A Guide for Choosing and Operating an On-Site Distillation Unit

The following guide outlines some important points your business should think about when choosing and operating a distillation unit to reclaim your solvent waste. Although spent solvents are often hazardous wastes, many contaminated solvents can be reclaimed, and then reused. Distilling solvents at a facility (on-site) is a common way to recycle solvents.

Before investing in a distillation unit, see if there is a simpler recycling process that can produce a useful recycled product, such as decanting, simple filtration, or centrifugation. For example, filtration is used to separate solvents from solid contaminants, whereas a still is used to distill miscible solvents or separate dissolved solids. Also, the amount and type of solvent you use is important when deciding if on-site recycling is a good idea for your business.

Before you purchase a still, answer the following questions:

- ***Can the distilled solvent be used again for the same process at your company?*** In many cases, solvent blends are used for cleaning and as components in paint, ink or adhesive formulas. If the solvents in the blend have a wide range of boiling points, distillation will yield a solvent that is different from the virgin blend, which may be unsuitable for the original use. Ask your solvent supplier if the solvent can be rebuilt. In other cases, contaminants that are not sufficiently removed can cause problems. For example, the breakdown of chlorinated degreasing solvents creates acids, and residual acid catalyzes the formation of more acid, which can result in the corrosion of 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 that may not be usable for any of the current solvent uses. Make sure that any procedure necessary to prevent the cross-mixing of different solvents can and will be followed by all employees. Also consider reducing the number of different solvents used, if possible.

- ***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 of vastly different molecular sizes, like a solvent and a polymer or resin, consider using membrane filtration to recover the solvent.

Pollution Prevention

Reduce your need to manage hazardous solvents by asking yourself the following questions:

- ***Is there a less toxic substitute?*** Before buying any solvent, check the Material Safety Data Sheet (MSDS), and try to choose a non-hazardous or less hazardous water based cleaner.

- ***Can I reduce the amount of solvent I use?*** Good housekeeping, preventive maintenance, proper waste management,

and inventory control practices help reduce solvent use.

- ***Can I use a filtration device when using the solvent?*** This can reduce the amount of solids and prolong the use of the solvent. For example, placing a mesh screen in the opening of a drum is one simple way to filter the solvent.

- ***Can I consolidate the different kinds of solvent I use and use only one solvent for several purposes? Is this solvent recyclable?***

Benefits

After deciding that an on-site distillation unit is right for your business, here are some of the potential benefits:

- Reduces the amount of hazardous waste generated and stored on-site
- Reduces your generator status and regulatory requirements
- Reduces the amount of virgin solvents you need to purchase
- Reduces long-term liability related to transporting spent solvents off-site for treatment and disposal.

Shop Around Before Choosing a Still

Questions to Ask Your Vendor

- ***Will the vendor distill a sample of my waste?*** This can help you evaluate the quality of the reclaimed product and determine what percentage of the initial waste can be successfully recovered.

- ***Can I easily set the still up at my facility?*** Before you can operate the still, you need to identify any special installation requirements such as electrical, water, or a fireproof room.

- ***Will the vendor provide operator training and a training manual?*** This will help ensure that the employee assigned to the unit has the skill to operate it safely and correctly.

- ***What kind of maintenance is required?*** Make sure the maintenance procedures are written down in a manual and provided by the vendor.
- ***Do I need to keep the different types of solvent separated?*** If the answer is yes, make sure the employees understand the solvent separation procedure.

- ***Are the still bottoms easily removed from the pot and how will I dispose of them? 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 them from the still. High solids can also coat and insulate the still's heating surfaces. This causes the distillation to take more time and may cause hot spots and chemical decomposition. This type of waste may require that you use still liners for smaller units, or a still with an automated surface scraper (scraped-surface still) for larger applications.

- ***Will the unit need a vacuum?*** A vacuum unit lowers the boiling temperature. If you have large volumes of solvent with high boiling points to distill, a vacuum unit can make recovering the solvent more energy efficient. A vacuum unit can also be used to avoid problems when distilling compounds that are heat sensitive.

  Vacuum units are more expensive than atmospheric units. Ask your vendor if a vacuum unit is needed for your solvent and what level of vacuum will provide the best solvent recovery.

- ***What kind of condenser will I need?*** Choosing the right condenser depends on the type of solvent you are distilling. A still boils solvent into vapors by adding heat. The condenser then removes that heat from the vapors to form a liquid again. An inadequate condenser will only condense a portion of the vapors, thereby allowing the uncondensed vapors to escape to the atmosphere.

In some cases, an air-cooled condenser may be adequate. However, these condensers are not as effective as water-cooled condensers in controlling the solvent vapor temperature. Water-cooled equipment delivers a higher, more consistent condensation than air-cooled equipment. Water-cooled condensers are generally more efficient and provide more consistent solvent recovery year-round.

- ***Will the solvent deteriorate any components of the still with extended use?*** Use a still built with components that are compatible with your solvents.

- ***Can I upgrade my existing still?*** Your vendor may be able to repair, modify, or upgrade your existing distillation unit. Remember, switching to a newer or more efficient piece of equipment may be the most cost effective solution in the long run.

- ***Do you have a customer user list, referrals, and/or a letter of recommendation?***

Safety Features

By asking your vendor a few additional questions you will help secure the health and safety of your employees.

