# The Disposal of Chemical Laboratory Wastes

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# DISPOSAL OF LABORATORY WASTES

## Ohio's Hazardous Wastes Rules

Ohio's hazardous waste rules 3745-51-10 through 3745-41-33 define what a hazardous waste is and many laboratory materials could be classified as a hazardous waste.

The hazardous waste regulations require various administrative and technical procedures and it would be advantageous to be excluded from the requirements. Pertinent exclusions are:

1) Generators and storers of hazardous waste that accumulate less than 1000Kg (2200lbs.) of waste or generate less than 1000kg per month. For acutely hazardous generic materials which are specifically listed in the Regulations. Those that accumulate less than 1kg (2.2lbs.) or generate less than 1kg per month are excluded.

2) Storers of hazardous waste do not have to obtain a storage permit if wastes are stored in tanks or containers and oil is removed from the site within 90 days, provided that certain requirements are adhered to for ensuing safe storage.

3) Wastes are generally excluded from the law if the wastes are to be reused, recycled, or reclaimed.

Because of the small quanity generator exemption it is expected that most laboratories would not be required to comply with the law. In addition, the distinction of when a material becomes a waste rather than a useful material is not clearcut. The rest of this text assumes that the laboratory is exempt from the hazardous waste regulations and that the disposal of laboratory wastes is a pragmatic problem more than a legal one.

## Recycling of Wastes

All chemicals which are labelled and unopened have potential for reuse

by another user. Prime accepters are other laboratories--training, research labs (university, high school, etc.), and analytical labs. Sometimes chemical distributors will accept these materials, especially high volume use materials such as strong mineral acids. Other specific users would be electroplaters for sodium cyanide and caustics, chemical treaters for caustics and acids, and chemical manufacturers for large amounts of chemicals which can be used as feedstocks for producing other products.

Chemical waste exchanges do exist but are not common. In general, they are not suited to small amounts of waste as would be found in a laboratory. There is a potential for the creation of exchanges between labs, but we are not presently aware of any activity. Hazardous waste reprocessors may take specific labwastes but we have not verified this potential. A list of chemical reprocessors is included in Appendix 2.

Landfill of Laboratory Wastes

The inorganic chemicals listed under Appendix 1 (plant nutrients) can be disposed on a land surface with proper consideration of the material and the potential for contamination of ground and surface water. In any case, relatively small amounts of these inorganic materials (up to a few pounds) can be incorporated with sanitary trash that will end up at a sanitary landfill. Many other inorganic salts which are non-reactive and relatively non-toxic can equally be included with refuse. Those materials which can cause injury like caustics should be sufficiently packaged so that no one will be directly exposed during collection, trash compaction, transportation, and burial. Small bottles of liquids should be overpacked in containers which have enough absorbent (vermiculite, etc.) to absorb all of the material in case of a spill. Large volumes of liquids should be absorbed first before packing. Small packages of asbestos can be included with normal refuse but must be first wetted and packed in plastic.

Many organic chemicals are degraded in the enormous biological activity that takes place in a sanitary landfill. A rule of thumb is that organic chemicals not containing toxic metals or halogens (F,

Cl, Br, I) are eventually destroyed in a sanitary landfill. Small amounts of hydrocarbons are of little concern and in general carbon-oxygen, especially carbohydrates and carbon-nitrogen compounds are usually quickly degraded. Medicines are generally sensitive to environmental degradation in a landfill situation. Unsubstituted Aromatics can take longer however landfill containment is very long. In all cases, significant amounts of materials should not be disposed which are highly toxic. When consulting toxicity references, any material which has an oral LD50 of below 500mg/kg is to be considered toxic. Materials which have an LD50 below 50 mg|kg are considered highly toxic. Under no circumstances should reactive materials be included with municipal refuse.

Halogenated hydrocarbons are resistant to degradation and should not be sent to a landfill unless in a non-liquid, widely-dispersed form.

A liscensed landfill in Ohio can only accept normal refuse — other materials need special approval. For disposal in a sanitary landfill, the agency would probably approve small amounts of lab wastes which conform to conditions described here. However, it must be remembered that even with Ohio EPA approval it is the landfill's decision on whether to accept wastes other than refuse.

## Disposal in Sanitary Sewer

All inorganic salts listed in Appendix 1 can be disposed in a large municipal sanitary sewer. In addition many other salts which are soluble and do not contain the toxic metals As, Ba, Cd, Cr, Pb, Hg, Se and Ag (unless in very small amounts) can be disposed in this way.

