

RCRA Waste Minimization and Recycling Initiatives at the Health Center

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PURPOSE

EPA is committed to a national policy for hazardous waste management that places the highest priority on waste minimization. EPA's overall mission to protect human health both present and future and the environment by making source reduction a priority for every aspect of Agency decision-making and planning, with environmentally-sound recycling as a second and higher priority over treatment and disposal.

Section 3002(b) of the Resource Conservation and Recovery Act (RCRA) requires generators of hazardous waste or who transport their waste off-site to certify on their hazardous waste manifests that they have a waste minimization program in place to reduce the volume or quantity and toxicity of hazardous waste generated to the extent economically practicable. Section 3005(b) requires owners and operators of facilities that receive a permit for the treatment, storage, or disposal of hazardous waste on the premises where such waste was generated to make the same certification no less often than annually. The University of Connecticut Health Center is currently registered with EPA and Connecticut DEP as a "Large Quantity Generator". Therefore, an active waste minimization program is mandated.

Congress further clarified the role of pollution prevention in the nation's environmental protection scheme, by passing the Pollution Prevention Act (Pub. L. 101-508.42 U.S.C. 13101, et seq.). In section 6602(b) of this law, 42 U.S.C. 13101(b), Congress stated that national policy of the United States is that pollution should be prevented or reduced at the source whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner.

The methods to achieve these goals include equipment or technology modifications, process or procedure modifications, reformulation or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training, inventory control or recycling.

The potential benefits that accrue to facilities that pursue an active waste minimization plan often include:

1. Minimizing quantities of hazardous waste generated, thereby reducing waste management and compliance costs and improving the protection of human health and the environment;
2. Reducing or eliminating inventories and possible releases of "hazardous chemicals;"
3. Possible decrease in future Superfund and RCRA liabilities, as well as future toxic tort liabilities;
4. Reducing worker exposure; and
5. Enhancing organizational reputation and image

ELEMENTS OF PROGRAM

The key waste minimization program elements are as follows:

A. Top management support.

The effectiveness of an organization wide minimization program is directly related to the level of management support. The University is committed to pollution prevention and has developed this program to encourage, faculty, staff and students to conserve resources and to minimize the impact that our activities may cause to the environment. The implementation and oversight of this program is the responsibility of the Office of Research Safety and Facilities Development and Operations. Together, we will coordinate the reduction efforts, maintain the required documentation and will provide status reports to the University community and the State of Connecticut DEP as needed.

B. Characterization of waste.

Waste characterization plays an important role in determining the waste streams ultimate disposal method. The Health Center actively evaluates waste packaging, labeling and storage during routine laboratory hazard assessments as mandated by OSHA's Hazard Communication Standard, CFR1910.1450. Waste identification is performed at the time of pick-up and characterized prior to shipment off site.

C. Periodic waste minimization assessments.

Assessment of waste generation, both volume and toxicity will be based on our hazardous waste pick-up and disposal record. The Office of Research Safety maintains a database of all waste pick-ups that includes volume and constituent of waste being generated at a particular location. This database is analyzed quarterly to identify areas/procedures that may benefit from potential waste reduction activities. Analyzing the cost benefits, effectiveness or practicality of a process alteration may only have to be performed initially or in the event the process raw materials are changed.

D. Encourage technology transfer.

The Office of Research Safety continually monitors waste minimization success stories either through web sites, trade associations, technical publication and ultimately EPA's assistance program. (Pollution Prevention Information Clearing House (PPIC)).

E. Program implementation and evaluation.

The cooperative efforts of the Office of Research Safety and Facilities Development and Operations will be reviewed periodically to document the program effectiveness or as waste reduction opportunities. This assessment will take into consideration the increase or decrease in the number of principal investigators, number of laboratories or number of research grants that will influence overall generation rates. Based on this information, over time a trend will be evident and we will be able to identify waste streams requiring attention.

