SECTION I INVENTORY OF HAZARDOUS CHEMICALS ON CAMPUS

Introduction - Michael Duke

A bottle containing a toxic chemical is delivered to the UC Berkeley campus. The bottle is vacuum sealed and securely packed in a box and is basically harmless. There is very little chance for the chemical inside to do harm.

Then the bottle comes to the laboratory, where it is opened and used, and suddenly the risks of accident and the opportunities for misuse greatly increase. The bottle can leak, break, or spill. It could be mislabeled or not labeled at all, causing confusion with possibly disastrous results. It could be improperly stored, increasing the chance of an unwanted reaction with another chemical. In addition, the chemical could be disposed of inappropriately - into the public waste stream instead of being properly handled by trained technicians.

Any or all of these possibilities present danger in the laboratory, campus or even the community, and laboratory personnel are responsible for ensuring that none of them occur.

This section represents the combined effort of several students to analyze the chemical inventories, safety and storage techniques, and hazardous waste disposal activities in some of the laboratories at UC Berkeley. By assessing in detail the present inventory, storage, and safety practices in a few of the laboratories, in addition to surveying the awareness and needs of the laboratory personnel, we hope to get a general idea of the complexities involved in strengthening our present waste disposal program. Dealing with hazardous substances is a complex problem. Thus, before presenting the individual papers, we explain our general methodology, as well as some of the problems encountered in researching such a sensitive topic. For the uninitiated, we offer a quick hazardous substances primer.

Perceptions of attitudes encountered - John T. Barnard

During the course of our projects, we encountered different reactions from the people we approached, giving us the impression hazardous materials management is inconsistent and a source of confusion. Some lab personnel felt hazardous materials management was an individual researcher's responsibility, whereas others felt departments or other groups such as Environmental Health and Safety should take a more active role in managing these materials.

Many of those we approached were obliging and showed great interest in our study, allowing us access to their labs and personnel. Their cooperation and assistance made this group's projects possible. In general, they were aware of the importance of hazardous materials management, and responses such as "I'm too busy with my research" or "It's too far out of my way to do that" were encountered infrequently. However, many lacked specific knowledge of proper management techniques. We feel most of these researchers would establish or update their materials management programs, given the information and resources to do so.

Disposal Procedures - Janine Young

Proper disposal of chemical waste is important for safety and waste reduction because the chances of human injury are decreased. Without disposal guidelines, chemicals of incompatible hazard classes could mix, resulting in fires, explosions, carcinogenic fumes, or a combination of the three. Therefore, knowing types of chemicals that can be disposed of through the sewer, how properly to package waste that must be disposed of through EH&S, and how to identify unknown liquids or solids for proper disposal should be required by all laboratory personnel.

Trash Disposal: Only non-hazardous dry materials, such as sugars and powdered detergent, may be put into the trash. In other words, absolutely no hazardous solvents or solids should be placed into the trash bins located around campus. As a constant reminder of this golden rule, EH&S has placed labels on almost all of the campus' trash bins (figure 1).

Drain Disposal of Chemicals: Restriction of chemical disposal to sewers is required because some chemicals can interfere with the functioning of sewer treatment facilities; others react with water to create hazards of fire, explosion, and air pollution; and some can corrode the drain system (NRC, 1983). For this reason, wastewater treatment plants regulate chemical types and concentrations according to the capabilities of the plant. East Bay Municipal Utilities District (EBMUD) is the water and sewage plant which governs UC Berkeley.

At the present, EBMUD allows the University to dispose of a few hazardous substances (in low concentrations) through the sewers. This is allowed because when these substances mix with the city's effluent, they will be in harmless, nontraceable amounts. Furthermore, the sewage treatment procedures will remove some of the chemicals. Solutions of inorganic salts, some organic compounds, protein solutions, sugars, liquid detergents, acids and bases with strengths between pH 2.5 and pH 12.5 can be deposited into the sinks providing the chemicals are in dilute concentrations.

To insure that these chemicals are diluted, some labs mix the solutions in water then pour the dilute solution down the drain with the faucet running more water. When dealing with acids, another lab first plugs the drain, pours the acid into the basin, and adds sodium bicarbonate to neutralize the acid . Finally, large amounts of water are added and the drain is unplugged (the faucet is left running during this step).

