TECHMER PM
POLYMER MODIFIERS

LOW RETENTION,
HIGH PERFORMANCE

A GUIDE TO NON-PFAS FLUID MANAGEMENT IN PIPETTE TIPS AND LABWARE

PREMIX

Introduction

In modern laboratory and diagnostic environments, precision and purity are non-negotiable. Whether pipetting microliters of valuable reagents or ensuring trace-free fluid transfer in microfluidic devices, minimizing fluid retention is essential to achieving accurate results.

Traditional approaches to low retention have relied heavily on fluorinated coatings or chemical additives. However, the industry is now facing a critical turning point: **the global push to eliminate PFAS (per- and polyfluoroalkyl substances)** is forcing manufacturers to rethink their material strategies.

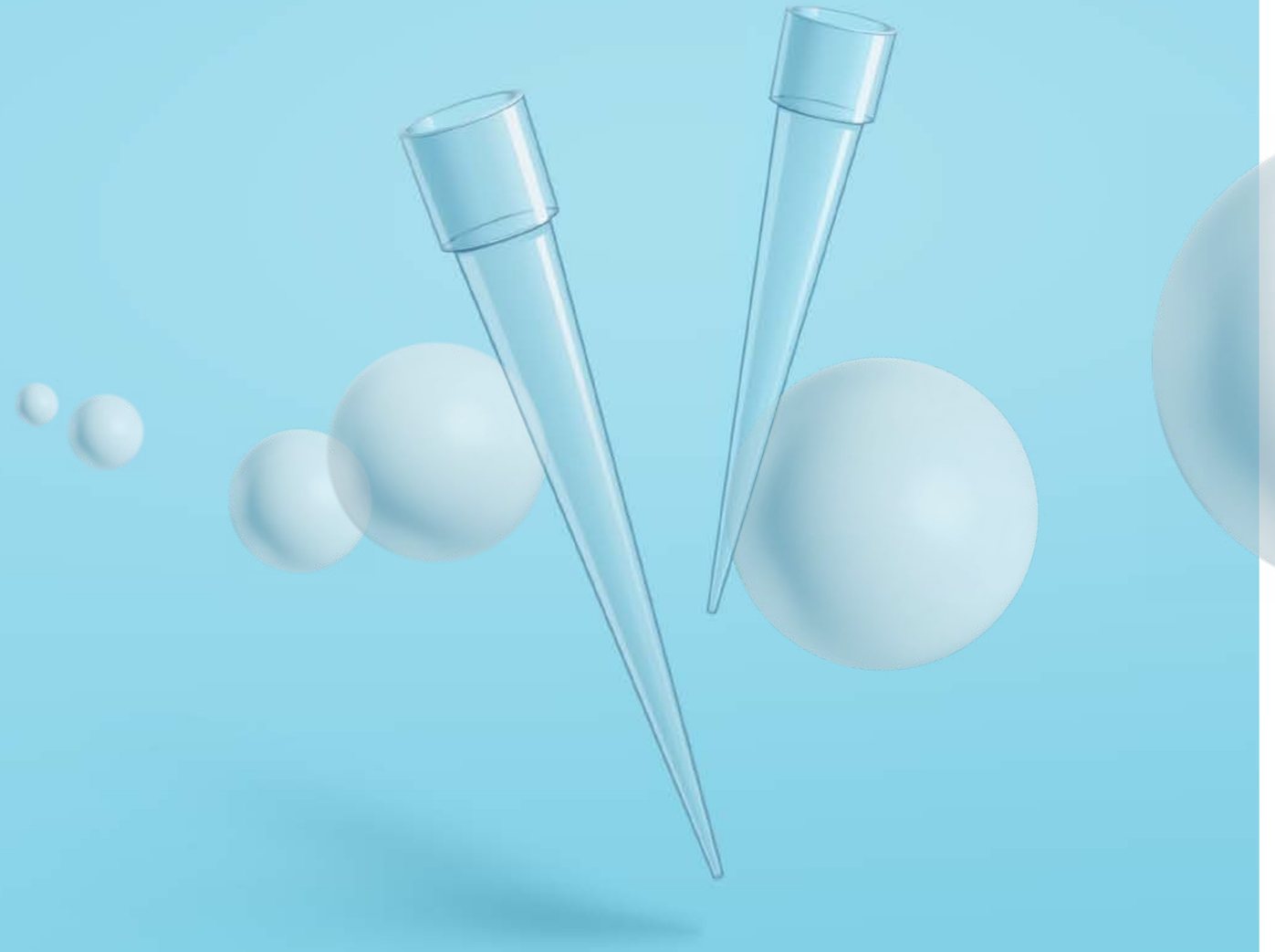
Enter a new era of surface-modified, Non-PFAS solutions – where material science and sustainability meet. At Premix, we are working in collaboration with Techmer PM to support labware manufacturers with innovative, additive-based materials that provide **excellent low retention performance** without the environmental and regulatory downsides of fluorinated technologies.

