

The TURI Cleaning Laboratory Verifies Cleanliness for Umicore



Overview

Umicore Electrical Materials USA Inc. manufactures contact materials, including clad metals, tapes, buttons, absorber rods, and brazing materials for the electronics industry. This ISO 14001 certified facility employs 40 people in Attleboro, Massachusetts.

The facility had been using a vacuum degreaser manufactured by PERO Corporation. The machine held 2,000 pounds of perchloroethylene (PCE) which was changed out annually. Working with the manufacturer, Umicore was able to extend the changeout to 18 months, resulting in a 2,000-pound reduction in PCE over three years. EHS staff at the facility wanted to eliminate the use of PCE entirely, for the benefit of worker health and safety and to reduce cost. Working with PERO and chemical manufacturer Kyzen, Umicore identified and purchased a new vacuum degreaser to be used with a new, modified alcohol-based cleaning solvent blend, Metalnox M6386.



New vacuum degreaser

Testing for Environmental, Health and Safety Differences

An environmental health and safety assessment was conducted on the original solvent versus the identified alternative using TURI's publicly available hazard assessment tool, Pollution Prevention Options Analysis System (P2OASys). Comparisons of chemicals and products using P2OASys can be made by inputting both quantitative and qualitative data on the chemical toxicity, ecological effects, physical properties, process factors, and life cycle factors of each chemical or chemical mixture. Based on the P2OASys overall assessment of PCE and the alternative cleaner, Metalnox M6386 is considered a safer alternative.

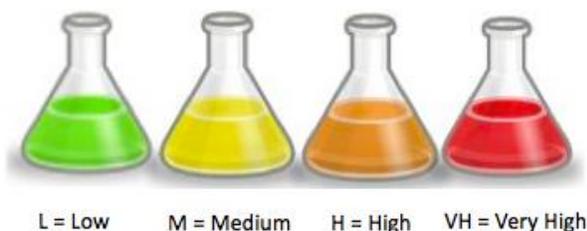
TURI developed the Pollution Prevention Options Analysis System (P2OASys) tool to help companies determine whether the toxics use reduction (TUR) options they are considering improve upon their existing process when looking at environmental, health and safety endpoints. By using P2OASys, unforeseen negative environmental, worker or public health impacts may be identified prior to adopting the proposed changes.

Potential hazards posed by current and alternative processes identified during the TUR planning process are compared using data endpoints for eight main categories that encompass chemical, physical, psychological and environmental hazards.

Using both quantitative data and qualitative input, the tool can rate each category based on endpoints that correlate with values, key phrases, Global Harmonizing System (GHS) classifications, and other government agencies designations.

Environmental, Health and Safety Comparison		
Category	Original Solvent: Perchloroethylene	Identified Alternative: Metalnox M6386
Acute Human Effects	VH	VH
Chronic Human Effects	VH	L
Ecological Hazards	VH	M
Environmental Fate & Transport	H	M
Atmospheric Hazard	H	L
Physical Properties	VH	VH
Process Factors	VH	M
Life Cycle Factors	VH	M
Weighted Average	VH	M

Key:



Based on the information from safety data sheets, Metalnox 6386 is a safer alternative to PCE, if appropriate personal protective equipment is worn and safe handling practices are followed. The hazards of each solvent are listed below:

Perchloroethylene:

- Harmful if inhaled
- Skin irritation (GHS Category 1A)
- Dermal toxicity (GHS Category 2)
- Carcinogen (GHS Category 2A)
- Neurotoxicity (GHS Category: Single Exposure Category 3)
- Endocrine disruptor (European Union Category 2)
- Acute and chronic aquatic toxicity

Metalnox 6386:

- Skin irritation (GHS Category 2)
- Eye irritation (GHS Category 2A)
- Combustible liquid (NFPA 2; GHS Category 4)

Testing for Performance

Among its products, Umicore manufacturers multi-layered button contacts that are used in welding applications when a material can't be directly welded to the main substrate or for varying thickness between the two materials being welded. Button contacts are used in applications like light switches, vehicle controls, and motor protectors.