- Will the still automatically shut down in case of water failure, in case the pot exceeds a safe operating temperature, or in case the condenser water goes above a preset temperature?
- Does the still have a pressure relief valve that will activate in cases of extreme pressure?
- Can the unit sense when all the solvent has been distilled and only contaminants are cooking?
- For flammable solvents, is an explosion-proof electrical still available?
- Does the unit have a feature to prevent the pot's lid from opening until the contents have cooled to a safe temperature?
- Will the vendor provide operator safety training?
- **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.*

Getting The Most Out Of Your Still

How to Recover a Quality Solvent

- Distill different types of solvents separately, and do not mix different types of spent solvents in the same container.
- Do not contaminate the solvents with water.
- Make sure the distillation unit has the proper temperature range, capacity, and processing time for the solvent you want to recycle.
- Low solids in the material to be distilled will help the still operate efficiently. High solids insulate the heat source from the solvent and reduce the efficiency of the recovery.
- If the reclaimed solvent cannot be used in the original process, look for alternative uses such as cleaning painting equipment. Mixing pure solvent with recovered solvent will probably not return the recovered solvent to its original effectiveness.
- The success of your solvent recycling program may depend on having an individual dedicated to supervising and initiating the operation. Remember, an employee responsible for collecting, recycling, and ensuring that the solvent is reused will make your program a success.

Reducing Still Bottoms

Still bottoms should be minimized by filtering out solids before distillation, if possible, and operating the still in such a way that the maximum amount of solvent is recovered.

In some cases, still bottoms can be reused in the manufacturing process. Consider the still bottoms for possible reuse before discarding them as waste. For example, the still bottoms from fiberglass may be used for filler in certain

applications. Also, some vendors can recycle the still bottoms from paints and inks.

Complying with the Hazardous Waste Regulations

Regulatory Reminder

You are legally and financially responsible for properly handling your wastes.

Hazardous wastes are regulated until they actually enter the recycling process. Before the spent solvent enters the still, you are responsible for complying with the regulations on proper accumulation, handling, transportation, and storage for hazardous waste.

While the useful solvent reclaimed from the distillation unit is not regulated as a hazardous waste, most residues or still bottoms coming from the distillation of substances such as spent paints, fiberglass acetone, or ink are regulated as hazardous waste.

Counting Spent Solvents and Determining Generator Status

Generators who reclaim spent materials at their facility must follow these requirements:

1. Maintain a log book to document the amount of:
    a. Spent solvent processed
    b. Solvent reclaimed
    c. New solvent used
    d. The weight of the still bottoms generated.

2. Determine the amount of hazardous waste generated by adding the following materials together once a month:
    a. The initial spent materials (solvent) generated, reclaimed, and to be reused
    b. All residuals, sludges, and filters from the reclamation processes
    c. Solvent added during the month to the original stock in order to make up for losses in the reclamation system from evaporation or mishandling.

Local Requirements

Talk to your Fire Department— They may require a still that is listed by Underwriters Laboratory or approved by Factory Mutual. Also, check the building and fire codes of the local County or City Fire Department.

Consider a Lease

Small businesses may be able to lease solvent recovery equipment for less than their current cost of disposal. Then they can use the savings from reduced solvent purchases in other areas of business operation.

COST-BENEFIT ANALYSIS

There are obvious and not-so-obvious costs and savings to look at when considering a still. The most obvious cost is the price of the still, and the most obvious savings are the reduced disposal fees. For a more accurate analysis you should take into account, at a minimum:

- Capital
- Installation
- The operation and maintenance
- Raw materials
- Disposal costs.

EXAMPLE PAYBACK ANALYSIS

The following example is an analysis of how to use payback when considering whether to purchase a still. For the purposes of this example, we made the following assumptions:

- 20% solids in the waste solvent
- A 3 kWh distillation unit
- A generation rate of 5 gallons of solvent/day (24 drums/yr.)
- 3 batch/week frequency

Assumed Costs

Distillation Unit	$6,000
Power	$0.061/kWh
Installation	$1,700
Labor rate	$20/hour
Disposal	$200/drum solvent
Labor for still (1 staff-hour per batch)	$350/drum still bottoms
Labor for maintenance	0.5 hours/week
Raw solvent	$4.50/gallon

Initial Capital Investment

Distillation Unit	$ 6,000
Installation	$1,700
Total Capital Investment	$ 7,700
Annual Savings; Raw solvent savings	$ 4,752
Current disposal (24 drums)	$4,800
Disposal after installation (3 drums)	$(1,050)
Total Annual Savings	**$ 8,502**

Annual Costs

Operation	$ 3,640
Utilities	$228
Total Annual Costs	$(3,868)
Net Annual Savings	$ 4,634
Payback period (approximately 2 years)	$7,700 Capital Costs
Annual savings	**$4,634**

COST WORKSHEET

Waste Solvent Generated

(A) Gallons per year: Gal/day x No. of working days/year =

(B) Drums per year: Gals/yr. (A) ÷ 55 (gals/drum) =

Capital Costs

(C) Recovery Unit Cost =

(D) Installation Cost (include materials and labor) =

(E) Total Capital Costs: (C + D) =

Annual Savings in Disposal

(F) Current Disposal Cost: drums/yr. (B) X $/drum =

(G) Future Disposal Cost: % solids x drums/yr. (B) x /drum solids =

(H) Net Savings for Disposal: (F - G) =

Annual Savings in Raw Solvents

(I) Gals/yr. (A) x % liquid x $/gal new solvent =

Annual Operating Costs

(J) Operation Labor: hours/week x rate/hr x 52 weeks/yr. =

(K) Maintenance Labor: hours/week x rate/hr x 52 weeks/yr. =

(L) Power Costs: Power req'd (kWh) x operating hrs/yr. x $/kWh =

(M) Water and Sewer if needed =

(N) Total Operating Costs: (J + K + L + M) =

Net Annual Savings

(O) Disposal and solvent savings less operating costs: (H + I) - M =

Projected Payback Period

(P) Capital Costs (E) divided by Net Annual Savings (O): (E/O) =

For more information contact:
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