Field Experiences with High Corrosion Resistance Trivalent Conversion Coatings

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Abstract

The zinc electroplating market has seen a major policy shift over the past year. Automotive suppliers have issued specifications eliminating hexavalent chromium in conversion coatings for zinc. Trivalent conversion coatings have met this challenge and are now in widespread use. This paper will relate the experience of several platers using this new technology. Techniques to consistently meet the specifications, automate control, and reduce costs will be discussed. The plater will also be given techniques for selling this technology outside the automotive industry.

Trivalents Are Proven Technology

Chrysler, Ford, and GM responded to the European Union's End of Life Directive by rewriting their specifications to eliminate hexavalent chromium in conversion coatings for zinc. (*See Table 1*) Suppliers have responded by improving trivalent chromium conversion coatings to meet these specifications. Products are now being processed with these new conversion coatings.

The corrosion resistance of the trivalent conversion coatings, when tested in accordance with ASTM-B117 is between 125 and 175 hours to white salts. The corrosion resistance can be increased to 250 hours with the appropriate topcoat.

These trivalents are made up at 3 to 8% concentration and operated at room temperature. Air agitation is necessary. The immersion time of the work falls into the 45 – 60 second range.

Many electroplaters have begun to use these conversion coatings in production. These early pioneers have learned what to do and what not to do. Some of this experience is related below.

OEM	***Specification***
GM	**GMW 3044**
Chrysler	**PS 1207**
Ford	**WSS M21-17-B1**
Delphi	**DX 551200**

Table 1

Get Qualified First!

In order to get in the game with the Big Three, your electroplating shop needs to get qualified. One cannot simply start plating automotive parts. Most automotive manufacturers have made it necessary to be certified to apply the latest trivalent conversion coatings. The required corrosion resistance makes the knowledge of the system important. Thus the automotive manufacturers have required the suppliers of approved conversion coating chemistries to certify all the end users of these products.

GM and Delphi have published their certification requirements and electroplaters have begun testing. Chrysler and Ford will soon follow with similar testing methods. The certification process involves a laundry list of required tests. For example, Table 2 lists GM's requirements for non-fasteners.

Test Requirements for Non-Fasteners
Thickness
Corrosion resistance
Adhesion
Dry-to-Touch
Handling resistance
Hex chrome free

Table 2

A specified number of parts must be processed on line and submitted to a certified laboratory for testing. Once the testing is completed, the results are sent to the supplier for submittal to the automotive company for certification.

When the shop has passed all these tests and becomes certified to apply the conversion coating, the testing doesn't end. Some of these tests must be repeated at regular intervals during production to maintain certification.

The ability to plate automotive parts will require a capital outlay before any parts get in the door.

Corrosion Resistance is Paramount

The very first baths put into production were controlled as every other blue bright chromate bath is controlled, by color and appearance. Soon work was not meeting the anticipated salt spray numbers. Investigation led to the conclusion that the baths were not being maintained as required by the suppliers.

Electroplaters and their customers soon realized that corrosion resistance is the primary function of these trivalent conversion coatings. The color of these coatings must be of secondary importance. This principle is contrary to the industry standard of judging a chromate conversion coating on aesthetics. Failures can result if the conversion coating is judged by its color. For example, these coatings will produce a brilliant blue bright in less than the recommended immersion time. If the work is pulled after a 15 second immersion, the corrosion resistance will be less than expected.

Analysis

Adherence to the operating parameters was found to be crucial to obtaining the desired corrosion resistance on a consistent basis. Concentration and pH must be monitored and additions made at regular intervals.

Concentration has been monitored by the color of the solution instead of titrations. A series of standards bracketing the operating concentration are made up. Each time the operator checks the concentration, he just compares the color of the solution to the standards. Additions are made based on this visual determination. Periodically, the titration is used as a double check. Check with your supplier to see if this method of control is applicable to your system.

Electroplaters seem to spend a lot of time trying to find ways around the analysis. Don't try! Baths operated outside the limits defined by the supplier can produce acceptable looking work, but the corrosion resistance will be lacking.

Experience from the field has shown that an electroplater must pay attention to the chemistry of these conversion coatings. Corrosion resistance cannot be seen! Make sure the bath is analyzed on a regular basis. pH probes must be kept clean and standardized. The bath must be dragged for parts on a regular basis. Finally, additions to replenish the solution should be made in small regular intervals.

Bright Dip

Experience has also shown that counterflow rinsing after plating and a 0.25 – 0.5% nitric acid bright dip ahead of the conversion coating results in more consistent corrosion resistance and color. The bright dip is mandatory for alkaline plating baths. If high alkalinity is carried into the chromate solution, the chemistry of the solution goes towards neutralizing the alkalinity instead of producing a conversion coating.

The bright dip must be air agitated and controlled with a pH meter. The pH should generally be maintained in the 1.5 – 1.8 range. On a rack line, keep the solution free of dropped parts.

Rinsing

Good rinsing before and after the conversion coating is also essential. A good counterflow rinse after plating will go a long way towards prolonging the life of the solution. The new conversion coatings are not cheap. One does not want to drag in contaminants which will prematurely end the life of the conversion solution.

The rinses after the conversion coating must be kept absolutely free of hexavalent chromium. Automotive parts are required to be free from hexavalent chromium. Periodic testing is required to prove that the parts are free of hex chrome.

Using a rinse common to other hexavalent containing conversion coatings will result in the trivalent conversion coating picking up hex chrome and failing the resulting testing. Steps must be taken in the shop to eliminate any chance of cross contamination.

Drying

Work which was spun dry or forced air dried above 110°F exhibited better corrosion resistance than parts which were dried at lower temperatures or allowed to air dry.

Dryers will have to be monitored to insure they are producing temperatures consistently in the range to maximize corrosion resistance. Application of a torque tension control coating, a topcoat required for certain fasteners, may also require the rotations per minute of the dryer to be kept within a specified range.

No longer will the spin dryer be a forgotten piece of equipment.

Handling

Handling becomes very important when corrosion resistance is at stake. Trivalent conversion coatings do not have a healing property that hexavalent coatings possess. Parts cannot be scratched because the corrosion resistance can suffer.

Barrel work should ideally be conversion coated offline for maximum corrosion resistance. If parts must be left in the barrel, slow rotational speeds are a must. Rack work should be handled carefully. The plater must dispense with the careless tossing of rack work into a bin. Throughout the shop, employees must realize that the old ways of handling parts will have to change.

Outside the Box

Hexavalent chromium has been tagged as an undesirable substance by all the negative media attention over many years. Many industries will be willing to switch to this new technology as long as it provides a benefit to their customers. The selling of this technology outside of the automotive industry will center on it being a "green" technology. The added expense of these coatings will be minimized by volume. The use of these conversion coatings has already begun to spread outside of the automotive industry. Hardware and appliance suppliers have already begun to test hex chrome free coatings.

Summary

The new high corrosion resistant trivalent chromate conversion coatings are meeting the directive for hexavalent chromium free coatings. However, these new solutions require a higher degree of upkeep than everyday chromate conversion coatings. Color cannot be the property used to control these chromates. Operators must pay close attention to the chemistry and make frequent additions in order to maintain the corrosion resistance. Rinsing, drying, and handling all become more important because, if done wrong or carelessly, they can adversely affect the corrosion resistance of the coating.

High corrosion resistance trivalent conversion coatings are the standard for the automotive industry. This technology is also spreading to other industries. The electroplating job shop needs to be aware of these systems and learn from the experience of others.