Alternative Cleaning Technologies for Vapor Degreasing and Cold Dip Processes



Minnesota Technical Assistance Program .

REASONS TO CONSIDER ALTERNATIVES

Industrial applications for ozone-depleting chemicals have been carefully studied. As a result, their use has come under ever-increasing controls. Additionally, the 1990 Clean Air Act Amendments, based on the modified Montreal protocol, is mandating the phase-out of two widely used degreasing solvents: CFC 113 (1,1,2-trichloro-1,2,2-trifluoroethane, Freon® 113) and 1,1,1-trichloroethane (TCA, methylchloroform). Higher taxes on the use, and tighter restrictions on the manufacturing of certain chlorinated solvents are also included in the Clean Air Act Amendments.

As pressure to reduce and eliminate the use of ozone-depleting chemicals grows, industries using these solvents as cleaning agents will see potential benefits in alternative cleaning chemicals and processes. In response, the Minnesota Technical Assistance Program (MnTAP) has developed this guide as an overview on the assessment of alternative cleaning technologies. A reference section at the end of this guide explains how to get more information from MnTAP on this topic.

START WITH THE CLEANING PROCESS

The first step in evaluating cleaning alternatives is to determine if the cleaning operation is needed. A review of any cleaning process should consider the following:

- the part configuration,
- the substrate material to be cleaned,

- how parts become contaminated,
- the types of soils to be removed, and,
- the purpose of the cleaning operation.

The process review may reveal that manufacturing modifications can reduce or even eliminate the need for several cleaning steps or the whole cleaning process. For example, using "no clean" or low-solids fluxes has eliminated the need for cleaning in some manufacturing processes of the electronics industry. Increased care in the handling of component parts can reduce contamination and the need for cleaning.

If cleaning is needed, the next step in the review is to develop cleaning requirements. Cleaning requirements are generally based on two factors: process specifications and customer requirements. A system to measure cleanliness should be included in the requirements to prevent over-cleaning and ensure efficient use of cleaning agents. Once cleaning requirements are in place, cleaning alternatives can be considered.

STUDY ALTERNATIVE CLEANING TECHNOLOGIES

The next step in making changes to your cleaning process is to evaluate how alternative cleaners and equipment can work together. The cleaning agent should be considered with equipment choices in mind, because cleaner choices may become very limited when equipment choices are made first. Cleaning agents that can typically replace ozonedepleting cleaning solvents include aqueous and semi-aqueous cleaners.

Aqueous cleaners. This type of cleaner is readily available and offers the greatest number of applications. Many aqueous degreasers use surfactants to clean. They can be either alkaline or neutral solutions, and fall under two categories: nonemulsifying and emulsifying.

Nonemulsifying cleaners cause contaminants removed to either sink to the bottom of the cleaning tank or float on the cleaner's surface. These cleaners work well in continuous-use systems because contaminants can be removed, and the cleaner can be recharged with concentrate and reused. However, nonemulsifying cleaners may not remove all contaminants and may require heating for the best performance.

Emulsifying cleaners remove more types of contaminants than nonemulsifying cleaners and are effective at lower temperatures. However, emulsifying cleaners have a shorter life span, and treatment for proper disposal may be more difficult than treatment for nonemulsifying cleaners.

Semi-aqueous cleaners. These cleaners are hydrocarbon mixtures which are synthetically produced or derived from natural products. Semi-aqueous cleaners can be used in applications where aqueous cleaners are not compatible with the product substrate or contaminant to be removed. Semi-aqueous cleaners also can be recycled to extend use. Examples of this cleaner type include the "terpenes" used to remove rosin flux residue from printed circuits. Other types of semiaqueous cleaners are used in the metal finishing industries to remove difficult machining fluids and waxes. However, semi-aqueous cleaners have disadvantages which include:

- the possibility that they are combustible,
- they may leave a residue,
- their use may be governed by volatile organic compound (VOC) regulations, and
- they may be toxic in waste waters.

Other solvents. For cleaning of some oils or greases, solvents such as mineral spirits or Stoddard solvent may be used. However, special safety considerations must be made for use of these solvents due to their flammable and toxic properties. These solvents also emit regulated VOCs.

Equipment for alternative cleaners. Choosing cleaning equipment is just as important as choosing an alternative cleaner. The equipment should be selected either at the same time or after the cleaner is selected. The equipment should be designed to take advantage of the cleaner by providing ultrasonics, agitation or sprays. It would be wise to work with vendors to perform some pilot testing. This would give some indication of the total system's effectiveness in cleaning your parts. When the cleaner and equipment work together as a system, maximum efficiency can be achieved which can help take full advantage of savings from reusing and recycling the cleaner.