Organic material that is miscible with water can be washed down the drain with plenty of water providing the material is not toxic and resistent to degradation (such as halogenated hydrocarbons and aromatic compounds).

Small amounts of caustics can be disposed of by flushing with water. Strong mineral acids should not be disposed down the drain without prior neutralization because natural waters are insufficient to neutralize them in a reasonable time and plumbing can be considerably damaged before the strong acids are dispersed.

The following organic compounds are frequently suitable for disposal down the drain if sufficiently miscible with water. These compounds are generally consumed in the biological activity that takes place during the wastewater treatment process.

alcohols
aldehydes
ketones
esters
organic acids
hydrazines
amines
amides
cyanides and nitrites (only extremely dilute alkaline solutions)
ethers (non-volatile)
mercaptan (if extremely dilute because of odor problems)

Organic compounds which are unsuitable for disposal down the drain are:

Azides and Azo compounds (explosive)
Carbon disulfide (highly flammable)
Peroxides (explosive)
Halogenated Hydrocarbons (degrades slowly and/or toxic)
Aromatic compounds (degrades slowly and/or toxic)

It is assumed that all of the above materials will be washed individually down the drain with large quantities of water.

These guidelines are what the OEPA considers reasonable for the disposal of some compounds. It must be remembered that the option

of whether to allow these types of materials in the sanitary sewer system belongs to the respective local department responsible for the sanitary waste treatment system and they should be contacted prior to disposal.

## Open Burning and Evaporation
## Fire Departments | Fire Marshall

Open buring is not permitted by Ohio law unless a waiver is given by your local air pollution agency or the Ohio EPA district office where there is no local air agency. The following phone numbers are pertainent:

1) Norman Keckler, Air Pollution Control, Akron (216) 375-2480
2) Rubert Pattison, Air Pollution Control, Canton C.H.D. (216) 489-3385.
3) E.D. Ermenc, Southwestern Ohio Air Pollution Control, Cincinnati, (513) 352-4880.
4) Richard Lemkuhl, Southwestern Ohio Air Pollution Control, Cincinnati, (513) 948-8997. (handles Butler, Warren, and Clermont counties)
5) Gary J Nied, Div. A.P.C., Dept. Public Health and Welfare, Cleveland, (216) 664-3500.
6) Leon Weitzel, Air Pollution Control Div., Painesville, (216) 352-0766.
7) Rubert Ramhoff, Mahoning-Trumbull A.P.C., Youngstown (216) 744-1928.
8) H.E. Woodward, Mansfield-Richland C.H.Dept., Mansfield (419) 524-2333.
9) Pat DeLuca, North Ohio Valley Air Authority, Steubenville (614) 282-3908.
10) Don Cavote, Portsmouth C.H. Dept., Portsmouth (614) 353-5153.
11) RAPCA, W. Burkhart, Montgomery C.H. Dept., Dayton (513) 225-4435.
12) T. Kovacik, Toledo Env. Ser. Agency, Toledo (419) 247-6524.

OEPA Northeast District, Twinsburg (216) 425-9171
OEPA Northeast District, Bowling Green (419) 352-8461
OEPA Southeast District, Logan (614) 385-8501
OEPA Southwest District, Dayton (513) 461-4670
OEPA Central District, Columbus (614) 466-6450

For small amounts of ignitable solvents, open burning becomes a practical disposal option because commercial incinerators are not adapted for taking wastes from small generators. There is a danger in this procedure which can be minimized by igniting relatively small amounts in a shallow container out in an open space.

Before attempting open buring yourself you may want to check with the local fire department as they may have use of flammable materials for a demonstration or practice.

Ignition should take place by an excelsior fuse with a chemical extinguisher close at hand. The solvents should not produce toxic fumes or contain dissolved material which may be toxic. Solvents composed of only carbon, hydrogen, and oxygen are reasonable materials for burning. Organic solvents containing a nitrile group (-CN which can produce HCN) and halogens ( which can produce acid fumes) should be carefully burned either with proper safety equipment or very small amounts in a well ventilated safety hood. Small amounts of very flammable solvents (flashpoint below 100 degrees F) may be suitable for evaporation, that is: the material is placed in a shallow dish in a well ventilated hood or outdoors. A prime example is ethyl ether which will evaporate very quickly. The solvents should be relatively non-toxic.

