

101 Ways to Reduce Hazardous Waste in the Laboratory

1. Write a waste management/reduction policy.
2. Include waste reduction as part of student/employee training.
3. Use manuals such as the American Chemical Society's (ACS) "Less is Better" or "ACS Waste Management Manual for Laboratory Personnel" as part of your training.
4. Create an incentive program for waste reduction.
5. Centralize purchasing of chemicals through one person in the laboratory.
6. Inventory chemicals at least once a year.
7. Indicate in the inventory where chemicals are located.
8. Update inventory when chemicals are purchased or used up.
9. Purchase chemicals in smallest quantities needed.
10. If trying out a new procedure, try to obtain the chemicals needed from another laboratory or purchase small amounts initially. After you know you will be using more of these chemicals, purchase in larger quantities (unless you can obtain excess chemicals from someone else).
11. Date chemical containers when received so that older ones will be used first.
12. Audit your laboratory for waste generated (quantity, type, source, and frequency).
13. Keep MSDSs for chemicals used on file.
14. Keep information about disposal procedures for chemical waste in your laboratory on file.
15. If possible, establish an area for central storage of chemicals.
16. Keep chemicals in your storage area except when in use.
17. Establish an area for storing chemical waste.
18. Minimize the amount of waste kept in storage.
19. Label all chemical containers as to their content (even those with only water).
20. Develop procedures to prevent and/or contain chemical spills—purchase spill cleanup kits, contain areas where spills are likely to occur.
21. Keep halogenated solvents separate from non-halogenated solvents.
22. Keep recyclable waste/excess chemicals separate from non-recyclables.
23. Keep organic wastes separate from metal-containing or inorganic wastes.
24. Keep nonhazardous chemical wastes separate from hazardous waste.
25. Keep highly toxic wastes (cyanides, etc.) separated from the previous groups.
26. Avoid experiments that produce wastes that contain combinations of radioactive, biological and/ or hazardous chemical waste.
27. Keep chemical wastes separate from normal trash (paper, wood, etc.).
28. Use the least hazardous cleaning method for glassware. Use detergents such as Alconox, Micro, RBS35 on dirty equipment before using KOH/ethanol bath, acid bath or No Chromix.
29. Eliminate the use of chromic acid cleaning solutions altogether.
30. Eliminate the use of uranium and thorium compounds (naturally radioactive).
31. Substitute red liquid (spirit-filled), digital, or thermocouple thermometers for mercury thermometers where possible.
32. Use a bimetal or stainless steel thermometer instead of mercury thermometer in heating and cooling units. Stainless steel laboratory thermometers may be an alternative to mercury thermometers in laboratories, as well.
33. Evaluate laboratory procedures to see if less hazardous or nonhazardous reagents could be used.
34. Review the use of highly toxic, reactive, carcinogenic or mutagenic materials to determine if safer alternatives are feasible.
35. Avoid the use of reagents containing: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. Consider the quantity and type of waste produced when purchasing new equipment
37. Purchase equipment that enables the use of procedures that produce less waste.
38. Review your procedures regularly (e.g. annually) to see if quantities of chemicals and/or chemical waste could be reduced.
39. Look into the possibility of including detoxification and/or neutralization steps in laboratory experiments.
40. When preparing a new protocol, consider the kinds and amounts of waste products and determine whether they can be reduced or eliminated.
41. When researching a new or alternative procedure, include consideration of the amount of waste produced as a factor.
42. Examine your waste/excess chemicals to determine if there are other uses in your laboratory. Neighboring laboratories, departments or non-laboratory areas (garage, paint shop, art department) might be able to use them.
43. Review the Chemical Exchange inventory on <http://www.pp.utk.edu/ChemInv/default.htm> to review the list of chemicals that EHS has stored under the Chemical Exchange program.
44. Contact EHS if you have unused chemicals to add to the Chemical Exchange program, or if you would like to obtain a chemical from the exchange.
45. Call the chemical recycling coordinator to discuss setting up a locker or shelf for excess chemical exchange in a laboratory, stockroom or hallway in your department.
46. When solvent is used for cleaning purposes, use contaminated solvent for initial cleaning and fresh solvent for final cleaning.
47. Try using detergent and hot water for cleaning of parts instead of solvents.
48. Consider using ozone treatment for cleaning of parts.
49. Consider purchasing a vapor degreaser, vacuum bake or bead blaster for cleaning of parts.