RECOMMENDED WASTE MINIMIZATION TECHNIQUES

The following methods are easily integrated into existing programs at the University. Many areas of the campus already utilize one or more of the following procedures to reduce or to prevent the production of hazardous waste. Whatever an individual's duties at the University, the following techniques should be used whenever ordering or using a hazardous material:

- Maintain a current inventory of all hazardous materials in your area. Maintain container labels to eliminate the production of unknown materials. Always check your inventory before ordering materials. Ask others in your department if they have available materials. Use materials before they reach their expiration date.
- Only order the quantity of the material that you need. Larger containers may appear as a cost savings for the department, however, the cost to the University, including additional disposal expenses, storage space and labor costs, may eliminate any departmental cost savings.
- Substitute a non-hazardous or a less hazardous material whenever possible. Use a flammable liquid with a higher flash point, use a less toxic reagent if one is available.
- Use or recycle a material from one department to another. Another department may have an excess of the material that you need. It never costs to ask if any is available. Call the Office of Research Safety for assistance in finding a chemical.
- Never purchase cylinders or lecture bottles if they cannot be returned to the vendor. The disposal of compressed gasses is very costly to the University.
- Significant contributions to the University's waste stream is generated as a result of faculty and staff turnover. Many projects supported by external funding are short term in nature. The result of this persistent change, both personnel and projects, very often involve specialized materials that are of little or no use outside of a specific research field. Be diligent and always consider waste minimization when purchasing these unique and very often toxic materials. In addition, transient researchers must be diligent when leaving Health Center service. Contact the Office of Research Safety prior to departure to dispose of unwanted chemicals/reagents.
- Dispose of materials as soon as you determine that they are no longer needed. There may be a use somewhere else on campus. Notify the Office of Research Safety for such items so that they may be included in the chemical redistribution system. Do not hold a material so long that the container begins to degrade and the material is of no use.
- Proper labeling of containers is a critical EPA requirement and if done improperly can have significant monetary penalties. Please be aware that improperly or unlabeled bottles (unknowns) are very costly to dispose of due to the necessity of performing analytical screening test on each bottle to determine the proper DOT shipping category.
- Laboratory neutralization as part of an experiment and completed according to documented procedures is allowed. Please contact Health and Safety to ensure that your procedure is both safe and in compliance with all applicable regulations.
- Good laboratory practice including material handling and waste stream segregation will reduce the amounts of hazardous waste materials produced. Avoid mixing hazardous and non-hazardous wastes, avoid mixing waste materials with different physical states. Learn the hazards of the materials that you work with and keep the hazardous waste minimized and separated.

- Become familiar with University hazardous waste disposal, non hazardous waste disposal and recycling policies and opportunities.
- Be willing to change to protect yourself and the environment.

PROGRAMS IN PLACE

Specific waste minimization activities that have been implemented or are in progress:

Mercury Elimination Efforts

The Health Center has endorsed the MOU between AHA and EPA regarding the elimination of mercury containing devices in healthcare by CY2005. The efforts to minimize the use of mercury containing devices and eliminate releases of mercury to the environment have involved several key UCHC areas. These areas include the Facilities Development and Operations, the John Dempsey Hospital, the Dental School and the UCHC Research Community.

The Facilities Development and Operations is vital in reducing the release of mercury containing items to the environment. As part of the Universal Waste regulatory requirements, appropriate staff have been instructed to collect mercury containing devices such as thermostats, switches and fluorescent lamps. In addition, procedures were developed and issued on March 8, 2005, that require the recovery of mercury from sewerage traps during renovation work. Facilities has also included language in contracts requiring proper disposal of these waste streams by contractors. A routine used lamp pickup and recycling program exists with documentation of disposals back to 1998. Training is offered every year on proper handling, storage and labeling of used lamps.

Lamp Disposal History

2005	9,646 lbs.
2006	12,027 lbs.
2007 (to 8/07)	6,451 lbs.

