ADVANTAGES AND DISADVANTAGES OF NEW ELECTROPLATING TECHNOLOGIES: CORPUS CHRISTI ARMY DEPOT

Jim Holiday
PURPOSE OF BRIEFING

Identify the HAZMIN equipment and new processes being investigated at the Corpus Christi Army Depot and provide our findings.
PURPOSE OF PLATING

- CORROSION PROTECTION
- WEAR RESISTANCE
- METAL BUILDUP

WASTE DISPOSAL REGULATIONS
AIR REGULATIONS

REGULATIONS:

CAA - Clean Air Act (1990)
CAAA - Clean Air Act Amendments (1990)

PURPOSE: The CAA controls all discharges into the air. The CAAA establishes production ceilings on air polluting chemicals.

IMPACT: Vapor Degreasing
Fume Scrubber Emissions
WASTE DISPOSAL REGULATIONS

WATER REGULATIONS

REGULATIONS:

**CWA** - Clean Water Act (1977)

**NPDES** - National Pollution Discharge Elimination System

PURPOSE: To regulate discharges of wastewater into the waters of the United States.

IMPACT: Wastewater Treatment Plant
Establishes Discharge Requirements

WASTE DISPOSAL REGULATIONS

LAND REGULATIONS

REGULATIONS:

**RCRA** - Resource Conservation & Recovery Act (1976)


PURPOSE: RCRA established guidelines and standards for hazardous waste generation, transportation, treatment, storage, and disposal.

HSWA amends RCRA to include regulations on waste minimization, land disposal of HW, and underground storage tanks.

REFERENCE: Commanders Guide to Environmental Mgt
WASTE DISPOSAL REGULATIONS
LAND REGULATIONS - cont.

IMPACT: IWPP Waste Disposal
Process Solution Disposal
Established HAZMIN Program
Requires BACT Technology
Applicable to Air, Water, and Land

THE IVADIZER
**IVADIZER ECONOMIC DATA**

- **EQUIPMENT COST:** $900,000 (installed)
- **OPERATING COST:** $154,000 per year
- **ANNUAL COST SAVINGS:** $1,094,000 per year
- **PAYBACK:** 0.91 years

**IVADIZER HAZMIN DATA**

- **WASTE STREAM REDUCED:** cadmium sludge and calcium carbonate crystals
- **QUANTITY REDUCED:** 6938 lbs Cd sludge 194 gal CaCO3 crystals
- **COST SAVINGS OF WASTE DISPOSAL:** $77,200
IVADIZER
ADVANTAGES

✓ IMPROVED CORROSION RESISTANCE
✓ EMPLOYEE SAFETY
✓ POLLUTION FREE PROCESS
✓ NO HYDROGEN EMBRITTLEMENT
✓ 925 DEGREE SERVICE TEMPERATURE
✓ NO EFFECT ON FATIGUE LIFE

IVADIZER
DISADVANTAGES

- DRY TORQUE PROBLEMS
- COATING INTERNAL DIAMETERS
- HIGH CAPITAL COST
- PROCESS ACCEPTANCE PROBLEMS AT THE COMMODITY COMMANDS
CHROME RECOVERY - RINSEWATER

CHROME RECOVERY - RINSEWATER ECONOMIC DATA

EQUIPMENT COST: $95,000 (installed)

OPERATING COST: $9,000 per year

ANNUAL COST SAVINGS: $35,700 per year

PAYBACK: 3.1 years
CHROME RECOVERY - RINSEWATER
HAZMIN DATA

WASTE STREAM REDUCED: chrome sludge and water

QUANTITY REDUCED: 19,200 lbs Cr sludge
1,728,000 gal water

COST SAVINGS OF WASTE DISPOSAL: $42,000

CHROME RECOVERY - RINSEWATER
ADVANTAGES

✓ RECLAMATION OF RINSEWATER
✓ RECLAMATION OF CHROME
✓ BETTER RINSING - DI WATER
✓ APPROACHES "ZERO WASTE" GENERATION
CHROME RECOVERY - RINSEWATER DISADVANTAGES