## Disposal of Laboratory Chemicals

In general, the most advantageous place for disposal of unused laboratory chemicals is at the laboratory itself. Most laboratory chemicals can be changed to an environmentally harmless form and the chemical laboratory which has various reactants, ventilation hoods, access

to sanitary sewers, etc. is a secure place to perform these chemical transformations.

A basic reference for the disposal of laboratory chemicals is: "Laboratory Waste Disposal Manual", Manufacturing Chemists Association (1969). and a later edition "Guide for Safety in the Chemical Laboratory" Manufacturing Chemists Association, Van Nostrum-Rheinholt Publishing company (1972). Besides the aforementioned references, some additional comments regarding disposal are presented here:

## Toxic Metals

The inorganic salts of arsenic, cadmium, chromium, lead, mercury, and selenium present special problems for disposal, while no chemical or physical process can actually destroy these metals, some may change their form. For example, chromium in a hexavalent state is much more of a concern than trivalent chromium and so the first step should involve chemical reduction. Toxic metal salts can be disposed in a secure landfill. This alternative is not attractive for small amounts of wastes because of packaging requirements; bottles of toxic salts must be packed in vermiculite and sealed in a steel drum. Secure landfills, generally, are not interested in smaller quanities than drum size. In addition, the actual disposal costs are expensive; however, if enough material is available to fill a drum and the difficulty of disposing of toxic metals is considered, this method becomes more attractive.

As an alternative to secure landfilling, the toxic metal compounds may be returned to the distributor or manufacturer or to a processer. Their receptiveness to this procedure has been found to vary widely, two sources for this type of service are: Mercury in liquid metal form only can be sold to a reprocessor if the amount is greater than ten pounds.

Smaller amounts of Mercury may be accepted at no charge, provided that transportation costs are paid by the donor. For details

call:

Bethlehem Apparatus Co.
890 Front Street
Hellertown, Pa. 18055
(215) 838-7034

--Mercury is accepted only from institutions, Universities, colleges, etc.

Mercury in the form of mercury sulfide (free of chlorides) is acceptable to a reprocessor without charge, provided that transportation is paid by the donor. They will also ~~accept an aluminum or~~ zinc amalgam of mercury. This latter form is especially convenient for removing mercury from various neutral waste streams used in analytical procedures, since it avoids the use of sulfides and percipitates. The mercury amalgams and sulfides can be sent in a plastic bottle or container to:

Mercury Refining Co., Inc.
Railroad Avenue
Albany, New York
(518) 489-7363
--Be sure to check packaging and mailing instructions.

Until more disposal alternatives for toxic metals compounds are discovered, the only remaining alternative is storage on your shelf.

## EXPLOSIVE CHEMICALS

Ethers such as ethyl ether and 1, 4-dioxane have the ability, upon long standing, to form explosive peroxides. This explosive ability is overrated and has only occured when the ethers were kept very dry, with chemical dryers, and when the peroxides were concentrated by evaporations or distillation. Since, under ordinary conditions, these materials readily pick up water from the air, the potential for peroxide formations is usually minimal. In any case, allowing water to come into contact with the material or with the cap threads of the bottle when opening the container will remove the danger of

explosion. Then the material can be evaporated or for ethers that are miscible with water such as 1, 4-dioxane, the material can be washed directly down the drain.

Benzoyl peroxides can explode, but the reported incidences are rare. To put the matter into perspective, benzoyl peroxide is the hardener material in many epoxy resins used in automobile body repair. Again, peroxides are not explosive when moist and prior to opening, it is prudent to soak the bottle in water with a small amount of detergent to wet any material that may be lodged in the cap threads. The material can then be deactivated by adding to it ten times its volume of 20% sodium hydroxide, wait 24 hours, then neutralize and/or directly wash into a sanitary sewer. A strong bubbling reaction occurs when the hydroxide is added, so it is convenient to place the bottle in a large plastic bucket and add small amounts of hydroxide at a time.

Picric Acid is explosive but not when moist, in any case an old bottle of picric acid can be quite dangerous especially upon opening. It is recommended that the nearest bomb squad be contacted for removal. By adding a sufficient quantity of a solution of 1 part sodium hydroxide: 21 parts sodium sulfide: 200 parts water by weight of the material, it can be neutralized. Enough solution should be added so that the weight of neutralizing solution is 25 times the weight of the picric acid. After 24 hours, the reacted material can be discharged into a sanitary sewer with excess water. The reaction must be carried out in a fume hood since toxic hydrogen sulfide and ammonia gasses are produced.

