



www.hazmat-alternatives.com

A service of Rowan Technology Group

**SUMMARY OF METAL FINISHING SESSION AND
SIDE MEETING**

**PARTNERS IN ENVIRONMENTAL TECHNOLOGY
SYMPOSIUM**

November 28, 29, 2006

Keith Legg

February 15, 2007

Contact information:

Dr. Keith O. Legg

Rowan Technology Group, 1590 South Milwaukee Ave, Suite 205, Libertyville, IL 60048

Tel: 847-680-9420, Fax: 847-680-9682

Email: klegg@rowantechnology.com

1. Introduction

Session 1C and its companion Side Meeting were a follow-on from the Metal Finishing Workshop held in Washington, DC in May 2006, the results of which are available on-line on the SERDP-ESTCP web site¹.

The aim of Session 1C was to make DoD attendees aware of the results of the workshop, and the options used in the commercial world. The purpose of the Side Meeting was to initiate collaboration between DoD and commercial organizations on the best approaches for reducing hazardous materials in DoD weapons systems and sustainment. The Side Meeting was set up to help both industrial and defense participants to learn from and adapt from each other and to begin establishing a framework for future collaboration.

2. Session 1C – Metal Finishing

Agenda

1. **Keynote: Regulatory Trends for Metal Finishing** –Christian Richter, The Policy Group
2. **Surface Finishing Community Response to ESOH Regulations** – Craig Bishop, Atotech USA
3. **Addressing Emerging Environmental Regulatory Requirements on DoD Tactical Ground Vehicles** – John Beatty, Army Research Lab
4. **Replacing Cd and Chromates on Boeing Commercial Airplanes** – Joe Osborne, Boeing
5. **Elimination of Cd and Cr platings and Cr⁶⁺ from DoD Aircraft Systems, New and Legacy** – Sheldon Toepke, Toepke Consulting
6. **Fasteners for Military and Commercial Systems** – Liang Zeng, Alcoa Fastening Systems

The session had 120-150 attendees.

3. Side Meeting

Moderators – Keith Legg (Rowan Technology Group), Christian Richter (The Policy Group).

Response of Ford and General Motors to environmental regulations – Claudia Duranceau (Ford), Doris Hill (GM):

The automakers have adopted a voluntary Global Automotive Declarable Substances List (GADSL)² and track hazardous materials data through an International Material Data System (IMDS). The entire supply chain was involved in this effort and all get the same information. It was suggested that this approach of involving all the user and supplier managements in a single organization to track and replace hazardous substances is an approach that could serve DoD well.

The European End of Life Vehicles (ELV) rules severely restrict Pb, Cd and Cr⁶⁺, as do the European Waste Electrical and Electronic Equipment (WEEE) and Restriction of Hazardous Substances (RoHS) rules.

Forced by the ELV restrictions, cars have not used Cd or Cr⁶⁺ for quite a number of years. Cd has been replaced by ZnNi and ZnCo, while paint systems use Cr³⁺ inhibitors. Automotive fasteners now use Zn- and Al- filled polymers and inorganics. In addition vehicle electronics are now adopting non-Pb solder, which is rapidly replacing leaded solder throughout the electronics industry.

Nickel is a processing issue but not an ELV issue, except the extent that some electroless Ni coatings contain Pb or Cd. There are Scandinavian regulations on skin exposure to Ni.

Introducing products to DoD using a new on-line specs and standards tool – Ed Lipnickas, NAVMAR Applied Sciences:

Ed described a web site that has been set up to permit companies to input their proprietary data for consideration of their products by DoD. The URL is www.dsp.dla.mil. Data submitted can be seen only by a DoD team, not by competitors or OEM users. It is intended to make it possible to introduce and in some cases qualify products for DoD use. Since this data is not available to OEMs or widely available in DoD it does not serve as a data repository for use by OEM or DoD engineers for engineering decisions.

¹ SERDP-ESTCP Metal Finishing Workshop Summary, <http://docs.serdp-estcp.org/viewfile.cfm?Doc=metalsworkshop%2FMFWreportRevisedFinal%2Epdf>

² <http://www.gadsl.org/>

Discussion

General issues:

At the beginning of the discussion the moderator, Keith Legg, suggested concentrating on Cd and Cr⁶⁺ since those are the major concerns for DoD today. Bruce Sartwell, while agreeing with this, pointed out that this did not mean that HVOF had replaced all chrome plate. Detailed engineering test data are now available, and there is a growing body of service experience, but after some years and many millions of dollars HVOF is still only slowly replacing hard chrome. We should expect a similar experience with Cd and Cr⁶⁺.

Although we generally consider the issue of Cr⁶⁺ in hard chrome plating to be purely a processing issue, one attendee reported detecting Cr⁶⁺ in hard chrome plate at the 300-800ppm level. The assumption is that chromic acid was trapped in the microcracks in the plate. Although this is not entirely unexpected, others expressed surprise at such a high number. If such a level is at all common it would be a concern since it is close to the RoHS limit of 0.1wt%. Since the test used the standard ISO method of boiling the coating in water, it was suggested that the very same method could be used to extract the chromic acid if necessary prior to shipping.

