The White Paper

Platinum™ Anilox Technology

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WHITE PAPER
PLATINUM™ ANILOX TECHNOLOGY

Harper Corporation of America has continued to stay on the leading edge of new surface technology for anilox rolls since its pioneering efforts in Flexographic printing with ceramic materials in 1971. In the early evolution of ceramic coatings, one of the biggest hurdles to overcome compared to the traditional chrome plated mechanically engraved anilox rolls was ink release.

This still holds true today.

The nature and texture of “as sprayed” ceramic materials on mechanically engraved rolls reveals high levels of roughness. The peaks and valleys of the roughness increase surface area and surface tension, which decrease the roll’s ability to release ink. This is also true on laser engraved ceramic but to a lesser degree and varies with laser engraving methods. The issues involved not only relate to printing, but also the ease of cleaning the rolls.

Harper entered the laser engraved rolls market in the later 1980’s. During Harper’s introduction of the first 60-degree hexagonal cell shapes, we discovered that in most printing applications, the depth to opening ratio of the cells was a huge contributing factor in efficient ink release, repeatable engravings and efficient cleaning. The effects of depth to opening ratios are not universal and vary with ink systems, plate systems and press components.

As a result, in general truth, depth to opening is a factor that must be understood. Simple physics tell us that a cell will only transfer some of its total volumetric capacity. The deeper the cavity the less the transfer efficiency. To our knowledge, any testing conducted that quantifies the amount of actual cell evacuation shows a release of less than 40 percent, maximum, across the gamut of CO2 engravings. With this knowledge, we want an anilox engraving with the smallest, most shallow cell that meets print quality requirements, offers good wear resistance and cleans easily.

Today the push continues to understand materials and engraving methods and how they interact with ink systems, plate systems, substrates and other press components. The Flexographic industry continues to boom with its ability to compete with both Offset and Gravure on the economic, environmental and print fidelity fronts, and therefore we must continue to understand and control all the variables in the process.

Over the years we have invested heavily in pushing the envelope of anilox surface technology, challenging ourselves to never be satisfied with the present. To enhance ink release and cleaning characteristics we explored many avenues most of which were designed around post laser engraved coating treatments such as polymers and other materials applied by various methods. None were successful, falling prey to wear, chemical cleaners or off-press cleaning systems. We came to the conclusion that due to these and other variables in the press environment, no post coating treatments we were aware of would hold up; therefore, we started looking elsewhere to obtain the attributes we felt would truly benefit industry needs.

In 2001 we began developing a system that would hopefully address some of the release and cleaning issues of anilox rolls without revisiting the negative experiences of post laser coatings. To accomplish this we discovered that we could alter the surface of the anilox roll as opposed to a post coating. The alteration was a combination of laser generation delivery and its interaction/reaction to various ceramic materials.
Thus was born **PLATINUM™**.

In July 2001, twelve customer Beta sites were chosen to test the new surface. Twenty-three rolls were distributed among the sites to conduct testing, running five consecutive months, in several industry segments. The customers were chosen primarily on their value of being a qualified, above average, flexographic printing company along with their ability to measure and quantify results.

Simultaneously extensive metallurgical testing continued, on the “as sprayed” and laser engraved ceramic as we interchanged between several different ceramic chemistries. We also have an in-house printing deck used for various testing, which was utilized to perform wear tests comparing our Echocel™ surface to the Platinum™ surface.

The results presented here are combinations of comprehensive consumer reports, metallurgical lab analyses and in-house testing. It is important to note that the reports from customers vary depending on several factors that we are continuing to explore and understand. Some of them are ink systems, plate systems and substrates or a combination thereof. The majority of the reports were extremely favorable and verified what we felt the new process would achieve. However, a small minority of the reports showed no difference between our Echocel™ and Platinum™ products in regards to ink release and cleanability. This led us to begin to evaluate the different ink, plate and substrate systems being used in the trials.

Based on the feedback from customers, metallurgical and in house testing, the Platinum™ product was launched in January 2002. The process cost thousands of dollars to implement in our facilities and consumable product costs used in the process of thermal plasma spray and laser engraving for the Platinum™ increased significantly.

