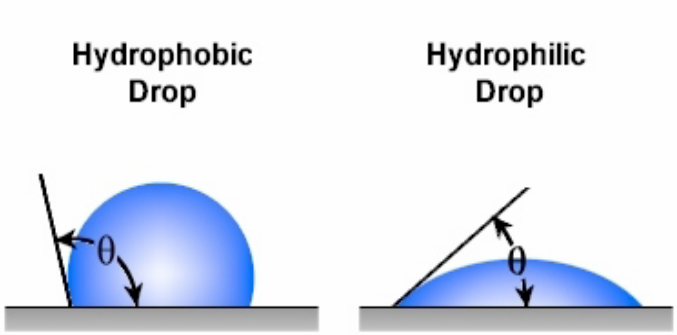
feldtenmarine
Inspired by tradition - Powered by nanotechnology

It's all about droplets...

In the last years many new products were launched in the market, being advertised as "lotus effect", "self-cleaning properties", "super hydrophobic properties" etc. But what is it all about? And do we ever get in touch with these properties in nano technological products we buy today? Basically, the goal is to find a method to review and compare products for surface protection that claim to offer extreme pearl off and easy-to-clean properties (hydrophobic properties). A very simple measuring method to give answer on these questions is contact angle measuring and durability testing under standardized conditions.

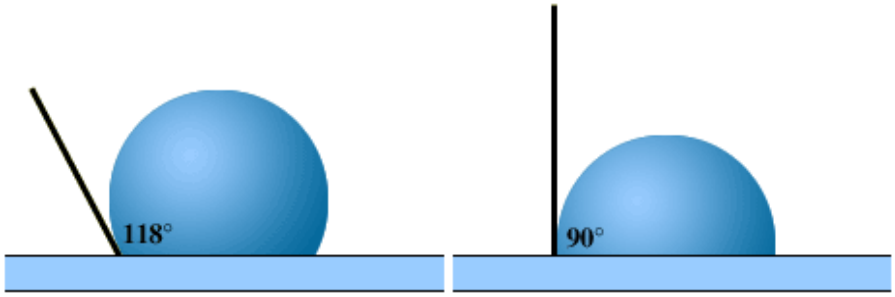
We at Nanogate are using a method where we are simultaneously measuring contact angles and exposing the surface to simulated abrasion. By using this method we are able to create graphs that show how different products perform initially and when exposed to abrasion.

As shown picture 1, we are measuring contact angle α between solid surface and water droplet, and how it develops during abrasion testing.



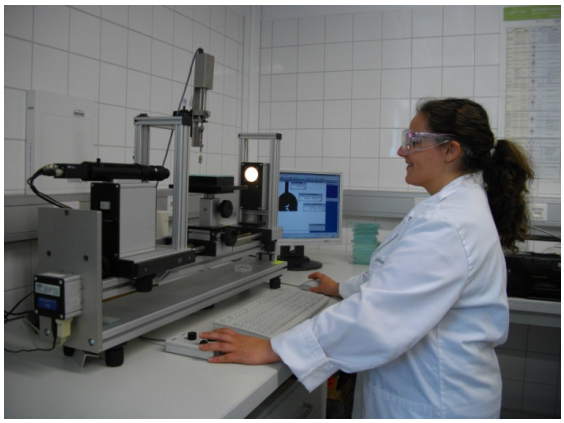
Picture 1: Water droplets on surface with different surface properties

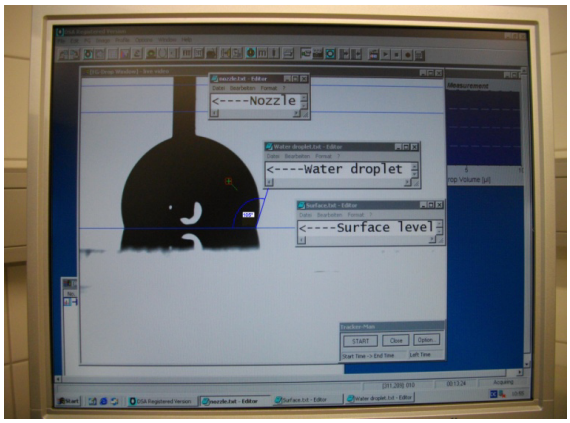
Contact angle is a result of interactions between the surface tension of the water droplet and the energy of the surface. Strong interactions lead to good wetting and low contact angles, poor interactions lead to poor wetting and high contact angles. If contact angle is higher than 90° (left side in picture 1) we are talking about "hydrophobic" properties and opposite, when angles are smaller than 90° (right side in picture 1) we are talking about hydrophilic properties. Basically traditional products based on ordinary waxes form water contact angles of about 90°. Lotus effect starts at a level of about 140° and more. As shown in picture 2, there is quite visible difference between 90° and 118°. In order to achieve higher contact angles we need to use more advanced technologies like Nanogate technology® which is used for Feldten Marine product range in f.exp. Gelcoat Sealer. With contact angles at about 110 – 120° a user of such products will experience pretty extreme droplets "dancing" across surface as "quick silver" droplets. As a consequence, if water droplets have such poor interaction with the hydrophobic surface, they pearl off the surface and remove dirt and soiling pretty well.