The Dental School has instituted Best Management Procedures to minimize mercury release into the sanitary sewerage system during dental procedures. Extracted teeth containing amalgam are placed into a container for pick up as hazardous waste. Amalgam released during filling and drilling operations are collected at chair side, and as backup, a centralized amalgam separator was installed during the period November to December, 2003. The amalgam separator was supplied by Benco Dental and services the entire Dental School discharge prior to release into the sanitary sewerage system. As an additional precaution, prefilled capsules for mixing amalgam are used in the Dental Clinics. Using prefilled capsules reduces the risk of a spill. The Office of Research Safety submitted samples of “typical” dental amalgam for TCLP testing. The TCLP test results indicated that amalgam is not a hazardous waste viewed from the RCRA definition of a hazardous waste.

The main source of mercury involving research activities at the UCHC is that contained in mercury thermometers. The Office of Research Safety performs laboratory hazard inspections semiannually, and during the round of surveys conducted during July-August 2006, and inventory of mercury thermometers was completed. A total of 249 mercury containing thermometers containing on the order of 996 grams (2.2 pounds) were identified. As a Best Management Practice the UCHC research administration agreed to replace all thermometers and provided funding to purchase non-mercury containing thermometers. A total of 189 (1.7 pounds) or 75% of the thermometers were

collected, disposed and replaced by non-mercury containing thermometers. Further efforts are planned to collect the remaining devices and liquid mercury still outstanding in the research areas.

The major sources of mercury in the Hospital are thermometers, sphygmomanometers, Cantor and Miller Abbot Tubes and Maloney or Hurst Bougies. An initial effort to replace mercury thermometers was undertaken from the period 1994 through 1998. A total of 160 thermometers containing approximately 100 grams of mercury were collected and replaced. Replacement of remaining thermometers was accomplished by during CY2001. The Clinical Engineering Department has been instrumental in reducing the mercury burden in the Hospital, and it is through their efforts that virtually all of the mercury contained in devices have been replaced. To the best of our knowledge, all Cantor & Miller Abbot Tubes (136 grams per set) and all Maloney/Hurst Bougies (1361 grams each) have been replaced. During October 2004, a campaign was initiated by the Clinical Engineering Department to replace all mercury containing sphygmomanometers in the hospital and clinics. As a Best Management Practice, a request for funding to replace mercury containing blood pressure devices with Welch Allyn Aneroid BP units was made. A total of 230 mercury containing units containing a total of 46,000 grams (101 lbs.) were replaced. Of these devices, 190 were sent to Welch Allyn as trade ins and 40 were disposed as hazardous waste by the Office of Research Safety. As of January, 2005, virtually all mercury containing devices were replaced. Mercury thermometers are not stocked by the UCHC Warehouse.

Used Electronics

A program for recycling used electronic waste was initiated during CY2003. This program involves the Materials Management Department, Facilities Development and Operations and the general UCHC population. Used electronics are collected and shipped for recycling. Individuals directly involved in handling and shipping electronic waste were trained initially and offered annual refresher training. Facilities Development and Operations provides information to contractors concerning proper disposal of used electronics and oversees this for renovation projects. UCHC staff are informed of requirements and a notice is published in the UCHC Newslines once each year reminding the UCHC community about proper used electronic disposal procedures.

<u>Used Electronics Recycling</u>	
CY 2003	56,000 lbs.
CY 2004	115,700 lbs.
CY 2005	57,744 lbs.
CY 2006	72,568 lbs.
CY 2007	69,444 lbs.
CY 2008	66,881 lbs.

