

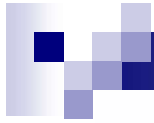


CHE 392 - CHEMICAL ENGINEERING LABORATORY I

# LABORATORY SAFETY AND CHEMICAL WASTE MANAGEMENT

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# PURPOSE

- *Security program includes your responsibilities for your health and safety and of your environment*



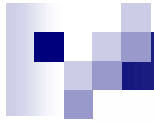
# CONTENT

- Working in the laboratory
- Being aware of the dangers
- Things to do in case of accident



# Working in the Laboratory

- ☑ Being careful
- ☑ Using personal protection equipment
- ☑ Following general rules
- ☑ Having prior knowledge about the experiment



## **General rules**

### ***In the Laboratory,***

- Do not work in the laboratories alone and without the knowledge of the laboratory staff.
- Personal protection equipment (PPE) should be used while working in the laboratory.

# Personal Protection Equipment(PPE)

*Necessary equipment at minimum conditions :*

Safety glasses, long lab coat, gloves



It should be worked in the lab with a long lab coat and its front should be kept attached.



Gloves (preferably nitrile) and safety glasses should be worn when working in the laboratory.




# **General rules**

## *In the Laboratory,*

- Do not work in laboratories alone and without the knowledge of the laboratory staff.
- Personal protection equipment should be used while working in the laboratory.
- Shoes should be closed and suitable for working in the laboratory; It should not be entered with muddy or dusty shoes to the laboratory.
- Long-haired students cannot enter the laboratory without making ponytail.
- Working with items such as rings, necklaces, bracelets in the laboratory can be dangerous. Take off them before starting work.
- Do not enter with a contact lens.
- Turn off your mobile phones.



- 
- Complete your preliminary research on your experiment.
  - Obtain “Material Safety Data Sheet” (MSDS) information about the chemicals you will use in your experiment.  
(<http://www.jtbaker.com/asp/Catalog.asp>)





## ***“Material Safety Data Sheet” (MSDS)***

- Material Identification
- Ingredients and Hazards
- Physical Data
- Fire and Explosion Data
- Reactivity Data
- Health Hazard Information
- Spill, Leak and Disposal Procedures
- Special Protection Information
- Special Precaution and Comments

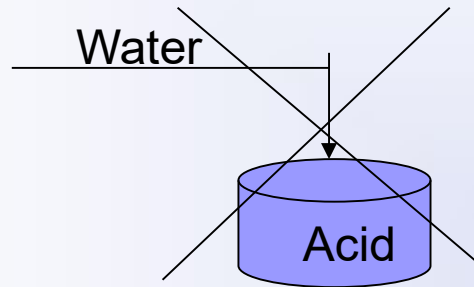


## *In the laboratory;*

### ■ **DO NOT Hurry.**

- Do not run and avoid sudden movements.
- There must be a good harmony among laboratory group of your friends.
- No smoking, no food or drink.
- Do not put food and beverages in the refrigerator in the laboratory.
- When carrying chemical containers and desiccators, two hands should be used. Hold the lid firmly with one hand while at the same time, the bottom of the container should be supported by the other hand.
- Do not leave the drawers, gas stoves and taps you use open.
- Do not sit on work benches.
- When you need to leave the laboratory during the experiment, take out your PPE and wash your hands.

- ALWAYS add acid to water, NEVER add water to acid.



- Use the pipettes with the help of "puar".



- Carefully read the labels of the chemicals you use.
- Leave the bottles of the chemicals you use by closing the cover.
- Do not change where chemicals are.
- Do not heat or mix chemicals for trial purposes without the knowledge of the relevant instructor.
- Do not mix acids and solvents.

## *When you leave the laboratory,*

- Do your checks on your experiment.
- Do not use your personal protection equipment outside the laboratory.
- Always wash your hands.





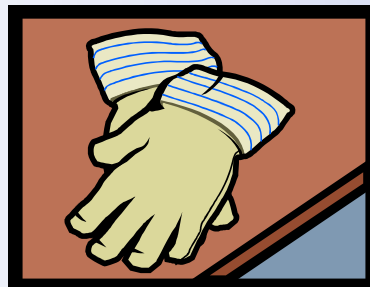
## *Awareness of the Hazards*

- When you are doing dangerous and potentially hazardous experiments, ask yourself the following questions :
  - What is the danger for the experiment ?
  - What is the worst thing that could be wrong?
  - How can I deal with danger?
  - Do I have experience and equipment required to minimize the risk of danger ?

