

Selecting a Still for On-Site Solvent Recycling

Become better prepared to select the right still for your on-site solvent recycling. This fact sheet answers questions about solvent recycling and provides regulatory information for Minnesota businesses.

Many solvents can be recycled, reprocessed, and then reused. Solvent recycling is preferred to other disposal methods for minimizing adverse environmental effects. Distillation is the most common method of solvent recycling, although filtration can be used to remove solids and nonmixable liquids. Recycling can be done at your facility or off-site.

Off-site solvent recycling is generally economical for solvents generated in truck load quantities over three months. As long as the recycled solvent can be reused, on-site recycling is usually economical at these same volumes and smaller. Economic viability improves as the value of the solvent increases or as the cost of waste disposal increases. Carefully evaluate the feasibility of small-scale, on-site distillation before purchasing distillation equipment. Use this fact sheet as a guide to determine if on-site distillation is right for your company.

Recycling is a useful strategy for reducing the volume of new solvent purchases and waste regulatory burdens but doesn't actually reduce the generation of waste from a process. Ensure you consider how and why a solvent is used and then question whether process or procedural modifications can be implemented that actually reduce generation of solvent waste in the first place.

Questions to Ask

By answering the questions in the next four sections, your company will be better prepared to select the right still for your needs. Distillation equipment suppliers, companies in your industry that already distill solvents for reuse, and trade associations are good sources of information related to economic and safety considerations of specific stills.

Feasibility Considerations

Are other separation technologies more appropriate? Distillation works well at separating similar liquids. If solid particles are the main contaminant, consider recovering the solvent by filtration. If the waste consists of liquids with vastly different molecular sizes, like a solvent

and polymer or resin, consider using membrane filtration to recover the solvent.

Can the distilled solvent be used again for the same process at your company? If the solvents in the blend have a wide range of boiling points, they may be unsuitable for the original use because distillation will yield a solvent different from the original blend. Ask your solvent supplier if the solvent can be reformulated to meet your requirements. In other cases, contaminants not sufficiently removed can cause problems. For example, the breakdown of chlorinated degreasing solvents creates acids. These residual acids catalyze the formation of more acid, which can corrode both products and process equipment.

If the distilled solvent cannot be used in the original process, is there another process in which the solvent can be used? Uses where requirements are less stringent than the original use are good candidates for using distilled solvent.

Do different waste solvents need to be stored separately? When different solvents are accumulated in a single waste drum, simple batch distillation will produce a mixed solvent product which may not be usable for any of the current solvent uses. Make sure that procedures necessary to prevent the cross-mixing of solvents can and will be followed by all employees. Also, if possible, reduce the number of different solvents used.

Technical, Economic and Operational Considerations

Will the distillation equipment supplier distill a sample of your waste solvent? You should evaluate the quality and quantity of both the distilled product and the still bottoms. Be sure to distill enough waste so that the recycled solvent can be tested in your facility.

What is the percentage of solids or nonvolatile liquid contaminants in your waste? Many stills claim a high solvent recovery percentage. If only half your waste is solvent, a high recovery rate may still be inadequate to pay back the equipment investment after operating expenses.

What is the physical nature of the still bottoms or residue produced by the still? Is the still designed to handle this type of residue? Solids and liquids that gel or polymerize can require significant amounts of labor to remove from the still. High solids can also coat and insulate the still's heating surfaces. This causes distillation to take more time and energy, and may cause hot spots and chemical decomposition. Waste of this type may require you to use still liners for smaller units, or a still with an automated surface scraper for larger applications.

Should waste solvent be distilled under vacuum? Since vacuum distillation lowers the temperature at which liquids boil, it allows the distillation of some materials that are not safe to distill at atmospheric pressure, speeds up most distillations, and protects some materials from breaking down under high temperatures. Vacuum distillation can add significantly to the purchase price and operating costs of the still.

How will the still bottoms be managed and what are the disposal costs? Most still bottoms must be handled as hazardous waste. The disposal costs for pumpable liquid wastes will generally be less per pound than for solids or semi-solids. However, if the volume can be reduced sufficiently, the disposal of solids may be economically feasible. In some machining operations oily still bottoms can be reused as a lubricant. Regulatory agencies require evidence that reused still bottoms are providing a valuable function and are not being disposed of in an unregulated manner.

What are the costs of operating the still? Costs can include labor to operate, load, monitor, unload and clean the still; electricity; condenser water including sewer or treatment charges; and still liners, if needed.

How much space will the distillation equipment require compared to the space needed to store waste or original solvent? At larger volumes, floor space should be freed up, while at smaller volumes, extra space will be needed. Consider the value of this space.

How much labor will be needed to operate the solvent recycling equipment and related materials handling? How does this compare to labor required to manage original and waste solvents? Generally, recycling will require a little more labor than materials handling alone. Is the still easy to operate or will it require extra labor or supervision? Is any surplus time available, or are current employees stretched now? Do the economics justify adding labor?

Will any more equipment or special utilities be needed for the still to operate? At what cost? What is required to install the still? These indirect costs should be factored into the total cost of purchasing a still.

How much maintenance will the still require? Will the solvent eventually deteriorate any of the still components? Stainless steel and Teflon fittings and gaskets are required for some solvents, but they add cost. Check to see if the candidate chemicals are compatible with the equipment you are considering.

