# Hazardous Waste Management Procedures

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# HAZARDOUS WASTE MANAGEMENT PROCEDURES

## Foreword

The following are basic guidelines for University departments in the identification, collection, and temporary storage of hazardous wastes as defined primarily under 40 CFR 261 and 3745-50 through 52 OAC (Ohio Administrative Code). These procedures should be considered as minimal and need to be used as a foundation for more detailed guidelines developed by individual departments.

Hazardous waste management procedures developed by departments should be reviewed by the University's Hazardous Waste Coordinator, in the Department of Environmental Health and Safety (EHS), to determine consistency with existing waste management standards.

## Waste Determination

An initial step in effective hazardous waste management is the proper identification of materials that require some form of final disposition. The purpose, of course, is to be able to ascertain whether these materials are considered "hazardous" or not. Realistically, all materials considered for drain disposal or landfilling should be evaluated by departmental personnel to determine its proper status.

Initial waste determination will be based on whether the material has been contaminated or "spent" during its use. All such chemicals are to be considered as waste and therefore managed accordingly. Containers of unspent or uncontaminated chemicals will not be formally identified as waste until assessed by either the University's Hazardous Waste Coordinator or the University's hazardous waste management company. Assessment will be made following movement of these chemicals to the University's Hazardous Waste Storage Facility.

To aid in waste determination, specific chemicals/products deemed as hazardous are listed as a part of 40 CFR 261 or 3745-51-(30 to 33) OAC. General hazardous waste categories (ignitable, corrosive, reactive, and toxic) are also defined for nonspecific chemicals and products that exhibit one or more of these hazardous characteristics. If the status of the waste material remains uncertain, the University's Hazardous Waste Coordinator is available to assist in that determination.

All locations of hazardous waste generation within the department/area must be identified to assure that the waste chemicals generated are being correctly managed. Materials that are spent and/or destined to be commingled with other compatible materials necessitate a more stringent management protocol than materials that are just no longer wanted. Determining the materials status will also dictate the form of storage and labeling procedures to be implemented. These will be explained in upcoming sections.

All pertinent waste inventory data from departmental laboratories and other building areas need to be relayed periodically to the department's designated Hazardous Waste Liaison or other departmental representative so assigned. This will permit the timely compilation of all waste chemical/product inventories generated by the department.

Regular chemical/product inventories should also be conducted to reduce the stockpiling of unwanted or unusable materials. Such assessments should be performed during periods of least interruption to ensure their accuracy and completeness. Personnel having responsibility for chemicals/products within the department

should conduct these inventories. A Hazardous Waste Inventory form is available to assist departments/areas with waste inventories and provide consistency in the reporting of waste data.

Once all points of hazardous waste generation have been identified within the department, every effort should be made to minimize the quantities of hazardous wastes being generated. As mentioned previously, waste minimization techniques need to be incorporated whenever possible to reduce the amounts of waste that require special handling procedures. Certain chemicals and/or specific quantities of chemicals may be legally disposed by means other than formal collection and removal from the department.

The EPA specifications for the identification of hazardous wastes that are included in this manual should be made available for review at strategic locations throughout the department. Any questions concerning the identification of hazardous wastes need to be directed to the applicable departmental Hazardous Waste Liaison or the University's Hazardous Waste Coordinator (372-2171).

## Waste Collection

All containers used for the collection/storage of hazardous wastes must be structurally sound. The utilization of proper containers minimizes the potential for leakage and/or other releases into the environment. Whenever possible, the original container(s) need to be used. Container determination should be based on chemical characteristics of the waste material to be stored. For example, corrosive wastes should not be placed in a metal container.

Collection sites need to be established within the laboratory or other areas where hazardous wastes are generated. Waste containers should be conveniently located at these points as well. Individuals moving wastes to temporary storage sites must be knowledgeable of the relevant waste characteristics, waste handling guidelines, and appropriate spill control measures. Safety/spill control materials should also be readily available should a spill occur during transfer.

NOTE: Safety cans and other similar storage containers are available through various commercial outlets. Recycled containers for waste storage may also be used. Information on acceptable chemical containers can be obtained through the Hazardous Waste Coordinator.

## Waste Labeling

One of the most important aspects of the hazardous waste management process is proper labeling of waste containers. Containers with missing or illegible labels are classified as "unknowns." Unknown chemicals requiring disposal place an unnecessary and costly burden on the University. Testing of the chemical must be performed to determine the appropriate hazard category of the unknown waste. Therefore, all containers holding hazardous wastes must be properly labeled. Any container with a label that is not secure or is becoming illegible must be relabeled.