This guide provides a technical overview of the challenges, solutions, and best practices in designing low retention pipette tips and diagnostic labware – powered by **Non-PFAS additive technologies** that are scalable, sustainable, and built for modern applications.

Whether you are in R&D, production, or regulatory compliance, this resource will help you:

- Understand why low retention is critical
- Navigate the regulatory shift away from PFAS
- Evaluate Non-PFAS surface modification technologies
- Benchmark performance across additive approaches

Let's explore how smarter materials can enable **cleaner, safer, and more efficient** labware for the future.



Understanding the Challenge: Fluid Retention in Pipette Tips

Fluid retention might seem like a minor issue — until it compromises results in critical lab procedures. In pipette tips and other fluid-handling labware, even a small droplet left behind can lead to inaccurate dosing, wasted reagents, and costly repeat testing. In high-throughput diagnostics or precision drug delivery, the stakes are even higher.

What causes fluid retention?

At the root of the issue is surface energy. When the surface of the plastic tip has too much affinity for the liquid (often water-based or protein-based solutions), fluid tends to cling to the material instead of cleanly dispensing. This is especially problematic in:

- PCR and molecular biology workflows
- Diagnostic assays where low sample volumes are used
- Sensitive microfluidic systems
- Reagent dispensing in automated lab platforms

Why does it matter?

The consequences of poor fluid release include:

- Volumetric inaccuracies in pipetting
- Skewed assay results or reduced sensitivity
- Increased reagent costs due to residual waste
- Cleaning or disposal challenges in multi-use systems

With PFAS-based coatings being phased out and secondary treatments often adding complexity, manufacturers are increasingly seeking **built-in, additive-based solutions** that modify surface properties during the compounding or molding stage. These integrated approaches are more sustainable, scalable, and compatible with high-volume manufacturing.

The Regulatory Landscape

Across the globe, regulatory agencies are moving quickly to phase out PFAS due to growing concerns about their persistence in the environment and potential health effects. Once valued for their low surface energy and chemical resistance, PFAS substances are now under intense scrutiny.

What's driving the change?

- In the United States, the Environmental Protection Agency (EPA) has introduced regulations to restrict the use and manufacturing of PFAS in many consumer and industrial products.
- In Europe, REACH regulations continue to tighten, with upcoming proposals to ban thousands of PFAS compounds altogether.
- Several states and countries have adopted proactive legislation banning PFAS in food contact materials, textiles, and medical products.

Why it matters to labware manufacturers

Laboratory and diagnostic equipment manufacturers are now expected to offer non-PFAS alternatives that meet the same performance standards. For pipette tips and microfluidic components, this means achieving low retention without relying on fluorinated coatings or additives.

The opportunity

This regulatory shift is creating demand for **materials that are clean, compliant, and future-proof** – opening the door for innovative additive-based solutions that provide permanent surface modification without regulatory risk.

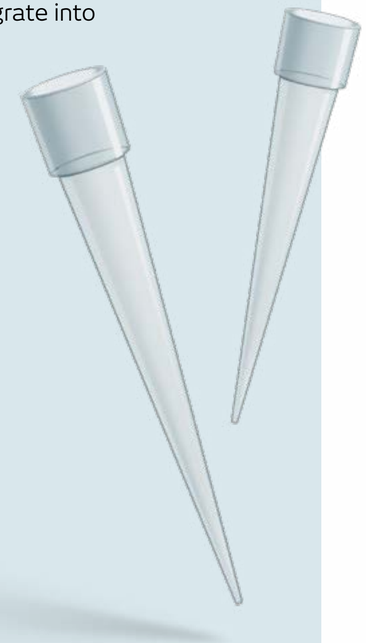
PFAS-Free Alternatives: What Works – and What Doesn't

As the industry searches for safer, compliant solutions, not all non-PFAS alternatives are created equal. The challenge lies in achieving comparable low retention performance while maintaining chemical compatibility, processing ease, and product safety.

Legacy options, such as siloxanes and amide-based additives, often fall short. They may migrate, degrade under sterilization, or interact unpredictably with biologics. Many still present regulatory concerns or are unsuitable for applications requiring low extractables and leachables.

