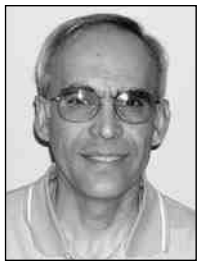
Stephen F. Rudy, CEF
Hubbard-Hall Inc.
563 South Leonard Street
Waterbury, CT 06708
E-mail: sfrudy@optonline.net



Replacing Chlorinated Solvents with Aqueous Based Cleaning Processes

Chlorinated solvents have enjoyed decades of popularity as quick, effective and efficient means of cleaning parts as a first critical step in many metal finishing processes. Specific applications include: cleaning and degreasing, printed circuit boards, carbon removal, intricate and sophisticated parts cleaning, and as drying agents. Popular among these solvents are: trichloroethylene, 1,1,1-trichloroethane, perchloroethylene and methylene chloride. In fact these agents are still in use for their intended purposes, affording reliable sources for cleaning parts in a wide array of industrial manufacturing and finishing applications. Let us then review why these chlorinated solvents became targeted for replacement and the strict requirements for their handling and use in today's work environment.

Over thirty years ago, applied research detected a steady decline in the upper atmospheric ozone layer. This layer, protecting the earth's surface from harmful ultraviolet radiation, would steadily lose its shielding ability. This would expose us detrimentally to potential health problems when exposed to prolonged sunlight. Ongoing scientific work and study confirmed that particular solvents, containing chlorinated and fluorinated compounds, were highly suspect. Evaporation and release of these compounds into the stratosphere, resulted in their chemically attacking the ozone layer. This continued chemical attack led to a gradual, alarming degradation of the ozone layer.

Two classes of these compounds were identified: chlorinated fluorocarbons (CFC) and chlorinated hydrocarbons (CHC). Two major sources of CFCs were in heavy use - aerosol propellants and refrigeration gases. CHCs in demanding applications included dry cleaning of clothing, separation of materials and solvency to prepare various consumer and commercial products, hard surface and precision cleaning, and in food preparation.

Overall depletion of the earth ozone layer became alarmingly critical to several organizations. These included educational interests, environmentalists, industries, governments and many other concerned groups. The common theme to action was to be a good steward of our world, thereby ensuring the safety of future generations. Some of the key actions developed throughout the years are probably familiar to many of us. These include:

- 1990 Montreal Accord
- U.S. Clean Air Act Amendments
- U.S. Clean Water Act
- VOC and HAP regulations
- Hazard communications
- RCRA
- CERCLA
- Superfund
- Strict regulations
- Compliance mandates

Actions and triggers, such as those described, led to additional studies on the health and safety associated with chlorinated solvents. Toxicological data were quantitatively determined. Potential acute health effects were established. Of these, perhaps, the most critical was OSHA's classification of some of these chlorinated solvents as carcinogenic. Actual exposure limits (in ppm and mg/m^3) were also determined, as strict requirements in the affected workplace. This resulted in new, more stringent engineering controls for operating equipment, such as vapor degreasers. It is a relatively simple concept to control airborne concentrations of vapors below their respective threshold limits. However, to achieve this at very low ppm levels does result in quite expensive equipment control devices. Ecological considerations include byproducts of biodegradation. In this respect, long term degradation products are more likely. In fact, the degradation products may be more toxic than the parent compound. Some of these solvents, such as trichloroethylene, 1,1,1-trichloroethane, methylene chloride, perchloroethane (perc, trichloroethylene) are Class 6.1 (Poisonous Material). Perhaps most clear in caution is California Proposition 65, which states these CHCs have been found to cause cancer.

Over the past two decades, many solvent cleaning operations employing CHCs have switched to alternate, more stable agents, such as n-propyl bromide and other specialty solvents that are non-flammable, exhibit low odors and toxicity, and are EPA and SNAP approved. These alternate cleaning compounds are not reportable under SARA 313 and not regulated as air pollutants under NESHAP. Most important this class of solvents has a low ozone depleting potential, as compared to the traditional CHCs, as described previously. Existing solvent cleaning machines are also quite amenable to the newer class of non-chlorinated solvents. Boiling points are similar, within a range acceptable to temperature settings in existing cleaning equipment. This is very important, as it permits an almost "slide conversion" when switching solvents, by using existing equipment.