Packing Chemicals for EH&S Pick Up: Chemicals that must be disposed of in landfills must be picked up by the campus' Environmental Health & Safety department (EH&S). EH&S, however, will not pick up any chemicals from any lab that are not properly packaged and labelled. The following are EH&S requirements for pick up:

First, each container to be disposed of must be labelled as to content, amount, and physical state. In addition, only compatible chemicals can be boxed together for transport, and a packing list must be filled out for each box describing the contents. If the chemical to be disposed of is an unknown, the laboratory or responsible department must "make every effort" to identify it.

Secondly, glass bottles must have screw caps, and be boxed and cushioned so that they do not break. The boxes must be sturdy and large enough that bottle necks do not protrude. Dry waste should be in its own container, and glass and needles should be packed safely.

Finally, once the chemicals and contaminated instruments are separated into compatible groups, identified, labelled, and packed they are ready to be picked up by EH&S. Generally, a department will collect waste from several labs since EH&S does not have the resources to pick up waste from individual laboratories (Dave Belk, pers. comm., 1988). EH&S will then pick up waste from a previously acknowledged location, usually about five days after a request. Someone must be on hand to answer questions the EH&S technician might have.

Individual labs are asked to label and package their chemicals because EH&S is a very small department. It simple does not have the manpower to go through every container, decipher its contents for the Manifest form, and then package the chemical waste. Furthermore, proper packaging prevents EH&S' personnel from being punctured by contaminated bottles, needles, and other instruments.

Identifying Unknowns: Unknown bottles of chemicals and solutions are produced often in the labs. A common practice in laboratories, for instance, is to pour chemicals from large containers into small containers. Many chemicals are sold in two or four liter containers. These containers are very heavy to manage so lab personnel pour the chemicals into smaller flasks or beakers. Since there is a constant inflow and outflow of students and visiting researchers, labs will begin to store many small containers of unknown chemicals. Another way unknowns are produced is by labels falling or deteriorating off of bottles. In either case, the lab will eventually face the difficult task of disposing of these unknown chemicals.

At the present time, there isn't a department that handles unknowns for the campus. EH&S cannot manage the task because they are too small. It is the lab's responsibility to identify their unknown. Unfortunately, only a few labs have the experience to identify unknowns. One lab, for example, follows a set of procedures that identify unknowns by observing smells, colors, pH, and performing small tests within the lab. Another lab, however, found someone from another department that had experience in working with unknowns. Once the unknown becomes known, the lab should know how to dispose of the chemical properly (through the trash, by packing, or through the drains).

Figure 1. Labels Placed on Trash Bins

Source: Belk, pers. comm., 1988

The Legislative Background for the Inventory

-Geraldine M. Tolentino, Johan Wohlleben

In 1986, in response to legislative pressure, U.C. Chancellor Ira Michael Heyman established a Hazardous Waste Management Policy (Heyman, 1986) which binds all campus employees. In his declaration, Heyman outlines the following responsibilities:

1. Lab employees must observe all hazardous waste management procedures including storage, safety, emergency, and disposal aspects;

2. Individual departments must develop and enforce management practices applicable to their field; and

3. Environmental Health and Safety (EH&S) is designated as the university agency responsible for:

   a. providing information to campus personnel,
   b. developing hazardous waste disposal techniques, and
   c. maintaining and evaluating all management activities.

Underlying each of these responsibilities is current state and federal legislation. In California, state regulations are usually stricter than federal regulations. Like most institutions, and specifically, as a state-run institution, UC Berkeley must comply with the stricter state regulations; city and county regulations do not apply, although the East Bay Municipal Utilities District (EBMUD) does dictate what hazardous wastes the University may dispose of through the drains.

