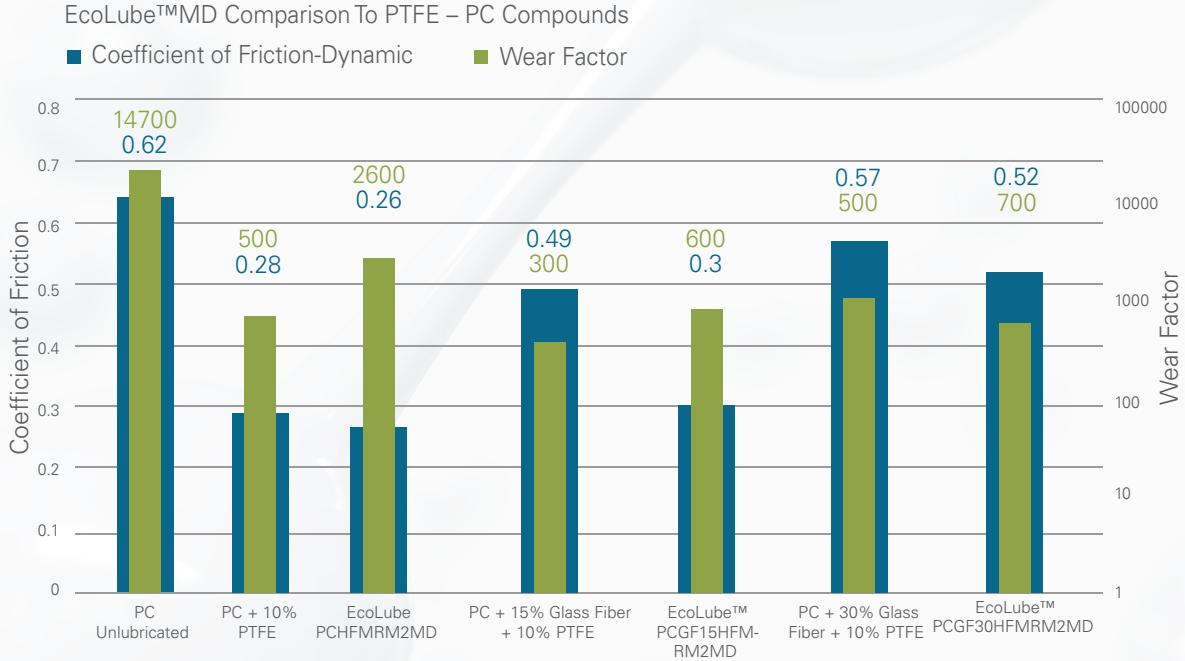
For example, EcoLube™ compounds formulated with PA66 demonstrate lower wear and friction compared to equivalent PTFE-based materials. These compounds also tend to offer improved impact resistance and reduced density, which can benefit both performance and environmental impact. Similar outcomes have been observed in polycarbonate and polyacetal systems.

ECOLUBE™ MD COMPARISON TO PTFE – POMC COMPOUNDS



Test method – ASTM D3702 Thrust-Washer
Plastic versus hardened bearing steel stator, 40psi, 50 ft/s, 2000 pvt
Wear factor unit = 10E-8 mm3/Nm

