THE MASSACHUSETTS TOXICS USE REDUCTION INSTITUTE

SURFACE CLEANING LABORATORY

CASE STUDY #2

Wyman-Gordon Company, Inc.

North Grafton, MA

Summary

Aqueous ultrasonic cleaning of ionizing aluminum exhaust scrubber plates was,successfully implemented at the Wyman-Gordon Company replacing a potassium hydroxide and glycol ether soaking operation. An in-depth investigation at the Surface Cleaning Laboratory of the Toxics Use Reduction Institute was conducted to assess the proper chemistries for removing airborne contaminants from the aluminum plates.

Background

Wyman-Gordon operates facilities in Worcester and North Grafton Massachusetts and employs approximately 800 people. The company performs metal-working of ferrous and nonferrous alloys producing high strength alloy forgings for the aerospace and other industries.

Forgings are made by mechanically formirig hot metal with open or closed die presses. During the process, fumes and particulate matter become airborne. Wyman-Gordon utilizes an electrostatic precipitator (ESP) equipped with aluminum ionizers and cells to entrap the contaminants.

The ESP components require routine cleaning. The ESP plates, composed of >98% 3003 aluminum, 1.5% manganese and 0.05-0.20% copper become heavily soiled with a combination of lubricants, carbon black and other exhaust materials resulting in a tar-like, gummy substance on the plates'exterior.. Cleaning was previously accomplished by mechanical agitation in a solution of glycol ether

Substrate: aluminum and potassium hydroxide followed by a water rinse Soil: lubricants, carbon black until passing an electroconductivity test. Although Aqueous chemistry: alkaline, low foam, effective, this method is potentially hazardous to silicates, phosphates, no glycol ethers workers and the caustic cleaning solution etches the Aqueous process: ultrasonic wash, rinse, dry aluminum substrate, hastening plate replacement. In he cont 'nated glycol ether/potassium addition, t ami hydroxide solution poses a hazardous disposal problem.

Toxics Use Reduction Planning Goals for Wyman-Gordon's toxics Rise reduction plan include (1) eliminating glycol ether and potassium hydroxide from the cleaning process, (2) installing an environmentally safer cleaning system, (3) increasing operator safety by minimizing exposure to any cleaning chemistry and (4) reducing waste disposal requirements and associated costs.

Wyman-Gordon's,corporate decision was to focus on an aqueous cleaning alternative which did not contain solvents. TURI's Surface Cleaning Laboratory (SCL) was solicited to examine several aqueous cleaner chemistries under various experimental conditions.. Specifically, the company aimed to ultrasonically clean the scrubber plates within one minute at approximately 1600 F and requested assistance with:

- validating various chemical cleaners' effectiveness on the contaminants
- verifying ultrasonic cleaning performance
- evaluating other methods of mechanical agitation for cleaning
- investigating the feasibility of manually scraping the scrubber plates prior to ultrasonic aqueous cleaning
- sourcing possible vendors

Testing in the Surface Cleaning Laboratory

Contaminated plate samples were obtained from Wyman-Gordon. The forging soil deposit ranged from 1/8-1/2" thick. The panels chosen for testing had aged soils that would be most difficult to remove. The plates were cut into 3" x 6" or 2"

x 12" coupons to accommodate the laboratory equipment.

Chemistries were chosen on the basis of pH, substrate compatibility, manufacturers' recommendations, known industrial applications, previous Laboratory testing and client interest. The aqueous cleaners selected by Wyman-Gordon for testing were Spray Clean 400-T by S&SIndustrial; Services, Inc., SeaWash Neutral by Warren Chemical Company, and Okemclean and Okemclean with 2.5% LADD additive (contains glycol ether) by OaUte Products, Inc. Additional cleaners selected by the Laboratory were Daraclean No s. 232, 282 and 282 GF by W. R. Grace & Company and Brulin 815 GD'by Brulin, Corporation.

Due to the stubborn nature of the contaminant, a 25 KHz fixed-frequency ultrasonic unit supplied by a 600 watt generator was used instead of the typical 40 KHz unit. The lower frequency generates more intense agitation. For most trials, plates were periodically lifted and lowered in a vertical dip motion to increase mechanical action. Cleaning bath temperatures ranged from 1540-1900 F with cycles extending from 20 seconds to 20 minutes. Cleaner concentrations ranged from 10%-20% by volume in deionized water.

In subsequent trials, plates were scraped before ultrasonic cleaning to reduce the soils' thickness, although surfaces remained entirely covered with contaminants. Tap-water rinsing (60 seconds at 1650 +/- 50 F) and air-knife drying (to completion at ambient temperature) were briefly examined.

Results

Three of the original eight cleaners, used in conjunction with 25 KHz ultrasonic equipment, proved successful in removing the forging soils from the aluminum collector plates. They were W. R. Grace Daraclean 232 (1640 F), Brulin Corporation 815 GD (1600 F) and Oakite Products Okemclean (1800- 1900 F) at volumetric concentrations of 10% for periods of 29, 27 and 60 seconds,

respectively. None of these formulations contain glycol ether or potassium hydroxide.

In all cases, manual scraping, along with the mechanical movement of plates in the ultrasonic bath, enhanced aqueous cleaning efficiency. Effective cleaning was achieved without manual scraping when the ultrasonic cycle was lengthened to 9.5 minutes for Daraclean 232 and to 12 minutes for Brulin 815 GD. Both products cleaned optimally at lower temperatures, presenting an opportunity to decrease energy consumption. No loss in aluminum substrate material was observed.

Patterned after the protocol of scrape/ultrasonic clean/rinse, Wyman-Gordon installed an aqueous ultrasonic cleaning system employing an Oakite specialty chemical (containing no glycol ethers).

The Toxics Use Reduction Institute is a multi-disciplinary research, education, and policy center established by the Massachusetts Toxics Use Reduction Act of 1989. The Institute sponsors and conducts research, organizes education. and training programs, and provides technical support to promote reduction in the use of toxic chemicals or the generation of toxic chemical byproduct in industry and commerce.