However, state regulations are based on federal law and must at least meet federal standards. The Resource Conservation and Recovery Act (RCRA) of 1978 is the backbone of hazardous waste legislation, for it defines the characteristics of hazardous substances and requires that all hazardous wastes and substances on the U.S. Environmental Protection Agency's (EPA) hazardous waste list in the Code of Federal Regulations (CFR), Title 40, Part 261, Section 32-33, be tracked from the point of origin (the lab) to the final disposal site (the landfill). Toxic and radioactive substances are listed under Title 29 and Title 10, respectively.

Under RCRA, a generator is defined as any industry that produces over 1000 kilograms of hazardous wastes. U.C.Berkeley produces over 1000 kilograms of hazardous waste per month and therefore is defined as a generator of hazardous wastes by RCRA and must comply with RCRA's Uniform Hazardous Waste Manifest policy. The manifest is a form which must be filled out by the generator when disposing of regulated material. It must include the disposal facility's EPA identification numbers and addresses and a list of all wastes to be disposed, identified by the Department of Transportation (DOT) codes under Title 49 of CFR.

The federal government, concerned over health and environmental dangers posed by hazardous substances, has gone one step further to protect the health of its citizens and the environment with the ratification of the Superfund Amendments and Reauthorization Act (SARA) of 1986. SARA is important because it not only includes hazardous wastes, but also hazardous materials. (The government is concerned with hazardous materials because these materials, such as hazardous chemicals in the lab, may later be discarded to become waste.) Under Title III, Subtitle B, SARA requires that a facility with hazardous chemicals on site provide an estimate of the chemical types, both in daily and in annual quantities present, and the general location of these substances. Thus, the University should develop an efficient lab inventory system.

The Hazardous and Solid Waste Amendments (HSWA) to RCRA in 1984 require that all hazardous substances and wastes be stored in a manner which minimizes risk to workers and the environment. The EPA identification numbers of the generator and its disposal facilities, and particularly, a report on the nature and quantity of hazardous wastes generated by the generator (i.e. the University), must be submitted to the EPA biennially (Knox, 1986). These regulations greatly increase the active role of the laboratory in waste management procedure.

These federal regulations are broad outlines of waste management, whereas the state regulations apply specifically to the proper and safe storage of hazardous substances. The California Occupational Safety and Health Administration's (CalOSHA) list of hazardous and carcinogenic substances are found in the California Administrative Code (CAC). CAC Title 8 treats the storage of chemicals by hazard class (and in some cases, lists specific chemicals) and suggests proper storage techniques for each class. CAC Titles 19, 24, and 26 address the standards for building codes, general storage and fire safety. In addition, the Uniform Fire Code (UFC), and the State Fire Code offer minimum standards for equipment in rooms, such as storage cabinets and fire extinguishers, in order to provide proper storage and fire safety.

Hazard Class and Incompatibility - Ellen E. Dehr

Some chemicals will react violently or generate highly toxic fumes when mixed. They are said to be incompatible. Therefore, stored chemicals should be separated into groups of chemicals with similar properties to prevent dangerous reactions should a spill occur. Chemicals must also be separated by hazard class for proper disposal with the Office of Environmental Health and Safety (EH&S). Therefore, storing chemicals within these groups makes the process of disposal easier.

There are different ways of classifying hazards. The Department of Transportation (DOT) classes are widely used for both transportation and final disposal. However, we chose to use the EH&S hazard classes in the inventories because the definitions are simpler and because laboratories on campus are more likely to deal with EH&S than with DOT. After completing the inventories, the group realized that this was a poor choice, as most references use the DOT or similar classes.

EH&S (1986) divides chemicals into the following hazard classes:

Flammables and Combustibles: materials which burn vigorously and persistently. Fire and explosion hazard.

Corrosives: strong acids, bases and dehydrating agents. Burn human tissue. Will react with flammables and combustibles.

Toxics and Poisons: can cause injuries or lethal effects from overexposure. Usually safe if kept in original containers.

Compressed Gasses: highly reactive. Danger of fire or explosion. Cylinders are potential bombs or rockets if knocked over.

Oxidizers: react violently with water, fire and combustible materials. Decompose to yield oxygen under certain conditions. Should be kept away from flammables.

Peroxide-forming Chemicals: when used after expiration date, these chemicals can explode. Extremely dangerous and should never be stored in quantities that will remain unused after expiration date.

