Office of Pollution Prevention

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# Onsite Solvent Recycling Equipment

*The generation of solvent wastes contributes to air and water pollution and hazardous waste generation. It is one of Ohio's most common environmental problems. Pollution Prevention for industrial solvents should be practiced whenever*

Reducing solvent wastes is currently one of the most important elements of pollution prevention (P2) programs nationwide. Solvent use is a major contributor to air and water pollution, and is a leading source of hazardous waste. Chlorinated solvents are a major contributor to ozone depletion. The Clean Air Act Amendments of 1990 mandate a reduction in the amounts of solvents released into the atmosphere. As a result the costs of complying with the Clean Air Act have risen accordingly. Generators of solvent wastes can profit by reducing the costs associated with waste disposal. Reducing solvent use also reduces the cost of purchasing virgin solvents as well as reducing storage and management costs.

When implementing a pollution prevention program aimed at reducing solvent wastes, the first alternative should be to reduce or eliminate the use of solvents at the source, (source reduction). Source reduction reduces the release of wastes and pollutants, and the costs associated with those releases. The second option is to recycle or reuse the wastes in an environmentally sound manner. Disposal of solvent wastes, even when they are used as fuel, is not considered pollution prevention, and would not be considered part of a pollution prevention program.

Businesses may be able to eliminate their solvent wastes by finding an aqueous or semi-aqueous cleaner to replace the solvent. The Ohio EPA Office of Pollution Prevention provides over a dozen documents and fact sheets on solvent substitution, alternatives to ozone depleting solvents and on aqueous degreasing and parts cleaning. Please contact the Ohio EPA Office of Pollution Prevention for more information.

If solvents cannot be eliminated from the process, the second option, is to recycle or reuse the wastes that are generated in an environmentally sound manner (waste minimization). Businesses can recover spent solvents though the use of an outside recycler, or recycle sol-



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vents on-site using their own equipment, as discussed in this fact sheet. Before a company purchases any solvent recycling equipment it needs to consider possible limitations. These limitations include:

- The cost of purchasing and maintaining recycling equipment
- The cost of training and staffing equipment operators
- Will the amount of spent solvent recycled justify the costs of recycling?
- Potential fire and/or explosion hazard
- Is the final product of the recycling process usable in the original process?
- Regulatory considerations for air emissions and bottoms disposal

Before investing in a recycling process, it is important for a company to investigate whether its spent solvents are recyclable. Some industrial solvents are blends of two or more pure solvents and additives. Recycling could alter the solvent's composition and usefulness. 1,1,1-trichloroethane, for example, can break down during distillation and become acidic. By-products of the industrial process may also prevent recycling. Stabilizers and/or other additives may be required in order to make the recycled product usable. Suspended solids affect the efficiency of the recycling apparatus and limit which types of recycling units can be used.

Before purchasing a recycling system, ask the equipment supplier to recycle samples of the spent solvent. Analysis of the distillation product will demonstrate the effectiveness of the recycling still and help determine what is required to make the recycled solvent usable. It will also help to determine the characteristics of the still bottoms waste.

Explosion or fire hazard conditions can be created when some materials are distilled. Some printing and painting process wastes for example, contain nitrocellulose which can pose a fire or explosion hazard if not distilled under strict conditions. Consult with the manufacturer to see if the still comes equipped with a “nitrocellulose” or other explosion proof package.

The quality of the distilled product of the recycling process needs to be considered as some recycled solvents may not be usable for their original purpose. Alternative uses generally can be found. It may not be necessary to recycle a solvent to 100 percent purity for an intended purpose. Additives may be necessary for a solvent to be safe and effective for an industrial process. If not usable for its original purpose, the final product could be used in another process or sold to another company through a waste exchange program .

## Solvent Still Types

There are three general solvent still types: simple distillation units, fractional distillation units, and thin film evaporators. The most common method is simple distillation. During simple distillation, solvent wastes are heated, driving off the solvent in vapor form. The vapor is reverted back to liquid form in the condenser and collected. The still bottoms, or waste remaining in the bottom of the still is then collected and disposed. Simple distillation units are run in batches.

The second type of unit, fractional stills, produce a higher purity of recycled product. A fractional still may separate an industrial solvent blend into its pure constituents. Fractional distillation units are generally more expensive to operate and are generally better suited to larger volumes. Fractional distillation units are also usually batch units.

The third type, thin film evaporators, distill by running a thin film of dirty solvent down a heated cylindrical vessel where it is vaporized. The vapors are collected and condensed back into liquid form for reuse. Thin film evaporators are generally

suited for use in high volume, continuous processes. Thin film evaporation requires the dirty solvent to have a low suspended solids content to work well.

## Still Operating Considerations

Wastes should be segregated whenever possible. If two wastes containing two solvents are distilled, a simple still may produce a solvent blend of the two solvents. This blend may not be usable for the original purposes of the individual solvents. When pure solvent is the goal, it is best not to mix wastes containing different solvents.

If the suspended solids content is high, additional equipment may be necessary. This equipment is necessary to facilitate distillation in addition to cleaning. As the still bottoms becomes more and more concentrated, the solids can insulate the solvent and slow the distillation process. Some "total recovery systems" use microwave units or other technologies that can drive the solvent out of the solids once the ratio of solvent to solids is too low to be distilled normally.