Kyzen satisfactorily tested the cleanliness of the Umicore button contacts using Metalnox M6386, but Umicore asked the TURI Cleaning Lab to verify the cleanliness through a blind test.

Umicore sent the TURI lab cleaned multi-layered button contacts (90% silver and 10% cadmium) of three different sizes. The parts were divided into batches cleaned by Product A, Product B, and Product C. The brand names were presented anonymously to deter any bias. The facility requested that the lab test using three different analytical methods – contact angle, wipe test, and dyne test.

There were three different cleaning products used with the three different equipment configurations, because the goals of the test were to:

- determine the cleaning effectiveness of the cleaner and equipment selected by Umicore
- see if adding ultrasonics to the cleaner and the degreaser enhanced cleaning effectiveness
- make sure that the new cleaning solvent and equipment cleaned at least as well as PCE with the old equipment

For the contact angle test, one drop of DI water was placed on the smooth surface of the button part supplied by Umicore and software measured the contact angle. Usually, the higher the contact angle, the more contaminated the surface. For the wipe test, a clean, white cotton swab was swiped over the surface of the button and then observed for evidence of any dirt. For the dyne test, a clean swab applied 3 lines of dyne test solution on the button and a lighted magnifying glass enhanced visual observation of lines that held their shape.

Cleaning Results				
Product	Cleaner and Equipment	Contact Angle	Wipe Test Results	Dyne Test Results
A	Metalnox and new degreaser	77.98°	Clean/no residue	70% effectively cleaned
B	Metalnox, new degreaser, Ultrasonics	75.94°	Clean/no residue	60% effectively cleaned
C	PCE and old degreaser	75.64°	Clean/no residue	40% effectively cleaned

Product C was the least effective, but products A and B performed well.

Financial Comparison

The new vacuum degreaser is an expensive piece of equipment, but Umicore will enjoy significant savings over time.

Cost Comparison: Old vs. New Systems			
Cost item	Annual Costs		Capital Costs
	Old Machine (PCE)	New Machine (Metalnox)	New Machine (Metalnox)
Equipment investment	n/a	n/a	\$250,000
Training investment	n/a	n/a	\$7,280
Repairs	\$15,000	None in the first year and none expected for several years after	
Solvent/cleaner	\$4,851	\$2,736 for 80 gallons (expected to last a minimum of one year)	
Stabilizer to maintain acidity	\$2,410		
Booster ¹		If used, \$41 per year for a third of a gallon	
Waste disposal costs	\$2,200	\$110 per year for a 55-gallon drum	
Total costs	\$24,461	\$2,887	\$257,280

¹ Booster is an additive that is required only if the Metalnox begins to deteriorate. Alternatively, Umicore could dump all the Metalnox and replace it when it starts deteriorating.

The annual savings from the Metalnox system are expected to be \$21,574. With a capital investment of \$257,280, this results in a payback period of about 12 years. As the unit is expected to last well over 20 years, this is a worthwhile investment for Umicore. While this calculation does not factor in eventual repair costs, it does factor in the use of 80 gallons of Metalnox per year, and Umicore will almost certainly use less than that per year. Also, Umicore estimates that the new Metalnox system uses 50% less electricity than the PCE system, which is an additional source of savings.

Conclusions

The TURI lab verified the effectiveness of the safer alternative to PCE, as well as using P2OASys to analyze the improved health and safety of the new solvent. Umicore is satisfied with the cleaning effectiveness of the new degreaser and Metalnox M6386. The facility expects to save money in cleaning chemicals over a three-year period. The new degreaser is more energy-efficient than the previous one and should deliver additional cost savings in energy. Umicore's EHS staff are pleased with the improvement for worker health and safety.



The Toxics Use Reduction Institute (TURI) at UMass Lowell provides the resources and tools to help Massachusetts companies and communities make the Commonwealth a safer place to live and work. TURI awards grants to businesses, community organizations, and researchers to discover new opportunities to reduce the use of toxic chemicals and to demonstrate technologies to peers. For more information, visit <http://www.turi.org> or contact Joy Onasch (joy@turi.org, 978-934-4343).