Cryogens: extremely cold chemicals. Freeze material on contact, including human tissue. Have properties and hazards similar to compressed gasses.

Pyrophoric Substances: ignite spontaneously on contact with air.

Water Reactives: react with water to produce flammable or toxic gasses.

It is important to realize that these hazard classes are general and that there are incompatible chemicals within these classes. For example, acids and bases are both corrosive, but strong acids and bases can cause a fire when mixed and should be stored separately. Also, chemicals may have properties of more than one hazard class. One chemical may be toxic and flammable. Therefore, on the shelf of flammables, one side should be for chemicals that are also toxic.

Assigning an overall hazard class to chemicals with multiple hazards is not only a problem for storage, but a problem for inventory as well. CFR 49 states that materials having more than one DOT hazard be classed according to the following order of hazards: Radioactive Materials, Poison A, Flammable Gas, Nonflammable Gas, Flammable Liquid, Oxidizer, Flammable Solid, Corrosive Material (liquid), Poison B, Corrosive Material (solid), Irritating Material, Combustible Liquid (over 110 gallons per container), ORM-B, ORM-A, Combustible Liquid (110 gallons or less per container), ORM-E. However, there is no such information for the EH&S hazard classes. Therefore, in classifying the chemicals inventoried for these reports, we had to decide our own order of hazards using the order given by DOT. Generally, compressed gasses take top priority, then peroxide-formers, flammables, corrosives, and toxics.

It is obviously important to know the properties of the chemicals one stores and uses. Although some manufacturers now put this information on the label, many do not. In the latter case, information on the hazards and compatibilities of a chemical can be found on the Material Safety Data Sheet (MSDS) supplied by the distributor or manufacturer and available at EH&S. The MSDS's should be kept in the laboratory. If the hazard class is not given on the MSDS, consult Council of State Science Supervisors (1984) , CFR 49, or Sax (1975). These references list most hazardous substances and their hazard classes.

References

Code of Federal Regulations (CFR), Title 49; Washington, D.C., Superintendent of Documents, U.S. Government Printing Office.

Council of State Science Supervisors (CSSS), 1984. *School science laboratories: a guide to some hazardous substances;* Washington, D.C., U.S. Consumer Product Safety Commission, 60p.

Office of Environmental Health and Safety (EH&S), 1986. *A guide to the safe storage of laboratory chemicals;* Berkeley, University of California, Office of Environmental Health and Safety, 31p.

Sax, N.I., 1975. *Dangerous properties of industrial materials;* New York, Van Nostrand Reinhold Company, 1258p.

Principles of Safe Storage - Stephen Lee

The safe storage of hazardous chemicals can be a difficult task because laws and regulations deal in generalities, government agencies have differing schemes of chemical classification, and laboratory personnnel are ignorant of dangerous storage practices. What follows is a set of safe storage principles, which should be considered in laboratories needing improved safety.

The first goal is to establish an inventory and labelling system. This will enable personnel to avoid over-stocking a seldom-used chemical, as well as provide a means to keep track of chemicals with short storage lives. All containers should be labelled with adequate information – even to the point of supplementing manufacturers' labels.

Storage areas should be kept clean and organized. This means passageways should be kept clear, cabinets and shelves storing hazardous chemicals should be clearly identified with warning signs, and emergency equipment (such as fire extinguishers and neutralizing agents) should be placed in convenient locations. Storage areas should be well lit, appropriately ventilated, and kept at a moderate temperature. Inspections of storage areas should be made at regular intervals, especially for hazardous chemicals which need special storage precautions.

All hazardous chemicals should be stored in a cabinet or shelf with rim guards to help lessen the impact of an earthquake or fire. The type of cabinet or shelf to use depends on the type of chemical being stored. A corrosive chemical, for example, should not be stored on metal shelves because the potential for shelf corrosion still exists. If a cabinet is used, however, it may have to meet state specifications for storage cabinets (in California the specifications are found in Title 8, Section 5533 of the California Administrative Code). Chemicals should not be stored in a fume hood because this will "restrict performance by reducing work space and by obstructing air flow, so that velocities may be too low to retain toxic materials within the unit" (Steere, 1971). Cabinets or shelves housing liquid chemicals should be lined with plastic trays to catch accidental spills. If liquids are stored with solids, liquids should be placed on lower shelves. Large bottles should not be stored higher than two feet from the floor. Storage facilities should be level and stable, kept free of chemical contamination and dust, and located away from heat sources. If storage shelves are used, they should be secured to the wall.