The ease of cleaning should be considered when choosing a still. Still liners facilitate cleaning the still and in disposing the still bottom wastes. Still cleaning can make up a significant portion of still operating costs. In cases where suspended solid content is higher, additional equipment and/or considerations may be necessary .

Solvents with very high boiling points may require reduced pressures to be distilled, a vacuum can be used to reduce the distillation pressure. The risk of fire hazards or explosions that are possible in some stills, can be reduced with the use of a vacuum unit.

Stills come in a wide range of sizes and specifications. Batch stills can range in size from two to over 55 gallons. They distill their capacity in a six to eight hour work shift. Continuous flowing stills range in distillation capacity and can distill as much as 500 gallons per hour. Smaller stills can run on electricity while larger stills may require a steam connection. The condenser may be cooled by circulating air, water or a chemical coolant or refrigerant. A water hook-up is necessary for water cooled stills.

During distillation of spent solvents, water can mix with the solvent resulting in an acidic mixture that is corrosive to the still. Stainless steel and Teflon fittings and gaskets which are corrosion resistant, last longer than other materials under these conditions.

## Safety Consideration

Safety features also need to be reviewed before choosing a still. Safety features which are available include explosion proof electrical compartments and automatic shutdown features. Investigate if the still shuts down automatically after a batch is finished, if there is a coolant failure, when the boiling chambers temperature exceeds a threshold setting, and if the water/coolant temperature in the condenser goes above a certain threshold temperature.

Some other safety considerations: Electrical components should be explosion proof and made with Underwriter Lab approved components. The pot should have a pressure relief valve. Some stills come equipped with an automatic shutoff feature that senses when all of the solvent has been distilled.

Safety regulations must also be met when instaling a new solvent recycling system. OSHA requirements for ventilation and employee safety should be considered. Local fire regulations need also to be considered. Finally, notify your insurance carrier to ensure that the installation of the equipment does not affect your coverage.

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## Recycling Costs

Several factors should be considered when reviewing the cost efficiency of a still. These factors include the amount of solvent used by the business, the cost of new solvent, the cost of still bottom or other waste disposal, usefulness of recycled solvent, the operating cost of the still, and the payback period. Electricity, labor requirements, and still liners should also be included in the operating costs.

## Regulatory Considerations for Solvent Recycling Stills and Still Waste

It is important to note that "waste" that is recycled or sold to another compay is not subject to hazardous waste regulations. Reducing the use of virgin solvents, could give a business the regulatory advantage of falling below the Superfund Amendment and Reauthorization Act (SARA) reporting requirements (SARA 311, 312, 313 reporting). Hazardous solvent wastes sent off site for recycling or disposal must be reported under SARA 313 toxic release requirements. Solvent wastes which are recycled ***onsite*** do not have to be reported, except for that portion of the solvent which is released in the form of air emissions.

Another important consideration are the air emissions of the still and/or the recycling process. Air emissions from a distillation process are regulated in two forms: Fugitive emissions and point source emissions. Fugitive air emissions are leaks in the unit, or emissions from the recycling process, opening the unit, filling the unit, cleaning the unit etc. Point source air emissions would be emissions via a ventilation stack. The design of most modern stills should limit the amount of solvent which is released into the air in vapor form during operation. A business should investigate the emissions of a particular still since improper design or maintenence could result in emissions which would require an air emissions permit. Depending on the geographic region in which the company is located and the air emissions of a particular model and/or process, the distillation unit might require a permit to install, or permit to operate an air emissions source under title V of the Clean Air Act. For more information please contact the Ohio EPA Division of Air Pollution Control.

Still bottoms are considered hazardous when a listed hazardous waste solvent is distilled or if they meet hazardous waste characteristics as defined by the Federal Resource Conservation and Recovery Act and by the Ohio Administrative Code (OAC).

Microwave still bottoms recyclers and other "Total Recovery" systems can significantly reduce solvent content of still bottoms in some cases. If the solvent is the only hazardous component in the waste and enough solvent is removed from the still bottoms they may no longer meet the characteristics of hazardous waste. However, when a **listed** hazardous waste is distilled the still bottoms are *always* a listed hazardous waste. For more information on hazardous waste rules, please contact the Ohio EPA Division of Hazardous Waste Management.

Onsite Solvent Recycling Equipment at www.epa.state.oh.us/opp/SolventRecycEquip.html

**Sources:**


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USEPA. 1996. *Partners for the Environment - Green Chemistry Challenge*. http://es.inel.gov/partners/chemstry/chemstry.html

**This is the 16th in a series of documents Ohio EPA has prepared on pollution prevention. For more information, call the Office of Pollution Prevention at (614) 644-3469.**

***The Office of Pollution Prevention was created to encourage multi-media pollution prevention activities within the state of Ohio, including source reduction and environmentally sound recycling practices. The Office analyzes, develops, and publicizes information and data related to pollution prevention. Additionally, the Office increases awareness of pollution prevention opportunities through education, outreach, and technical assistance programs directed toward business, government, and the public.***

**Office of Pollution Prevention WWW address:** www.epa.state,oh.us/opp