ECOLUBE™ MD COMPARISON TO PTFE – PC COMPOUNDS



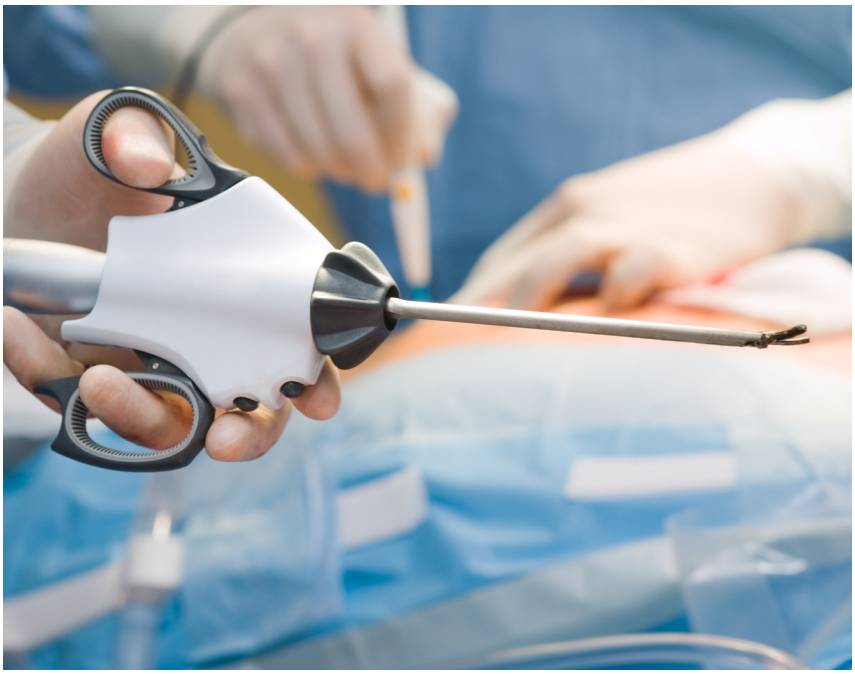
Test method – ASTM D3702 Thrust-Washer
Plastic versus hardened bearing steel stator, 40psi, 50 ft/s, 2000 pvt
Wear factor unit = 10E-8 mm3/Nm

ECOLUBE™ MD:

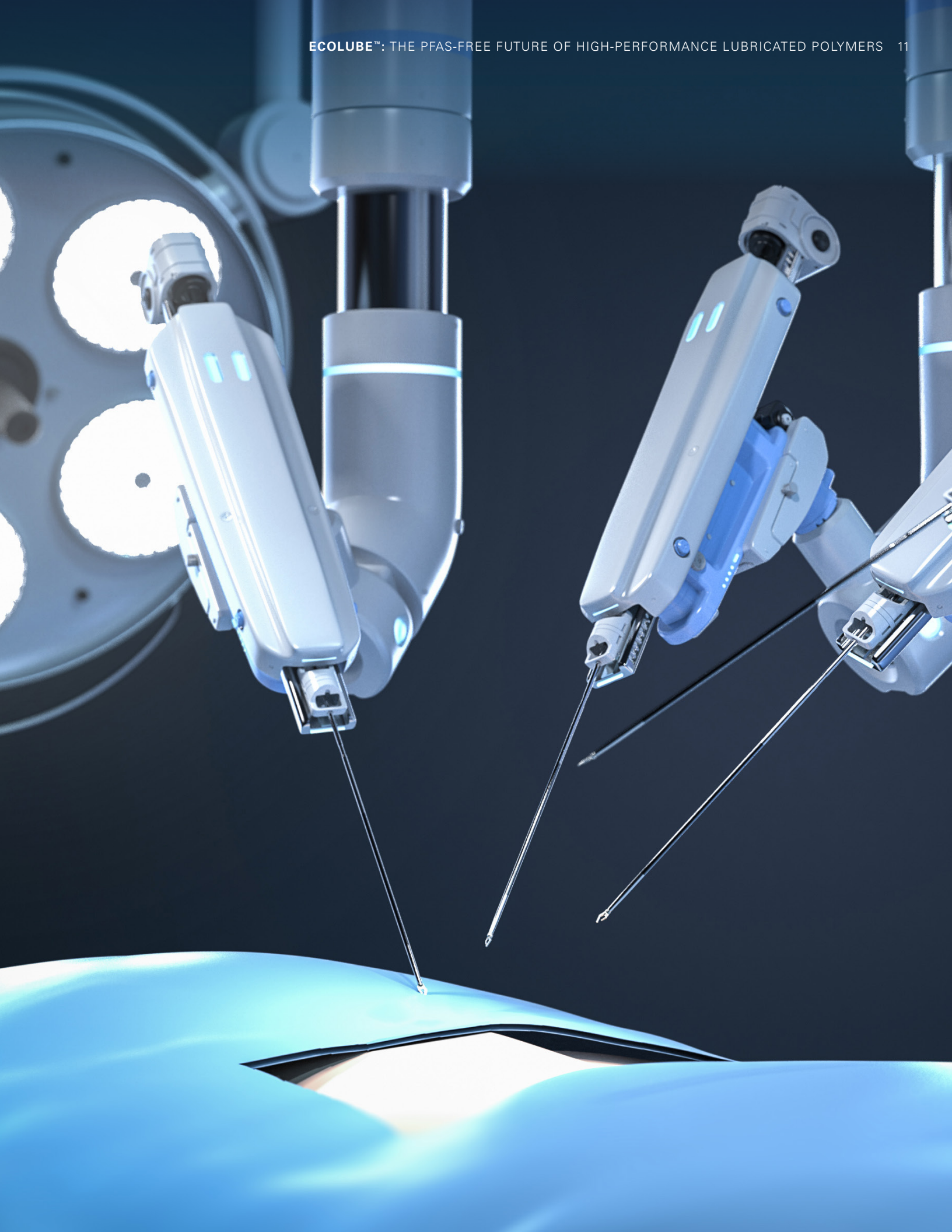
ADVANCING HEALTHCARE APPLICATIONS

EcoLube™ MD represents a subset of compounds within the EcoLube™ line that are specifically tailored to healthcare applications. These materials are designed with locked formulations for consistency and are compliant with ISO 10993 biocompatibility standards. .

The **EcoLube™ MD** series is suitable for use in applications such as catheters, prosthetics and minimally invasive surgical instruments. These compounds offer smooth actuation and reduced wear, which are important for performance and reliability in medical devices. Color management can be maintained through Americhem's ColorRx® technology.



EcoLube™ MD delivers smooth, PFAS-free performance in laparoscopic instruments and robotic-assisted surgical devices.



APPLICATIONS:

INDUSTRY IMPACT

The need for PFAS-free lubricated materials is growing across multiple industries. Manufacturers are beginning to test and integrate alternatives like EcoLube™ into their product development pipelines. Applications range from medical device components to industrial assemblies and consumer products.

From outdoor equipment to fluid systems, EcoLube™ compounds deliver clean, long-lasting lubrication without PFAS.

While formal product validation and commercialization timelines can vary, early use cases suggest that PFAS-free materials like EcoLube™ can offer comparable performance in real-world scenarios. These materials may also assist manufacturers in meeting future regulatory and sustainability requirements.

PFAS-free EcoLube™ compounds reduce friction in enclosed gear systems, ideal for high-load applications like worm drives.

EcoLube™ improves motion and durability in consumer mechanisms like blind rollers and seat latches, without PFAS.

AMERICHEM'S APPROACH:

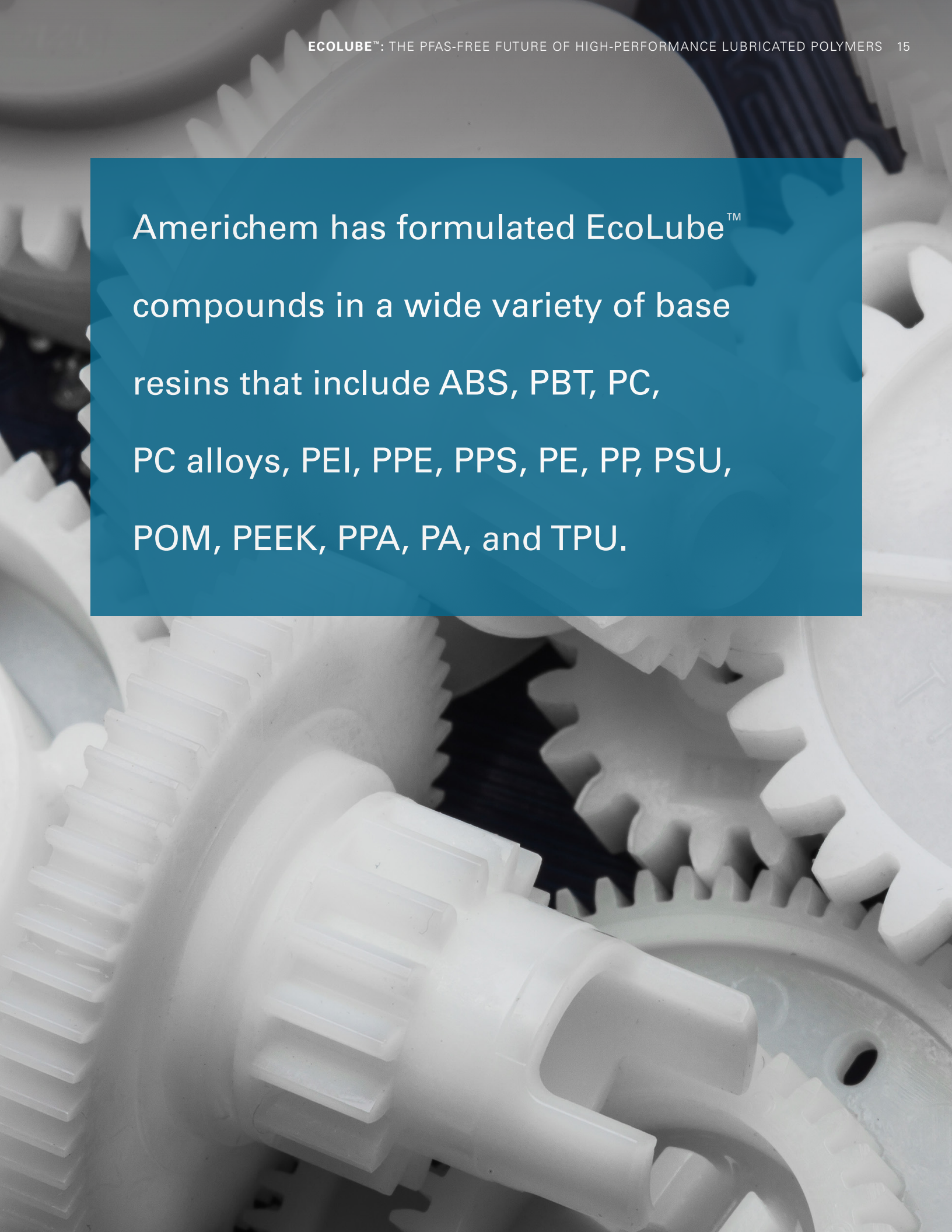
TECHNICAL SUPPORT AND MATERIAL VERSATILITY

One of the distinguishing aspects of the EcoLube™ platform is Americhem's approach to customization and support. Rather than offering fixed, off-the-shelf products, the company collaborates with customers to identify PFAS-free formulations that align with specific performance goals.

This includes evaluating wear conditions, material compatibility and regulatory considerations. EcoLube™ has also been adapted to work in high-temperature resin systems such as PEEK, PPSU, and PEI. These resin systems are already a core competency of Americhem, and EcoLube™ expands our capabilities in these advanced polymers.

Americhem collaborates with customers to **identify PFAS-free** formulations that align with specific performance goals.

EcoLube™ compounds are engineered for compatibility across a wide range of base resins– enabling custom PFAS-free solutions for complex, high-performance parts.



Americhem has formulated EcoLube™ compounds in a wide variety of base resins that include ABS, PBT, PC, PC alloys, PEI, PPE, PPS, PE, PP, PSU, POM, PEEK, PPA, PA, and TPU.

ECOLUBE™:

SUSTAINABILITY CONSIDERATIONS

The shift to PFAS-free materials aligns with broader sustainability efforts. EcoLube™ compounds are designed to reduce environmental and health risks associated with fluorinated chemicals. Their performance characteristics can contribute to lighter parts, longer service life and simplified end-of-life disposal.

These benefits are particularly relevant as industries move toward more circular and environmentally responsible product design. Reducing reliance on persistent chemicals is one part of that transition.

PFAS-free compounds support circular design and environmental stewardship.

High speed automation conveyor belt.