Containers of waste chemicals require the words "Hazardous Waste" above the chemical name. All containers used for commingling of wastes must be labeled with the words "Hazardous Waste" and include an identification of the contents. A preprinted tag or other label acceptable to the Hazardous Waste Coordinator is recommended. All labels must include an identification of the chemicals/products placed into the container. An estimate of the quantity of each individual chemical is also recommended, particularly when mixtures of various chemicals are added. This process should occur at the time the chemicals/products are placed into the waste container. Additional tags/labels may be needed if numerous compatible wastes are placed into one container.

## Waste Storage

Locations for the temporary storage of departmental hazardous wastes need to be selected carefully. Working fume hoods, for example, would be necessary for waste materials requiring adequate ventilation. Specific waste storage areas should be separate from other "usable product" storage sites if possible. A sign or other appropriate means to prevent confusion over the status of the stored material should identify all waste storage areas. Additionally:

- All containers of hazardous waste must be kept closed always except for adding or removing waste
- Funnels or other similar devices cannot be kept in containers between uses
- Containers of hazardous waste cannot be stored on the floor

Compatibility standards also apply to waste storage locations. Waste materials which are incompatible should not be stored together or in such as manner inconsistent with acceptable chemical storage practices. Separate containers must be used for incompatible wastes.

The most recent inventory of all hazardous wastes should be kept within the storage area. Departmental Hazardous Waste Liaisons or other designated individuals need to be routinely informed of the waste chemicals/products and their respective quantities being generated within their department. All hazardous wastes should remain at the temporary storage locations until transferred to central departmental storage sites, if available.

## Interdepartmental Waste Transfer

Periodically, hazardous wastes from laboratories and other building storage areas may be moved to a central storage site within the department where they are consolidated. Specific transfer procedures involving the movement of hazardous wastes should be developed and implemented by each department having centralized storage.

During transfer, all hazardous waste containers must be adequately secured. Lab carts or other types of temporary storage units may be used if spill potentials are minimized. Since the potential of a spill increases during chemical/product movement, only individuals trained in departmental spill control protocols should transfer hazardous wastes. Spill control equipment should be within easy access to those moving hazardous wastes.

## Central Departmental Transfer

Consolidated storage of hazardous waste requires similar procedures as those of general chemical/product storage. Chemical compatibilities, acceptable labeling, and the structural integrity of the containers are all important storage issues which must be considered. If possible, containers of hazardous waste should be kept in a location separate from usable chemical/product storage. Any separate waste area should be marked by a sign or other means of identification.

A current and comprehensive inventory of all departmental wastes must be maintained. As in the routine inventory procedures explained previously, the "Hazardous Waste/Orphan Chemical Inventory" form should be used for this purpose. Waste data should be added to this form at the time the wastes arrive at the central storage area. The departmental Hazardous Waste Liaison or other departmental representative should have the

responsibility for maintaining this inventory. Up-to-date waste information is vital in facilitating the necessary waste removal arrangements with a licensed hazardous waste management company. Copies of the hazardous waste inventory should be provided to the Hazardous Waste Coordinator upon request.

While in storage, routine inspections should be conducted by departmental personnel having responsibility for those areas. Hazardous waste containers should be observed on a regular basis for leaks and other problems such as labeling and structural integrity. Corrective actions can then proceed as necessary.

Since the storage of departmental hazardous wastes is concentrated in this central location, spill control equipment should be conveniently stored within this area. Neutralizing solutions, absorbent materials, and related safety equipment need to be easily accessible to those in charge of central storage areas or those responsible for spill response.

## Waste Pickup/Transfer

The removal of departmental wastes must be scheduled with the University's Hazardous Waste Coordinator. A copy of any departmental inventory form(s) will accompany the chemicals during their transfer to the University's Hazardous Waste Facility. Containers of chemical wastes will initially be checked for structural integrity prior to being transported. Any container deemed unsound will remain at the site until the contents are repackaged.

The Hazardous Waste Coordinator and/or personnel from the University's hazardous waste management company will move the waste materials from the appropriate building(s) to a vehicle(s) used for waste transportation. A designated University vehicle is primarily utilized for this purpose. The waste chemicals are placed either in a wooden shipping box or other protective shipping unit(s) within the transportation vehicle. The wooden shipping box is compartmentalized to protect the chemical containers from damage. The box contains an appropriate layer of absorbent material to absorb any spilled materials during movement to the facility. The vehicle will also be equipped with spill control materials (i.e. spill control pillows) and protective equipment for use in case of a spill.

All hazardous wastes received from University departments and areas are taken directly to the University's Hazardous Waste Facility. Wastes will remain at this location until a final determination is made as to the status of the material. All materials determined to be wastes will be packaged and removed from campus by a licensed hazardous waste management company. The packaging, transportation, and disposal of the University's hazardous wastes will be performed according to all state and federal regulations and in conjunction with the University's hazardous waste management company.

