

# **CHEMISTRY DEPARTMENT**

## **Guidelines for Chemical Laboratory Protocols and Safety Rules for Students and Staff at the Chemistry Department**

## **The text for internal use at the Chemistry Department**

Authors:

Milica Balaban, PhD

Sanja Pržulj, MSc

Dragana Gajić, MSc

Savka Vračević, MSc

## Chemistry Laboratory Safety Rules

When working in chemical laboratory, various chemical reactions, procedures and operations are performed. Used chemicals can be toxic, corrosive, and very often, flammable and/or explosive, while glassware and apparatus are mainly used for experiments. Constant risk of poisoning, fire, explosion and other serious injuries during laboratory work, can be significantly reduced, if safety procedures and rules are known and applied.

Obligation of all people, who are present and work in chemical laboratory, is to strictly comply and carry out the **safety rules** set out here.

- *During the work, it is obligatory to wear lab coat, and when it is emphasized, protective gloves and goggles.*
- *Before the beginning of the work, it is necessary to inform assistant or other responsible person about allergies to chemicals or other health problems.*
- *It is strictly forbidden to keep and consume food and drinks and smoke in the laboratory.*
- *It is not allowed for a student to stay and work alone in the laboratory, without supervision.*
- *Before the work, it is necessary to check and prepare work space. Current and water installations must be at an appropriate distance, and all flammable substances and unnecessary items must be removed to an appropriate place.*
- *Before the work, it is necessary to check the cleanliness and accuracy of glassware. Impurities can cause the side effects, while cracked glassware can burst during the heating.*

- *Experiments which involved toxic and flammable substances must be performed in fume hood with good ventilation. Used chemical dishes must be first rinsed in the fume hood.*
- *It is obligatory to follow the work instructions and any modification of experimental procedures is forbidden, before the consulting the responsible person.*
- *It is forbidden to leave the laboratory during the experiment. Presence next to the equipment is obligatory.*
- *Workplace must be cleaned before the leaving the laboratory. All used glassware and utensils must be washed, dried and placed according to the responsible person instructions.*
- *It is forbidden to leave switched on electrical appliances or burners that are not used. Before leaving the laboratory, it is necessary to check all the installations and, if necessary, turn off the water and electricity and close the gas vents.*

In case of any incident, it is necessary to immediately inform assistant, technician or other responsible person.



## Classification and hazard classes

According to the Rulebook of classification, packaging and labeling of chemicals and certain products, "Official Gazette of Republic of Srpska", number 9/16, 2016.

I. Substances and mixtures present the physical hazard if, based on their physical and chemical properties, they can be classified into at least one of the following hazard classes:

- explosives
- flammable gases
- aerosols
- oxidizing gases
- gases under pressure
- flammable liquids
- flammable solid substances and mixtures
- self-reactive substances and mixtures
- self-ignition liquids
- self-ignition solid substances and mixtures,
- self-heating substances and mixtures
- substances or mixtures which, in contact with water, release flammable gases
- oxidizing liquids
- oxidizing solid substances and mixtures
- organic peroxides
- corrosive substances and mixtures

II. Substances and mixtures pose a danger to a human health if, based on the properties of affecting human life and health, can be classified into at least one of the following hazard classes:

- *acute toxicity,*
- *corrosive skin damage/skin irritation,*
- *severe eye damage/eye irritation,*
- *respiratory sensitization/skin sensitization,*