(Before attempting to remove any material that is a known explosive hazard or a suspected explosive, contact the local police department for access to a bomb squad.)

## Radioactive chemicals

Disposal of chemicals that are radioactive must comply with the rules of the Nuclear Regulatory Commission (NRC). Most radioactive chemicals

found in ordinary laboratories exhibit low level radioactivity and do not fall under the jurisdiction of the NRC.

For a detailed evaluation of radioactive wastes, the following state Agency can be contacted:

Environmental Health
Ohio Department of Health
(614) 466-1380

## Cyanides

A method for disposal of cyanides can be found in the reference quoted previously. Another method for disposal of cyanides is to simply add chlorine bleach and sodium hydroxide. Excess chlorine bleach must be added and then the fully reacted material may be washed into a sanitary sewer after standing for 24 hours. Larger quantities may be sent to:

Nelson Chemical Co.
12345 Schaefer Highway
Detroit, Michigan 48227
(313) 933-1550
--Their disposal costs are reasonable.

## Professional removal and Disposal

There are a number of companies which will come in, properly pack your lab waste, and transport them in accordance with DOT specification and with chemical transportation requirements to a treatment or disposal facility. These services are not cheap but might be a consideration if you have large amounts of waste and little expertise to dispose of it. Refer to Appendix 4 for a list of Lab Pack Service Companies. There are also companies which will transport and|or

broker and/or dispose various portions of laboratory wastes. Those companies which have applied for a treatment, storage or disposal permit from Ohio are listed in Appendix 3.

## Appendix 1

## Inorganic Plant Nutrients

Alumina Aluminum Oxide; $Al_2O_3$

Aluminum Phosphate ($AlPO_4$)

Aluminum Sulfate; $Al(SO_4)_3 \cdot 18H_2O$

* Ammonia; $NH_3$

Ammonium Chloride; $NH_4Cl$

Ammonium Metaphosphate

(1) Ammonium Molydate; $(NH_4)_2MoO_4$

Ammonium Nitrate; $NH_4NO_3$

Ammonium Phosphates

Ammonium Sulfate; $(NH_4)_2SO_4$

Ammonium Thiosulfate; (NH )

(1) Borax; $Na_2B_4O_7 \cdot 10H_2O$

* Calcium Hydroxide

Calcium Nitrate; $Ca(NO_3)_2 \cdot 4H_2O$

* Calcium Oxide; CaO

Calcium Phosphate

Calcium Sulfate

Carbon

Cobalt Sulfate (Cobaltous Sulfate)-($CoSO_4 \cdot 7H_2O$)

(1) Copper Carbonate

(1) Copper Oxide

(1) Copper Sulfate

Ferric Oxide; $Fe_2O_3$

Ferric Sulfate; $Fe_2(SO_4)_3 \cdot 9H_2O$

Ferroaminonium Sulfate; $(NH_4)_2Fe(SO_4)_2$

Ferrous Carbonate

Ferrous Sulfate; $FeSO_4 \cdot 7H_2O$

Iron Phosphate; $FePO_4$

Magnesium Carbonate; $MgCO_3$

Magnesium Oxide

Magnesium Phosphate

Magnesium Sulfate; MgSO4

Manganous Oxide; MnO

(1) Molybdic Oxide; $MoO_3$

* Potassium Oxide; $K_2O$

Potassium Carbonate; $K_2CO_3$

Potassium Chloride

* Potassium Hydroxide; KOH

Potassium Nitrate; $KNO_3$

Potassium Phosphates

Potassium Sulfate; $K_2SO_4$

Silica (Silicon Dioxide, $S:O_2$)

(1) Sodium Molydate; $Na_2MoO_4$

Sodium Nitrate; $NaNO_3$

Sulfur

Urea; $CO(NH_2)_2$

(1) Zinc Ammonium Nitrate

(1) Zinc Ammonium Sulfate

(1) Zinc Nitrate; $Zn(NO_3)_2 \cdot 6H_2O$

Zinc Oxide; ZnO

Zinc Sulfate; $ZnSO_4$

*Can cause injury upon contact or injestion.

(1) Micronutrient, excesses can easily damage plants.

