HIGH VELOCITY OXY-FUEL (HVOF) THERMAL SPRAY

Revision: 7/94
Process / Product: Velocity Oxy-Fuel (HVOF) Thermal Spray Process
Process Code: ID-06-99
Substitute for: Hard Chrome Plating
Waste Stream: Wastewater from rinsing of chrome plated parts and the washdowns of wet scrubbers used in the ventilation systems contains chromic acid, heavy metals, and sulfuric acid. Air aerosol emissions generated from the heated chrome plating bath that contain chromic and sulfuric acid. Plating sludge (sludge buildup on tank bottom) from periodic maintenance of the chrome plating bath contains heavy metals, including chrome, lead, nickel, and copper.

Applicable EPA Hazardous Waste Code(s): D007, D008

Applicable EPCRA Targeted Constituent: Chromic Acid, Sulfuric Acid, Lead, Chromium, Nickel, and Copper

---

Description: Velocity Oxy-Fuel (HVOF) thermal spray process is a dry process that produces a dense metallic coating whose desired physical properties are equal to or surpass those of hard chrome plating (HCP). These properties include wear resistance, corrosion resistance, low oxide content, low stress, low porosity, and high bonding strength to the base metal.

HVOF thermal spray uses a fuel (i.e., propylene, hydrogen, kerosene)/oxygen mixture in a combustion chamber. This combustion process melts a metal containing powder that is continually fed into a gun using a carrier gas (argon) and propels it at high speeds (3,000 - 4,000 ft/sec) towards the surface of the part to be coated. The high speeds of the spray coating produce a coating that can be used as an alternative to the HCP process. The metal powder is available in many compositions, including nickel, nichrome, inconel, chrome carbide, and tungsten carbide. Uniform coating thicknesses of up to 0.250 inches can be achieved.

The only waste stream produced by HVOF is from the capture of the overspray. Current users either use a water curtain filter system or a dry high efficiency particulate air (HEPA) filter. Since the overspray contains only the pure metal or alloy, it is feasible to recycle or reclaim this waste stream.

The one limitation to HVOF, as with all thermal spraying processes, is that it is a line-of-sight process. This means that you can coat only external surfaces of parts, not the inner diameters. Other limitations of HVOF are a high capital expense, operators must wear personal

protection equipment, and the process must be housed in a closed chamber of sufficient size to process parts that normally undergo HCP.

Materials Compatibility: **N/A**

Safety and Health: When working with fine particulate matter that consists of various compositions of different metals, inhalation is a primary concern. Proper personal protective equipment should be worn.

Consult your local Industrial Health specialist, your local health and safety personnel, and the appropriate MSDS prior to implementing any of these technologies.

Benefits: Estimated cost savings: $70,000.
Payback period: 1.5 years.
Reduction of HW: More than 90 percent of the wastewater that would have been generated from the parts that were transferred from the HCP process. There will be a reduction in toxic air emissions from the reduction in the number of HCP process tanks in use as the work load shifts to the HVOF process. Savings and HW reduction will increase, and payback period will decrease further as additional HCP work load is transferred to HVOF.

The example facility (an air logistic center) facility goal is to transfer up to 35 percent of current work load to HVOF thermal spray, for an estimated annual cost saving of $200,000.

Economic Analysis: The cost for implementing HVOF will depend on many factors, including the quantity of HCP work that can be substituted to HVOF, whether a manual or robotic system is used, the type of capture system used, and the availability of space at the facility to house the HVOF chamber. To better define these costs, an existing DoD facility that has implemented HVOF on their HCP line will be used. Extensive testing and prior command approval would be required for an activity to implement HVOF process.

Major Assumptions:
- Potential percentage of HCP work load substitution with HVOF is 20%.
- Number of HCP tanks: 8.
- Existing space available to house HVOF process: Yes.
- High Efficiency Particulate Air (HEPA) filter system selected for overspray capture system.
- Fuel mixture: Oxygen/Hydrogen.
- Metal powder selected: Tungsten or Chromium Carbide.
- Current disposal treatment for HCP waste stream: IWTP (unless

the facility has a zero discharge rinsewater recycling system installed).
- No additional labor required (current platters are trained in new process).
- Worker training provided by manufacturer of HVOF equipment.

Implementation costs:
- Cost of HVOF system: $100,000 - $120,000 (includes installation).
- Automated enclosed room system, not a robotic system.
- Cost of HEPA filter system: approx. $50,000.
- Disposal Costs for overspray: recovered metals sold to local refiner which results in no additional costs.

Operational costs:
- Dependent on the number of parts and the finished thickness required.
- Materials: fuel, oxygen, metal powders ($40 -$65/lb).
- Labor: no additional labor costs.

Points of Contact:

Michael Viggiano, Code 423
NFESC, Information and Technology Transfer Branch
560 Center Drive
Port Hueneme, CA 93043
(805) 982-4895, DSN: 551-4895

Leonard Hayes
Oklahoma City Air Logistics Center
Tinker Air Force Base, OK 73145-5990
(405) 736-7462, DSN: 336-7462

Vendors:

The following is a list of HVOF equipment manufacturers. This is not meant to be a complete list, as there may be other manufacturers of this type of equipment.

Hobart TAFA
146 Pembroke Road
Concord, NH 03301
(603) 224-9585

PT Coating Systems
Electra-Plasma Inc.
17426 Daimler Street
Irvine, CA 92714
(714) 863-1834

Sulzer Plasma Technik, Inc.
1972 Meijer Drive
P.O. Box 84310
Troy, MI 48084

Approving Authority: Approving authority is controlled locally and is not required by the major claimant.

Note: This recommendation should be implemented only after engineering approval has been granted by cognizant authority.