***OBTAIN PRE-INFORMATION REQUIRED TO WORK IN THE  
LABORATORY***

# ***How Toxic Substances Can Get Into Our Body***

Respiratory  
Absorption  
Digestion





It is most important to be calm in any accident.

In case a contact with the chemical, the eyes or skin should be washed with plenty of water for at least 15 minutes and shown to the doctor.

In case of fire (if it can be done),  
If working with the device, the power plug must be unplugged  
If working with gas, the gas line is closed.

Accidents that occur are reported to the Laboratory Staff and the relevant Faculty Member.

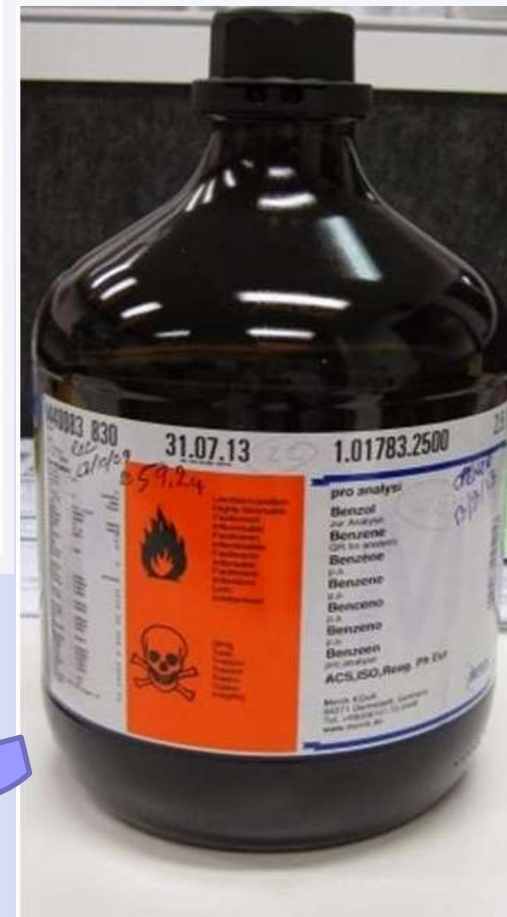
- ☑ Fire extinguishers,
- ☑ Safety showers
- ☑ First-aid kit
- ☑ Emergency exit

can be used for EMERGENCIES in the laboratory.





# **Classification, Labeling and Packaging of Substances and Mixtures**



## NEW LABEL

**Product identifier (full name)**

**Identity and proportion of each ingredient**

**Hazard pictograms**

**Details of manufacturer or importer**

**Front panel**

Read label before use. Keep out of reach of children


**Flammosol**

**FLAMMABLE LIQUID, TOXIC N.O.S.**

(aliphatic hydrocarbons, toxicole)

**UN 1992**

Contains:  
Aliphatic hydrocarbons 95%  
Toxicole 5%



4 L

**DANGER**

Highly flammable liquid and vapour  
Toxic if swallowed  
Causes skin irritation

Signal word relating to the greatest hazard- in this case the flammability pictogram

**Hazard statements**

Madeup Chemical Company, 999 Chemical Street, Chemical Town, My State. Telephone: 1300 000 000  
[www.madeup-chemical-company.com.au](http://www.madeup-chemical-company.com.au)

**Back panel**

**Precautionary statements-response**

IF ON SKIN (or hair): Take off contaminated clothing and wash before re-use. Rinse skin using plenty of soap and water.  
If skin irritation occurs: Get medical advice/attention.  
IF SWALLOWED: Immediately call a POISON CENTRE or doctor/physician. Rinse mouth.

**Precautionary statements-prevention and general**

In case of fire: Use powder for extinction.  
Keep away from sparks and open flames. – No smoking.  
Keep container tightly closed.  
Ground/bond container and receiving equipment.  
Use explosion-proof electrical equipment.  
Use only non-sparking tools.  
Take precautionary measures against static discharge.  
Wear protective gloves and eye and face protection.  
Wash hands thoroughly after handling.  
Do not eat, drink or smoke when using this product.

**Precautionary statement-storage**










Store locked up in a well-ventilated place. Keep cool.

**Precautionary statement - disposal**

Dispose of contents/container in accordance with Jurisdictional Regulations.  
Refer to the Safety Data Sheet before use.