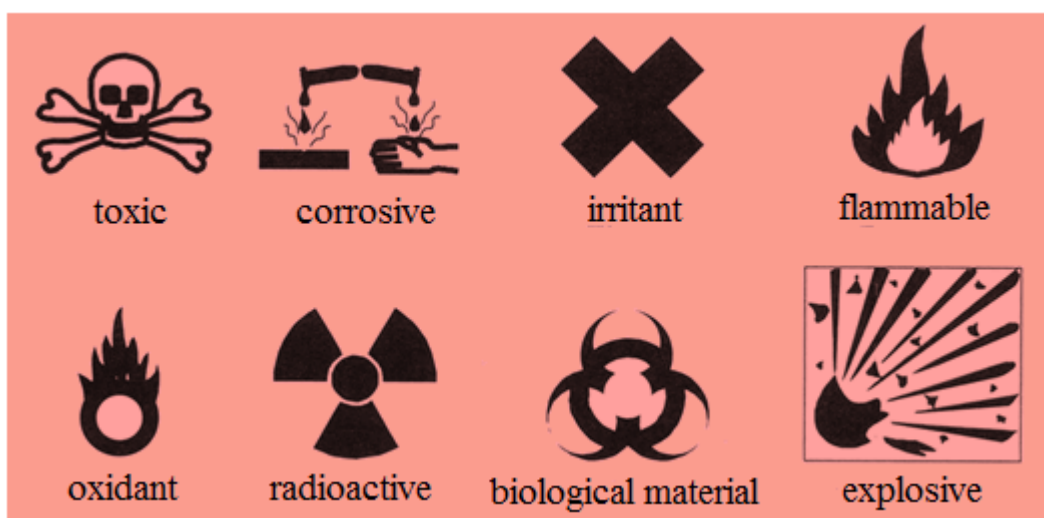
- *mutagenicity,*
- *carcinogenicity,*
- *reproductive toxicity,*
- *specific target organ toxicity – single exposure,*
- *specific target organ toxicity – multiple exposure and*
- *danger of aspiration.*

**III.** *Substances and mixtures pose a danger to the environment if, based of the properties that affect the environment, can be classified into the hazard class: „Hazardous to the aquatic environment“, or into the additional hazard class „Dangerous for the ozone layer“.*

## **Chemical handling**

- It is strictly forbidden to smell chemicals and pipette by mouth. A pipetting head must be used for pipetting.
- Always use clean dishes to take chemicals. Students may use only chemicals from labeled containers of reagent bottles to perform laboratory experiments.
- It is forbidden to measure different chemicals with same pipette or glassware. When handling, never lift the bottle by the stopper.
- It is forbidden to return spilled chemicals to a reagent bottle.
- The reagent bottle, after measuring the chemical, should be immediately tightly closed and put back in place.
- In case of chemical spillage, it should be neutralized and removed immediately. Consult the laboratory staff about the removal procedure.
- Before the experimental work, properties of used chemicals should be known.

For some chemicals and materials used in chemical laboratory, but also in other areas, it is necessary to apply special precautions. Warnings are always listed of the original packaging, which are presented with internationally recognized illustrations, the co-called *pictograms*. A hazard pictogram is an image on a label that contains a warning symbol and a special color to provide information about the harmfulness of a substance or mixture, or how a particular chemical can affect human health or environment.



**Figure 1.** Pictograms for labeling chemicals and mixtures used until 2017.  
 (black symbol on orange background)

The European Chemical Agency (**European Chemicals Agency, ECHA**) in 2008 introduced new system for the classification, labeling and packaging of chemicals and mixtures in the European Union (**CLP Regulation - classification, labeling and packaging of substances and mixtures**). Also, in accordance with the Globally Harmonized System of United Nations and this regulation, new pictograms have been introduced.



### Explosive!

**Symbol:** Exploding bomb

**What does it mean?** Unstable explosive. Explosive; mass explosion hazard. Explosive; severe projection hazard. Explosive; fire, blast or projection hazard. May mass explode in fire.

**Examples of where we can find it:** Fireworks, ammunition

**Examples of precautionary statements:** Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep away from heat/sparks/open flames/hot surfaces. No smoking. Wear protective gloves/protective clothing/eye protection/face protection. Use personal protective equipment as required. Explosion risk in case of fire.



### Corrosive!

**Symbol:** Corrosion

**What does it mean?** May be corrosive to metals. Causes severe skin burns and eye damage.

**Examples of where we can find it:** Drain cleaners, acetic acid, hydrochloric acid, ammoniac

**Examples of precautionary statements:** Do not breathe dust/fume/gas/mist/vapors/spray. Wash...thoroughly after handling. Wear protective gloves/protective clothing/eye protection/face protection. Store locked up. Keep only in original container



### Flammable!

**Symbol:** Flame

**What does it mean?** Extremely flammable gas. Flammable gas. Extremely flammable aerosol. Flammable aerosol. Highly flammable liquid and vapor. Flammable liquid and vapor. Flammable solid.

**Examples of where we can find it:** Lamp oil, petrol, nail polish remover.

**Examples of precautionary statements:** Do not spray on an open flame or other ignition source. Keep away from heat/sparks/open flames/hot surfaces. No smoking. Keep container tightly closed. Keep cool. Protect from sunlight





### Acute toxicity!

**Symbol:** Skulls and Crossbones

**What does it mean?** Fatal if swallowed. Fatal in contact with skin. Fatal if inhaled. Toxic: if swallowed. Toxic in contact with skin. Toxic if inhaled.

