

ChemFacts

Safe Handling of Extremely and Highly Toxic Materials

Background Information- How toxic is “toxic”?

The toxicity of materials is assessed by their Lethal Dose 50% (LD₅₀) or Lethal Concentration 50% (LC₅₀). LD₅₀ is defined as the oral dose at which 50 percent of the exposed test animals (rats or mice) died, usually within 1-2 hours. LC₅₀ is defined as the concentration in air at which 50 percent of the test animals (rats or mice) died, usually within 1 hour.

A substance is considered extremely toxic if it has an LD₅₀ of less than 5 mgs/kg of animal body weight. To humans, this is the equivalent of a taste (less than 7 drops).

A substance is considered highly toxic if it has LD₅₀ of 5-50 mgs/kg of animal body weight or an LC₅₀ of <200 ppm or <2,000 mg/m³. To humans, this LD₅₀ corresponds to between 7 drops and 1 teaspoon.

A substance is considered moderately toxic if it has LD₅₀ of 5-50 mgs/kg of animal body weight or an LC₅₀ of <200 ppm or <2,000 mg/m³. To humans, this LD₅₀ corresponds to between 1 teaspoon and one ounce (medicine cup).

A substance is considered slightly toxic if it has an LD₅₀ of 500 to 5,000 mgs or an LC₅₀ of 500-5,000mgs/kg of animal body weight or an LC₅₀ of 2,000-20,000 ppm or 20,000-200,000 mg/m³. To humans this corresponds to between 1 ounce and 1 pint.

A substance is considered practically nontoxic if it has an LD₅₀ greater than 5,000 mgs or greater than 1 pint.

Most highly and extremely toxic materials are organic in nature, although a few are inorganic.

Before you purchase or start working with any substance read the MSDS. If the material is highly or extremely toxic, or if you are unsure about it's level of toxicity, call EH&S for a Hazard Assessment .

EH&S will

- Review the toxicological data for the material with which you intend to work.
- Inspect your work area.
- Review your Standard Operating Procedure for working with highly and extremely toxic compounds.

- Review the training records of all persons in the lab.
- Test engineering controls as appropriate.
- Test safety equipment as appropriate.
- Provide recommendations for PPE appropriate for the particular material with which you are working.
- Determine if medical surveillance of affected employees is needed.

Remember, not all MSDSs list all hazardous ingredients. This is because these ingredients are not government regulated, and by law, the manufacturer does not have to admit that they are hazardous. Always read the entire MSDS for clues about the true level of hazard presented by a product's ingredients.

You will also be required to write a Standard Operating Procedure for each process involving highly or extremely toxic materials.

Exposure Limits

Georgia Tech is not subject to Federal Occupational and Health Administration (OSHA) regulations and therefore does not need to adhere to the OSHA Permissible Exposure Limits (PELs). Georgia Tech Environmental Health and Safety (EH&S) has chosen to use a more protective standard, the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) to assess occupational exposures to hazardous substances. These limits will vary from substance to substance and may not be directly related to a material's LD₅₀, as method of exposure and ease of absorption (especially through the skin) are also considered. Not all materials have TLVs. Remember that this does not make a material safe, it just means that it is untested.

Facility requirements for working with highly and extremely toxic materials.

Requirements will vary, depending on the nature of the chemical, such as its form at room temperature and its volatility. However, some requirements you may see:

- Fume hood tested at no less than 120 lfm average face velocity or Class II laminar flow hood tested at no less than 100 lfm average face velocity. This applies to highly toxic powders as well as volatile liquids.
- Gas cabinets for all new processes involving highly toxic gases.
- Eye wash station must be no less than 10 seconds from the work area and the path of travel must be free of obstructions (doors, fixtures) that may inhibit the immediate use

- Emergency shower must be no less than 10 seconds from the work area and the path of travel must be free of obstructions (doors, fixtures) that may inhibit the immediate use
- Vinyl floor coverings may be required.
- Appropriate spill kits (specific to the hazard), will be kept in the lab. It's location will be prominently displayed with a sign.

Work practices for highly and extremely toxic materials

Try to substitute a less toxic alternatives in chemical syntheses.

Always read the MSDS for all the chemicals involved in your process before purchasing them. They may require special equipment for handling/storage that you will need to acquire prior to their arrival.

At all times practice strict chemical hygiene:

- Do not eat, drink, smoke, or apply cosmetics in the lab
- Do not store food in laboratory refrigerators
- Do not store chemicals in break room refrigerators
- Wash hands when you remove your gloves, and before you leave the lab.
- Avoid skin and eye contact- do not touch your face or rub your eyes in a laboratory

Dress appropriately to work in the lab- long pants, closed shoes (no open toes, no canvas)

Use appropriate Personal Protective Equipment

- Safety glasses with side shields (or wrap around style) or goggles must be worn by all persons, including those already wearing prescription glasses.
- Lab coat- knee length
- Gloves appropriate to ALL chemicals you are using- not just the highly toxic ones. Contact EH&S for help in choosing gloves

Compounds with a LD₅₀ of less than 50 mg/kg (highly or extremely toxic) must be handled in a fume hood or in a Class II biosafety cabinet. (Get this information from the MSDS or EH&S)

All materials with an LD₅₀ of 50 mg/kg or less (highly toxic) must be kept in locked, restricted access area (such as a locked lab)

Materials with an LD₅₀ of 5 mg/kg or less (extremely toxic) must additionally be kept in a locked cabinet and there must be a sign out sheet to keep a record of who has used the material, how much they used, and when they used it.

