UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

April 1, 2003

OFFICE OF WATER

Memorandum

Subject: Regulatory Determination for the PreKote™ Surface Preparation Process

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To: Water Division Directors, Regions 1 - 10

Overview

The United States Air Force (USAF) has requested clarification from EPA on the Metal Finishing effluent guidelines (40 CFR 433) and whether these technology-based limitations and standards apply to a particular metal surface painting preparation operation. The USAF is replacing the chemical Alodine with a chemical marketed as "PreKote"[1] and a liquid epoxy primer in a preparatory operation conducted on aircraft aluminum surfaces prior to painting. The use of Alodine is regulated as a chemical conversion coating process under the Metal Finishing effluent guidelines and is considered a "core" operation.[2] The USAF requests clarification on whether the use of PreKote as a metal surface painting preparation operation is regulated as a core operation by the Metal Finishing effluent guidelines. This document is intended to discuss and clarify EPA's position on the applicability of the Metal Finishing effluent guidelines with respect to the PreKote metal surface painting preparation operation.

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[1]PreKote™ is manufactured by Pantheon Chemical, 225 West Deer Valley Road, Suite 4, Phoenix, Arizona 85027.

[2]There are six "core" metal finishing operations (*i.e.*, Electroplating, Electroless Plating, Anodizing, Coating (chromating, phosphating, and coloring), Chemical Etching and Milling, and Printed Circuit Board Manufacture) and forty "ancillary" process operations listed at 40 CFR part 433.10(a).

Background

In the late 1990s the USAF began investigating alternatives to chromate conversion coatings (commonly called Alodine) used for painting anodized aluminum aircraft skins. Chromate conversion coatings help prepare aluminum for the application of paint and they also provide a corrosion preventative barrier. In aircraft paint systems, chromate conversion coatings are used in conjunction with modern epoxy primers that also contain chromate to guard against corrosion. EPA notes that conventional acid-based conversion coatings chemically react with the metal oxide and form a new material on the surface. The new surface layer becomes part of the metal and cannot be easily removed as measured by military 168-hour salt spray corrosion test on unpainted metal panels (ASTM B117, MIL-C-5541). The primers are topped with a layer of polyurethane paint.

The USAF conducted a series of investigations and field studies to evaluate a number of non-chromate metal surface painting preparation treatments. Recently the USAF authorized the use of PreKote as an alternative to chromate conversion coatings for painting T-1, T-37, T-38, and F-16 aircraft.[3] There are now approximately 16 Air Force bases (AFB) that are allowed the use of PreKote on selected aircraft. At least two USAF bases, Sheppard Air Force (Texas) and Columbus Air Force (Mississippi) are currently replacing the use of Alodine with PreKote. The USAF is expected to expand the use of this alternative surface preparation process for aluminum, magnesium, and composite surfaces in order to minimize the discharge and worker exposure of chromate-containing materials (such as Alodine) and reduce time and effort associated with aircraft painting.

The PreKote formulation is a non-chromic alkali soap with a saline adhesion promoter and inorganic inhibitor package. The PreKote application cleans the surface and deposits a very thin layer of adhesion-promoting organic molecules on the surface of the substrate. This layer is extremely attracted to coatings. In addition, PreKote provides a polar/non-polar molecule that attaches itself to permanently imbedded contamination which also attracts coatings.

The PreKote manufacturer, Pantheon Chemical, recommends that PreKote-treated surfaces be painted within 24 hours of application as the thin layer of adhesion-promoting organic molecules are easily removed. PreKote-treated surfaces cannot pass the previously mentioned military 168-hour salt spray corrosion test and the thin layer of adhesion-promoting organic molecules are easily removed by rinsing with water. Pantheon Chemical also states that PreKote can be used on many non-metallic surfaces including fiberglass and Kevlar surfaces.

Review of Data and Information

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[3]E-mail from Dennis Kirsch, Randolph AFB, to Lee Bohme, EPA Region 6 Pretreatment Coordinator, January 7, 2003.