Appendix 2

## Hazardous Waste Processer-Recycler

| Name, Address, Contact | Materials Accepted | Services |
|---|---|---|
| Chemtron Corporation<br>35850 Schneider Court<br>Avon, Ohio 44011<br>Phone number: (216) 934-6131<br>Contact: Mr. Ronald Guenther,<br>Mr. Robert Guenther, or<br>Mr. Carl Guenther | 1. Trichloroethylene, perchloroethylene, methylene chloride, 1,1,1-trichloroethane, trichlorotrifluorocarbons (Freon).<br>2. No PCB's, pesticides, or flammable materials accepted.<br>3. Drum quantities only. | 1. Recycles solvents for resale or return to the customer.<br>2. Transportation available. |
| Commercial Oil Services<br>3600 Cedar Point Road<br>Oregon, Ohio 43616<br>Phone number: (419) 836-3694<br>Contact: Mr. Dan Soncrant or<br>Mr. Ken Mikolas | 1. Halogenated and non-halogenated solvents.<br>2. Waste petroleum based oils for fuel blending.<br>3. Drum or tank quantities. | 1. Recycles solvents for return to the customer.<br>2. Transportation available (vacuum tank truck or flat bed trailer). |

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## Hazardous Waste Processer-Recycler

| Name, Address, Contact | Materials Accepted | Services |
|---|---|---|
| Environmental Processing Services<br>416 Leo Street<br>Dayton, Ohio 45404<br>Phone number: (513) 222-1062<br>Contact: Mr. Doug Benbow | 1. Halogenated and non-halogenated industrial solvents<br>2. Drum Quantities only. | 1. Recycles solvents for resale or return to the customer.<br>2. Transportation available for drum quantities. |
| Granville Solvents, Inc.<br>Palmer Lane<br>Granville, Ohio 43023<br>Phone number: (614) 587-0079<br>Contact: Mr. John Reeb | 1. F001 wastes (tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons).<br>2. F003 wastes (xylene, acetone, ethyl acetate, ethylbenzene, ethyl ether, n-butyl alcohol and cyclohexanone).<br>3. Toluene, methyl, ethyl, propyl or butyl alcohols.<br>4. Benzene not accepted.<br>5. Drum, tank or bulk quantities. | 1. Recycles solvents for resale or return to the customer. |

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## Hazardous Waste Processer-Recycler

| Name, Address, Contact | Materials Accepted | Services |
|---|---|---|
| Hukill Chemical Corporation<br>7013 Krick Road<br>Cleveland, Ohio 44146<br>Phone number: (216) 232-9400<br>Contact: Mr. Robert Hukill or<br>Mr. Bruce Hotton (sales) | 1. Halogenated and non-halogenated solvents.<br>2. Benzene, PCB and pesticide materials not accepted.<br>3. Drum and tank quantities. | 1. Recycles solvents for resale or return to the customer;<br>2. Transportation available. |
| Klor Kleen, Inc.<br>3159 Spring Grove Avenue<br>Cincinnati, Ohio 45225<br>Phone number: (513) 681-0060<br>Contact: Mr. Elmer Lay,<br>Mr. Al Perry, or<br>Mr. Carl Luken | 1. F001 Wastes (tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, and chlorinated fluorocarbons).<br>2. Carbon tetrachloride not accepted.<br>3. Drum or tank quantities. | 1. Recycles solvents for resale or return to the customer.<br>2. Transportation of drummed materials available. |

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Appendix 5
References

The following codes indicate the kind of information provided by each source. The (*) indicates those reference which should be available in the District Offices.

| Code | Information |
|---|---|
| Bib | Bibliographic Materials (additional references) |
| CAS | Chemical Abstracts Service Registry Number (CAS#) |
| DM | Disposal Methods |
| G | General Physical and Chemical Data; Constitutents |
| HAND | Handling procedures and Safety Considerations |
| HFR | Health, Flammability, Reactivity |
| P | Production and Use in Industry, Medicine, Etc. |
| RR | Resource Recovery |
| T | Toxicity |
| M | Manufacturer |
| PSYN | Proper Chemical Name and Synonyms |

