
The Waste-Paper

The Hazardous Waste Disposal Monthly Update

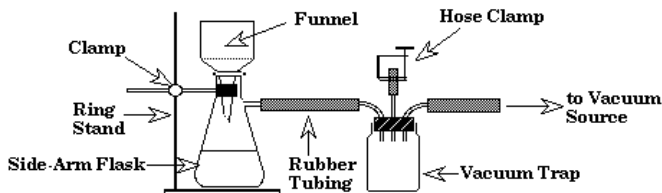
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Vacuum Trapping

When using a vacuum source, it is important to place a trap between the experimental apparatus and the vacuum source. The vacuum trap protects the pump and the piping from the potentially damaging effects of the material; protects people who must work on the vacuum lines or system, and prevents vapors and related odors from being emitted back into the laboratory or system exhaust.

There have been incidents at Princeton where improper trapping caused vapor to be emitted from the exhaust of the house vacuum system, resulting in either re-entry into the building or potential exposure to maintenance workers. Unfortunately, this type of incident is not the worst that can happen. Two years ago, at the University of California - Davis, two plumbers were badly injured when a house vacuum line burst after one of the plumbers attempted to solder a fitting on the copper line. Results of analysis found evidence of copper perchlorate (an oxidizer) and acetate, which created an explosive mixture upon heating by the torch.



Proper Trapping Techniques

To prevent contamination, all lines leading from experimental apparatus to the vacuum source should be equipped with filtration or other trapping as appropriate.

- For **particulates**, use filtration capable of efficiently trapping the particles in the size range being generated.
- For most **aqueous or non-volatile** liquids, a filter flask at room temperature is adequate to prevent liquids from getting to the vacuum source.
- For **solvents and other volatile liquids**, use a cold trap of sufficient size and cold enough to condense vapors generated, followed by a filter flask capable of collecting fluid that could be aspirated out of the cold trap.

- For **highly reactive, corrosive or toxic gases**, use a sorbent canister or scrubbing device capable of trapping the gas.

For most volatile liquids, a **cold trap** using a slush of dry ice and either isopropanol or ethanol is sufficient (to -78°C). Avoid using acetone. Ethanol and isopropanol are cheaper and less likely to foam. Liquid nitrogen may only be used with sealed or evacuated equipment, and then only with extreme caution. If the system is opened while the cooling bath is still in contact with the trap, oxygen may condense from the atmosphere and react vigorously with any organic material present.

For more information on vacuum trapping, please contact Robin Izzo (rmizzo@princeton.edu or 8-6259).

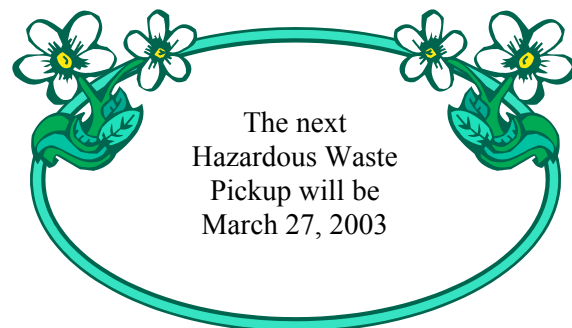
State Waste Inspection

The NJDEP may conduct an unannounced inspection of chemical waste activities this year. As a reminder, per University policy, fines received for operations within a particular laboratory or work area are charged back to the offending department.

Please make an extra effort to ensure that your work area is in compliance, especially:

- All waste containers must be labeled as to their contents and with the words "Hazardous Waste", preferably using a yellow waste sticker.
- All containers must be sealed except when filling. No funnels may be left in open containers.

Please contact Steve Elwood at 258-6271 or selwood@princeton.edu for more information or for an inspection.



Solvent Purification

High purity, experimental-grade solvents are a necessity in many of the University's laboratories. Many organic and organometallic reactions require solvents free of water and, sometimes, free of oxygen. Historically, solvent purification was accomplished through thermal distillation and solvent refluxing. To scavenge the water and oxygen contaminants, this reflux procedure is performed with highly flammable sodium or potassium metal and benzophenone. There have been countless "still" fires throughout the chemistry world and indeed some right here at Princeton.

The fire risk arises through the use of heating mantles, which present a spark fire risk and potential ignition source during the thermal distillation process. In the average organic chemistry laboratory, several liters each of four or five different "purified" solvents are required per day to meet the experimental demand. This poses an obvious fire hazard due to the fact that many liters of solvent must be allowed to reflux for long periods of time, more often than not unattended.



EHS has recently supported an effort to replace the thermal units in one chemistry laboratory with a new solvent purification system that does not utilize heating the flammable liquids in the presence of sodium or potassium. The new systems are comprised of refillable stainless steel "kegs" that the solvent is received in and that act as the solvent reservoir. Dry argon is used to force solvent over packed columns that contain activated alumina (water-scavenging) and copper catalyst (oxygen-scavenging). The solvent is drawn out of the system by evacuating a delivery flask via house vacuum. The system operates at ambient temperature, so there is no heat source posing a fire risk.

Though the column-absorption system is indeed much safer, not everyone in the chemistry world is lining up to purchase this new technology. The main

reason is for not changing to the new technology is the significant initial cost to replace the thermal stills, generally \$4,000 to \$5,000 per solvent line. In addition, the cost to replace spent columns is approximately \$200. However, it is estimated that hundreds of liters of solvent can be purified per column using the new solvent purification systems. The cost associated with the system purchase can be recovered through cost reduction in several areas.

Assuming an average chemistry lab runs four solvent lines, the following costs can be attributed to the equipment associated with thermal distillation.

Compressed Gas (annual)	240
Glassware	1,920
Heating Mantles	600
Stand, arms, clamps	700
Total	\$3,460

The laboratory is aware of the costs paid directly through departmental budget; however, a significant cost is also paid by the University in electricity and other utilities. The efficient nature of the new solvent purification systems generate utility cost savings. Additionally, the intrinsically safe properties of the system allow it to be setup virtually anywhere in the laboratory; thus, eliminating the operating costs associated with a chemical fume hood. The annual utility cost savings provided by the system is approximately \$3600.

Another favorable result is the considerable reduction in hazardous waste. For thermal stills, it is common to generate 200 – 400 ml of waste contaminated solvent per week, per solvent line. That number is now reduced to less than 10 ml. This translates to an annual reduction of 55 gallons of solvent purchased and equal amount of hazardous waste minimization. Considering the costs of both the new solvent and waste solvent, an annual savings of \$400.00 is attainable.

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