FINE-TUNING THE VAPOR DEGREASING PROCESS

While alternative cleaners are being evaluated, or if you decide to use a regulated but not banned solvent, achieving maximum efficiency with a vapor degreasing operation can make significant reductions in fugitive emissions and create cost savings through reduced solvent use. Some of the techniques used to reduce solvent emissions include:

- Slowing the rate of parts withdrawal. Parts should be removed from the vapor degreaser at a rate that gives the solvent enough time to evaporate off the parts in or immediately above the vapor zone.
- Eliminating external drafts.
- Keeping the chamber covered when not in use.
- Minimizing the use of sprays.
- Super-heating the vapor.
- Adding more cooling coils to the degreaser.

A MnTAP fact sheet is available on this subject. Check the listing at the end of this guide.

CLEANER TREATMENT AND WASTE ISSUES

Switching from solvent cleaners used in vapor degreasing and cold dipping to alternative cleaning agents offer the potential to treat and recycle cleaners on site. But on-site treatment of these cleaning agents can also create a waste, which previously had been shipped to a treatment facility along with spent solvent. This waste is made up of the contaminants removed from parts during the cleaning process. As mentioned previously, some cleaners let contaminants settle out of the cleaning solution or float on the surface-allowing them to be removed. In machining operations, it may be possible to remove oil and metal-chip contaminants to extend the life of the cleaner. Wastewater treatment can be simplified by using a system which breaks the cleaner emulsion to allow oil separation.

Any contaminants removed from cleaners during treatment form a sludge which needs to be tested for hazardous characteristics. If the sludge is hazardous, then it needs to be disposed of according to federal and local regulations.

To get fact sheets on waste testing labs and hazardous waste treatment facilities, check the MnTAP reference section at the end of this guide.

TRAINING ENCOURAGES EFFICIENT CLEANING

Employee training is critical for maintenance of standards in cleaning requirements, implementation of cleaning alternatives, and maintenance of efficient vapor degreasing operations. Without effective training, employees may take shortcuts in the cleaning process which cause parts to appear clean when they are not—particularly when cleanliness measurement is not part of the cleaning system. An effective training program should include clearly documented instructions and a method to measure employee understanding of the cleaning system and of their ability to perform required cleaning process steps.

MAKE A PLAN FOR EVALUATING CLEANING Options

Manufacturers are developing and evaluating alternative cleaning technologies in response to increased air pollution control requirements, and the continued need for cleaning. However, these alternatives are still relatively new and may not be tested in all industrial processing situations. Therefore, create a plan that will help you evaluate your cleaning options and minimize your risks. A plan should include the following:

- 1. Work with your customers to determine and negotiate cleaning requirements and standards.
- 2. Maximize the efficiency of your current degreasing process through employee training and equipment modification.
- 3. Evaluate solvent substitutes. Work with as many vendors as possible to determine the best alternative cleaner and operating conditions that will produce maximum cleaning results in your operation.
- 4. Evaluate equipment designed to work with the selected cleaner. Work with as many vendors as possible to determine the best kind of equipment for your cleaning operation.
- 5. Implement an ongoing employee training program for your cleaning operation.

Changing from vapor degreasing and cold dip solvent cleaning to alternative cleaners offers the potential for the following benefits:

- Increased efficiency and profits due to reduced use of hazardous materials and reduced hazardous waste disposal costs.
- Compliance with toxic materials use and release regulations.
- Increased employee safety.
- Improved corporate image as a result of using less toxic materials.
- Implementation of cleaning requirements.
- An improved understanding of your cleaning process.

CALL MNTAP FOR MORE INFORMATION

MnTAP provides technical assistance and services to help Minnesota businesses prevent pollution at its source, and reduce and properly manage industrial wastes.

In addition to the overview on cleaning options provided in this guide, further information is available from MnTAP through the following fact sheets and reference lists:

- Aqueous Parts Washing Equipment
- Choosing a Hazardous Waste Management Facility
- Cleaning: Waste Reduction Opportunities Checklist
- Commercial Laboratories (for waste testing)
- Hazardous Waste Brokers, Transporters and Disposal Facilities
- Industrial Cleaning Formulations
- Reducing Emissions from Vapor Degreasers
- Selecting a Consultant

To receive a copy of any of these publications, or to ask about other topics related to industrial waste, please write to MnTAP at 1313 Fifth St. SE, Suite 207; Minneapolis, MN 55414, or call 612/627-4646, or 800/247-0015 from greater Minnesota. If you have questions, comments or suggestions about information in this guide, contact Robert Lundquist at MnTAP.

MINNESOTA TECHNICAL ASSISTANCE PROGRAM is supported with a grant made by the Minnesota Office of Waste Management to the School of Public Health, Division of Environmental and Occupational Health, at the University of Minnesota. The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, religion, color, sex, national origin, handicap, age or veteran status.

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