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Hazardous Waste Minimization Plan

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Applies to: **(examples; Faculty,Staff, Students, etc)**

Faculty , Staff , Students

Policy Overview:

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University of Health Sciences and Pharmacy in St. Louis (UHSP) is classified as a “small quantity generator” of hazardous waste by the Missouri Department of Natural Resources (MoDNR) and the U.S. Environmental Protection Agency. These agencies enforce the Resource Conservation and Recovery Act of 1984, which requires a “large quantity generator” to certify that it has a program in place to reduce the volume and toxicity of waste generated to the degree it has determined to be economically practicable (RCRA Sections 3002(b) and 3005(h)).

Waste Minimization is necessary in order to minimize present and future threats to human health and the environment. Consistent with our sustainability efforts, UHSP has developed a Waste Minimization Plan although not required by our small quantity generator status. The RSC Waste Minimization Plan presents guidelines that can be used by Univeristy personnel to reduce the amount and toxicity of wastes generated at UHSP. While Plan procedures described below are voluntary, participation from UHSP personnel is expected to reduce our impact on our environment, generation of hazardous materials, and byproducts.

Definitions:

Term	**Definition**
Container	Any easily and readily movable enclosure constructed of manmade materials that may be used for hazardous waste storage, treatment, transport, or disposal
Generator	Any person, by site, whose act or process produces hazardous waste identified or listed in the regulations, or, any person whose act first causes a hazardous waste to become subject to regulation.
Hazardous Waste	Any waste or combination of wastes as defined or listed by regulation, which, because of its quality, concentration, physical, chemical, or infectious characteristics, may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness, or pose a threat to the health of humans or other living organisms.
Regulated Quantity	The generation or accumulation of a minimum amount of hazardous waste, as defined by regulation, which subjects the generator to following certain regulatory requirements.
Waste	Any material for which no use or sale is intended and that will be discarded, or any material that has been or is being discarded. Waste also includes certain residual materials that may be sold for purposes of energy or materials, reclamation, reuse, or transformation into new products that are not wastes.

Details:

1. Waste Minimization
    a. It is important that every member of the University community be aware of the environmental and financial impacts related to the disposal of hazardous wastes and materials and to help reduce the volumes that are generated. Areas on campus that generate hazardous wastes and materials include laboratories, maintenance and facilities, and more. It is important that proper waste management be an integral part of the University’s operating procedures.
    b. This plan has been designed to assist campus waste generators in operating their areas with waste minimization in mind. General examples of waste minimization activities are presented below, and further information can be obtained by

contacting Environmental Health and Safety at extension 8133. Using this plan, lab managers and PI's can adopt specific minimization procedures that are applicable to their particular situations.

Procedures:

1. a. Waste Minimization
    i. There are three general methods of waste minimization:
        i. Source Reduction
        ii. Recycling
        iii. Treatment
    ii. The benefits that accrue to facilities that pursue waste minimization often include:
        i. Minimizing quantities of hazardous waste generated, thereby reducing waste management and compliance costs and improving the protection of human health and the environment.
        ii. Reducing or eliminating inventories and possible releases of hazardous chemicals in the workplace or into the environment.
        iii. Possible decrease in future Superfund and RCRA liabilities, as well as future toxic tort liabilities.
        iv. Reducing worker exposure; and
        v. Enhancing organizational reputation and image
    b. Source Reduction
    i. Changing practices and processes to reduce or eliminate the generation of hazardous wastes and materials is referred to as source reduction. Some source reduction methods include process modification, chemical substitution, and improved operating procedures. Here are some examples of reducing chemical waste generation at the source.
        i. Implement waste minimization procedures and train all personnel in those procedures.
        ii. Do not mix hazardous and non-hazardous waste.
        iii. Neat operations reduce waste.
        iv. Take care when weighing or transferring chemicals to minimize spills.
        v. Seal and contain processes to prevent the escape of fumes or leaks to the environment.
        vi. Use heat guns to remove paint rather than chemical solvents.
        vii. Consider the use of micro scale laboratory experiments.
        viii. Consider pre-weighed or pre-measured reagent packets where waste generation is high.
        ix. Minimize your inventory (buy less, store less, use less). Purchase chemicals in quantities that will be used in the near future. Waste may be generated by buying too much and having it go bad before it's used.
        x. Date all chemical product containers when received so that older products will be used first.
        xi. Keep all chemical product containers labeled to prevent accumulation of unknown products.
        xii. Centralize purchasing of chemicals and products within the department or laboratory to prevent order duplications.
        xiii. Substitute computer simulations/modeling, videos or demonstrations for wet laboratory experiments, when possible.
        xiv. Evaluate procedures to see if a less hazardous or a non-hazardous reagent can be substituted, some examples include:

Hazardous Chemical	**Safer Substitute**	**Used For**
Acetamide	Stearic Acid	Freezing point depression
Benzene	Xylene or Hexane	Many solvent uses
Benzoyl Peroxide	Lauryl Peroxide	Some polymer catalysis
Carbon Tetrachloride	Cyclohexane	Qualitative test for halides
Formaldehyde (formalin)	Ethanol	Specimen storage
Halogenated solvents	Non-halogenated solvents	Some extractions and other solvent uses
Sodium Dichromate	Sodium Hypochlorite	Some Oxidation reactions
Sulfide ion	Hydroxide ion	Qualitative test for heavy metals
Chromic acid solutions	Ultrasonic baths, Alconox or similar detergents, Pierce RBS-35, or similar detergents	Cleaning laboratory glassware
Toluene-based Scintillation Cocktail	Non-ignitable Scintillation Cocktail	Studies using radioactive materials

Mercury thermometers	Alcohol (red liquid), digital or thermocouple thermometers	Temperature
Solvents	Detergent and hot water	Parts cleaning
Oil-based paint	Latex paint	Painting operations

ii. In addition to the above, and in support of the United States Environmental Protection Agency's (USEPA) National Waste Minimization Program, RSC should all focus on efforts for reducing thirty-one (31) Priority Chemicals (PCs) found in our nation's wastes by finding ways to eliminate or substantially reduce their use. If these chemicals cannot easily be eliminated or reduced at the source, we must focus on recovering or recycling them.

Priority Chemicals	
Organic Chemicals and Chemical Compounds	***CAS Number***
1,2,4-Tricholorobenzene	120-82-1
1,2,4,5-Tetrachlorobenzene	95-94-3
2,4,5-Tricholorophenol	95-95-4
4-Bromophenyl phenyl ether	101-55-3
Acenaphthene	83-32-9
Acenaphthylene	208-96-8
Anthracene	120-12-7
Benzo(g,h,i)perylene	191-54-2
Dibenzufuran	132-64-9
Dioxins/Furans	1746-01-6
Endosulfan, alpha and beta	959-98-8 33213-65-9
Fluorene	86-73-7
Heptachlor and Heptachlor epoxide	76-44-8 1024-57-3
Hexachlorobenzene	118-74-1
Hexachlorobutadiene	87-68-3
Hexachlorocyclohexane, gamma-(Lindane)	58-89-9
Hexachloroethane	67-72-1
Methoxychlor	72-43-5
Naphthalene	91-20-3
Pendimethalin	40487-42-1
Pentachlorobenzene	608-93-5
Pentachloronitrobenzene (Quintozene)	82-68-8
Pentachlorophenol	87-86-5
Phenanthrene	85-01-8
Polycyclic Aromatic Compounds (PACs)/PAH Group	
Polychlorinated Biphenyls (PCBs)	1336-36-3
Pyrene	129-00-0
Trifluralin	1582-97-6
Metals and Metal Compounds	
Cadmium	7440-43-9
Lead	7439-92-1
Mercury	7439-97-6

c. Recycling
   i. Another method of waste minimization is recycling. Recycling is when a waste material is used for another purpose, treated and reused in the same process or reclaimed for another process. Some examples include (only when consistent with UHSP's Chemical Hygiene Plan and Standard Operating Procedures):
      i. Re-distilling used-solvents (stringent Standard Operating Procedures should be developed for recovering solvents since solvents can be extremely flammable or explosive). Recovering some solvents like ethers should be avoided.
      ii. Acetone or ethanol used for drying glassware can be collected and reused several times before disposal.
      iii. Purchasing gas cylinders (including lecture bottles) from manufacturers who will accept the return of the empty or partially used cylinders.
      iv. In some cases, excess pesticides and paints can be returned to the distributor.
      v. Some materials are commercially recycled by UHSP including; batteries, fluorescent lamps and ballasts and electronics (computers).

vi. Reclaiming metallic mercury.
vii. Re-circulate unused, excess chemicals within your department.