Chemicals of differing hazard classes should never be stored together. Specific regulations for storage requirements and storage limits for each hazard class should also be consulted (in California the appropriate regulations are found in Title 8 of the California Administrative Code). Storage facilities should be separated by space or physical barrier. The amount of separation space is, of course, dependent on space availability. If space is available, a separation of three to five feet between storage facilities containing different hazard classes may be sufficient.

References

Steere, N.V., ed., 1971. *Handbook of laboratory safety;* Cleveland, Ohio, The Chemical Rubber Company, 854p.

Methodology --- Maura Lane

Several methods of data collection were used to assess the safety and efficiency of chemical storage and inventory on the campus. These included interviews, a questionnaire, and inventory. A standard procedure for each inventory began with a brief interview. Questions were limited to essential information concerning dangerous equipment to avoid in the lab.

A variety of information regarding chemical purchasing and storage, laboratory safety, and waste disposal methods was included in a written questionnaire (Appendix A). The written format allowed lab assistants to respond as they had time, thereby increasing the number of assistants willing to respond.

Specific chemical stock and storage information was collected on inventory sheets (Appendix B) after the interview was completed. First, the lab or storage area was sketched in the large box on the first sheet. Each chemical storage area was given a code symbol, such as a letter or number. Next, chemical data were collected. Chemicals in each storage area were given codes corresponding to those in the sketch, for later reference to their location. The inventory form is basically functional, but it needs more information for use by the general public. A brief description of hazard classes, a list of abbreviations for each hazard class, as well as directions for use of the inventory sheet should be included.

Ideally, at least two people did each inventory. One copied information as another dictated it. This was faster and safer than doing inventories alone since it was difficult for one person to write on a clipboard while trying to read labels on shelves often packed with chemicals.

Safety measures included minimal handling of chemicals and the use of gloves and safety glasses. We became familiar with common peroxidizable chemicals, and avoided handling chemicals that were potentially explosive when stored past their expiration date.

The chemical manufacturer was not recorded on the inventory sheet after initial inventories. The information was not essential to our reports, and inventories then took approximately three-quarters to one-half the time of previous inventories. The chemical manufacturer column was not deleted from the inventory sheet, however, because this information would be important for an actual working inventory in a storage area or laboratory.

The hazard class of each chemical or mixture was recorded after the inventory was completed. Material Safety Data Sheets, chemical reference books, such as *Dangerous Properties of Industrial Materials* (Sax, 1975), and a table of incompatible and compatible chemicals were used.

Further modifications to methodology were made as individual inventories proceeded. The modifications are specified in individual reports.

Problems Encountered in the Inventory Process

There were quite a few unforeseen problems encountered in the course of inventorying. I will describe these problems here and give a brief overview of basic steps to storeroom reorganization, with the aim of helping others avoid some of the problems we encountered.

Several problems arose because we could not find actual inventory studies and had only general guides, such as *A Guide to the Safe Storage of Laboratory Chemicals* (EH&S, 1986). The guides gave the basic format for an inventory sheet, but did not mention details. For example, we did not realize many chemical manufacturers print the weight of a liquid on the label, rather than its volume. In order to be consistent, it was desirable to record liquid substances in units of volume (gallons or fluid ounces), and solid substances in units of weight (pounds). Therefore, we had to be careful to note the form of each chemical before simply recording information given on the label. We estimated the volume of containers, using containers of known volume as a reference, when liquid volumes were not specified. This introduced a source of error in calculating the final volumes and weights.

