

THE PROPERTIES  
AND BENEFITS  
OF HYDROPHILIC  
COATINGS

# WHY HYDROPHILIC COATINGS?



## A White Paper

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# INTRODUCTION TO HYDROPHILIC COATINGS

## Why choose hydrophilic over hydrophobic coatings?

After much research, testing and experience with hydrophilic coatings, our subject-matter-expert team at Hydromer® have carefully put together an article to answer the most important questions in medical and industrial applications alike.

First let's answer this question, what is a Hydrophilic coating? Hydrophilic, plainly means, 'water loving' or 'lubricious' and can occur naturally or synthetically. Once a hydrophilic surface is exposed to water or moisture, the hydrophilic surface grabs the water molecules and holds on to them. Hydromer's hydrophilic coatings become lubricious when wet out or slippery-when-wet. An easy way to think of a hydrophilic coated, lubricious surface is like trying to hold a lemon seed. We have all tried, at one time or another, to get those slippery suckers out of our drinks, but usually to no avail. Just like the slippery lemon seed, any device that has Hydromer® hydrophilic coating will have the same feature, slippery when it gets wet. This allows water to disperse, lowering friction and adherences of liquids to the surfaces of your devices or products. The water loving function of such hydrophilic coating lends itself to numerous useful applications in a wide variety of industries such as medical, industrial, commercial, consumer, automotive, and aviation to name a few. Don't worry, we will dive much deeper into more applications and uses later.

Let's continue to discuss the other common coating choice, hydrophobic coatings. Hydrophobic, as many of you can probably guess, is the exact opposite of hydrophilic, meaning it doesn't make a surface slippery, as it repels water. What does that mean for your device or product? Imagine trying to fit a triangle into a circle. Did you imagine it? Well if you did, I can imagine it was a thought of something like this...

# IT'S JUST NOT GOING TO HAPPEN!



## With Hydromer® Hydrophilic Coatings



Friction is virtually nonexistent, allowing further and easier access of application



Patients experience less pain and irritation, due to hydrophilic coating



Visibility is better than ever, allowing your customers a clear field of vision

The friction caused by the features of the hydrophobic coating causes it to resist smooth movement. With hydrophilic coatings its easier than ever to get into places that were hard to reach before!

Another feature of hydrophobic that doesn't work well on devices and products is that it does not disperse liquids to enable optical clarity of your coated products surfaces. Since it will not disperse the liquid on your products surface, it can also cause it to become damaged in moist atmospheres. Hydrophobic surfaces aren't 'slippery-when-wet', so the moisture would just stick to the surface until it was wiped away. This causes fogging and condensation build up, which looks something like this...



# APPLICATIONS AND USES FOR HYDROPHILIC COATINGS

## Industrial and Medical

Hydrophilic coatings are used in a wide variety of markets and applications ranging from agricultural to health care, from catheters to greenhouse panels, and everything in between. Below are some of the most important areas where not just any hydrophilic coating is used, but where HYDROMER'S hydrophilic coatings find wide-spread use. As the subject-matter-experts, we have partnered with numerous companies, helping them become leaders in their industries by giving their products the technology they need to outperform their competitors and to get their products to market faster as well as more efficiently.





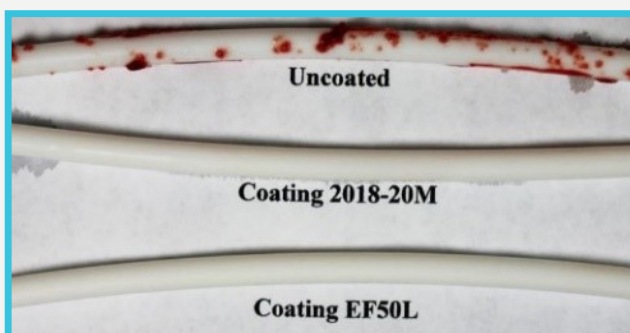
## Medical and Healthcare Applications For Hydromer® Hydrophilic Coatings

The use of hydrophilic coatings on disposable medical devices has existed for several decades. Companies, like Hydromer, that manufacture and apply these coatings are constantly improving the performance characteristics of the coatings. The most prominent use of a hydrophilic coating on a medical device is to improve or create lubricity. Lubricity, or as you may remember earlier in our definition of hydrophilic, or 'lubricious' coating is the slippery when wet feature that permits the easy passage of catheters, guidewires or medical accessories through tight and torturous anatomical pathways in patients. This allows physicians to access areas normally difficult to reach through veins, arteries, the gastrointestinal system, and urological tracts for improved diagnosis and treatment outcomes.