However, by streamlining our operations, introducing our exclusive new thermal spray processes and increasing efficiencies across all operational segments of our organization, we were pleased to be able to absorb the additional costs associated with the Platinum™ process and pass the savings on to our customers by not increasing the price of the product.
SURFACE CHARACTERISTICS

We used Scanning Electron Microscopy (SEM) to evaluate the surface of the Platinum™ engraving as compared to the Echocel™. Because we wanted to ensure that the lab conducting the tests was blind to the attributes that we were expecting, we simply submitted various samples and asked the Metallurgists who conducted the tests to comment on their findings. The findings were impressive. Platinum™ cell walls were rounder, smoother and more level and cell cavities were smoother. We also found that we improved the structure of the bottom of the cell cavities at higher than normal volumes per given line screen counts. Typically, with CO₂ engravings, abnormally high volumes can result in what we call “pin-holing”, a small diameter hole at the bottom of the cell. If not careful, this pin-holing effect can be calculated in the volume and skew volume readings. Also, with CO₂ engravings at higher than normal volumes we lose the ability to form parabolic cells which in a huge contributor to more efficient ink release and cell cleanliness. The Platinum™ process has helped reduce these effects and give a more symmetrical bottom shape.

![Platinum™ vs Echocel™](image)

Due to these positive attributes, we are now able to offer screen counts at volumes that are up to 50 percent higher than before. Some of these volumes are out of our traditional “depth to opening” sweet spots; however, they now have the release capabilities that were not possible before. This is having a very positive impact on a customer’s ability to print more combination plates at finer rulings in the screen areas while maintaining solid coverage densities.

As an example, a customer recently reported the ability to go to a Platinum™ 360 line screen, 5.0 BCM volume engraving to replace their 250’s at 7.0 BCM. Another customer went from a 280 line screen, 5.8 BCM Echocel™ to a 400 line screen, 4.8 BCM Platinum™ for the same application.

In addition, we used Interferometry (Echotopography™) to measure the levelness of the cell walls in Platinum™ rolls verses Echocel™ directly out of the laser prior to post polishing. After analyzing the data from a selection of engraved line screens, the Platinum™ engravings reduced cell wall height variance by an average of 11 percent. This makes for a better doctor blade or rubber roll metering surface.
PLATINUM SURFACE WEAR

As it turns out, Platinum™ cell walls were only slightly harder (about 60 Vickers) than that of the Echocel™ so we did not expect any real decrease in the wear rate. We do question the validity of the hardness testing due to the thin laser melted ceramic layer and how hardness readings might be influenced by the rest of the coating layering that is not laser treated during the engraving process. However, since the tops of the walls were smoother and rounder we felt maybe we would see a decrease in the break-in period of the roll’s surface.

Wear tests were conducted on a Harris and Bruno print station with an enclosed doctor blade system using Swed-Cut® doctor blades and water as a fluid. The intent was to accelerate the wear process for test purposes. The tests were conducted over 78-hour periods. The anilox rolls were engraved as a 500 line screen, 4.5 volume. In these tests, to decrease the chance of variables, we ran banded rolls engraved with half Echocel™ and half Platinum™ technology. We measured the percent of depth and volume loss as a function of time. In deed, the results show what may be viewed as a small but certainly noteworthy increase in wear resistance on the Platinum™ engraving. The results graphed below are a compilation average of the testing.

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<tr>
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<th>Echocel Depth</th>
<th>Platinum Depth</th>
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<tbody>
<tr>
<td>29hrs</td>
<td>5.22</td>
<td>3.33</td>
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<tr>
<td>53.75hrs</td>
<td>17.32</td>
<td>13.74</td>
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<tr>
<td>78hrs</td>
<td>47.09</td>
<td>45.11</td>
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PRINTED DENSITY

Due to the smoother characteristics of the Platinum™ cells, we felt that ink release should be better than that of the Echocel™. To prove this theory, we used information supplied by some of our Beta testing sites. Based on using the same line screen and volume, reported density increases have ranged from between 2 and 8 percent.

We then called on a local printer to run a banded roll trial utilizing a roll engraved half Platinum™ and half Echocel™ using the identical line screen and volume. The color printed was a 072 Blue. Without using a Spectrophotometer you could visually see a clear difference, which showed the Platinum™ gave a higher density. We used the printed results from the actual press run to prepare samples for the public showing the difference. Here are the specific density numbers and graph of the Platinum™ verses the Echocel™ related to density increases.