## Hazardous Waste Minimization

An essential element of any successful hazardous waste management program is that of waste minimization. Limiting the quantities of hazardous wastes being generated benefits the University in several ways. Most importantly, it reduces the risks associated with hazardous materials to University students, faculty, and staff. Secondly, it decreases the amounts of hazardous wastes which need to be safely handled, stored, and eventually moved from the various points of generation to the University's waste storage facility. Finally, it reduces the costs of packaging, transportation, and disposal.

Several methods can be used to minimize the amounts of hazardous wastes being generated. A variety of methods are identified below including an explanation of how the techniques can be applied. This review should assist in determining which techniques can be used in your situation. Any questions regarding waste

minimization may be directed to the Hazardous Waste Coordinator in the Department of Environmental Health and Safety (EHS) at 372-2171.

## METHODS OF WASTE MINIMIZATION

### Substitution

The PRIMARY option for waste minimization is the replacement of a hazardous material (according to 40 CFR 261) with a less or non-hazardous material. A major consideration in successful substitution is whether the substituted material provides acceptable results. Optimally, the determination of whether substitution is possible should be made prior to obtaining the new material.

Initially, hazardous materials need to be identified. Reviewing product inventories and examining the uses of existing materials can detect materials that are potential candidates for substitution. Once identified, the individual having the administrative responsibility for the use of the material should investigate the substitution potential. This may be accomplished by requesting information from the manufacturer or supplier of alternative products. A Safety Data Sheet (SDS), formerly known as Material Safety Data Sheet (MSDS) or product label should be obtained for the potential substitute (as well as for all chemical materials on hand) to verify its "less or non-hazardous" status. A pilot application of the material should then be initiated to determine the effectiveness of the product during actual use. Unless unreasonable purchase price differences exist between the hazardous material and the less hazardous/non-hazardous substitute, replacement of the hazardous material in question should proceed. In an academic setting, identifying viable chemical substitutes may be difficult. Contact with colleagues or chemical suppliers may be useful in obtaining information on potential substitutions. Assistance in determining the hazardous/non-hazardous status of the product or material may be obtained through EHS as indicated above.

### Inventory Management

Implementing an on-going chemical inventory management system will serve to reduce the amounts of overstocked chemicals that would require additional management. Even though other waste minimization options may still be available for management of these additional chemicals, it should not be necessary to have to deal with over-stocked chemicals. The chemical inventory management system that is used by BGSU is ChemTracker.

### Micro-Quantities

If substitution for the hazardous materials cannot be accomplished, a SECOND option would be using micro-quantities of the material. Reducing these amounts decreases the quantities of hazardous wastes that require formal handling. Initial expenditures may be necessary for equipment needed to implement the micro-quantity techniques. However, once these "start-up" costs have been defrayed, an ongoing cost savings should be realized by limiting the purchase of virgin materials. Again, for this minimization technique to be viable, the process must achieve the intended results.

### Other Management Techniques

The management techniques addressed in this section mainly apply to academic settings. Only individuals experienced in the technique (i.e. treatment) and the materials with which they are working should consider implementing any of the procedures identified below.

The information provided has been taken in part from Prudent Practices for Disposal of Chemicals from Laboratories, National Academy Press, Washington, D.C., 1983. These methods of disposal are acceptable to the Wastewater Treatment Division for the City of Bowling Green and the Ohio EPA.

## Drain Disposal in the Sanitary Sewer System

With appropriate dilution (100 times the volume), there are certain organic and inorganic compounds that can be properly disposed of in the sanitary sewer system in quantities of approximately 100 grams at a time. Generally, water-soluble organic compounds with a boiling point <50o C should not be disposed of in the sanitary sewer system. The compounds identified below are water soluble to at least 3% and present a low toxicity hazard. The organic compounds listed on the following pages are readily biodegradable. Some chemicals suitable for drain disposal are:

Organic Chemicals
Alcohols
Alkanols with less than 5 carbon atoms
t-Amyl alcohol
Alkanediols with less than 8 carbon atoms
Glycerol
Sugars and sugar alcohols
Alkoxy alkanols with less than 7 carbon atoms
n-C4H9OCH2CH2OCH2CH2OH
2-Chloroethanol

Aldehydes
Aliphatic aldehydes with less than 5 carbon atoms

Amides
RCONH2 and RCONHR with less than 5 carbon atoms
RCONR2 with less than 11 carbon atoms

Amines
Aliphatic amines with less than 7 carbon atoms
Aliphatic diamines with less than 7 carbon atoms
Benzylamine
Pyridine