OUTLOOK:

SUPPORTING THE TRANSITION TO PFAS-FREE POLYMERS

As regulatory landscapes evolve and supply chain uncertainties increase, the need for PFAS-free alternatives is expected to grow. Materials like EcoLube™ can help manufacturers navigate this shift by providing functional replacements that meet performance and compliance goals.

Adopting these alternatives early may also reduce business risk by limiting dependency on materials facing regulatory pressure. The transition may require collaboration across engineering, procurement and compliance teams, as well as engagement with suppliers who understand both technical and regulatory dimensions.

Materials like **EcoLube™** can help manufacturers **navigate** this shift by providing **functional replacements** that meet performance and compliance goals.

CONCLUSION

The use of PFAS in engineered polymers is increasingly scrutinized, and manufacturers are exploring new materials to maintain product performance while reducing environmental and regulatory exposure. EcoLube™ represents one such approach, offering a range of PFAS-free compounds designed for friction and wear resistance.

By combining tribological functionality with environmental considerations, materials like EcoLube™ may support industries in adapting to a changing regulatory climate while maintaining operational performance.

MEET OUR AUTHORS

Raphael Delegado and Robert Krieger bring extensive expertise in polymer science and product development, playing essential roles in the creation and advancement of the EcoLube™ line.

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Whether you're optimizing performance or advancing sustainability, our team is ready to help you integrate EcoLube™ into your next project.

Source: Plastics News, November 2023, "Tangled Web of PFAS Landscape Poses Challenges for Medical Device Industry."

ADDITIONAL OFFERINGS FROM AMERICHEM

At Americhem, we go beyond materials—we deliver custom-engineered solutions that empower innovation in the medical nonwovens industry. Our expertise in functional additive technologies is backed by a commitment to R&D, collaborative development, and global insight.

Research & Development

We maintain a strong focus on innovation through robust R&D investments and partnerships with leading academic institutions and global collaborators. This proactive approach keeps us ahead of emerging market needs and drives continuous improvement across our additive platforms.

Customer Collaboration

Our success is rooted in close collaboration with customers. Through ideation sessions and real-time market feedback, we co-develop targeted solutions that are both technically sound and commercially relevant. Every product we create reflects the unique performance, regulatory, and sustainability goals of our partners.

Additional Offerings

InStruc® – Structurally Reinforced Compounds

InStruc® compounds combine glass, carbon, and mineral fillers for enhanced strength, stiffness, and dimensional stability. Used in surgical tools and housings, they can be tailored with flame retardants, colorants, and PFAS-free EcoLube™ MD lubricants. Compatible with 30+ base resins and engineered to replace metal without compromising performance.

InElec® – Electrically Active Compounds

InElec® compounds achieve antistatic, dissipative, or conductive properties using carbon and metal-based fillers. Ideal for diagnostic housings and smart devices, with optional PFAS-free EcoLube™ MD for low-friction performance. Customizable across 30+ resins with color, EMI shielding, and sterilization-compatible additives.