d. Treatment
   i. The last technique for waste minimization is treatment of waste. Wastes that are neutralized or detoxified and managed at the source can reduce environmental risks that might occur during transportation and handling. Our Plan encourages in-lab chemical management (only when consistent with RSC's written Chemical Hygiene Plan and Standard Operating Procedures), such as neutralization of acids or bases and chemical treatment of toxic chemicals as the final step of the experiment. These steps either decrease or eliminate toxicity or help to reduce the volume of waste. The following are some examples:
      i. Neutralize acids and bases
      ii. Precipitate metals out of solution to reduce volume of waste
      iii. Polymerize solutions
      iv. Oxidize cyanide salts and bromide solutions with bleach
      v. Convert compounds into less volatile forms
   ii. As a general note, University of Health Sciences and Pharmacy in St. Louis does not currently operate as a recycling or treatment facility for hazardous wastes. Hazardous wastes should first be reduced and minimized before options of recycling and treatment are explored.

e. Managing Waste In most cases, waste can be minimized, but not eliminated. Waste is a natural product of research, teaching, testing and many other maintenance operations. It is prudent to manage all wastes as efficiently as possible for the associated benefits referenced above. The management of chemical waste is most efficient when waste types are properly segregated, which also helps to reduce disposal costs.

   The importance of proper separation of chemical wastes into various groupings cannot be over emphasized. UHSP generates and disposes of quantities of the waste streams shown below. In most circumstances, the volumes and types of wastes, rather the concentrations of wastes, determines the costs of disposal. As a result, EH&S requests that areas generating waste make an effort not to dilute their wastes any more than is necessary. Also, do not mix hazardous chemical with non-hazardous wastes, and do not mix hazardous chemical with radioactive wastes. Appropriate labeling and marking of containers will assure the proper collection and segregation of hazardous wastes and materials. The following sections are meant to give waste generators some information on how to minimize disposal costs of some of the more common waste streams generated at UHSP. In some situations, these suggestions will be difficult or impractical to implement.
   i. Flammable Liquids
      i. Examples: acetone, methanol, ethanol, toluene, xylene, hexane, acetonitrile
      ii. Flammable liquid wastes are typically burned as fuel in cement kilns and waste disposal incinerators, and as a result, disposal is relatively easy and inexpensive. For this reason, the lower the water content in the waste the less expensive the costs of disposal. Solvents contaminated with materials not suitable use as fuel supplements will require alternative, costly treatment methods.
      iii. Some suggestions for reducing disposal costs:
         i. Minimize water content of waste by minimizing any unnecessary dilutions.
         ii. If possible, keep separate from wastes that contain heavy metals, pesticides, cyanides, or acute hazardous "P-listed" wastes. These wastes tend to drive up the costs of disposal due to the need for more complex waste treatment.
         iii. Recycle or redistill solvents.
         iv. Investigate the use of nonflammable or biodegradable alternative solvents.
         v. Replace solvent based inks in printing operations with soy-based inks.
         vi. Make multiple use of cleaning solutions before disposing of them.
   ii. Flammable/Corrosive Mixtures
      i. Examples: trifluoroacetic acid & acetonitrile, phenol & chloroform, potassium hydroxide & methanol, methanol & hydrochloric acid
      ii. Flammable acids and alkaline mixtures are difficult to dispose of due to their corrosive nature. This waste can cost at least four times more to dispose of than other flammable liquids.
      iii. Some suggestions for reducing disposal costs:
         i. Minimize unnecessary dilution of wastes.
         ii. Do not mix unnecessarily with other solvents.
         iii. Keep acidic and alkaline wastes separate to minimize the risk of reactions.
         iv. Minimize the volume of these wastes by keeping separate from other waste streams.
         v. If possible, keep separate from wastes that contain heavy metals, pesticides, cyanides, or acute hazardous "P-listed" wastes. These wastes tend to drive up the costs of disposal due to the need for more complex waste treatment.
   iii. Acids and Bases
      i. Examples: hydrochloric acid, sulfuric acid, phosphoric acid, potassium hydroxide, and sodium hydroxide.
      ii. If not contaminated with other hazardous wastes (i.e. heavy metals, listed hazardous wastes, etc.) most acids and bases can be neutralized and then drain disposed. Neutralization of acids and bases reduces disposal costs. Some acids and bases, such as chromic acid or barium hydroxide, cannot be made non-hazardous by neutralization due to their heavy metal content. Diluting acids or bases with water is not neutralization and is not allowed. Neutralization must be accomplished by carefully mixing an acid with a base or vice versa. The

resulting solution must be as close to pH 7 as possible before pouring down the drain. Some acids, such as hydrofluoric and Perchloric acid, are quite dangerous and require additional preparation and supervision for disposal of these acids.

iii. Some suggestions for reducing disposal costs:
    i. Minimize unnecessary dilution of wastes.
    ii. Neutralize waste if possible following Standard Operating Procedures.
    iii. Do not mix unnecessarily with other waste streams.

