OZONE-DEPLETING SOLVENT REPLACEMENT – Case Study

Location: Y-12, Oak Ridge, Tennessee

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Process: **R**eplace ozone-depleting solvents used in batch cleaning and wiping applications

The Facility:

Y-12 Plant Defense Program assignments include the dismantling of nuclear weapon components returned from the national arsenal, maintaining nuclear production capability and stockpile support, serving as the nation's storehouse of special nuclear materials, and providing special production support to DOE programs. Another mission of long standing is the support of other federal agencies through a Work for Others program. The goal of the technology transfer mission is to apply expertise initially developed for highly specialized military purposes to a wide range of manufacturing problems to support the capabilities of the U.S. industrial base.

Background:

In 1986, staff at Y-12 began looking for alternatives to chlorinated solvents. This process was originally prompted by the knowledge that new emissions standards for these solvents would be forthcoming. Once the process was underway, the issues of ozone-depletion also became a factor in decisions regarding what replacement processes would be used. The largest portion of solvent use at Y-12 was for batch cleaning of parts. This cleaning had generally been undertaken through the use of vapor degreasers and other batch processes. A smaller usage area was wiping of parts to remove oils, coolants, etc. prior to machining, inspection, welding or joining.

The Y-12 team that was brought together to work on this project included staff from environmental safety and health, fire protection and industrial hygiene. Because many solvent alternatives are flammable or have worker exposure concerns, the Y-12 team wanted to make sure that all environment, safety and health requirements were considered when identifying the alternatives.

Approach:

The Y-12 team took a three-tiered approach to solvent substitution. Initially they reviewed the ozone-depleting chemicals contained in the facility stores, and the records of where these substances were used around the facility. With this information in hand, they sent out surveys to collect data about substance use. These surveys were followed up with actual shop visits, to ensure the accuracy of the data received. A list of ozone-depleting solvents with their common trade names was included with each survey. This helped avoid the problem of a particular shop knowing what it was using, but not being aware that the solvent was an ozone-depleter. In the final stage of the substitution process, Y-12 has been tracking chemicals purchased through the stores by use of a purchasing system. Based on the information provided by this system, Y-12 has been able to document a 97% reduction in the use of ozone-depleting solvents.

The Y-12 team provided training to shop personnel on the issues of ozone-depleting and why a change from the traditional and effective solvents they were using was necessary. Shop personnel were also involved in the process of determining the best solvent options to be used. Because they were early in the solvent replacement process, Y-12 had to undertake a significant amount of testing to ensure that the new solvents achieved the required cleaning level and met all material compatibility requirements. Solvent substitutes had to meet design agency criteria. Y-12 was able to use high-technology methods to confirm cleaning ability and materials compatibility. The data from these tests is available for use by other DOE facilities facing similar cleaning challenges.

Funding:

The process of solvent replacement was incrementally funded. Because it was driven by environmental regulations (emission standards), Y-12 was able to use management funds to identify and test alternatives. Once the alternatives were chosen, they were incorporated into Y-12 activities. The process was then to use up remaining CFCs in the stores as new alternatives were purchased to replace them.

In the end, Y-12 chose an ultrasonic, aqueous system for the batch cleaning operations. The additional wastewater produced by this process was easily handled by Y-12's existing onsite water treatment system. For wiping applications, two options were chosen. Solvent 140, a high flash mineral spirits, was implemented in moisture sensitive areas of the plant. A solvent blend, MMK Blend, was developed, patented and licensed by personnel at the Y-12 plant. The blend is a hydrocarbon-based solvent with a polar solvent which enables the solvent to clean both polar and non-polar contaminants. This blend was used in all other wiping applications.

Accomplishments:

To date, Y-12 has reduced its solvent usage by 97%. There are only two remaining systems that still use CFCs. This usage is in the order of 5 to 10 gallons annually.

Special Considerations:

One area where CFCs are still used in the cleaning of uranium chips. These chips are cleaned with water, and a CFC is used to evaporate the water and dry them. Y-12 is currently investigating a vacuum process for drying the chip, but the change out will require additional testing before it is ready to implemented. Although the CFC is used primarily for drying, it also helps in the cleaning process. A vacuum system will likely require more water washes to achieve the same level of cleanliness.

The Future:

Y-12's solvent substitution is mainly complete. Future actions will include replacement of the final CFC-using processes.

Excess ODSs:

Because there is no requirement to phaseout the use of ozone-depleting solvents, Y-12 has tended to use whatever solvents they had purchased before switching the system to the new alternatives. The very small amount of CFC currently being purchase is not sufficient to create any excess supply.

Lessons Learned:

Y-12 found that working closely with the shop personnel was very effective in ensuring a smooth transition process. By educating the employees on the need to replace the old solvents, Y-12 was able to overcome the typical aversion to change. An understanding of the process was also crucial to ensuring that the transition went smoothly. Personnel working with the batch degreasers had to adjust their activities to the somewhat slower operating time of the new ultrasonic systems. Evaporation rates of the new solvents are also slower than CFCs requiring adjustments by personnel. Because of the amount of testing that had to be done on the solvent substitutes, Y-12 field tested the chosen alternatives in a single shop before applying them to all activities. Finally, to help shop personnel, the team put together a manual on the new practices and processes.

The solvent replacement at Y-12 is a good example of how to smoothly transition from ozone-depleting chemicals to approved alternatives. DOE facilities going through this process today can take advantage

of the lessons learned at Y-12, and the information on materials compatibility that Y-12 put together for its processes.