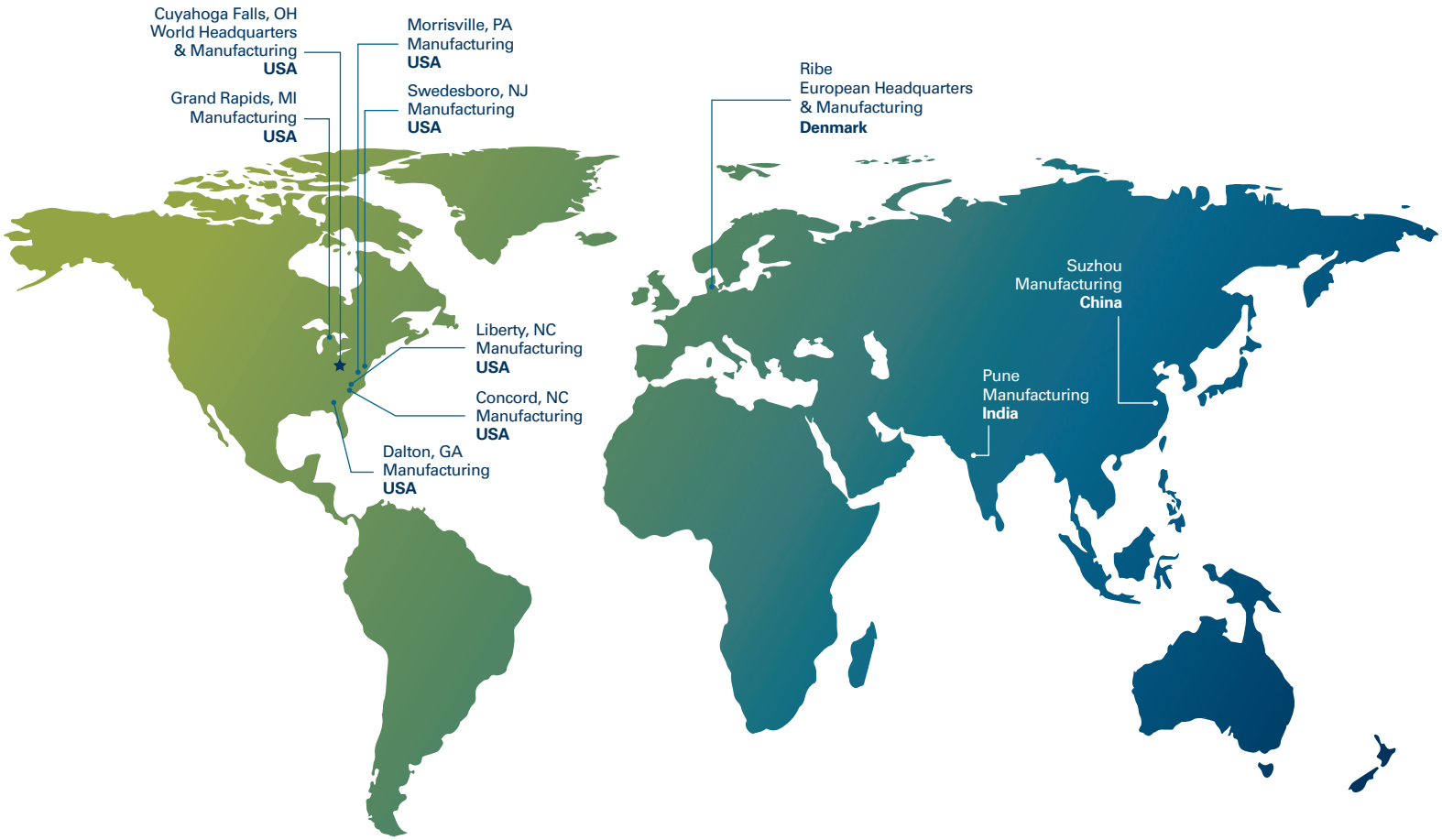
nREPEL / nBlock – PFAS-Free Alcohol Repellent Additives

Americhem's nREPEL and nBlock additives offer effective alcohol repellency and fluid resistance without PFAS or fluorine-based compounds. Designed for medical, hygiene, and industrial applications, these additives enhance durability and sustainability with seamless in-melt integration.

nDryve™ PFAS-Free Alcohol Repellent Additives

As global regulations tighten on PFAS chemicals, Americhem has introduced nDryve™, a PFAS- and PFOS-free additive designed for alcohol repellency in polyoleftin nonwovens. This in-melt technology improves alcohol resistance, durability and fluid protection in medical, hygiene and industrial applications while supporting environmental sustainability.

A GLOBAL LEADER



BATCH TO BATCH.
MARKET TO MARKET.
CONTINENT TO CONTINENT.

From our headquarters in Cuyahoga Falls, Ohio, to our manufacturing locations and sales offices across the world, our expansive footprint provides global reach for your organization's needs. Not only are we dedicated to getting your materials where they need to be, when they need to be there, we work behind the scenes to reduce your supply risks. In addition to our network of plants, regulatory and compliance teams, we have contingency plans and support services in place to secure your product against unforeseen interruptions.

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