Ethylene Oxide Emissions

Ethylene oxide is used as a sterilant for surgical equipment in Central Sterile Supply and was used for disinfection of surgical devices until March 1, 2004. At that time, and as a Best Management Practice, a Sterrad Plasma Hydrogen Peroxide sterilizer was put into service. This resulted in a significant reduction in emissions of this hazardous air pollutant, as hydrogen peroxide decomposes into water and hydrogen. At present, ethylene oxide must be used for sterilization of various scoping devices and cannot be discontinued. At present, two containers of ethylene oxide are used per week. Each container holds 100 grams of ethylene oxide. This results in a yearly emission of 10,400 grams per year (22.9 pounds/year). The table below summarizes reported ethylene oxide emissions for the periods indicated.

Reported Ethylene Oxide Emissions, UCHC

CY 2002	114.5 lbs/yr
CY 2003	114.5 lbs/yr
CY 2004	46.7 lbs/yr
CY 2005	34.4 lbs/yr
CY 2006	34.4 lbs/yr
CY 2007	22.9 lbs/yr
CY 2009	18.5 lbs/yr

The emission of ethylene oxide has been reduced by 84 %.

Formalin Recycling Anatomic Pathology

The Anatomic Pathology Department purchases approximately 600 gallons of formalin per year at an annual cost of \$ 2,640. The waste volumes are greater on the order of 1500 gallons per year. As a Best Management Practice, the management agreed to purchase a formalin recycling unit. A demo unit was installed and it was learned that the ventilation system in the Anatomic Pathology Area was inadequate. Management provided funding to install proper ventilation resulting in a significant reduction in controls for safe handling of formalin in the lab. This was done during early 2006. A formalin recycling unit (B/R Pureform 2100) was installed at this time. Use of this unit was problematic as the quality of the formalin produced was under par. After repeated attempts to resolve the problem, formalin recycling began in earnest during December, 2006. A summary of formalin recovery efforts is provided below.

<u>Year</u>	<u>Gallons</u>
CY 2007	226.5
CY 2008	238.5
CY 2009	445.5

Substitution of Environmental "Safe" Liquid Scintillation Fluids

The use of toluene based liquid scintillation fluids for radioactive materials assay was a mainstay of the research community. Use of these RCRA regulated fluids also resulted in the generation of mixed radioactive/hazardous chemical waste. For many years there was no disposal option for these mix-wastes and they were stored on site under a RCRA Part A permit. The Office of Radiation Safety instituted a "safe-fluor" substitution program for eliminating this waste stream. This program has been ongoing for many years and involves continuous interaction with the research community to use safe liquid scintillation fluids. The data below indicate the results of the program.

Safe Liquid Scintillation Substitution Program Waste Summary

CY	Gallons RCRA Waste	Gallons of "Safe" Fluors	RCRA/Tot %
1997	550	825	40
1998	275	165	62.5
1999	330	220	60
2000	*805	660	55
2001	110	770	12
2002	110	550	17

2003	55	770	7
2004	0	220	0
2005	55	825	6
2006	0	220	0
2007	0	220	0
2008	0	224	0

* 660 gallons was due to an onsite “historical” inventory of 63-Ni that could not be disposed prior to this date.

Liquid scintillation volumes have decreased over the years because of new lab techniques and a reduction in the total number of researchers. However, the program instituted for “safe chemical substitution” has reduced the hazardous RCRA component to a negligible amount.

Program to Reduce/Eliminate RCRA Liquid Waste Mixed With Radioactive Materials

The Office of Radiation Safety encourages researchers to reduce and/or eliminate the use of RCRA listed hazardous chemicals in conjunction with radioactive materials. This is done during the authorization process wherein the individual principle investigator requests authorization to use specific radionuclides. The table below summarizes the volumes of RCRA-mixed waste disposed by calendar year.

RCRA Mixed Waste Disposed By Calendar Year

Year	Gallons Disposed	Gallons/Investigator
1998	156	1.37
1999	17	0.18
2000	58.5	0.52
2001	26.5	0.24
2002	39.0	0.38
2003	12.0	0.12
2004	32.5	0.33
2005	12.4	0.13
2006	3.2	0.04
2007	1.3	0.02
2008	8.3	0.11

The efforts continue to reduce the quantity of mixed waste generated at the UCHC.