50. Reuse acid mixtures for electropolishing.
51. When cleaning substrates or other materials by dipping, process multiple items in one day.
52. Use the smallest container possible for dipping or for holding photographic chemicals.
53. Store and reuse developer in photo laboratories.
54. Precipitate silver out of photographic solutions for reclamation.
55. Neutralize corrosive wastes that don't contain metals at the laboratory bench.
56. Deactivate highly reactive chemicals in the hood.
57. Evaluate the possibility of redistillation of waste solvents in your laboratory.
58. Evaluate other wastes for reclamation in your laboratory.
59. Scale down experiments producing hazardous waste wherever possible.
60. In teaching laboratories, consider the use of microscale experiments.
61. In teaching laboratories, use demonstrations or video presentations as a substitute for some student experiments that generate chemical wastes.
62. Use pre-weighed or pre-measured reagent packets for introductory teaching laboratories where waste is high.
63. Include waste management as part of the pre- and post-laboratory written student experience.
64. Encourage orderly and tidy behavior in laboratory.
65. Use the following substitutions where possible:

Original Material	Substitute	Comments
Acetamide	Stearic Acid	In phase change and freezing point depression
Benzene	Alcohol	
Benzoyl Peroxide	Lauryl Peroxide	When used as a polymer catalyst
Carbon Tetrachloride	Cyclohexane	In test for halide ions
Chloroform	1,1,1-trichloroethane	
Chromic Acid cleaning solutions	Alconox, Micro, Pierce RBS-35, or similar detergents	In glassware cleaning
Formaldehyde; Formalin	"Formalernate" or Ethanol	For storage of biological specimens
Halogenated Solvents	Non-Halogenated Solvents	In parts washers and other solvent processes
Mercuric Chloride Reagent	Amitrole (Kepro Circuit Systems)	Circuit Board Etching
Mercury Salts	Mercury-free catalysts (Copper Sulfate, Potassium Sulfate, Titanium Dioxide)	Kjeldahl digests
Mercury Thermometers	Mineral Spirit dilled, stainless steel, bimetal, digital	
Mercuric Chloride (biocide)	5-10% Methylene Chloride, 1 % Formalin; 1 N Hydrochloric acid, Sodium Hypochlorite	
Sodium Dichromate	Sodium Hypochlorite	
Sulfide Ion	Hydroxide Ion	In analysis of Heavy Metals
Wood's Metal	Onion's Fusible Alloy	
Xylene or Toluene	Simple Alcohols and Ketones	
Xylene or Toluene	Non-Hazardous Proprietary Liquid scintillation	In radioactive tracer studies

Original Material	Substitute	Comments
Scintillation Vials	cocktails	

84. Use best geometry of substrate carriers to conserve chemicals.
85. Polymerize epoxy waste to a safe solid.
86. Consider using solid phase extractions for organics.
87. Put your hexane through the rotavap for reuse.
88. Destroy ethidium bromide using household bleach.
89. Run mini SDS-PAGE 2d gels instead of full-size slabs.
90. Treat sulfur and phosphorus wastes with bleach before disposal.
91. Treat organolithium waste with water or ethanol.
92. Seek alternatives to phenol extractions (e.g. small scale plasmid prep using no phenol may be found in *Biotechnica*, Vol. 9, No. 6, pp. 676-678).
93. Collect metallic mercury for reclamation.
94. Investigate possibility for recovering mercury from mercury containing solutions.
95. Recover silver from silver chloride residue waste and gold from gold solutions.
96. Purchase compressed gas cylinders, including lecture bottles, only from manufacturers who will accept the empty cylinders back.
97. When testing experimental products for private companies, limit donations to the amount needed for research.
98. Return excess pesticides to the distributor.
99. Be wary of chemicals donations from outside the University. Accept chemicals only if you will use them within 12 months.
100. Replace and dispose of items containing polychlorinated biphenyls (PCBs).
101. Send us other suggestions for waste reduction by campus mail or email to: Environmental Health and Safety, 916 22nd Street, or safety@utk.edu.

Source: *Pollution Prevention and Waste Minimization in Laboratories*, by Peter A. Reinhardt, K. Leigh Leonard and Peter C. Ashbrook