Additionally, hydrophilic coatings are used on devices like interocular lens (IOL) cartridges. The inner surface of the IOL cartridge is coated so that a synthetic replacement lens can be placed through a smaller incision in a patient's eye, most often for the treatment of cataracts. The ability to use a smaller incision is meant to assist with reduced scarring and quicker healing.

The lubricious nature of these coatings can create a passive type of thromboresistance, as well. The slippery surface on a coated medical device can potentially resist the attachment of proteins in the blood. These proteins can attach themselves to uncoated surfaces. Therefore, the likelihood of thrombus formation on a coated surface of a disposable medical device should be reduced. A benefit of having a thromboresistant coating on a disposable medical device is possibly prolonging the patency of catheter's inner lumen from being occluded by a thrombus. Claims such as this should be verified through independent lab results and the results made available to interested individuals.

Furthermore, hydrophilic coatings can be used as a delivery platform for complex molecules. Due to the matrix formed by the coating and the attachment of water molecules to the coating, complex molecules like therapeutic drugs and antimicrobials can be incorporated in the coating matrix.



### Uncoated catheter versus Hydromer® Hydrophilic coatings on catheters

As you can see, the uncoated tube has a significant amount of thrombosis, and the two tubes that are coated with Hydromer® Hydrophilic coatings reduced the blood adhesion significantly.

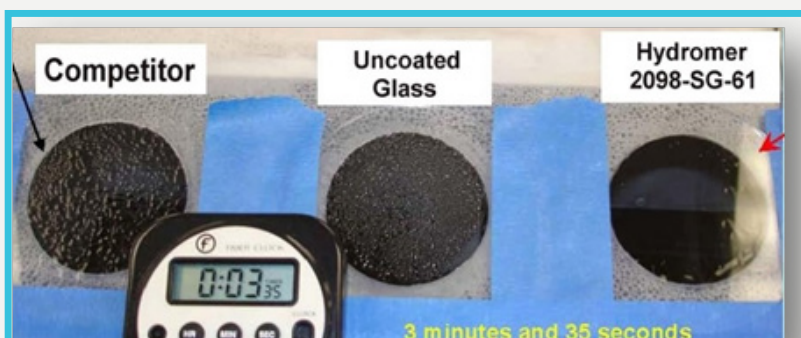


# APPLICATIONS AND USES FOR HYDROPHILIC COATINGS CONT.

## Industrial Applications For Hydromer® Hydrophilic Coatings

Hydrophilic coatings for industrial applications often involve the need for optical clarity or clear vision. An anti-fog (hydrophilic) coating is applied to the surface of a clear substrate (polycarbonate, acrylic, etc.) that is seen through and used in an environment that is often associated with high moisture and/or high temperatures. An uncoated surface in such an environment will attract water vapor to its surface and fog over, thus obscuring the vision of the user. The hydrophilic nature of the coating captures the water and evenly distributes them across the surface of the substrate. By evenly distributing the captured water molecules of the vapor, the fog effect is minimized and creates an optically clear surface. Anti-fog coatings are often used on sports eye protection, workers safety glasses, face shields, military goggles, automobile headlights, aviation windows and many other applications.

Anti-fog has a sibling called anti-frost, employing generally the same concept but used on transparent commercial refrigerator and freezer doors to prevent the buildup of frost on the inside of the door once it is opened and closed.