Key requirements for viable alternatives include:

- **Permanent modification:** Surface properties must be built into the material, not added as a coating.
- **Low extractables and low migration:** Additives must not leach or migrate into sensitive reagents or samples.
- **Durability:** Stability under irradiation, heat, and long-term storage conditions.
- **Biocompatibility:** Safe for diagnostic and drug-delivery environments.
- **Processability:** Compatible with standard injection molding and compounding equipment.



Techmer PM's non-PFAS additive technologies meet these benchmarks by embedding proprietary modifiers directly into the polymer matrix. This creates lasting low-retention performance without the need for secondary treatments or environmentally harmful substances.

Surface Modification Explained

Achieving low fluid retention begins at the molecular level – with how the material interacts with the liquid. This is primarily a function of **surface energy** and **surface topography**, both of which can be adjusted with the right polymer modifications.

Hydrophobic vs. hydrophilic surfaces

- Hydrophilic surfaces tend to attract water, leading to spreading and retention.
- Hydrophobic surfaces repel water, encouraging liquid to bead up and dispense cleanly.

Measuring performance: Contact angles

One of the most important metrics for evaluating surface modification is the **contact angle** – the angle at which a liquid droplet meets a surface:

- A **high contact angle** (>90°) indicates low wettability and good fluid release.
- A **low contact angle** (<90°) suggests fluid spreading and potential retention.
- Dynamic contact angle testing (advancing and receding) can give further insight into how liquids behave under use conditions.

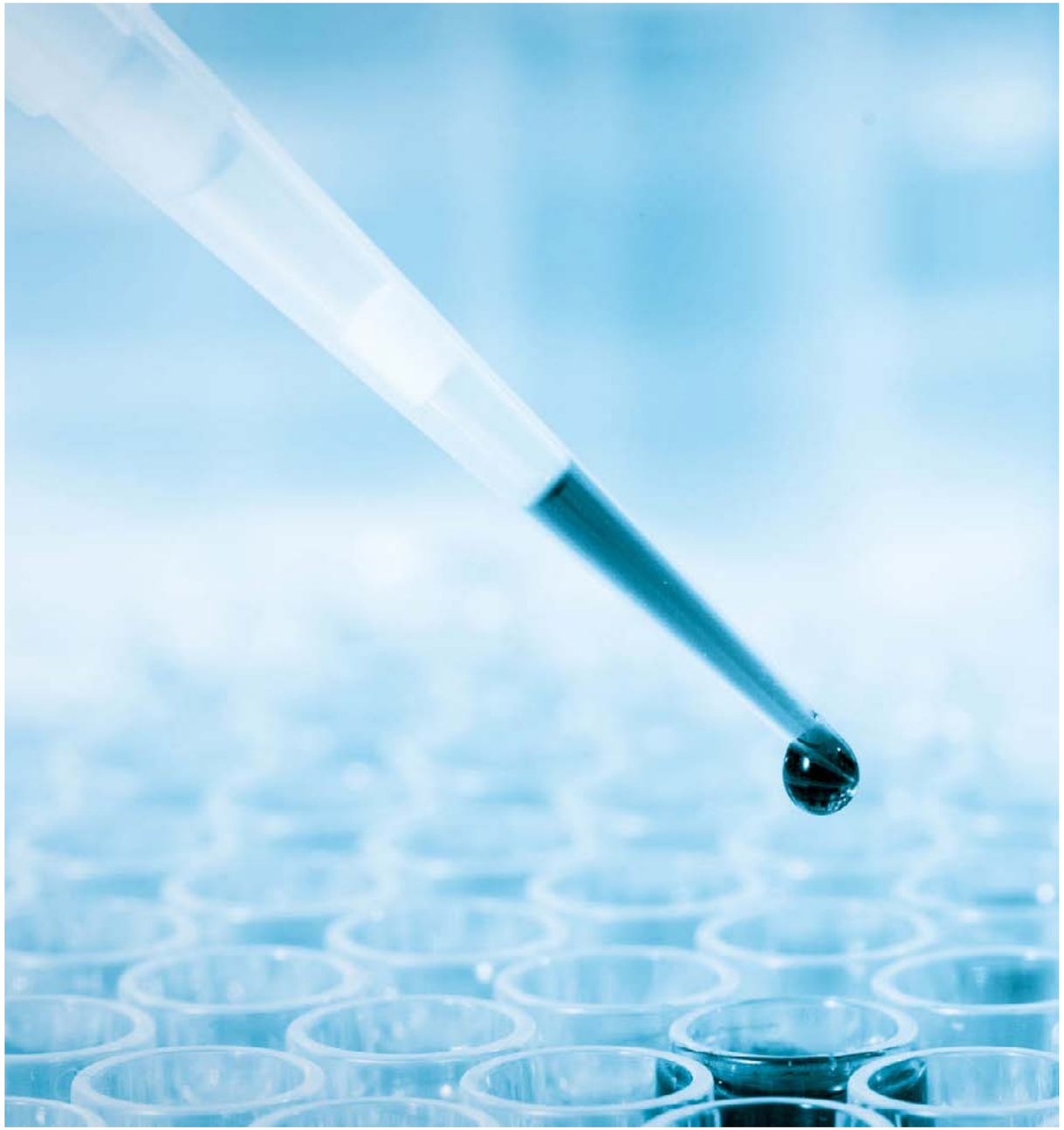
Compounded additives vs. surface coatings