Another problem in recording amounts involved metal or dark plastic containers. Since the form and amount of substance contained could not be seen, we estimated the weight or volume by tapping large containers or lifting smaller ones. We avoided shaking or opening containers for safety reasons. In situations where handling a container was not possible, we assumed that the container was full, and recorded it as such. Two examples of such situations are 55-gallon metal drums stored out of reach, and a group of potentially explosive peroxidizable chemicals stored closely together. Peroxidizables stored with other chemicals also presented a problem because we could not move the peroxidizables to record data on surrounding containers. Number of items and volumes or weights were estimated where possible in these cases. These problems also caused error in summarizing volumes.

A third difficulty was the amount of time required to inventory. Table 1 shows the time required to inventory two small storage areas. These areas contain relatively few items, yet the amount of time required to complete an inventory was 5 to 10 hours, an average of one working day. Thus, time will be a significant factor in a campus-wide inventory, especially if the University plans to hire non-laboratory personnel to take inventory.

	Storeroom A	Storeroom B
approx. time involved	5 hours	10 hours
no. pers. doing inventory	2 for 2 hours, 1 for 3 hours	1 for 3 hours, 2 for 7 hours
total number of items	160	552

Table 1 Comparison of time and number of people required for two inventories

Several books suggested using a tape-recorder to reduce time spent in the lab or storage area. Consequently, several students tried recording information on a tape recorder. Transcribing this information onto inventory sheets proved tedious and time consuming. Additionally, information was lost in recording. This method was abandoned and is not recommended for future inventories unless a very good recorder and a computer for transcribing are available.

A major problem in our projects was encountered as we tried to put chemicals in proper hazard classes. A significant amount of time was required to identify chemical compatibility classes, yet none of the inventory group were able to identify all chemicals. This raises a question: How have those responsible for labelling chemicals for correct storage and disposal been able to do so when we have been unable to find this information, after investing more time and effort than could be spared by employees of a laboratory? One answer is we may not have been looking in the right places. Another may be that this information is scattered and confusing, causing those involved to guess or give up and not label a chemical at all. The urge to dump a chemical down the drain, or put it back on the shelf, rather than to dispose of it properly, is understandable when seen in this context.

A solution to this problem may be to compile lists of chemical hazard classes and provide them to each department. The hazard class should be recorded on the label and on the inventory sheet when a chemical is received in a storeroom or laboratory.

Basic Steps for Chemical Storage Reorganization

The amount of time and effort involved in simply inventorying and identifying chemicals in these storage areas shows the importance of keeping accurate records and an organized system of storage. In order to facilitate re-organization of storage areas, I outline some basic steps which should help alleviate some of the unforeseen problems encountered in my project.

The first step is to become familiar with information in some general safety manuals, such as those suggested previously. Topics of particular importance include hazard and compatibility classes, safety regulations regarding chemical storage areas, inventory and labelling suggestions, and references to chemical guides. Keep at least one good chemical reference guide such as *Dangerous Properties of Industrial Materials* (Sax, 1984) on hand to minimize the problem of identifying compatibility classes for storage and disposal.

Next, make a preliminary inventory, which notes every chemical container, full or empty. Be sure to record the amounts of liquids and solids with consistent units. Mark the location of each chemical in some way. In the project inventories, for example, we use a letter for each individual shelf, along with a number for the set of shelves or cupboard containing that shelf. Thus, an item on the top shelf of the third set of shelves would be in section 3A. Inventory sheets similar to those in Appendix B can be used. Make a sketch of the storage area, with storage areas marked, for reference from the inventory sheet. Return each item to its location, noting old chemicals, unsuitable containers, labels, or storage conditions as you go.

The next step is to decide whether any reduction of stock is necessary. Chemicals which are:

1) in a form different than original (ie. separated into layers)

2) in excess of legal quantity limits

3) stored in badly corroding or leaking containers

4) missing a label

5) past expiration date, especially peroxidizables
should be identified if they are unlabelled, and disposed of. A viable chemical which has no label, but can be accurately identified, may be kept. Replacing a corroded container is sufficient in cases where corrosion has not affected the quality of the contents. Record the shelf life of all chemicals. Many have indefinite shelf lives, and can be kept for long periods of time. Others, such as peroxidizables, should not be kept past their expiration date.