How much operational support will be available from the manufacturer or distributor? How much might be needed? Will the manufacturer/distributor train your operators? Are the written instructions clear? Will the manufacturer/distributor make an operational guarantee and back its equipment?

Ask your vendor for references of companies using the equipment for similar purposes to verify vendor claims.

Safety Considerations

Is there a safe location for the still? When choosing a location consider fire code requirements, sources of ignition, ventilation needs, and the possibility of spills. Check with your fire marshal and insurance company to ensure that all of their requirements are met.

Can the electrical installation of the distillation equipment be inspected and approved by the local electrical inspector or the Minnesota State Board of Electricity? Most industrial equipment, whether it is a hard-wired installation or simply plugged into an electrical outlet, must be inspected. Stills listed under UL 2208 (Underwriter's Laboratories Standard for Solvent Distillation Units) or equivalent standards allow for the inspection approval. Using approved components is the next best situation. Consider making a purchase agreement contingent on installation approvals by the electrical inspector and fire marshal.

Are the following minimum safety features present on the still that you are considering?

- Automatic shut down for high pot temperature to prevent the still bottoms from continuing to cook after all solvent has boiled off.
- Automatic shut down for high condenser-water temperature preventing solvent vapors from being lost due to a malfunction that causes low or no coolant flow.
- A relief valve to release pressure buildup.
- Controls that are explosion-proof, intrinsically safe or installed in a remote location if flammable solvents are processed. Equipment installed in a hazardous location (as defined by the fire code) should be approved by an independent testing laboratory to verify compliance with the National Electrical Code.
- Interlock features to prevent opening of the still until it has cooled to a safe temperature.

How are the solvent vapors condensed? Water is generally the simplest and least costly cooling medium. Air cooling can make sense, for example, when using very small units. Electric fan motors are generally not explosion-proof and their use should be carefully evaluated. While refrigerated chillers are an option, they are often too expensive.

Does your waste solvent contain nitrocellulose? Nitrocellulose is explosive when dry. Special precautions are required to distill materials containing nitrocellulose. Automotive lacquers, and flexographic and gravure inks can contain nitrocellulose. Contact MnTAP for more information.

Regulatory Overview

Recycling your hazardous waste on-site is allowed provided you take safety precautions. Most solvents are hazardous waste after they are used in industrial applications. This is because the solvents themselves have toxic or flammable properties, or they become contaminated during use, making the waste solvents hazardous. From the time the solvent is no longer used in a process until recycling occurs, companies need to comply with hazardous waste storage, labeling, transportation, and inspection requirements for the waste solvents and solvent containers.

Still bottoms may also be hazardous waste. If you distill an F-listed solvent, then the still bottoms are also an F-listed hazardous waste. If the solvent was a characteristic hazardous waste, such as by being ignitable or containing heavy metal contaminants, then the stillbottoms may not be hazardous waste. However, you must assume they are hazardous waste until you test and document that they are not. For the complete F-list of solvents, see Minnesota Pollution Control Agency (MPCA) hazardous waste fact sheet #2.00, F List of Hazardous Waste, available at <<http://www.pca.state.mn.us/publications/w-hw2-00.pdf>>.

Distilling on-site can significantly reduce your regulatory requirements if the recycling sufficiently lowers the hazardous waste volume which 'counts' towards your generator size. For each month, you must count only the maximum volume of the waste accumulated in that month prior to reclaiming the waste. If you distill your waste more frequently than once a month, you still need only count that maximum accumulated volume once for the month. Thus, the more frequently you reclaim smaller volumes of your waste and avoid accumulating it, the more the reduction of your 'counted' hazardous waste.

The weight of any hazardous waste still bottoms must still be added to your monthly 'counted' generation; however, this is usually only a very small weight. You may also subtract the still bottoms from the first distillation in the month from the amount of still bottoms you must count for that month. For step-by-step instructions for 'counting' the volume of hazardous waste reclaimed and reused on-site, see MPCA hazardous waste fact sheet #7.12, Recycled Hazardous Waste Report Form, available at <<http://www.pca.state.mn.us/publications/w-hw7-12.pdf>>.

Closed-loop recycling identifies distillation that is totally integrated into a primary industrial process where contaminants are removed as they accumulate. In a closed-loop system, wastes (other than still bottoms) are never removed from the process. Closed-loop recycling is strictly prescribed, and does not include secondary or ancillary process activities like parts washing. When appropriately identified, closed-loop recycling is preferred over other recycling methods because of efficiency, less material handling, and less exposure.

Additional Resources

The considerations listed above are some of the more important points to evaluate before purchasing a still. MnTAP maintains a list of small still manufacturers in its reference list Solvent Recycling Equipment [#15], available online at <mntap.umn.edu/metalfinish/resources/15-SolventRcylEquip.htm>.



For More Information

MnTAP has a variety of technical assistance services available to help Minnesota businesses implement industry-tailored solutions that maximize resource efficiency, prevent pollution, increase energy efficiency, and reduce costs. Our information resources are available online at <mntap.umn.edu>. Please call MnTAP at 612.624.1300 or 800.247.0015 for personal assistance.