For those installations still using CHC cleaning agents, the required compliant equipment must be used, to meet the critical airborne exposure limits. For those installations that eliminated targeted CHCs, almost two-thirds focused on eliminating solvents. Almost the same fraction considered replacing these solvents with aqueous cleaners.

The challenge of replacing chlorinated solvents in effective and precision cleaning can be difficult to achieve, when consider-

Continued on page 71.

information, contact Stephen Childers, IWG High Performance Conductors Inc., Inman, SC: Phone: (864) 472-0438; E-mail: stephen.childers@IWGHPC.com. ASTM Committee B01 meets Oct. 20-21, 2009 during the October Committee week in Atlanta, GA.

Coming Events

NACE International to co-sponsor Materials Science & Technology 2010 in Houston

The four partnering organizations of North America's largest and most comprehensive forum for materials scientists and engineers – Materials Science & Technology (MS&T) - have announced that NACE International will co-sponsor MS&T 2010, to be held in Houston, Texas, Oct. 17-21, 2010.

MS&T offers an unreplicated technical program addressing Structure, Properties, Processing and Performance across the materials community because it is organized by four leading materials societies: American Ceramic Society (ACerS), Association for Iron & Steel Technology (AIST), ASM International (ASM) and The Minerals, Metals & Materials Society (TMS).

The NACE co-sponsorship in 2010 will bring specific content on corrosion to the MS&T technical program, providing new perspectives and expertise to expand the MS&T experience. "We're very pleased to participate as a co-sponsor of MS&T next year, not only to bring the progress made by NACE members to a wider materials audience, but to expose our membership to advances being made in other materials-related disciplines and processes," said Tony Keane, NACE Executive Director.

"This special co-sponsorship of MS&T'10 is highly relevant for us, as NACE is headquartered in Houston and corrosion solutions are of great importance to our four societies' members and customers," said Stanley C. Theobald, ASM managing director. For more information about this year's MS&T event, to be held in Pittsburgh, Oct. 25-29, visit www.matscitech.org.

Olympus Supports International Conference on Surface Metrology at Worcester Polytechnic Institute

The study of surface roughness, which can affect everything from the way a coating adheres to a pill to the way light travels through solar panels, is one of the fastest growing areas of industrial research and development. To explore surface metrology and its varied applications, Worcester Polytechnic Institute (WPI) is hosting a three-day international conference October 26-28, 2009 at the WPICampusCenter in Worcester, MA, with support from Olympus America Inc. (Center Valley, PA). The conference will focus on the latest advances and insights in surface metrology fundamentals, methods, equipment, software and applications.

The International Conference on Surface Metrology is open to engineers, scientists, technicians and the general public interested in surface roughness and surface metrology applications. The program features extensive tutorials, exhibits and technical sessions addressing numerous technologies, industries and applications. In addition to engineering topics, the conference includes technical presentations on surface metrology in archeology, anthropology and cultural preservation. There also will be poster sessions, an opening reception and a conference dinner for participants.

Olympus, whose Scientific Equipment Group's industrial microscopes and metrology systems play a leading role in precision R&D, engineering and manufacturing applications in fields as diverse as aerospace, the automotive industry, electronics, materials science/metallurgy, medical devices, photovoltaics and semiconductors, is supporting the conference with personnel and advanced technology, including the recently introduced LEXT OLS4000 laser scanning confocal microscope, which allows high quality imaging and data collection, even with the most complex and hard-to-measure surfaces.

"The roughness of surfaces is among the most important and least understood areas of metrology," said Matt Smith, Director of Sales and Marketing for Olympus America's Scientific Equipment Group-Industrial Microscopes business. "We are committed to advancing the field of metrology, and supporting the WPI Conference is part of our commitment to education, scholarship and special programs for metrology professionals."

For more information on the Worcester Polytechnic Institute International Conference on Surface Metrology, contact David Rideout at Olympus America Inc. (Center Valley, PA); Phone: (484) 896-5792; E-mail: david.rideout@olympus.com; or visit www.olympusamerica.com.

Finishers' Think Tank

Continued from page 15.

provide. Cold or warm CHC solvents typically provide cleaned, dry parts in one to three minutes. These solvents also remove metal chips, fragments and shavings from small parts, such as screws and rivets. Solvents are regenerated and purified by distillation.

Next month we will consider aqueous based cleaning alternatives: soak, ultrasonic and mechanical. Two of these employ additional sources of energy, providing a beneficial boost for efficient and effective cleaning. ***P&SF***