Evaluating the Performance of Protective Coatings - Have We Been Considering Only Half the Equation?

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Since the dawn of time, wise business managers the world over have known if you want to truly understand performance, you need to find an objective way to measure it. We know the fastest plane ever built because we can measure the speed of each and compare those performances worldwide.

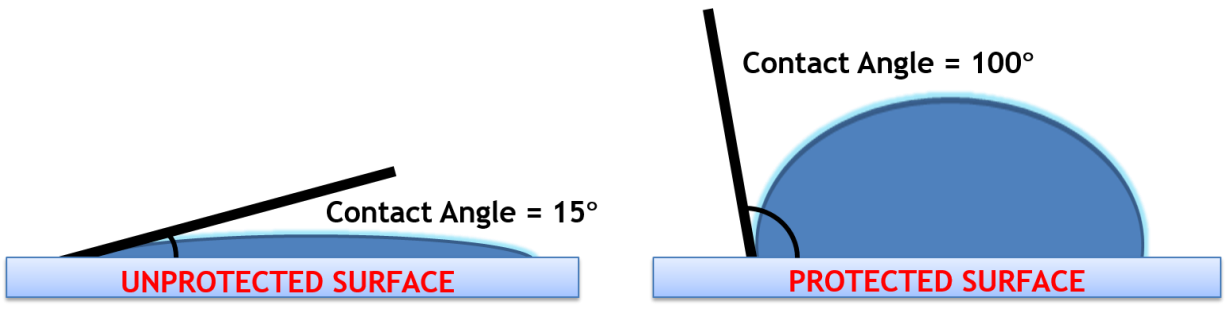
The key to making proper comparisons is ensuring the measurements and testing methods are standardized and a repeatable process. In the early days of flight, to determine a plane's performance we measured the distance it flew. The Wright brothers' first flight was 120 feet. As the technology grew, we started measuring in speed. Chuck Yeager was the first to fly faster than the speed of sound, speeding to Mach 1.06 on October 14, 1947. Later, the industry added new measurements as they became important – altitude and capacity (how many people or how much freight it can carry) became important measurements of performance. It is often the case that as industries grow it is necessary to introduce new measurements to properly evaluate and compare performance.

When you're risking your hard-earned money, or more importantly the reputation of your company, on the products you purchase and resell, ensuring you offer the best product for the dollar is critical to the survival of your business.

Contact Angle – Why It's Important

In the late 1990's, in an emerging field of coatings that made glass harder to stain and easier to clean, a few competitors started using Contact Angle measured in degrees to compare the water repellency of these coatings. This was because one of the main characteristics of these coatings is that they are all water-repellent or hydrophobic. It was believed that the more water-repellent a surface is the more water will bead off and so the minerals and contaminants (such as body oils, soap, etc.) that water carries cannot be deposited on the glass. Unfortunately, we've learned that this is not always true, so while Contact Angle alone may not be sufficient to evaluate a protective coating that also purports to be "Easy-to-Clean", it is a good first step.

For those of you unfamiliar with Contact Angle, it is simply how high a bubble of water stands on a surface.



More specifically, it measures the angle created between the edge of a drop of liquid and the surface of the substrate where the fluid is resting. The more repellent a surface is to that liquid, the higher the Contact Angle. Because of the nature of our business, we most often refer to water-repellency or hydrophobicity but often these coatings also repel other liquids, such as oil or alcohol.

Contact Angles are measured using a tool called a goniometer and is a very standard measurement tool, so it is very good for comparing the water-repellency of different coatings. Simply apply the coating to the surface of a substrate (again, in our industry, that's typically glass), wait for any cure-time the coating may have (most, but not all, do), then measure the Contact Angle. Repeat with competitive coatings and compare the results to evaluate the initial performance.

Of course in our industry we don't need the coating to perform just once, immediately, and then never again. We need it to perform time and time again, for years. So most protective coating manufacturers simulate cleanings and retest the Contact Angle to evaluate the performance over time. Again, the key to making proper comparisons is ensuring the measurements and testing methods are standardized and a repeatable process. Unfortunately, many manufacturers have created tests and run those themselves or asked a lab to do so. These self-created tests are often developed in such a way that they know they will "get a passing grade" and do not compare their coating to any others which would help an evaluator determine which is better. Other manufacturers adhere to industry standard tests created by groups of independent scientists and engineers to objectively evaluate performance.