Carboxylic Acids
Alkanoic acids with less than 6 carbon atoms *
Alkane dioic acids with less than 6 carbon atoms
Hydroxy alkanoic acids with less than 6 carbon atoms
Amino alkanoic acids with less than 7 carbon atoms
Ammonium, sodium, and potassium salts of the above acid classes with less than 21 carbon atoms
Chloroalkanoic acids with less than 4 carbon atoms

Esters
Esters with less than 5 carbon atoms
Isopropyl acetate

Those with disagreeable odor (i.e. dimethylamine, 1,4-butanediamine, butyric and valeric acids) should be neutralized and the resulting salts disposed of in a sanitary sewer drain with at least 1000 volumes of water.

Ketones
Ketones with less than 6 carbon atoms

Nitriles
Acetonitrile
Propionitrile

Sulfonic Acids
Sodium or potassium salts of most are acceptable

Inorganic Compounds
Compounds of any ions listed below which are strongly acidic or basic should be neutralized before being disposed of in a sanitary sewer drain.

| **Cations** | **Anions** |
|---|---|
| $Al^{3+}$ | $(BO_3)^{3-}$, $(B_4O_7)^{2-}$ |
| $Ca^{2+}$ | $Br^-$ |
| $Fe^{2+}$, $Fe^{3+}$ | $(CO_3)^{2-}$ |
| $H^+$ | $(HSO_3)^-$ |
| $K^+$ | $(OCN)^-$ |
| $Li^+$ | $(OH)^-$ |
| $Mg^{2+}$ | $I^-$ |
| $Na^+$ | $(NO_3)^-$ |
| $(NH_4)^+$ | $(PO_4)^{3-}$ |
| $Sn^{2+}$ | $(SO_4)^{2-}$ |
| $Sr^{2+}$ | $(SCN)^-$ |
| $Ti^{3+}$, $Ti^{4+}$ | |
| $Zn^{2+}$ | |
| $Zr^{2+}$ | |

## Treatment/Recycling

If other methods of waste minimization are inappropriate for your situation, a final option may be chemical treatment of the hazardous waste generated during use. Neutralization, precipitation, oxidation/reduction, and distillation are examples of treatment techniques that may be applied to reduce hazardous waste quantities.

**REMINDER: All the treatment procedures identified below necessitate the involvement of an individual experienced in such activities.**

Neutralization involving acids and bases is the most common type of treatment. Adjustments in pH can be made to neutralize a highly acidic or highly alkaline solution. A final pH level of between 6 and 9 is desirable. If the solution contains no other hazardous component as defined by 40 CFR 261 (i.e. one which is toxic), the neutralized solution can be treated as normal waste and disposed of in a sanitary sewer drain with proper dilution.

Precipitation and oxidation/reduction reactions can remove hazardous components from waste. Disposing of these materials may then be accomplished through normal means. Precipitates from these reactions may need to be treated more effectively in a formal disposal mode.

Incorporating treatment procedures as a part of experimentation within teaching laboratories serves a dual purpose. It not only reduces the hazardous wastes being produced, but it also teaches students responsible waste management. Providing students with the knowledge and understanding of correct minimization techniques would seem only to benefit the future generations of scientists.

An alternative to specific destruction of hazardous wastes in teaching laboratories would be to include within another experiment the hazardous waste generated. This procedure would serve the purpose of limiting waste production as well as supplying the "raw" materials for additional experimentation.

Recycling of spent materials (mainly solvents) allows the handler the opportunity to reuse material that would otherwise be disposed as hazardous waste. This procedure also reduces the need to purchase additional quantities of "fresh" product which, in turn, decreases overall departmental expenditures. The major factors involved when considering recycling are whether sufficient quantities of recyclable wastes are being generated to warrant the expense of appropriate distillation equipment and whether the quality of the recycled material is acceptable for reuse.

Both latter two alternative waste handling methods require prior planning to be incorporated within teaching lab activities. The benefits of doing so would be directed to the University (minimizing risks, overall waste reduction, lowering management costs), the academic department (minimizing waste generation, limiting waste handling), and the students as well (learning proper waste management responsibility, realizing the University's commitment to the reduction of hazardous waste).

## Conclusion

To adequately reduce the quantities of hazardous waste which necessitate formal disposal, the University must be committed to the implementation of waste minimization procedures. Academic and nonacademic departments alike must share this common goal of waste reduction. Together, through cooperative efforts in conjunction with the Department of Environmental Health and Safety, University departments and areas can achieve this goal. Implementing waste minimization procedures will not only result in posing less of an environmental hazard to students, faculty, and staff, but it should also result in costs savings to the individual departments as well as to the University in general.