Depending on the chemical, animal dosing may have to be done in a fume hood (This will be determined by EH&S during the Hazard Evaluation.)

Work with highly or extremely toxic materials must be limited to the areas indicated on your SOP.

Waste Disposal

The United States Environmental Protection Agency (US EPA) has produced a list of substances (P list) which it considers highly hazardous and requiring special disposal considerations. <http://www.safety.gatech.edu/acutes.xls>.

Depending on the chemical, animal bedding may have to be disposed of as hazardous waste. (This will be determined by EH&S during the Hazard Evaluation.)

Animal carcasses may need to be disposed of as hazardous waste. If this is the case, they should be sealed in plastic and frozen until they can be removed from the lab. Arrange for the waste to be picked up while still frozen by calling 4-6224 or 4-0499. Do not remove this waste from the freezer until a definite time for the pick up has been arranged.

Materials used in handling highly/extremely toxic or EPA P listed substances including pipet tips, syringes, and stock bottles must be disposed of as hazardous waste. Waste should be collected in sealable disposable containers and stored in the fume hood until they can be removed from the lab. Call for waste pick up weekly- do not allow this waste to accumulate to the point of interfering with fume hood function. Call 4-6224 or 4-0499 to arrange a pick up.

Emergency procedures

If you are splashed with a chemical in an area of your body which cannot be put under a sink faucet and flooded immediately- you must use an emergency shower

If your clothing is involved- remove it on the way to the shower:

- Yell for help
- Remain in the shower for 15 minutes
- Get someone to call the GT Police (4-2500)
- Do not re-don contaminated clothing

If you are splashed in the eyes:

- Yell for help
- Hold your eyelids open with your fingers as you rinse your eyes

- Have your helper watch a clock for you to make sure that you continue to rinse your eyes for a full 15 minutes
- All chemical exposures to the eyes require medical follow up

All chemical exposure cases requiring medical attention must be taken to Grady Hospital. (You may have to tell the ambulance driver this yourself)

Have a copy of the MSDSs ready for the first responders. Whether or not you are sent to the hospital may be determined by what is on the MSDS. If you do go to the hospital, make sure that you take the MSDS with you- present it to the treating physician when you get to the hospital.

Have someone inform your supervisor of the incident so he/she can file a First Report of Injury on your behalf.

Spills procedures

If possible, in the event of a spill of flammable material, immediately de-energize all sources of ignition in the laboratory.

As with any spill, you must use your own judgment as to whether this is a small spill that you can clean up yourself, or if you need to evacuate the lab and call for help by calling GT Police at 4-2500.

If you elect to clean up the spill yourself, Follow spill kit instructions and place waste in containers provided. Call EH&S (4-6224) to have the waste picked up.

Always replace the spill kit with a new one, no matter how much material is left over from the clean up.

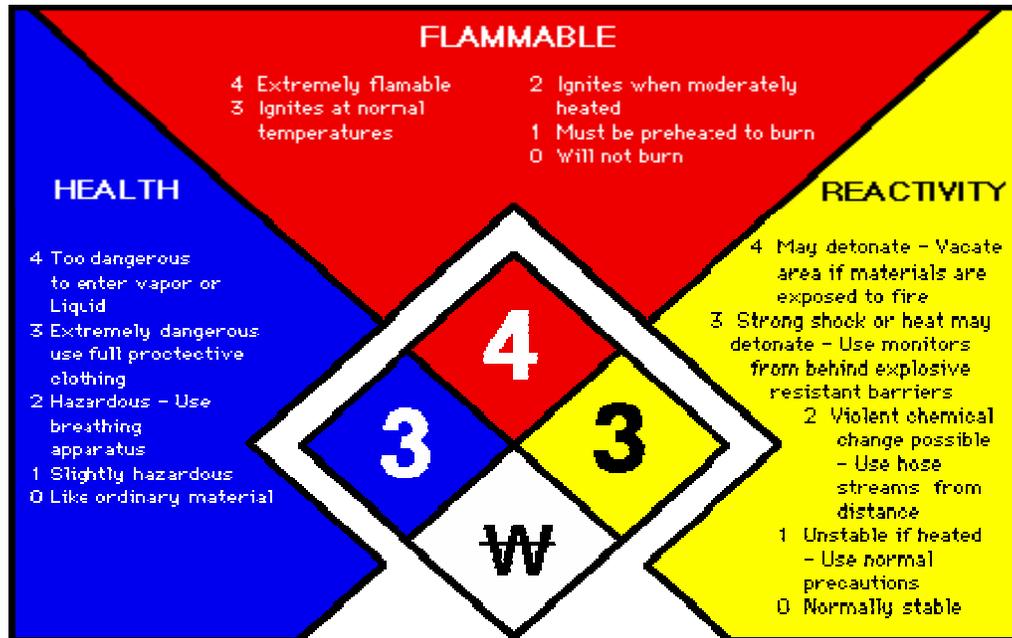
Medical Surveillance

EH&S will determine the need for biological monitoring or medical surveillance examinations of workers with potential exposure to highly/extremely toxic materials based on an evaluation of the operation; workplace controls; and any relevant human factors as well as input received from the research team. Departments/projects are responsible for covering the costs of medical surveillance.