| Code | Reference |
|---|---|
| G, Hand, P, PSYN | *Hawley, G.G. (Ed.). The Condensed Chemical Dictionary. 9th edition. New York: Van Nostrand Reinhold Company (1977). |
| G, PSYN | *West, R.C. (Ed.). Handbook of Chemistry and Physics. 60th edition. Boca Raton, Florida: CRC Press, Inc. (1979). |
| G,P,PSYN | Morrison, R.T., and Boyd, R.N. Organic Chemistry. 3rd edition. Boston: London: Sydney: Toronton: Allyn and Bacon, Inc. (1973). |
| Bib, G, HFR, P, PSYN, T | *Windholz, M. (Ed.). The Merck Index and Encyclopedia of Chemicals and Drugs. 9th edition. Rahway, N.J.: Merck and Co., Inc. (1976). |
| P | Perry, R.H., and Chilton, C.H. Chemical Engineer's Handbook. 5th edition. New York: McGraw-Hill Book Company (1969). |
| Bib, CAS, PSYN, T | *Lewis, R.J. (Ed.). Registry of Toxic Effects of Chemical Substances. 1978 edition. Cincinnati: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health (1979). |
| G, Hand, HFR, PSYN, T | *Fire Protection Guide on Hazardous Materials. 7th edition (1978). Boston: National Fire Protection Association. Composite volume containing parts FPI, 325M, 49, 491M, and 704. |
| G, Hand, P, M, PSYN, T | *Berg, G.L. Farm Chemicals Handbook 1980. Willoughby, Ohio. Meister Publishing Co. (1980). (Pesticides and Herbicides). |
| DM | Pojasek, R.B. (Ed.). Toxic and Hazardous Waste Disposal. 2 vols. Ann Arbor, Michigan: Ann Arbor Science Publishers, Inc. (1979). |
| G, Hand, HFR, PSYN, T | *Sax, N.I. Dangerous Properties of Industrial Materials. 5th edition. New York: Van Nostrand Reinhold Comp. (1979). |
| G, P, PSYN, T | Verschueren, K. Handbook of Environmental Data on Organic Chemicals. New York: Van Nostrand Reinhold Comp. (1977). |
| Hand, HFR, P, T | *Meyer, E. Chemistry of Hazardous Materials. Englewood Cliffs, N.J.: Prentice - Hall, Inc. (1977). |
| DM, G, Hand, HFR, T | *Laboratory Waste Disposal Manual. 2nd edition. Washington, D.C.: Manufacturing Chemist Association (1969). |
| Hand, PSYN, T | *Mackison, F.W. (Ed.). NIOSH/OSHA Pocket Guide to Chemical Hazards. U.S. Department of Health, Education and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, and the U.S. Department of Labor, Occupational Safety and Health Administration (1978). |

| Code | Reference |
|---|---|
| | Clayton, G.D. and Clayton, F.E. (Eds.). Patty's Industrial Hygiene and Toxicology: General Principles. 3rd edition. New York: John Riley and Sons (1978). |
| | Cralley, L.J. and Cralley, L.V. (Eds). Patty's Industrial Hygiene and Toxicology: Theory and Rationale of Industrial Hygiene Practice. New York: John Wiley and Sons (1979). |
| Bib, G, P Hand, HFR, PSYN, T | Sittig, M. Hazardous and Toxic Effects of Industrial Chemicals. Park Ridge, N.J.: Noyes Data Corporation (1979). |
| G,T | Gleason, M.N., Gosselin, R.E., Hodge, H.C., and Smith R.P. Clinical Toxicology of Commercial Products: Acute Poisoning. 3rd edition. Baltimore: The Williams and Wilkins Co. (1969). |
| Bib, DM, Hand, P | Kirk, R.E. and Othmer, D.F. Encyclopedia of Chemical Technology. 3rd edition, 22 volume. New York: John Wiley and Sons (1978). |
| Bib, T | Hayes, W.J.,Jr. Toxicology of Pesticides. Baltimore: The Williams and Wilkins Company (1975). |
| CAS, PSYN | Toxic Substances Control Act Chemical Substance Inventory. 4 volume. Washington, D.C.: Office of Toxic Substances, U.S. Environmental Protection Agency (1979). |
| CAS, M | Toxic Substances Control Act- Trademarks and Product Names Reported in Conjunction with the Chemical Substance Initial Inventory. 2 volume. Washington, D.C.: Office of Toxic Substances, U.S. Environmental Protection Agency (1979). |
| Bib, DM, Hand, P, RR | Solid Waste and Resource Recovery Management. Egan, Mn: International Research and Evaluation. (Microfishe System) |
| | Computer Data Bases |
| Bib, Cas, DM, G, Hand, HFR, M, PSYN, T | OHM/TADS (Oil and Hazardous Materials/Technical Assistance Data System) |
| Bib, CAS, PSYN,T | RTECS (Registry of Toxic Effects of Chemical Substances) |
| Bib | FRSS (Federal Registry Search System) |
| G, PSY | SANSS (Structure and Nomenclature Search System) (Compound Identification and Naming System) |
| | Bibliographic data bases (ORBIT, etc.) |