Discarded/Expired Pharmaceuticals

The Office of Research Safety collects discarded and/or expired pharmaceuticals from the Pharmacy. In order to reduce waste volumes, medications are removed from packaging resulting in a significant reduction in volume.

Substitution of Orange Solvent for Chloroform in Dental Clinic

Chloroform is used in the Dental Clinics for endodontic treatments. In order to eliminate this hazardous material, Orange Solvent was substituted beginning August, 2006.

Chemotherapy Waste

Chemo waste is picked up as needed by the Office of Research Safety. This waste is placed into plastic containers. In order to minimize this waste stream, the contents of the containers are bulked into drums prior to shipment as hazardous waste.

Ethanol/Xylene Recycling

Plans are underway to explore the possibility of recycling ethanol and xylene generated in the Dermatology Department. This area is located off site and a waste storage out building is under construction at this time. Once completed, a feasibility study will be done.

Chemical Redistribution Program

The Office of Research Safety maintains a chemical redistribution list. This list contains solvents, reagents, etc. that have been deemed reusable and are available to any staff member. They are distributed free of charge on a first come first serve basis. Technicians assigned to perform waste pick-up duties actively pursue redistribution of chemicals to surrounding laboratories. These activities will be documented for future review. The benefit of this aspect of waste minimization is two fold. Chemicals that would have been incorporated into a waste stream and an associated disposal cost have prevented the purchaser from purchasing additional material. As part of routine hazardous waste pick-up procedures, chemicals that have not expired and/or opened are considered for redistribution. This information is entered into the hazardous chemical database. This program is minimal at this time but the following transfers have been made.

7/23/09	2 gallons pump oil to researchers
7/24/09	12 pints ethyl alcohol to Anatomic Pathology

Efforts continue in this area.

Silver Recovery

In accordance with the Health Centers Photographic Waste Water Permit, the facility maintained 23 silver recovery units that are strategically placed throughout the campus and off-site clinics. For example, operations involving a high demand have a dedicated system (Diagnostic Imaging, Dental) while others coordinate use amongst individual staff members. The Office of Research Safety oversee the operation/maintenance of these systems by testing silver recovery unit effluent and influent monthly. Waste volumes have been reduced due to the replacement of 9 x-ray systems with digital image systems. The current number of silver recovery systems is 14.

Battery Collection

All types and styles of batteries nickel/cadmium, lithium, silver oxide, lead acid, mercury and zinc are collected from various locations and recycled through licensed contractors. Totals disposed for 2008 was 617 lbs and for 2009 497 lbs.

UW Lamps

Facilities Development and Operations has staff dedicated to the replacement and collection of fluorescent bulbs. The program is in operation in accordance with the "Universal Waste Rule". Recycling documentation is maintained in Facilities Development and Operations with copies in the Office of Research Safety.

Paper Recycling

There are established programs to recycle white office paper and corrugated cardboard. There are in excess of one hundred strategically placed collection receptacles throughout the Health Center complex. Corrugated cardboard is collected and transported to a dedicated compaction dumpster by housekeeping staff.

Freon Recovery

Members of the HVAC shop have three Freon recovery units for servicing, repair or surplus Freon containing equipment. Two of the units are stationed in the maintenance shop and one portable unit is carried in the shop vehicle for off-site recovery.

Although the approaches described above are directed toward minimizing “hazardous waste,” they are also important elements in the design of multi-media source reduction and recycling programs for all forms of pollution.

The nature of work conducted at the Health Center dictates the use of hazardous materials. The goal of this program is to identify opportunities for waste reduction and to increase staff’s awareness of this issue. The key aspects of this program will be conveyed to new researchers during Laboratory Safety Training and subsequently stressed during individual laboratory inspections. The ability to adopt and to implement new technically advanced procedures that reduce waste generation will support the institutions drive to be on the forefront of science, medicine, research and education.

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