- CONSUMES VALUABLE SPACE IN THE SHOP

- GENERATES A METAL HYDROXIDE SLUDGE WHICH CONTAINS CHROME

- HIGH CAPITAL COST
THE IONSEP PROCESS

CONVERSION OF SALTS

ECONOMIC DATA

EQUIPMENT COST: < $30,000 (installed)

OPERATING COST: $6,000 per year

ANNUAL COST SAVINGS: To be determined

PAYBACK: To be determined
CHROMIC ACID PURIFICATION
HAZMIN DATA

WASTE STREAM REDUCED: chromic acid plating solution

QUANTITY REDUCED: 200 gal Chromic acid

COST SAVINGS OF WASTE DISPOSAL: $1,100

CHROMIC ACID PURIFICATION
ADVANTAGES

✓ CONVERTS TRIVALENT CHROME TO HEXAVALENT CHROME
✓ RECLAMATION OF CHROME
✓ BETTER PLATING QUALITY
✓ REDUCES REWORK
✓ REDUCES PITTING AND "TREES"
✓ REMOVES METAL IMPURITIES: Ni, Pb, Fe, Cu, etc.
CHROMIC ACID PURIFICATION
DISADVANTAGES

- OCCUPIES SPACE IN THE TANK
  (8 INCHES SQUARE)

- OCCUPIES SPACE IN THE SHOP

- GENERATES HEAT IN THE TANK

- REQUIRES EMPLOYEE MONITORING

IN-TANK FILTRATION
(Flowking Filtration System)

PURPOSE: Filter plating solutions to remove particulate contaminants and eliminate chemical spills due to equipment malfunction.

EQUIPMENT COST: < 1,000 - AIF Funding

STATUS: Filter systems installed on 12+ process tanks
Purchasing additional filter systems

ADVANTAGES: No Chemical Spills
Reusable Filter Media
Increased Circulation
Ability to Treat Solution
Improved Solution Agitation
SOLUTION RECLAMATION
CADMIUM STRIP SOLUTION

PURPOSE: Develop a procedure to remove cadmium and other metals from the cadmium strip solution, eliminating the requirement for disposal.

STATUS: A Chemical Technician is testing a procedure obtained from the Boeing Aircraft Company which will precipitate the cadmium from the strip solution. Prototyping is complete. Preparing to implement.

BENEFITS: Minimize Hazardous Waste Generation
Cadmium sludge may be recycleable
Reduce Landfill Liability

REPLACEMENT PROCESS
CADMIUM PLATING

PURPOSE: Locate, perform R&D testing, and implement a substitute for cadmium plating which is less hazardous to the Environment.

STATUS: Two Chemists are working with Boeing Aircraft Company in Seattle, Washington to test a Zinc-Nickel coating. This process is being used on landing gear struts for the 767 aircraft. Hydrogen embrittlement relief for this coating is also being studied.

BENEFITS: Elimination of a toxic chemical (cadmium)
Employee Safety
Reduced Landfill Liability
Better Corrosion Protection
REPLACEMENT PROCESS
HARD CHROME PLATING

PURPOSE: Locate, perform R&D testing, and implement a substitute for hard chrome plating which is less hazardous to the Environment.

STATUS: Two Chemists are working with Boeing Aircraft Company in Seattle, Washington to test a Nickel-Tungsten-Silicon/Carbide coating. Plating parameters and QA test procedures are being developed.

BENEFITS: No Hazardous Waste Generation
Employee Safety
Heat Treatable

REPLACEMENT PROCESS
ALUMINUM CONVERSION COATING

PURPOSE: Locate an alternative process for aluminum conversion coatings or "Alodine".

STATUS: We have investigated four processes. To date, no substitute for "Alodine" has been located. Investigating "Alodine" purification equipment.