iv. Halogenated Solvents
    i. Examples: methylene chloride, chloroform, trichloroethane, perchloroethylene, carbon tetrachloride
    ii. Not only are many halogenated solvents (solvents containing CL- , F- , Br-) carcinogenic, but they are also difficult to dispose of, and can cost three times more to dispose of as compared to non-halogenated solvents. An effort to keep halogenated and non-halogenated waste in separate containers will help to reduce disposal costs.
    iii. Some suggestions for reducing disposal costs:
        i. Minimize unnecessary dilution of wastes.
        ii. Keep separate form acidic or alkaline waste streams Keep halogenated wastes separate from non-halogenated wastes.
        iii. Substitute non-halogenated solvents in place of halogenated solvents.
        iv. If possible, keep separate from wastes that contain heavy metals, pesticides, cyanides, or acute hazardous “P-listed” wastes. These wastes tend to drive up the costs of disposal due to the need for more complex waste treatment.
        v. Recycle or redistill solvents.
        vi. Investigated the use of alternative non-halogenated solvents.

v. Chromerge and Chromium-Bearing Waste
    i. If possible, avoid use of Chromerge® (potassium dichromate and sulfuric acid) for the cleaning of laboratory glassware.
    ii. Alternatives: Alconox®, Pierce RBS-3® 5 and NoChromix®.
    iii. Chromium is a concern due to its toxic characteristics. Researchers who use chromium as a part of their laboratory procedures should seek alternative methods.
    iv. Some suggestions for reducing disposal costs (if chromium-bearing materials must be used):
        i. Minimize the volume of waste generated by unnecessary dilution.
        ii. If possible, keep separate from wastes that contain heavy metals, pesticides, cyanides, or acute hazardous “P-listed” wastes. These wastes tend to drive up the costs of disposal due to the need for more complex waste treatment.

vi. Formalin and Formaldehyde Solutions
    i. Formaldehyde is a suspected human carcinogen, which is toxic, very irritating to the eyes, throat and breathing passages and can cause dermatitis. Formaldehyde is also a sensitizer, so the more a person is exposed to it, the smaller a dose it takes to have an effect on that person.
    ii. Some suggestions for reducing disposal costs:
        i. Minimize the volume of waste generated by eliminating any unnecessary dilution.
        ii. Do not mix with any other waste streams. Substitute ethanol, or commercial fixatives like Carosafe® or Formalternate® in place of formaldehyde for storage of biological specimens. Treatment and disposal of metal solutions such as barium, cadmium, lead, copper, selenium, silver, cobalt, mercury, etc. varies depending on the type and concentration of the metal present in the waste. Waste minimization recommends the substitution of less hazardous metals for those procedures that involve heavy metals

vii. Aqueous Metals
    i. Some suggestions for reducing disposal costs:
        i. Keep heavy metal solutions separate from other wastes.
        ii. Keep mercury free from all other waste streams including other metal waste.
        iii. Minimize the volume of waste by eliminating any unnecessary dilution.
        iv. Consider using micro scale techniques.
        v. Substitute less hazardous metals.
        vi. Eliminate metal catalysts in chemical procedures and allow more time for the completion of reactions.
        vii. Consider precipitating out metals from solution.

viii. Oil-based Paints and Solvents
    i. Unusable oil-based paints and solvents are hazardous wastes due to their flammable and/or toxic natures. These types of waste paint materials must be disposed of as a hazardous waste.
    ii. Some suggestions for reducing disposal costs:
        i. Do not contaminate usable paint and always reseal the containers (allows for re-use).
        ii. Use latex paint.
        iii. Minimize the volume by reducing any unnecessary dilution.
        iv. Minimize inventories of paints. Order only enough to satisfy short-term needs.

ix. Latex Paints
    i. Latex paints are not considered hazardous wastes; however unusable latex paint cannot be disposed of in the normal trash unless completely solidified. Liquid latex paints must be collected and disposed of properly.
    ii. Some suggestions for reducing disposal costs:

i. Do not contaminate useable paint, and always reseal the container (allows for recycling).
ii. Do not mix latex with non-latex paints or any other hazardous materials.
iii. Minimize the volume by reducing any unnecessary dilutions.

x. Used Oil
   i. Used oil is not considered a hazardous waste; however, it must be collected in a container that can be closed and labeled “Used Oil,” and the oil must be recycled. Recycling is simple as long water contamination is minimal and the oil is not contaminated with any hazardous substances.
   ii. Some suggestions for reducing disposal costs:
      i. Minimize the volume of waste by reducing any unnecessary dilution or addition of water.
      ii. Avoid contamination with hazardous materials. If the oil has been contaminated or exposed to heavy metals, solvents, antifreeze and/or chemicals, it is potentially hazardous, and must be disposed of in accordance with hazardous waste disposal procedures.