EPA reviewed a number of sources of information to determine the applicability of the Metal Finishing effluent guidelines with respect to the PreKote metal surface painting preparation operation. These sources are attached to this memo and include:

- PreKote Material Safety Data Sheet (MSDS);
- Pantheon Chemical vendor literature;
- Memorandum from Mr. Lee Bohme, EPA Region 6 Pretreatment Coordinator;
- Technology report on candidate non-chromate conversion coatings from Ogden Air Logistics Center, Science and Engineering; Laboratory;
- Material testing data from Scientific Material International, Inc.;
- Leaching and material testing data from Pantheon Chemical; and
- Wastewater sampling data from Columbus AFB and Sheppard AFB.

The MSDS indicates that PreKote is a water-based, biodegradable, non-toxic, non-hazardous, non-flammable, non-corrosive and stable formulation with a pH range from 10.8 to 11.2. The MSDS also lists the health hazards from exposure to PreKote as slight and the flammability, reactivity, and contact hazards as insignificant. The ingredient N-Methylpyrrolidone (NMP), 3%, CAS No. 872-50-4; is contained in the formulation and is subject to reporting requirements under SARA Title III Section 313 Part 372. All ingredients used are on the TSCA Inventory.

Mr. Lee Bohme, EPA Region 6 Pretreatment Coordinator, observed the PreKote application process at the Sheppard AFB.[4] Mr. Bohme observed that PreKote is applied with a pump-up sprayer (garden type) to the entire exterior of the aircraft. While still wet, the PreKote is scrubbed on the surface with abrasive pads (180 grit scrub pads which are similar to large kitchen or household pads) to evenly distribute the PreKote solution and to "work it into the pores." The entire surface is then washed with water before it dries. This process is repeated two more times per aircraft. At the Sheppard AFB approximately 300 gallons of process wastewater per aircraft is generated from these three washings of the PreKote applications. The Columbus AFB also reports similar process wastewater generation for the T1-A aircraft with 12 gallons of PreKote applied during each application followed by a rinse of 100 gallons of water.[5] Mr. Bohme reported that the PreKote process reduces the required amount of polyurethane paint and generates about half of the amount of wastewater as compared to the wastewater generated by the Alodine system.

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[4]Bohme, Lee, U.S. EPA Region 6. "PreKote," Memorandum to EPA Regional Pretreatment Coordinators, March 19, 2003.

[5]Mundrick, Douglas, U.S. EPA Region 4. Memorandum to Deborah Nagle, U.S. EPA Office of Wastewater Management, February 11, 2003.

Sheppard AFB's painting operations (including application of the strontium chromate primer) are dry. All overspray is captured by air filters and disposed as hazardous waste.[6] Sherwin Williams, a vendor of the strontium chromate primer (MIL-PRF-23377) confirms that there is no chemical reaction between the substrate (aluminum) and the strontium chromate primer.[7] Deft Finishes, Inc., another vendor, concurs, stating that chromates contained in aircraft primers may react with the painted metal surface to inhibit galvanic corrosion resulting from "in service" damage from scratching or abrasion that would allow moisture intrusion, but not during primer application and curing (drying).[8]

A thorough investigation of PreKote is detailed in a USAF technical report from Ogden Air Logistics Center, Science and Engineering Laboratory.[9] This report details a study of four candidate substitutes for chromate conversion coatings (e.g., Alodine). Laboratory testing included Electron Spectroscopy for Chemical Analysis (ESCA) to identify surface changes in the substrate brought on by the non-chromate metal surface painting preparation operations. The study also evaluated the potential for each treatment to eliminate or reduce pollution. Laboratory testing eliminated three of the four products based on unacceptable technical performances. The fourth candidate, PreKote, was tested extensively in the laboratory and in field studies for its technical properties as a substitute for chromate conversion coatings.

The study identified that PreKote technically performed equal or better than chromate conversion coatings and eliminated or reduced a major source of pollution and hazardous waste associated with aircraft painting. The study identified that the PreKote process could eliminate the solvent wipe down, acid brightener, and sand anodizing process used in conventional paint preparation procedures. ESCA testing identified that PreKote left a molecularly thin coating on the surface which promoted adhesion of the primer coating but did not chemically alter the substrate. The PreKote process was identified as an excellent potential to save time and money in painting aircraft. The study recommends expanded use of PreKote to save time and money and improve occupational health and environmental protection.