### Uncoated polycarbonate versus Hydromer Luxere® Anti-fog

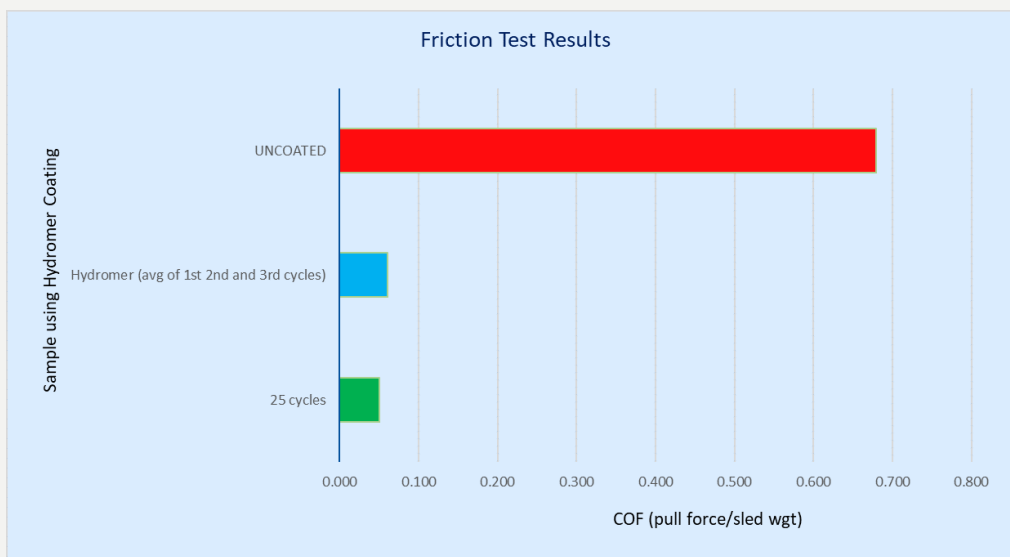
As you can see, our Luxere® Anti-fog and Condensation Control Coating significantly reduced the amount of condensation more so than our competitors, which appears to resemble the uncoated piece.



## Testing and Friction Reduction

Friction testing is a highly sought-after testing method with many medical device manufacturers. Being able to reduce friction of their device in vivo of a patient can vastly change the devices sellability. If you could reach further into a part of the body that was not reachable before, with more ease and less damage, wouldn't you prefer that device instead? Friction testing isn't just for medical, but industrial too. Depending on the intended application of the hydrophilic coating, for example medical, industrial, consumer and other markets there are a multitude of test and evaluation methods employed.

One of these testing methods is referred to friction and durability testing, which is guided using the American Society for Testing and Materials standard (ASTM) D1894. This test method is often used for hydrophilic coatings applied to medical devices such as catheters, guidewires, or devices with a configuration that permits the pads from the friction testing equipment to make contact along the coated surface of the device. This is a comparative test. The test compares the baseline coefficient of friction (COF) of the uncoated substrate, most often in distilled water or a water based saline solution to a coated substrate's COF. The comparison of the two COFs then provides the COF reduction factor over a predetermined force and number of passes on the friction test equipment. The durability portion of friction testing is comparing the COFs of the uncoated surface to the increasing numbers of passes on the coated surface out to 25, 50 and sometimes 100 passes depending on the durability requirement of the coating. Hydromer recently did a test on one of their hydrophilic coatings for medical devices. The test results determined that even after 25 passes through a friction testing machine, the friction with the coated sample held its integrity, and was dramatically lower than that of the uncoated sample.



**In-house Friction Test- Uncoated catheter versus Hydromer®  
Hydrophilic coatings on catheters**

# SO WHY CHOOSE HYDROMER® HYDROPHILIC COATINGS

Hydrophilic coatings have a wide variety of benefits and applications that greatly improve the performance of products across a wide spectrum of industries. Matching the chemistry of hydrophilic coatings to the numerous substrate materials, challenging product geometries, and the environments, these coated products are used in is a complex process that should be guided by those skilled in the field of developing, manufacturing, and applying hydrophilic coatings. Organizations or companies seeking to improve their products performance and portfolio by incorporating the use of hydrophilic coatings should enlist the assistance of experts, like Hydromer.

## About Hydromer® Hydrophilic Coatings

### Hydromer® Hydrophilic Medical Device Coatings

#### Features:

- Thromboresistant
- Antimicrobial
- Low particulate
- Cell-growth Enhancing
- Biocompatible
- Drug-eluting
- Non-leaching
- And many others





## **Hydromer<sup>®</sup> Hydrophilic Industrial Coatings**

### **Luxere<sup>®</sup> Anti-Fog and Condensation Control Coatings**

Hydromer's advanced Luxere<sup>®</sup> anti-fog and condensation control coatings can provide long-lasting, enhanced water sheeting and are optically clear.

### **Brilliantz<sup>®</sup> UV Stable Anti-fog and Condensation Control Coatings**

Hydromer's superior Brilliantz<sup>®</sup> coatings combine top-notch anti-fog and condensation controlling characteristics with UV stability.

### **Glacial<sup>®</sup> Anti-Frost Coatings**

Hydromer's innovative Glacial<sup>®</sup> anti-frost coating helps establish frost-free environments and is suitable for several types of challenging weather conditions.



## Our Mission

Our mission is to empower our customers' products to be ahead of their time and ahead of their competition.



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