These standard tests can be conducted anywhere in the world and the results compared exactly because they are standard. By using these standard tests we can be sure that we are comparing the same things in the same ways and so have a true comparison of performance over time. This is why we started using Contact Angle to begin with.

Why Contact Angle May Not Be Enough

As the protective coating market has developed we started to understand that repelling water and the contaminants it carries isn't enough because a coating, no matter how water-repellent, cannot repel everything, and not all the water will bead up and roll off. Depending on the coating, the result can be scores of smaller stains or spots, instead of big, spread-out stains. The good news is that some of these coatings also make the surface slicker and so easier to clean, as well as water repellent. And so those manufacturers who can, have begun to refer to their coating as "Easy-to-Clean".

Unlike "Self-Cleaning Glass" [see inset], adding Easy-to-Clean gave the consumer a better understanding of the value of the coating and the realistic benefit it provides. Unfortunately, if a coating was even marginally easier to clean than untreated glass, its manufacturer could claim it was Easy-to-Clean. This is really a disservice to the consumer, but in a nascent industry like protective coatings, we are yet to have the critical mass to create true industry standards that would set the bar to properly inform buyers which coatings provide a discernable benefit and which do not. Therefore the only option for

manufacturers is to compare their coating against the competition to prove which provides a greater benefit to the consumer. Until now, however, the protective coating industry didn't have a way to measure "Easy-to-Clean". With Contact Angle alone, we now know, we were really only considering half of the equation. As the industry evolves, we need to find a new measurement to judge how easy to clean the surface really is.

"Self-Cleaning" Glass

Unfortunately for the manufacturers of "Self-Cleaning" glass, their Marketing people got carried away and saddled the product with an utterly unattainable set of expectations. Self-Cleaning glass would be clean absolutely all the time with zero cleaning required – ever. No mass produced, affordable technology can delivery that. So while the technology has merit, the marketing created the biggest problem.

As for the coating itself, Self-Cleaning Glass consists of a coating with transient hydrophilic and photocatalytic properties which is fused into the glass at high temperatures during the manufacturing process. Photocatalytic means it reacts to the sun's ultraviolet light to destroy organic matter, then water (rain or induced water spray) is supposed to wash that matter away. Thus, these two elements (UV light and water) must be present for the coating to be effective. Thus the transient nature – if UV light is not present, the coating is neither hydrophilic nor photocatalytic. Due to its inherent characteristics, there are many limitations to this concept of "self-cleaning", such as the following:

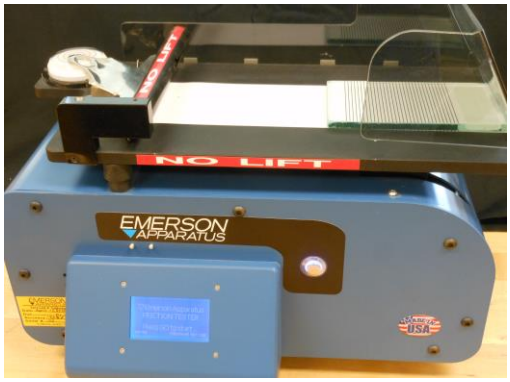
- The glass must receive both sunlight and water
- It is not applicable to all kinds of glass
- It cannot be applied in the field but rather at manufacturing level only
- It's typically a lot more expensive than hydrophobic coatings

The October 2007 Consumer Reports article Windows, contained a call-out box titled "The Great Unwashed?" which presented a test of a self-cleaning glass window versus a regular window, and concluded, "But no matter how hard we looked, neither window was cleaner than the other."

By contrast, most hydrophobic coatings require no "activation".