COATINGS INVESTIGATED: SANCHEM PROCESS
BOEING AEROSPACE PROCESS
MICHIGAN CHROME & CHEMICAL PROCESS
NAVY PROCESS - onboard ships

DESCOM CTX ASSIGNMENT
PROBLEMS TO OVERCOME

EQUIPMENT

- Verification of Equipment Capabilities
- Manpower to Develop Purchase Packages
- Available Space Requirements
- Funding for Projects

PROBLEMS TO OVERCOME

PROCESSES

- Manpower to Investigate New Processes
- Approval of Substitute Processes by the Commodity Commands and Army R&D Community
CONCLUSIONS

EQUIPMENT

✓ The lvadizer will decrease cadmium plating requirements.

✓ Chrome recovery equipment will be operational at CCAD by March 1992. It is economical, if it works.

✓ Chromic acid solutions can be reclaimed using the electrodialysis process.

✓ In-tank filtration WORKS!

CONCLUSIONS

PROCESSES

✓ The cadmium strip solution can be recycled.

✓ Hard chrome plating may be a dinosaur.

✓ Cadmium plating will be eliminated in the near future. Zinc-Nickel may be its replacement.

✓ Aluminum conversion coating solutions can be recycled.
NONCHROMIUM RINSE IN THE PHOSPHATING PROCESSES:
CHAMBERLAIN MANUFACTURING
SCRANTON ARMY AMMUNITION PLANT

Colin MacCrindle

Before 1991, all zinc phosphating systems used a chromic acid final rinse as part of the process. In 1988, Chamberlain Manufacturing, through the Scranton Army Ammunition Plant (SAAP), requested that work be initiated to find a substitute for chromic acid in the zinc phosphating process.

Under the Army Materiel Command (AMC) Manufacturing Technology (MAN-TECH) thrust titled, "Environmentally Acceptable Materials, Treatments and Processes" (EAMTP), SAAP was chosen to conduct a production test of the new technology in conjunction with the U.S. Army Research, Development, and Engineering Center (ARDEC).

The test at SAAP used the M107, 155mm projectile as the test vehicle. Before testing was to begin, the phosphating system (equipment) was modified to add fresh water sprays between the fourth and fifth tanks to rinse off residual acidic zinc phosphate from tank four. Also, a thorough neutralizing of the hexavalent chromium and complete rinsing of tank five was mandatory. If the hexavalent chromium is not neutralized, it will "kill" or negate the nonchromium rinse and make it ineffective. After tests using various paint systems and both chromium and nonchromium rinses were concluded, salt fog corrosion tests were performed. SAAP initially tested a group of parts for 96 hours and ARDEC tested parts for 500 hours.

The testing procedure dictated that 60 parts were used with the following mix of finishes:

- Coat 10 parts with zinc phosphate and use chromium rinse
  Paint with Mil-E-52891 (olive drab)
  Identified 1-10
  Salt spray tests: excellent

- Coat 10 parts with zinc phosphate and use the nonchromium rinse
  Paint with Mil-E-52891 (olive drab)
  Identified 11-20
  Salt spray tests: marginal to fail

- Coat 10 parts with zinc phosphate and rinse with chromium rinse
  Paint with DOD-P-15328 (wash primer)
  Paint with Mil-E-52891 (olive drab)
  Identified 21-30
  Salt spray tests: excellent

- Coat 10 parts with zinc phosphate and rinse with nonchromium rinse
  Paint with DOD-P-15328 (wash primer)
  Paint with Mil-E-52891 (olive drab)
  Identified 31-40
  Salt spray tests: excellent

- Coat 10 parts with zinc phosphate and rinse with chromium rinse
  Paint with Mil-P-53200 (epoxy)
  Paint with Mil-E-52891 (olive drab)
  Identified 41-50
  Salt spray tests: excellent

- Coat 10 parts with zinc phosphate and rinse with nonchromium rinse
  Paint with Mil-P-53200 (epoxy)
  Paint with Mil-E-52891 (olive drab)
  Identified 51-60
  Salt spray tests: excellent.

**Conclusion**

Salt spray tests were evaluated by ARDEC. The results indicated that the nonchromium rinse by Oakite Chemical produced comparable results to the chromium rinse.

Formal approval has been given to Chamberlain Manufacturing at SAAP to fully implement the nonchromium rinse in all projectile systems. Target date for installing the fresh water sprays and implementation of the nonchromium rinse is calendar year end 1991.