Labels and Storage

The following controls apply to the labeling and storage of all chemicals on Georgia Tech Property. Labels shall include:

- The chemical name
- Manufacturer or supplier's name
- Manufacturer/suppliers address and telephone number



- NFPA hazard ratings:

Chemical compatibility must be considered when storing any chemical. Remember that flammable materials requiring refrigeration must be stored in explosion proof refrigerators/freezers.

Minimize the amount of a material in use or in storage by practicing just in time ordering

Use containers made of impact-resistant material or put them in sturdy secondary containers.

Training

All persons working with chemicals must be trained in the hazards of the workplace prior to beginning work, this includes

- Georgia Right to Know Law
- Basic Chemical Hygiene
- Bio-Safety/Universal Precautions
- How to use a fume hood
- Specific hazards (chemical, physical or biological) of this laboratory (Contact EH&S for help with training)
- A review of the MSDSs for all chemical involved in each particular experiment
- How to use a spill kit

What needs to be included in a Standard Operating Procedure (SOP)

A Standard Operating Procedure is an account of your process. It can be written as a narrative or as a check list. It should start with how to set up to do the process and should conclude with waste disposal. All safety precautions, for example, fume hood use and glove selection, should be included in the SOP. It should also include the specific areas where the material may be used (include room numbers).

Chemical specific handling procedures

Safe handling procedures specific to the chemical(s) you are using will be developed for you by GT EH&S

Contacts

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Hazardous Waste Pick Up 4-6224 or 4-0499

Criteria Documentation

American Conference of Governmental Industrial Hygienists, Threshold Limit Values for Chemical Substances and Physical Agents, ACHIH, Cincinnati, Ohio, 2004

Bingham, E., Cohrssen, B., Powell, C., Patty's Toxicology Fifth Edition, Wiley-Interscience, New York, 2001.

Board of Regents of the University System of Georgia, Design Criteria for Laboratory Furniture and Fume Hoods, 2000

Georgia Department of Natural Resources, Title 45 Chapter 22. Public Employees Hazardous Chemical Protection and Right to Know Act of 1988.

Georgia Institute of Technology Business and Finance Manual Chapter 10.6 Environmental Health and Safety

Georgia Tech Lab Safety Manual www.safety.gatech.edu

Klassen, Curdis D. Casarett&Doull's Toxicology The Basic Science of Poisons, Fifth Edition, McGraw-Hill, New York, 1996

Laurence Livermore National Laboratory ES&H Manual Volume II Part 14.5
www.llnl.gov/es_and_h/hsm/doc_14.05/doc14-05.html

National Research Council, Prudent Practices in the Laboratory, Washington, D.C. 1995.

United States Environmental Protection Agency Title 40, *Code of Federal Regulations, Parts 260-273*, Resource Conservation and Recovery Act

Glossary of Terms

Absorption	A method whereby a substance can pass through intact, unbroken skin.
Extremely toxic	Having an LD ₅₀ of <5 mgs/kg of animal body weight.
Highly Toxic	Having an LD ₅₀ of 5-50 mgs/kg of animal body weight or an LC ₅₀ of <200 ppm or <2,000 mg/m ³
LC ₅₀	Lethal concentration- 50 percent. The concentration in air at which 50 percent of the test animals died, usually within 1 hour. This value, when referring testing with rats or mice is the basis for evaluating the level of toxicity for hazardous substances
LD ₅₀	Lethal dose- 50 percent. The dose at which 50 percent of the exposed test animals died, usually within 1-2 hours. This value, when referring to oral dosing of rats or mice is the basis for evaluating the level of toxicity for hazardous substances
Moderately Toxic	Having an LD ₅₀ of 50-500mgs/kg of animal body weight or an LC ₅₀ of 200-2000 ppm or 2,000-20,000 mg/m ³
Slightly Toxic	Having an LD ₅₀ of 500-5,000mgs/kg of animal body weight or an LC ₅₀ of 2,000-20,000 ppm or 20,000-200,000 mg/m ³

STEL- Short Term Exposure Limit	Exposure Limit <i>recommended</i> by the American Conference of Governmental Industrial Hygienists. This is the concentration in air to which a person can be exposed for no more than a 15 minute period up to 4 times in a 8 hour work shift. 15 minute exposure periods must be separated by at least 1 hour.
TLV- Threshold Limit Value	Exposure limit <i>recommended</i> by the American Conference of Governmental Industrial Hygienists. This is the concentration in air which a person who is fit enough to come to work each day can be exposed to for 8 hours a day over a working lifetime without adverse health effects