Unlike traditional coatings, additive-based surface modifications are achieved by dispersing functional additives directly into the polymer matrix during compounding. This results in:

- **Consistent performance** across molded parts
- **No risk of delamination or uneven application**
- **Compatibility with radiation and sterilization processes**

Because the surface-modifying properties are introduced through the compound itself, the resulting functionality is present from the moment the pipette tip is molded – removing the need for post-processing treatments or secondary coating steps.

This is particularly advantageous for applications like pipette tips, where high-volume production, tight tolerances, and sterilization requirements demand a more robust and efficient solution.



The Techmer Solution

Techmer PM has developed a non-PFAS additive technology designed to meet the most demanding fluid management needs in laboratory consumables. These proprietary surface modifiers are incorporated directly into the polymer matrix, offering reliable low-retention performance without the risks associated with coatings or migratory additives.

Key benefits of Techmer's approach include:

- **Permanent surface functionality:** The performance is built in – not sprayed on – eliminating concerns about layer degradation or removal during sterilization.
- **Low extractables:** Critical for use in sensitive diagnostic or pharmaceutical workflows, ensuring the integrity of reagents and samples.
- **Customizability:** Available in different loadings (e.g. 4% and 8%) to balance hydrophobicity, clarity, and cost-performance ratios. We can also tailor polypropylene formulations based on customer-specific performance or processing needs.

Designed with scalability in mind: These materials are formulated for compatibility with high-throughput injection molding environments. They offer a drop-in solution for manufacturers aiming to shift away from PFAS without sacrificing performance or process efficiency.

Real-World Applications

Non-PFAS, additive-based low-retention materials are already proving their value across a range of fluid handling and diagnostic tools. The benefits of stable performance, clean release, and non-PFAS formulation are especially critical in high-precision, regulated environments.

Current application areas include:

- **Pipette tips:** The most prominent application, especially for PCR, ELISA, and other sensitive analytical workflows. Additive-enhanced tips reduce fluid retention, ensuring more accurate dosing and less reagent waste.
- **Deepwell plates, cuvettes and microplates:** Used across high-throughput platforms and optical detection workflows, these components benefit from reduced fluid cling and clearer, more repeatable measurement conditions.
- **Microfluidic cartridge s:** These miniaturized lab-on-a-chip devices require ultra-clean fluid flow paths with minimal interference. Surface modification built into the material matrix supports consistent capillary action and minimal sample loss.
- **Drug delivery devices:** Where fluid migration, extractables, and interaction with the surface can alter dose reliability or shelf life, embedded low-retention functionality provides a safer path forward.

With strong mechanical properties, chemical resistance, and processing versatility, these non-PFAS solutions offer a more sustainable and environmentally conscious alternative to traditional fluorinated technologies – enabling the next generation of high-quality, compliant labware and medical components.

Toward Even Greener Solutions: ISCC-Compliant Options

Are you looking to further reduce your environmental footprint?

We also offer the capability to develop **ISCC-compliant versions** of our low retention compounds – using certified bio-based or recycled raw materials. These sustainable alternatives offer the same processing and performance benefits while aligning with your circular economy and corporate responsibility goals.

Summary & Next Steps

The push for safer, non-PFAS materials is no longer just a trend – it's a regulatory and ethical imperative. As this guide has shown, low-retention performance is essential in modern labware, but it doesn't have to come at the cost of sustainability or compliance.

Non-PFAS, additive-based solutions like those developed by Techmer PM offer:

- Permanent, embedded surface modification
- Low extractables and high chemical compatibility
- Performance on par with – or better than – fluorinated alternatives
- Scalable production without secondary treatments

WANT TO LEARN MORE ABOUT NON-PFAS SURFACE MODIFICATION TECHNOLOGIES?

Let’s organise a technical discussion or explore customized solutions for your application to meet evolving regulations, and support your sustainability goals.

Get in touch ›

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