Look at the amounts of chemicals in the remaining compatibility classes, after elimination of unwanted chemicals. Reread storage guidelines to see what kind of storage equipment you will need. For example, a large stock of poisons will require a lockable poisons cabinet (EH&S, 1986). Decide how you will re-organize the storage area to best separate incompatibles. Sources listed in past studies, such as *A Guide to the Safe Storage of Laboratory Chemicals* (EH&S, 1986), contain sample laboratory designs, which may be helpful. It would be a good idea to bring your design to a Fire Marshal or other knowledgeable person for further ideas. Extra care here will save having to re-organize again later.

Re-organization presents a good opportunity to update labels. There is no standard labelling system, and this creates confusion when trying to decide how best to store and label chemicals. Chemical manufacturing companies often have color-coded labelling systems. Creating such a system based on your needs can help prevent trouble in storing and finding chemicals. It is much easier and faster to match a label color to a shelf color than to read small words on each label. For example, one color could be used for each compatibility group storage area, with a letter for each sub-group in the group. This system can be used in conjuction with the number and letter system described earlier. In addition, each label should include at least the chemical name, compatibility group, manufacturer name and address, date received, expiration date if any, and special storage and handling guidelines. Be sure each chemical is in its proper place after new equipment and labels are in place.

The next step is to make a new inventory. Information in the inventory should include all information on the label, chemical location, container type, form of contents (solid, liquid or gas), as well as any other necessary information. A card file or computer file is much more flexible than a list. Because cards can be removed or added to a working file as necessary, inventory is not cluttered with cards for items no longer on the shelf. These cards can be kept in a separate file, to keep track of dispensed and discarded chemicals. A computer file can be re-organized quickly and easily when needed, for example to get a list of chemicals kept in 5-gallon containers. Finding this information in a card file or on a list would be more time consuming. A computer file is also desirable in the event a campus-wide inventory system is mandated. It is crucial to keep the items in the inventory accurate and up to date.

The most important step is to be sure everyone who uses the storage area is aware of how to use the system and understands its importance. Careless use will quickly make the most advanced system more of a burden than an aid.

Appendix A Inventory Questionnaire

PURCHASING & STORAGE

1) Where do you store your chemicals? What areas would you like us to avoid? Does your lab contain any peroxides?

2) How do you order your chemicals?

3) Please approximate your monthly quantities.

4) Do you have a current inventory system? Do you have a labelling system? Yes No

LABORATORY SAFETY

1) Are you familiar with the Material Safety Data Sheets? Yes No

2) Does the lab have a written emergency plan? Yes No

3) Please suggest methods or procedures that will increase the safety of your labs and personnel who handle hazardous substances?

DISPOSAL METHODS

1) Is there a designated employee in charge of chemical waste packaging? Yes No

2) Is there a designated area in the lab for hazardous wastes awaiting packaging or pick up? Yes No

3) Please approximate the amount of waste you generate monthly.

4) Please list the wastes that you usually dispose of through drains? (For each chemical, please approximate monthly amounts).

5) Are there specific procedures (i.e., packing of hazardous waste) that you find especially inconvenient? What are they?

6) Do you feel that current campus hazardous waste disposal procedures are (choose as many as apply):
   a) too time consuming
   b) a hindrance because there are too many extra boxes and containers around
   c) very difficult to comply with
   d) not a real problem to comply with

7) What changes in the present procedures or hazardous waste disposal services would make them easier for you to comply with? (Choose as many as you feel will help):
   a) the lab should be supplied with standardized containers for packing that meet EH&S standards for waste pick up/disposal
   b) more information needs to be provided to the lab regarding hazardous waste disposal procedure
   c) the response after a pick-up request is too slow; I would like to see EH&S come sooner after the call
   d) other suggestions that would improve efficiency or make it easier for you to comply with regulations. (Please state.)

Appendix B   Inventory Report Form

DEPARTMENT: ROOM#: SECTION: CONTACTS: DATE/TIME: PG#:

Chemical Name	Manufacturer	Hazard Class	Contnr Type	Contnr Size	Number Count	Total Volume	Expire Date	Notes (if cont., in aux. #)	#