TRANSFER EFFICIENCY

Some may view this similar to or in correlation with density variance. However, just to share all of the information we have collected a few of our customers actually measured ink transfer efficiencies by ink film weight differentials. We had these customers provide numbers of the efficiency differences between Platinum™ and Echocel™ for same line screen and volume rolls. The following graph is representative of one of these tests.
DOCTOR BLADE WEAR

During the investigations there have been numerous favorable reports concerning doctor blade wear when using the Platinum™ anilox verses the Echocel™. However, the comments range from customers seeing little to no difference all the way to customers telling us that when using the Platinum™ product, they can reuse blades that typically would have been changed between runs. Bottom line, we have not received any negative results of blade wear what so ever.

We have witnessed many variables with the use of blades such as pressure settings, angles etc., that quantifying the attributes of blade wear has been difficult. So we decided to evaluate the blades used during the controlled wear testing. This seemed to be most appropriate due to the fact that the anilox used were half Platinum™ and half Echocel™, same line screen, volume and using the same doctor blades. After the trials, four blades were examined and in all evaluations, even though the differences may be subjective to some, there was in fact difference in the wear characteristics between the blades.

The Platinum™ sides of the blades were consistently smoother and more level than the Echocel™. They had no noticeable large pieces of material removed from the blade edge, exhibited less material pull out in the contact area, and showed no signs of silver formation. This can be seen in the 400X-magnification photos below. An interesting note is that the Platinum™ side of the blade was always a shade darker under magnification than the Echocel™, which at this point we cannot conclude why. This condition has not caused any negative results in any of the applications and is only visible under high magnification.

CLEANING ATTRIBUTES OF THE PLATINUM™ SURFACE

This was the most subjective area of study during our investigations. There really has not been an adequate way to quantify the results in a meaningful manner. However, approximately 70 percent of the reports from customers using the Platinum™ anilox say that the rolls clean up easier and therefore faster. This was expected, as it is a direct result of the increased cauterization of the cells cavities and walls. We also have numerous reports of the rolls staying cleaner longer during the press run, which is attributed to these surface characteristics. Furthermore the increased cauterization of the Platinum’s surface, which is a decrease of roughness, can be validated immediately when viewing the surface side by side with the Echocel™ and other laser anilox rolls. Since the surface is smoother and more level it reflects more visible light as can be seen in its “Platinum like” color. This aids customers in visually observing the surface for cleanliness. It should be noted that since we are dealing with reflectivity, variations of lighting in the environment will vary the intensity of the reflective properties.
SUMMARY

After all of our testing internally, externally and now in hundreds of daily flexographic operations, it is acknowledged that the Platinum™ surface technology is making a quantifiable positive impact on 80 to 90 percent of those operations utilizing it. In fact in two short months we have gone from 100 percent Echocel™ production to 80 percent Platinum™ and 20 percent Echocel™. We estimate that by July 1, 2002 the Platinum™ surface technology will make up 98 percent of our total product shipments.

We are very proud to have introduced the Platinum™ technology at no additional cost to the Flexo community. This was made possible for many reasons, most of which revolve around our new, exclusive EchoPlasma II™ thermal spray equipment that sprays the anilox ceramic coatings at five times the rate of traditional systems while decreasing porosity and increasing particle to particle cohesion. Other contributing factors are our increasing efficiencies across our entire employee base, plus a continuous drive to help our suppliers increase their efficiencies and thus reduce our raw material costs.

Furthermore, we are not finished. Frankly, we never will be. While other anilox manufacturers have willingly participated in the global economic downturn over the last year or so by cutting services, staff and quality measures, Harper has continued to invest in the future of Flexography. It is so important to the future of our industry to stay strong and committed and not to take any steps backwards by reducing quality and services to try and maintain a healthy bottom line. By doing things such as increasing our technical services, maintaining our ISO 2001 registration and investing heavily in new technologies such as the Platinum™ and EchoPlasma II™, we will continue to lead the industry in products and services. We strive to assist in securing Flexographic printing to one day be the world’s preferred method of printing and other fluid transfer applications. And the only way that can happen is by continuously raising the bar in all areas.

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