Laboratory test results from Scientific Material International, Inc., a laboratory independent of the PreKote vendor, and the PreKote vendor, Pantheon Chemical, also confirm

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[6]McBurnett, Mark, Sheppard AFB. Letter to Lee Bohme, U.S. EPA Region 6, March 7, 2003.

[7]Wytiaz, Mark, Sherman Williams Chemical Coatings. Letter to Dennis Kirsch, Randolph AFB, December 3, 2002.

[8]Ray, Charles, Deft Finishes. Letter to Dennis Kirsch, Randolph AFB, December 11, 2002.

[9]Buchi, Richard H., Ken Patterson, Clyde J. Gowers, 1998. "Non-Chromate Conversion Coating," USAF Ogden Air Logistics Center, Science and Engineering; Laboratory.

that the PreKote process does not chemically convert, react with the metal substrate, or leach metals from the substrate. A number of substrates were tested including: clad or bare aluminum; magnesium; bare low alloy steel; cadmium plated steel; titanium; nickel-based alloy; a ferrous alloy; and a stainless steel alloy. These results across a wide variety of substrates identify no leaching of metals from the substrate, intergranular attack or end grain pitting.

In order to better understand the potential pollution prevention aspects of PreKote, EPA also reviewed wastewater sampling data from Columbus AFB and Sheppard AFB (see attachments). These results confirm significant reductions in chromium and other metals regulated by the Metal Finishing effluent guidelines. Concentrations of metals in PreKote process wastewater is either non-detect or significantly below the Metal Finishing new source pretreatment standards (40 CFR 433.17) which are the most stringent standards for this point source category.

EPA Conclusions

EPA finds that the use of PreKote is not one of the six core Metal Finishing effluent guidelines operations (see 40 CFR part 433.10(a)) and use of PreKote does not automatically trigger categorical industrial user (CIU) status under the Metal Finishing effluent guidelines. PreKote is a non-chromating application that does not chemically convert, react with the metal substrate, or leach metals from the substrate. Facilities engaged in metal finishing operations should consult the applicability section of the Metal Finishing effluent guidelines to determine whether other operations trigger CIU status.

Based on the available chemical information, PreKote is a non-chromic, non-hazardous and non-toxic alternative to chromate conversion coatings for metal surface painting preparation operations. PreKote reduces worker exposure to solvents and other toxic chemicals traditionally used in the painting operation. PreKote is a pollution prevention technology as it reduces the generation of metal surface painting preparation wastewater and the amount of pollutants in that wastewater. PreKote may provide facilities a suitable alternative to chromate conversion coatings for metal surface painting preparation operations.

Questions on this memorandum should be directed to Ms. Jan Marie Pickrel, U.S. EPA, Office of Wastewater Management, or Mr. Carey A. Johnston, P.E., U.S. EPA, Office of Science and Technology: (202) 564 7904, and (202) 566 1014, respectively.

Attachments

- PreKote Material Safety Data Sheet (MSDS)
- Pantheon Chemical vendor literature
- Memorandum from Lee Bohme, EPA Region 6 Pretreatment Coordinator, to EPA Regional Pretreatment Coordinators, March 19, 2003.
- Technology report from Ogden Air Logistics Center, Science and Engineering Laboratory, on PreKote, April 3, 1998.
- Wastewater sampling data from Columbus AFB and Sheppard AFB
- Material testing data from Scientific Material International, Inc.
- Leaching and material testing data from Pantheon Chemical
- Memorandum from Lee Bohme, EPA Region 6 Pretreatment Coordinator, to EPA Regional Pretreatment Coordinators, January 14, 2003.
- Memorandum from Douglas F. Mundrick, P.E., EPA Region 4 Water Programs Enforcement Branch, to Deborah Nagle, Office of Wastewater Management, Industrial Branch, February 11, 2003.
- Letter from Charles Ray, Deft Finishes, to Dennis Kirsch, Randolph AFB, December 11, 2002.
- Letter from Mark Wytiaz, Sherman Williams Chemical Coatings, to Dennis Kirsch, Randolph AFB, December 3, 2002.
- E-mail from Dennis Kirsch, Randolph AFB, to Lee Bohme, EPA Region 6 Pretreatment Coordinator, January 7, 2003.

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