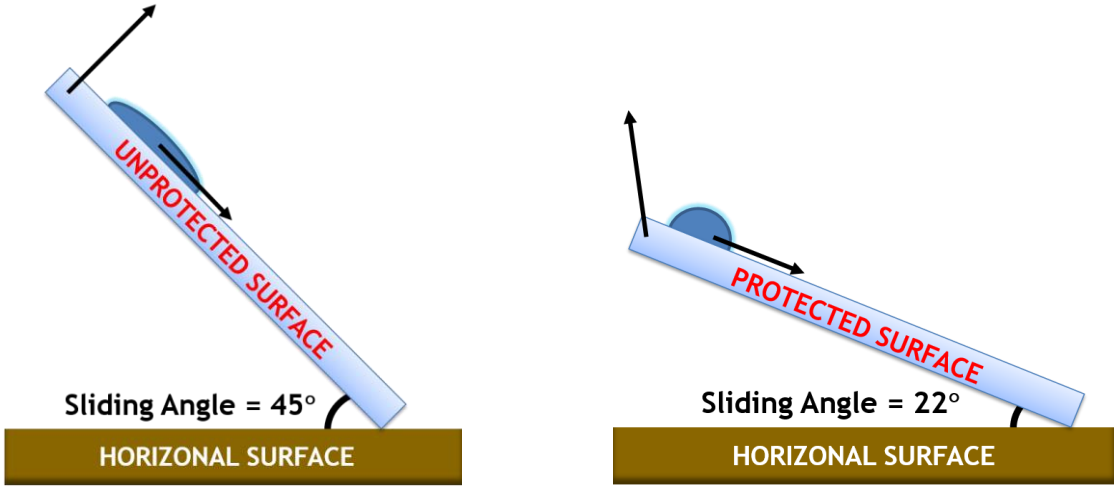
Sliding Angle – The Other Half of the Equation

Enter the Sliding Angle measurement. In its simplest explanation, Sliding Angle measures the "slickness" of a surface – whether coated or not. Sliding Angle is measured using industry standard methods and equipment such as the Sliding Angle Sled pictured below and the ASTM TAPPI T815 om-01 protocol.



A drop of water – the size of which is determined by the standard test - is placed at one end of the sample of coated glass. Then the sample is tilted until the drop of water begins sliding. The tilt of the glass at that very instant is the Sliding Angle. The lower the Sliding Angle the slicker the surface. The slicker the surface, the less things can stick.

As it measures how easy or difficult it is for things to stick to the surface, Sliding Angle therefore can be that credible proxy to measure "Easy-to-Clean" that we've needed. So the lower the Sliding Angle of a surface, the easier it is to clean. Better yet because more water slides off the surface with a lower the Sliding Angle, the less often cleaning will be required. Just as with the Contact Angle measurement, we need to consider performance over time when evaluating Sliding Angle. We need to use industry standard methods to measure how a coating holds up under normal cleaning conditions and compare those against other coatings to determine which provides a greater benefit. By including Sliding Angle in this fashion when describing the performance of their protective coating, manufacturers can now give potential purchasers a more accurate picture of the benefits their coatings provide.



When Considering a Protective Coating, Consider the Whole Equation

At their core, most protective coatings offer a surface that will stain less and be easier to clean when spots do occur. The ability to properly evaluate those core attributes are what this article has contemplated. However, different protective coatings may offer different benefits. Some may promote scratch and impact resistance, others may claim anti-bacterial properties, and on and on. If these are important to you, you should use the same criteria in evaluating those attributes: always look for industry standard testing (ASTM or ISO, for example) from independent labs to prove these claims; ask to see their test results and to what industry standards those tests conform. Only in this way can you be sure you're not looking at a self-made test which of course would be easy to pass.

While both Contact Angle and Sliding Angle individually are informative measurements of the core benefits of “Easy-to-Clean” coatings, each alone is only half of the equation. When considered together they become much more powerful. A higher Contact Angle tells relatively how much less a surface will be stained, because the water that does stick will be repelled and will dry in smaller spots producing smaller stains. A lower Sliding Angle indicates how much less often you’ll need to clean, because the less water that sticks to the surface, the fewer stains will occur. Additionally, a lower Sliding Angle also indicates that any spots that do occur will be relatively easier to remove, because it is more difficult for things to stick. When evaluated together a complete measurement of how *easy to clean* the coating is revealed.

When you’re considering spending your hard-earned money on a protective coating, you want to be sure you’re getting the best your money can buy. This is even more important when you’re not just risking your money, but you’re risking the reputation of your business. Your customers judge you by what you sell. If you sell poor performing products, you will be seen as a poor company. Ensuring you have all the right information in order to make an informed decision is one more way you can ensure your customers see you in the best light and your business thrives. Contact Angle and Sliding Angle will help you do that.