## GHS Hazard Symbols and Their Definitions

## EXAMPLES OF NEW SYMBOLS

GHS Symbol	GHS Class	
	<b>Explosive</b> <ul style="list-style-type: none"> <li>• Explosives</li> <li>• Self-reactive substances</li> <li>• Organic peroxides</li> </ul>	
	<b>Flammable</b> <ul style="list-style-type: none"> <li>• Flammable gases, aerosols, liquids, and solids</li> <li>• Pyrophoric liquids or solids</li> <li>• Self-heating substances</li> <li>• Self-reactive substances</li> <li>• Substances that emit a flammable gas upon contact with water</li> <li>• Organic peroxides</li> </ul>	
	<b>Corrosive</b> <ul style="list-style-type: none"> <li>• Skin corrosion/burns</li> <li>• Eye damage</li> <li>• Corrosive to metals</li> </ul>	 <b>Toxic Substance</b> <ul style="list-style-type: none"> <li>• Acutely toxic substances that may be fatal or toxic if inhaled, ingested, or absorbed through the skin</li> </ul>
	<b>Oxidizer</b> <ul style="list-style-type: none"> <li>• Oxidizing gases, liquids, and solids</li> </ul>	 <b>Irritant</b> <ul style="list-style-type: none"> <li>• Irritant (skin and eye)</li> <li>• Skin sensitizer</li> <li>• Acute toxins</li> <li>• Narcotic effects</li> <li>• Respiratory tract irritants</li> <li>• Hazardous to ozone layer (non-mandatory)</li> </ul>
	<b>Compressed gas</b> <ul style="list-style-type: none"> <li>• Gases under pressure</li> </ul>	 <b>Health Hazard</b> <ul style="list-style-type: none"> <li>• Respiratory sensitizers</li> <li>• Carcinogens</li> <li>• Mutagens</li> <li>• Reproductive toxins</li> <li>• Target organ toxins, single exposure or repeated exposure</li> <li>• Aspiration toxins</li> </ul>
		 <b>Environmental Hazard (non-mandatory)</b> <ul style="list-style-type: none"> <li>• Acute aquatic toxins</li> <li>• Chronic aquatic toxins</li> </ul>

Source: UNECE. Globally Harmonized System of Classification and Labelling of Chemicals, 2015. [www.unece.org/trans/danger/publi/ghs/ghs\\_welcome\\_e.html](http://www.unece.org/trans/danger/publi/ghs/ghs_welcome_e.html) (accessed Dec 1, 2015).



# CHEMICAL WASTE MANAGEMENT

- Rules
- Waste containers
- Labels
- Chemical waste storage
- Separation of wastes that are incompatible with each other



# RULES

- Chemical wastes should not be mixed with biological or radioactive wastes.
- Solid or liquid chemicals should not be mixed with general garbage.
- In order to prevent explosion, fire or spills, incompatible chemical combinations should not be mixed in a single container.





# WASTE CONTAINERS

- All containers used in chemical waste storage must be undamaged.
- Liquid waste containers can only be filled to 70-80% of its capacity to allow steam to spread and to minimize potential spills.
- The container material is compatible with the chemical waste stored. (For example, hydrofluoric acid should not be stored in a glass container.)



# **LABELS**

- All waste containers should be clearly labeled to prevent any unwanted reactions.





# **STORAGE OF CHEMICAL WASTES**

- Chemical waste can be temporarily stored in the laboratory.
- Waste should be separated according to compatible groups.



# WASTE CLASSIFICATION

- Acids
- Bases
- Organic compounds
- Solid wastes



# SEPERATION OF WASTES THAT DO NOT MATCH WITH EACH OTHER

## Group A – Inorganic Acids and Acid Salts

- All inorganic acids (eg. sulfuric, hydrochloric)
- All compounds that do not release gas when acidified (eg. sodium sulfite)
- Inorganic solids that are inert (eg. silica)

## Group B – Bases, Caustics and Acid Reacting Compounds

- Organic and inorganic bases (eg. pyridine, amines, sodium hydroxide)
- Elements that can react with acid and inorganic salts (eg. potassium cyanide, ferric sulfide)



## **Group C – Neutral Organic Solids**

- All neutral organic compounds (eg. carbon, styrene)

## **Group D – Flammable Liquids, Halogenated Solvents and Organic Acids**

- All organic liquids except organic bases (eg. toluene, chloroform)
- Organic acids (eg. formic acid, acetic acid)

## **Group E – Oxidizers**

- Igniting inorganic compounds (eg. hydrogen peroxide)



# WARNINGS

Never add water on acid.;

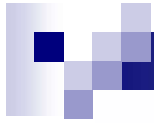
- ☐ Causes acid splashes that may be dangerous as heat will be released as a result of the reaction.

