Cromatipic® Test Results

The world is constantly looking for an environmentally friendly and healthy alternative for chrome electroplating. Hauzer has found the solution in Cromatipic®, a combination of lacquer with a thin metal layer; that transforms all kinds of plastics in chrome products. In this article Hauzer discusses the performance of the coating for some requirements set by the automotive industry.

By Chinmay Trivedi,
Senior Process Engineer

Based on Cromatipic® technology we are able to produce coatings which can meet various industrial requirements. Since Cromatipic® is mainly used for plastic substrates, ABS plastic is used for the tests described in this article. The coatings were deposited on rectangular test panels with dimension of 100 x 200 mm as well as on real parts.

Surface Condition

ABS plaques are cleaned with CO_2 cleaning and after that de-ionized to eliminate dust accumulation on parts. The objective for the cleaning process is to clean the surface from dust and remove contamination. The plaques were lacquered with patented bright Clean Green lacquer. Subsequently the process was carried out with an automatic spray gun. The lacquered products were UV-cured with a series of mercury UV-lamps. The aim of the lacquer is to create a uniform leveling effect and a good surface condition of the product such as gloss and hardness, so that on top of it a PVD coating can be deposited. The lacquer also has a buffer function which helps to absorb the difference in thermal expansion between the Cr layer and the plastic substrate.

Activation Process

The activation process is an important process step, essential to achieve the desired adhesion between the lacquer and the chromium layer. These lacquered products were plasma activated before PVD coating. A good activation is primarily dependent on the bombardment of ions. During the activation, with help of ions, the surface bonds are broken and the surface is prepared for good bonding with chromium. The ions have energy which depends on the type of gas or mixture of gases and plasma exposure time together with plasma power. Non-optimized activation condition can lead to poor-activated surface which will result in an unacceptable adhesion with the PVD layer. Typically activation is measured by the surface tension shown by the water contact angle. A good activation will result in less than 10 degrees water contact angle.

Hydrophilic with Free Bonds

Plastic surfaces with UV-curing are hydrophobic. In general a hydrophobic surface has close surface bonds which means a high contact angle, for example in the range of 80 degrees. The surface needs to be activated to deposit chromium which can have better bonding. After plasma activation the cured surface will have free bonds which makes it hydrophilic. As shown in figure 1, after activation the contact angle drops to less than 10 degrees. The Hauzer Metalliner® is an inline machine and has frames with dimensions of 1200 x 1500 mm. For a frame from front to back in moving direction and top to bottom, a good activation uniformity is shown in figure 1. As can be seen in the graph, a very low and uniform water contact angle has been achieved. On top of the activated surface a chromium layer is deposited by sputter technology.

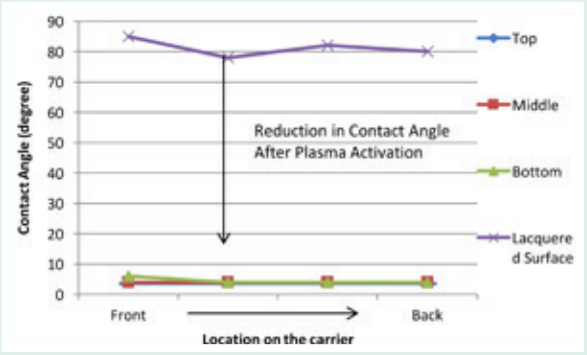

Figure 1 *Uniform water contact angle with different height and width for a carrier front to back*

Optimum Adhesion

One of the requirements for Cromatipic® is to pass a thermal cycle test followed by an adhesion test. This can be tested according to the industrial PV1200 standard. During this test, Cromatipic® parts were kept with controlled humidity and a high temperature of up to 80°C. After keeping these parts for several hours, the temperature was reduced to -40°C. After several hours the parts were brought back to room temperature. This temperature cycle has been repeated eight times; after that the adhesion of the coating has been checked by a tape test. Figure 2 shows visible Cr on tape after removal from poorly activated parts. After optimization and a good activation process, a perfect adhesion can be achieved (figure 3).

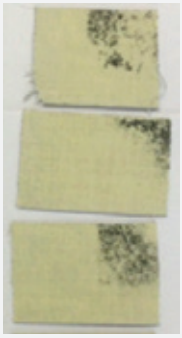

Figure 2 *Cr is visible on tape which means poor adhesion after PV1200 test with non-optimized process condition.*

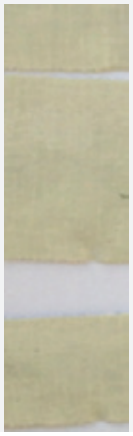

Figure 3 *Cr is not visible on tape which means Optimum adhesion after PV1200 test with optimized activation.*

Similar to the PV1200 test, Cromatipic® samples were also tested for a humidity cycle followed by an adhesion test. Cromatipic® coated products were kept for 72 hour at 90°C and > 96% HR humidity. After this, the adhesion of the coating was tested by a tape test. As shown in figure 4, the results were positive. There was no peel-off between the Cr and the lacquer.

Figure 4 *Optimum adhesion after a humidity test with optimized process condition*

Optimum Corrosion Resistance

Electroplated parts are prone to corrosion after a certain time. Cromatipic® parts are tested to check their performance in corrosive environments. According to the industrial standard a corrosion test was performed. Normally a CASS test would be performed for up to 48 hours and the parts are then observed for corrosion. The Cromatipic® parts were tested for a 144 hours lasting CASS test. There was no change on the surface appearance and no visually discernible corrosion when assessed as can be seen in figure 5.

Figure 5 *Optimum corrosion resistance on Cromatipic® sample after CASS test*

Optimum Mud Resistance

Another long term test is to check the performance with a Russian Mud test. This test is to evaluate coatings in severe environment conditions for certain areas of the world. Calcium chloride solution was placed on a Cromatipic® sample with 18 mm diameter and about 0.15 gram weight. For two weeks the solution was kept on top of the part at 60°C with 23%HR. Figure 6 shows the samples after the Russian Mud Test. The left part is Cromatipic® coated and the right part is electroplated. Clearly corrosion of the NiCu under-layer is observed with electroplated part whereas the lacquer + PVD coating is still largely intact.

Figure 6 *Performance of Cromatipic® (left) and electroplating (right) in Russian Mud Test*

Concluding

Only a few of the many different qualification tests were discussed in this article. The performance of Cromatipic® meets many more automotive test standards and we are happy to discuss your requirements in detail. In the near future we will introduce different finishes with Cromatipic®.