**Examples of where we can find it:** Pesticide, biocide, methanol

**Examples of precautionary statements:** Wash... thoroughly after handling. Do not eat, drink or smoke when using this product. If swallowed: immediately call a POISON CENTER or a doctor/physician. Rinse mouth. Store in a closed container. Do not get in eyes, on skin, or on clothing. Wear protective gloves/ protective clothing/eye protection/face protection. If on skin: gently wash with plenty of soap and water. Remove/take off immediately all contaminated clothing. Wash contaminated clothing before reuse. Do not breathe dust/fume/gas/mist/vapors/spray. Use only outdoors or in a well-ventilated area. Wear respiratory protection. If inhaled: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Store locked up



### Oxidizing!

**Symbol:** Flame over circle

**What does it mean?** May cause or intensify fire; oxidizer. May cause fire or explosion; strong oxidizer.

**Examples of where we can find it:** Bleach, oxygen for medical purposes

**Examples of precautionary statements:** Keep away from heat/sparks/open flames/hot surfaces. No smoking Wear protective gloves/protective clothing/eye protection /face protection. Rinse immediately contaminated clothing and skin with plenty of water before removing clothes.



**Gas under pressure!**

**Symbol:** Gas cylinder

**What does it mean?** Contains gas under pressure; may explode if heated. Contains refrigerated gas; may cause cryogenic burns or injury.

**Examples of where we can find it:** Gas containers

**Examples of precautionary statements:** Protect from sunlight. Wear cold insulating gloves/face shield/eye protection. Get immediate medical advice/attention.



**Serious health hazard!**

**Symbol:** Health hazard

**What does it mean?** May be fatal if swallowed and enters airways. Causes damage to organs. May cause damage to organs. May damage fertility or the unborn child. Suspected of damaging fertility or the unborn child. May cause cancer. Suspected of causing cancer. May cause genetic defects. Suspected of causing genetic defects. May cause allergy or asthma symptoms or breathing difficulties if inhaled.

**Examples of where we can find it:** Turpentine, petrol, lamp oil

**Examples of precautionary statements:** If swallowed: immediately call a POISON CENTER or a doctor/physician. Do NOT induce vomiting. Store locked up. Do not breathe dust/fume/gas/mist /vapors/spray. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Get medical advice/ attention if you feel unwell. If exposed: Call a POISON CENTER or doctor/physician. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Use personal protective equipment as required. If exposed or concerned: Get medical advice/attention. Avoid breathing dust/fume/gas /mist/vapors/spray. In case of inadequate ventilation wear respiratory protection. If inhaled: If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing.



**Health hazard!**  
**Hazardous to**  
**the ozone layer!**

**Symbol:** Exclamation mark

**What does it mean?** May cause respiratory irritation  
 May cause drowsiness or dizziness. May cause an allergic skin reaction. Causes serious eye irritation  
 Causes skin irritation. Harmful if swallowed. Harmful in contact with skin. Harmful if inhaled. Harms public health and the environment by destroying ozone in the upper atmosphere.

**Examples of where we can find it:** Washing detergents, toilet cleaner, coolant fluid.

**Examples of precautionary statements:** Avoid breathing dust/fume/gas/mist/vapors/spray. Use only outdoors or in a well-ventilated area. If inhaled: remove victim to fresh air and keep at rest in a position comfortable for breathing. If swallowed: call a POISON CENTER or a doctor/physician if you feel unwell. Wear protective gloves/protective clothing/eye protection/face protection. If on skin: wash with plenty of soap and water. If in eyes: rinse cautiously with water for several minutes. Remove contact lens, if present and easy to do. Continue rinsing. Do not eat, drink or smoke when using this product.



**Hazardous to**  
**the**  
**environment!**

**Symbol:** Environment

**What does it mean?** Very toxic to aquatic life with long lasting effects. Toxic to aquatic life with long lasting effects.