Glass fractures;

- ☐ Should be thrown into the solid waste container.

If mercury thermometer breaks;

- ☐ Mercury is very dangerous for human health and can penetrate through the skin.
- ☐ In this case, inform the laboratory staff immediately.



Each student is obliged to carry out his experiments in a way that he/she minimizes personal hazards and is aware of potential environmental pollution.

Working safely does not mean that it will protect you from all kinds of dangers.



# Material Safety Data Sheet (MSDS)

<http://www.jtbaker.com/asp/Catalog.asp>

## WARNING

All Chemical Eng. Students are expected to come to the experiment by learning about the properties of all chemicals to be used before each experiment.





You may not  
always be so  
lucky.





# References

- Turton, R., Bailie, R.C., Whiting W.B., Shaeiwitz J.A., 1998, "Analysis, Synthesis, and Design of Chemical Processes", Chapter:21, Prentice Hall, New Jersey.
- Safety in Academic Chemistry Laboratories" American Chemical Society, 7th, [www.acs.chemistry.org](http://www.acs.chemistry.org)
- "Handbook of Laboratory Safety" 4th edition, CRC Press, 2000
- Jarrell, D, Herrick K., 2001, "Laboratory Training Manual", Chem. Hygiene Plan Training, V8.0 12, University of Michigan.
- [www.umich.edu/~oseh](http://www.umich.edu/~oseh)
- [www.utoronto.ca/safety/chmdisp.htm](http://www.utoronto.ca/safety/chmdisp.htm)



# **TEAM WORK, REPORT WRITING AND ETHICS**

February, 2020



# TEAM WORK

***“Chains are only as strong as their weakest link.”***

- ☛ Managers who build a team are more successful,
- ☛ It is important to cherish respect and love for people cooperation,
- ☛ Using we statement in dialogs, not you and me.  
Alone we can do so little, together we can do so much.
- ☛ Remuneration leads to team members motivation.  
Promoting the right behaviours and thank the team,
- ☛ Keep calm in team work and create a pleasant work environment.  
Matching of skills with work-sharing.



# REPORT WRITING FORMAT

- Abstract
- Table of Content
- List of Table
- List of Figure
- I. Theory
- II. Experimental
- Data sheet
- III. Calculations
- IV. Results and Discussions
- V. Conclusions
- VI. Recommendations
- VII. Index
- VII. References
- Appendix



# EVALUATION OF THE REPORT

- ***Abstract 10%***
- ***Theory 10%***
- ***Experimental 5%***
- ***Calculations 25%***
- ***Results and Discussions 25%***
- ***Conclusions 10%***
- ***Recommendations 5%***
- ***Overview 10%***

\*\*Although the scoring presented above is taken as a basis, the scoring may vary depending on the scope of the experiment.



# ETHICS

**Members of the American Institute of Chemical Engineers (AIChE) shall uphold and advance the integrity, honor and dignity of the engineering profession by:**

- **Being honest and impartial and serving with fidelity their employers, their clients and the public;**
- **Striving to increase the competence and prestige of the engineering profession;**
- **Using their knowledge and skill for the enhancement of human welfare.**



## *To achieve these goals:*

- Hold paramount the safety, health and welfare of the public and protect the environment in performance of their professional duties.
- Formally advise their employers or clients (and consider further disclosure, if warranted) if they perceive that a consequence of their duties will adversely affect the present or future health or safety of their colleagues or the public.
- Accept responsibility for their actions, seek and heed critical review of their work and offer objective criticism of the work of others.
- Issue statements or present information only in an objective and truthful manner.
- Act in professional matters for each employer or client as faithful agents or trustees, avoiding conflicts of interest and never breaching confidentiality.
- Treat fairly and respectfully all colleagues and co-workers, recognizing their unique contributions and capabilities.
- Perform professional services only in areas of their competence.
- Build their professional reputations on the merits of their services.
- Continue their Professional development throughout their careers, and provide opportunities for the Professional development of those under their supervision.