The question was brought up of whether Cr⁶⁺ alone was the issue, or whether *any* form of Cr is a concern. For OSHA the issue is Cr⁶⁺. For landfills the issue is also Cr⁶⁺, and although the concern is frequently raised that Cr or Cr³⁺ might be oxidized to Cr⁶⁺ in landfills, there appears to be no evidence that this ever happens. Some user companies take the position that all Cr in the waste stream is toxic, and so do not differentiate between Cr⁶⁺ and Cr³⁺ for the purposes of waste disposal, although they are clearly different from the point of view of employee exposure.

As regulations become tighter it has become increasingly important to be able to measure hazardous materials reliably. This is particularly difficult in organics, where the measurement method can change the oxidation state of the Cr. In addition, of course, there is no approved method to measure Cr⁶⁺ as a weight percent in a conversion coating as required by the RoHS rules.

Industry and DoD experience:

The Navy pointed out that one undertaking that is required is to pull together all the Cr⁶⁺ alternative options for conversion and passivation. While some work has been done on this (e.g. in the May meeting) the list is incomplete.

Since the conversion and sealer layers are so thin, the issue of Cr⁶⁺ in the primer is the most

serious concern as it is far larger by weight, and therefore a far more serious personnel hazard. This view has been voiced by both the Navy and Lockheed.

An OEM voiced the common concern that Cr³⁺ finishes are simply not as good as Cr⁶⁺ and this makes it hard for OEMs to switch. This remains a serious issue for OEMs and depots. It was pointed out that in some cases the problem can be solved by changing the entire finishing system rather than just the conversion coat. For example, AlumiPlate with a non-chrome sealer has been shown to perform better in salt fog testing than traditional Cd + Cr⁶⁺. A full report on this testing will be presented at the HCAT meeting in January.

The issue of color differences between chromate and non-chromate finishes was raised. It was felt that the user expects to see yellow or olive and would not accept other finishes, especially in DoD. An industry supplier said that they had also encountered this perception at first in the commercial area. However, when as users realized that a different color actually allowed them to see immediately that this was not a Cr⁶⁺ finish, the customer base shifted to the opposite view that the color should be different. The bigger issue appears to be that non-Cr⁶⁺ finishes are often clear, making it impossible to tell whether the finish has in fact been applied at all.

One serious concern that was brought up in the May Workshop was that it would become increasingly difficult and expensive (and perhaps finally impossible) to obtain some of the Cd and Cr⁶⁺ finishes that DoD requires once they have been abandoned commercially. A supplier said, however, that these finishes will continue to be available, although, as a processor pointed out, their scarcity is a business opportunity since they will command higher prices.

This did bring up the concern that DoD has especially, that any finish, once specified, must be available for the life of the weapons system, which could be 50 years or more. Many of the new finishes are not well established and their vendors may or may not still be in business in five years, let alone fifty. What this presumably requires is that finishes be defined by chemistry or performance rather than trade name or vendor, a practice that DoD largely uses in any case.

To avoid confusion the finishing industry generally refers to Cr³⁺ coatings as passivation coatings rather than conversion coatings. A list of products was provided by some vendors (see linked documents).

It was pointed out that zinc phosphate conversion plus electrocoat has been found to be a good option for many OEM components, and could

work well on fasteners. This would not be a depot process.

Service experience is now showing that mold can grow in Cr⁶⁺-free primer and paint systems, especially in tropical climates.

Next steps:

Meeting: The NASF and SFIC would love to get together with DoD to exchange detailed information – an idea that was enthusiastically supported by the attendees. It was suggested that a 2-day workshop in or near May would be appropriate, perhaps associated with SFIC Washington Forum run by The Policy Group. (Later discussions concluded that holding the workshop near a depot could be a lot more effective in involving depot engineers and giving industry participants an appreciation of the depot environment.) Such a meeting would concentrate on a specific, well-defined topic with the purpose of identifying specific solutions.

Data: There is a clear need for detailed engineering data to be available to OEM and DoD engineers. At present data is very scattered in various locations and various forms. What is needed at least is a 1-step locator. It was suggested that the HCAT web site, which contains detailed engineering data on chrome and Cd alternatives, could provide links to data held in other locations, including NMFRC and AESF. Keith agreed that this will be done. Keith will e-mail all attendees when these links are available.

Alternatives Team: It was agreed that it would be valuable for HCAT to become a broader organization that would serve the needs of the DoD and supplier metal finishing community.

Associated documents

Session 1C briefings:

<http://www.serdp-estcp.org/Symposium/Technical/>

Side meeting briefings:

[Introducing products to DoD using a new on-line specs and standards tool – Ed Lipnickas](#)

[Substances of Concern \(Ford and GM\) – Claudia Duranceau and Doris Hill](#)

Some Commercial Alternatives:

[Cr⁶⁺ alternatives list – Atotech](#)

[Cr⁶⁺ alternatives list – MacDermid](#)

Attendees:

[List of attendees at Side Meeting](#)

Report of the SERDP-ESTCP Metal Finishing Workshop, May 2006:

<http://docs.serdp-estcp.org/viewfile.cfm?Doc=metalsworkshop%2FMFWreportRevisedFinal%2Epdf>

Some relevant web sites:

[Hard Chrome Alternatives Team \(HCAT\) data](#)

[SERDP/ESTCP information on metal finishing projects](#)

[DoD Corrosion Exchange](#)

[Hazardous Material Alternatives portal](#)

[National Metal Finishing Resource Center \(NMFRC\)](#)

[Joint Group – Pollution Prevention \(JG-PP\) information](#)