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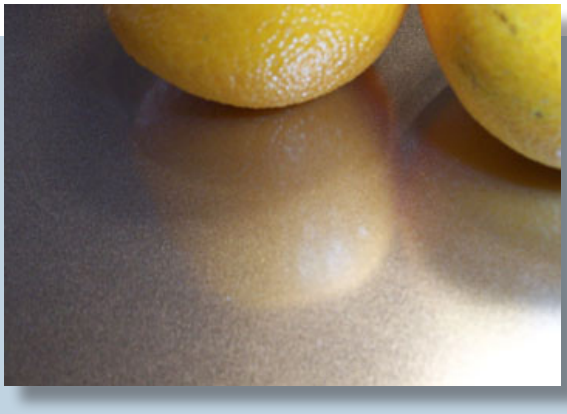
Reduce Costs

Self-Cleaning Stainless Steel Finishes

For applications requiring the maintenance of clean surfaces

There is no doubting the longevity of stainless steel building facades. The Chrysler Building, and numerous buildings that followed, have stood the test of time in providing durable facades that can be readily cleaned to restore their original appearance. Cleaning a stainless steel façade can be done with mild detergent solutions.

The best performance of all comes from the use of hydrophobic stainless steel surfaces that resist the accumulation of dirt, maximizing solar reflectance and minimizing the need to clean the roof or façade. Accumulated surface soil absorbs more solar radiation than it reflects. It is, therefore, important to keep the stainless steel clean in order to maintain maximum solar reflection. The use of a hydrophobic surface will delay, if not eliminate, the need to clean the building's surface.



While applications other than building envelopes do not necessarily require efficient solar energy reflection, there are numerous opportunities for increased efficiency from the use of hydrophobic stainless steel surfaces. Uses in food and chemical processing, heat exchangers, restaurant equipment; simply any case wherein it is desirable to have a surface stay cleaner longer and be more readily cleaned when the time comes to do so, can benefit from a hydrophobic texture.

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A hydrophobic surface, as defined by the angle of incidence of droplets, repels water and has low surface tension, which tends not to attract contaminants and rinses cleanly. A permanent hydrophobic surface is achieved in stainless steel by micro-texturing the surface of a mill-finished coil with a surface pattern that has features smaller than the diameter of a human hair. Rigidized® Metals Corporation produces several such hydrophobic stainless steel finishes, ranging from dull to bright.

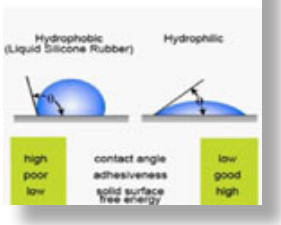
The contact angle between the drop and the surface is proportional to the difference in surface energy (Fig. 1).

If we want to know the energy of a surface, we measure the contact angle of a number of known surface energy liquids on its surface and make a Zisman plot (Fig. 2).

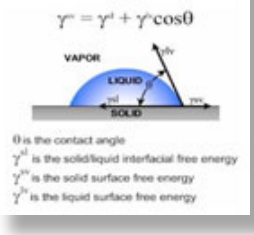
The concept here is that a liquid which spreads on a substrate surface has the same, or lower, surface energy than that surface and it will wet it. If a pollutant or soiling agent has lower surface energy than the surface in question, it will tend to stick to that surface. Non-soiling surfaces are low energy surfaces. In terms of stainless steel, water will bead on a common 2B mill finish at an angle of 50 degrees, which equates to a surface energy of 30 mJ/m^2 (Fig.3).

Common soilants have energy above 30 mJ/m^2, which is why dirt resistant surfaces need to be below that level. Paints have energies above 35 mJ/m^2. Metals do, as well. Glass is 83, about the same as water. While the 2B stainless steel finish is respectable enough at 30 mJ/m^2, the popular #4 finish is much worse at 40 to 50, exemplified by a water droplet angle of 35 degrees (Fig. 4).

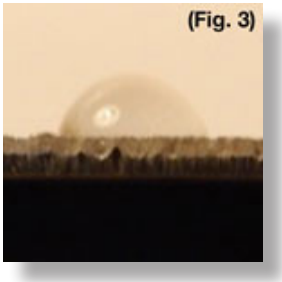
(Fig. 1)



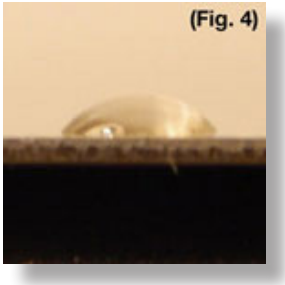
(Fig. 2)



(Fig. 3)



(Fig. 4)



Surface irregularities can help by preventing contact between foreign liquids or solids and the surface. Less contact implies lower contact angle, which implies less adherence. Grosser irregularities such as #4 polish and Linen finish stainless steel provide varying angles to help increase wetting, which is undesirable.

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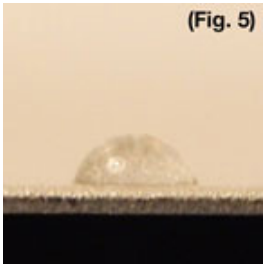
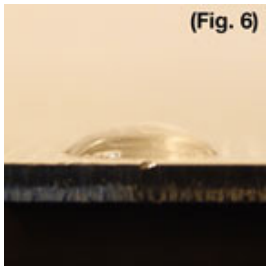
A Cassie Baxter surface is one which is hydrophobic, and thus has a higher contact angle than typical stainless steel surfaces like smooth 2B, #4 or Linen. A water droplet on InvariMatte® stainless steel measures at a contact angle of 60 to 70 degrees (Fig. 5). Note the internal reflection of air trapped at the steel/water interface. This hydrophobic surface consists of a high density of micron-sized indentations covering an otherwise very smooth surface. Since drops and dirt can't reach the bottoms of the indentations, they can't stick. Even soot and smoke, which are large enough to settle, are too large to get in. The diameter of a human hair is twice the size of the indentations on this surface.

In contrast, the popular #4 or Linen stainless steel finish is readily soiled. Its large, visible texture is more easily soiled than even smooth surfaces with a contact angle of 30 degrees (Fig. 6).



Note the white spots in the water droplet in Fig. 5. These are reflections of air pockets in the metal surface - an indication of the Cassie Baxter effect.



Stainless steel is well understood as a durable material that looks good and has hygienic properties. However, it is more than that. It is apparent from our research that it is possible to create self-cleaning surfaces that do not degrade over time. Please contact a Rigidized® Metals Corporation representative to learn more about how we can tailor a solution that minimizes maintenance for your application.