Picture 2: Left: Contact angle measuring at 118° Right: Contact angle measuring at 90°

Equipment for measuring contact angles from our laboratories is shown in the following pictures:

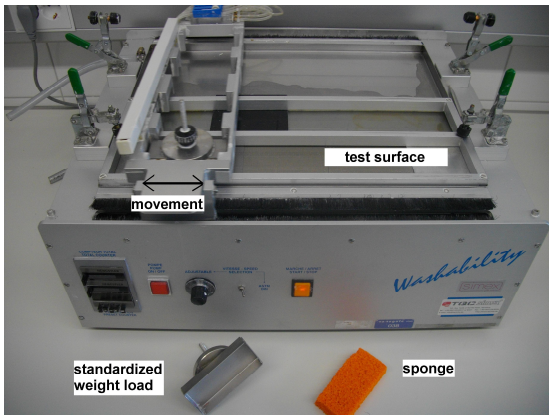


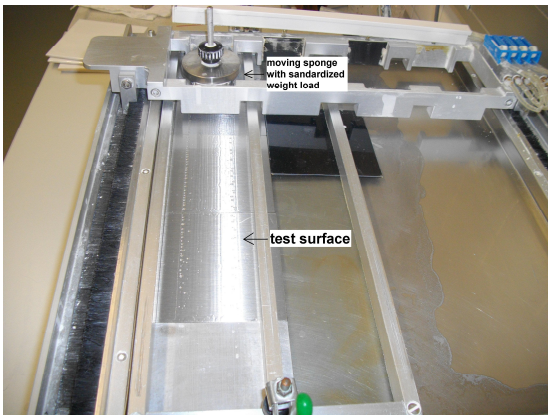


Picture 3 and 4: Contact angle measuring device at Nanogate Laboratories

That is one side of the story, on the other side we need to see how these products perform when exposed to abrasion in order to have a realistic picture during whole product life time.

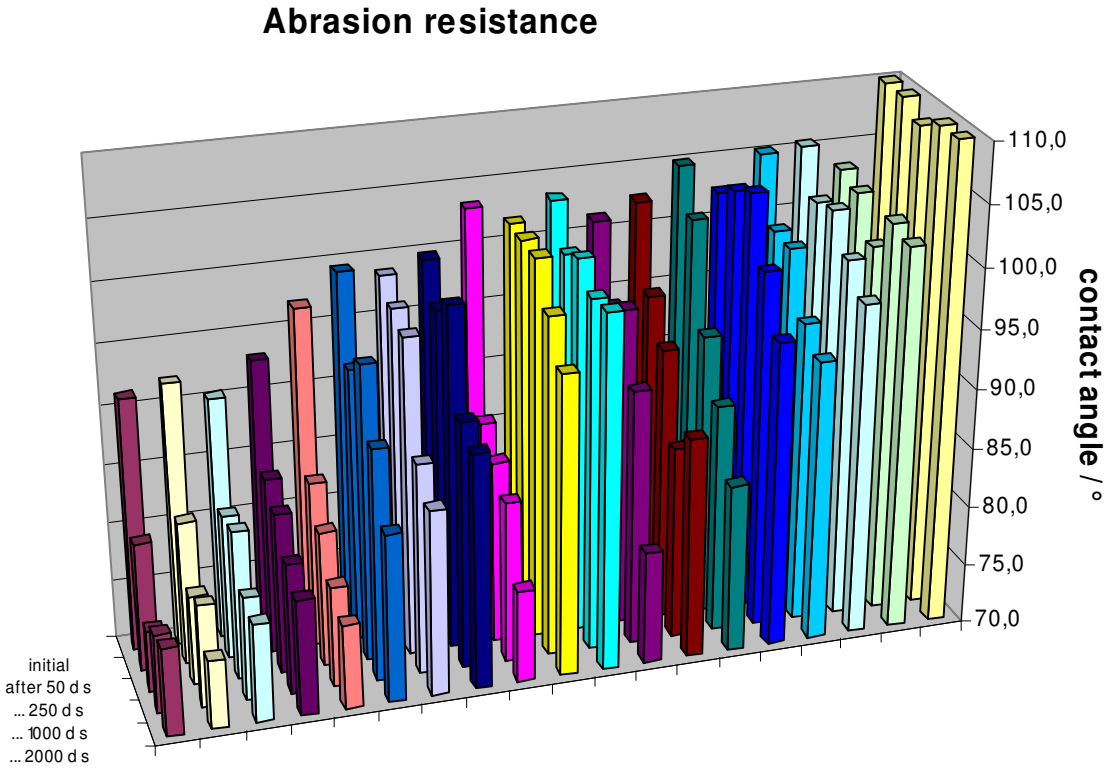
To test durability, we run a simulation in terms of an abrasion tester according to ISO standards. As shown in picture 4 below, it is made of a moving sponge, which is wetted with abrasive cleaning milk and other detergents, and it moves with double strokes across the surface. Depending on choice of detergents, we can simulate different real life conditions.





Picture 5 and 6: Abrasion tester with standardized wetted sponge and weight load

In cases where surfaces are exposed to UV light, as in marine environment, we add this factor to our simulation. The next graph shows how different products perform when exposed to abrasion and simultaneously contact angle measuring.



Picture 7: Test graph showing comparison between contact angles and abrasion cycles.

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Test graph (picture 7) is clearly showing how different products perform when exposed to abrasion over time. On the left you see poor performing products (like the pink one) which have low initial water contact angles of about 90° to 95°. They lose performance during abrasion test rapidly, and they undergo the limit of hydrophobicity during the test. On the right you see high performance products (like the yellow) which show high initial water contact angles of 100° and more, and they remain stable in performance during the test. At present state, it is possible to achieve very high contact angles in laboratory, but it is still a challenge to have these products to perform well when exposed to a real life abrasion. A growth in contact angle from 90°to 120° is a noticeable development with Nanogate Technology® and is something which is noticeable to users of our Feldten Marine product range in terms of both better initial performance and durability.

Based on the graph (picture 4) we can conclude that various materials from various producers are performing quite different when exposed to our standard test methods even though they all claim that the products are based on nano technology, having “lotus effect”, “super hydrophobic properties” etc…. As we said in the beginning, it’s all about droplets!

For more details about the test procedure do not hesitate to contact us.

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