xi. Unknown Chemicals
   i. The generation of unlabeled and unidentified chemicals results in an expensive waste disposal challenge. The number of unknown chemicals can be significantly reduced by simply making a concerted effort to label all containers. Unknown chemicals can cost up to ten times more to dispose of than properly labeled chemicals. Original chemical and product labels should be retained on containers until the chemicals/products are completely used and the containers no longer have any hazards related to its contents. When transferred to secondary containers chemicals/products should be labeled at a minimum with the chemical/product name, Right-To-Know label, and the primary hazard (i.e. flammable, poison, corrosive, etc.).
   ii. Some suggestions for reducing disposal costs:
      i. Prevent generation of unknown chemicals/products by keeping all containers labeled.
      ii. Do not let old chemicals and products accumulate, clean out stockpiles of old chemicals and products before they become “unknowns.”
      iii. Before a laboratory researcher or student leaves the work area, all samples and chemical formulations generated by that person, must be clearly labeled as to their content.
      iv. Chemicals must be transferred to another individual or properly disposed of prior to the individual’s departure.

xii. Unused or Excess Chemicals
   i. The American Chemical Society (ACS) estimates that 40% of the chemical waste generated at facilities consists of unused chemicals. As a result, University of Health Sciences and Pharmacy in St. Louis encourages departments/laboratories to purchase chemicals only in amounts that will be used within the budget year. Bulk purchases may be cheaper (price per unit) for laboratories; however, if these chemicals are unused, disposal costs will far outweigh any savings. The ACS has an excellent publication, Less is Better: Guide to Minimizing Waste in Laboratories, available on the web.
   ii. Some suggestions for reducing disposal costs:
      i. Redistribute usable/unwanted chemicals within your department or the University.
      ii. Do not stockpile large quantities of chemicals, clean out old chemicals periodically, saving only those that are needed.
      iii. Do not accept chemicals from outside organizations, companies or contractors without prior approval.

xiii. Mercury Compounds and Mercury-Containing Devices
   i. Mercury-containing wastes require special treatment; thus, disposal is expensive.
   ii. Some suggestions for reducing disposal costs:
      i. Do not mix mercury-containing wastes with any other waste streams.
      ii. Mercury thermometers and manometers should be replaced with non-mercury containing instruments.
      iii. If you must use mercury thermometers, purchase those with a Teflon® coating.
      iv. Containerize metallic mercury, so it can be recycled.
      v. If mercury is spilled cleanup following the guidelines on mercury spill procedures in the UHSP Chemical Hygiene Plan.
      vi. Due to the high toxicity and disposal costs of certain mercury compounds use alternative procedures whenever possible.
      vii. Use mercury free catalysts or simply let reactions run longer.
      viii. Fluorescent lamps also contain mercury, and must be recycled.

xiv. Compressed Gas Cylinders
   i. Compressed gas cylinders pose both physical and health hazards. Physical hazards include flammability (depending on the gas) and hazards associated with high pressures and cylinder ageing. Health hazards include inhalation of toxic or corrosive gases, chemical asphyxiation, or asphyxiation associated with oxygen displacement.
   ii. Some suggestions for reducing disposal costs:
      i. Use a supplier that recycles empty gas cylinders. This can be accomplished by renting not purchasing the cylinders.
      ii. Limit the purchase of specialized gas cylinders (lecture bottles) since these are hard to recycle. If lecture bottles must be purchased use a supplier that will recycle the empty or partially filled bottles.
      iii. Before purchasing gas cylinders check with your department for existing cylinders that may be available for use.

xv. Batteries

i. Many batteries contain one or more hazardous chemical components, and therefore must be recycled.
    i. Lead Acid (car batteries)
    ii. Mercury
    iii. Silver
    iv. Lithium
    v. Nickel Cadmium (Ni-Cad), Nickel Metal-hydride
ii. Common alkaline batteries (Duracell or Energizer batteries), which are not rechargeable are exempt and may be disposed of in the trash.

xvi. Electronic Devices
i. Electronic devices (computers, monitors, TVs, etc.) may contain hazardous materials and must be recycled.

f. Conclusion
i. All members of the University community should make waste minimization an ongoing component of day-to-day operations. It is essential that departments take responsibility for reducing the byproducts of operations and the waste that is generated. The success of the UHSP Waste Minimization Program is dependent on the participation of University departments to reduce wastes and creating new ideas to further reduce waste.

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