**Examples of where we can find it:** Pesticides, biocides, petrol, turpentine

**Examples of precautionary statements:** Avoid release to the environment. Collect spillage

## Disposal of used and waste chemicals

Almost all chemicals used in the laboratory are at some level toxic. Therefore, it is very important to follow above instructions for use. Also, it is very important to store or remove waste chemicals safely from the laboratory, so that human health and environment are not endangered in any way. This area is regulated by new **Law on Chemicals from 2018** (Official Gazette of Republic of Srpska 21/18), as well as large number of the above-mentioned European documents, in accordance with the Globally Harmonized System of the United Nations.

Every laboratory, whether intended for student work or research, or some other purpose, have to have clearly marked containers, usually bottles, for disposal of used chemicals. As for the other areas, the best solution for waste disposal is recycling. In an averagely equipped organic chemistry laboratory, it is possible, for example, to regenerate contaminated solvents by distillation process and reuse them. Down are listed some basic rules that students should be familiar before the work with chemicals:

- Used organic solvents should never be poured into sewage system, as they usually do not mix with water and are very flammable.
- After the use, solvents are collected in designated containers. Waste solvents are destroyed by combustion or, regenerated, by distillation.
- In the case of storage of chemicals with inconsistent chemical properties, waste chemicals must be separated during the disposal, preferably in other rooms, in order to prevent the possibility of mutual reactions.
- Water-soluble chemicals are discharged into the sewage system under certain conditions and in the case acid and base solutions, appropriate neutralization is required.
- Solid waste chemicals have to be, also, disposed in designated containers. Some toxic chemicals can be decomposed by oxidizing agents.

## Providing first aid

This section provides basic instructions for dealing with injuries that may occur in chemical laboratory. In case of an accident, it is necessary to provide first aid on immediately, and then, if it is necessary, to consult a doctor. That is the main reason why, every responsible person in the laboratory need to know basic first aid procedures for different type of injuries, which can be mechanical, thermal, electrical and chemical. Also, it is always necessary to have first aid kit nearby and to check it content regularly. The laboratory first aid kit should contain basic supplies and equipment (Table1).

**Table 1.** Supplies and agents for first aid in chemical laboratory

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Bandage, sterile gauze, bandaid, cotton wool, etc.

Sterile copression equipment

Scissors, tweezers, pins

Ethanol solution

Iodine tincture (7 g I<sub>2</sub>, 3 g KI i 90 g ethanol)

Aqueous solution of: 10% FeCl<sub>3</sub>, 3% NaHCO<sub>3</sub>, saturated solution of NaHCO<sub>3</sub>, 3% H<sub>3</sub>BO<sub>3</sub>, saturated solution of H<sub>3</sub>BO<sub>3</sub>, NaHCO<sub>3</sub>, 2% CuSO<sub>4</sub>x5H<sub>2</sub>O, 2% KMnO<sub>4</sub>

2% ethyl-*p*-aminobenzoate in olive oil (dissolve ethyl-*p*-aminobenzoate in olive oil, heat to 110 °C, cool down and pour into a sterile container)

Universal antidote: 2 g powdered coal, 1 g MgO, 1 g tannins

Vomiting agent: salt water or diluted solution of potassium-ammonium-tartrate

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**Mechanical injuries** most often occur while handling glassware and usually are cuts with bleeding. In that case, it is necessary to disinfect the injury with aqueous solution of ethanol or iodine tincture. IF there are deeper cuts, the wound should be washed well, check that no pieces of glass are left in it, then disinfected and covered with sterile gauze. Heavy bleeding should be stopped as soon as possible with a compression bandage, rubber hose or cloth, and then the injured person should be taken to the hospital as soon as possible.

**Thermal injuries** are caused by exposure to open flame, heated glass or metal, by pouring hot water, oil or boiling solutions. If the burn site is covered by clothes, it should not be removed, but carefully removed with sterile scissors. Burn sites should be carefully cleaned with diluted ethanol solution, and then, coated with vaseline, burn cream, seed or olive oil. Pain could be reducing with cold coating. In case of III- and IV-degree burns, the injured person should be taken to the hospital as soon as possible.

**Electrical injuries** occur due to electric shock and most often cause stiffness and cardiac arrest and respiratory organs, it is necessary, first, to turn off power supply, while the person providing first aid must be isolated, as not to endanger. The injured person must be warmed and supplied with a lot of liquids, and if necessary, artificial respiration should be given.



**Figure 2.** First Aid Kits Location at Chemistry Department

**Chemical injuries.** In case of injury with **concentrated acid solutions**, the injured area should be immediately washed with a lot of cold water, and then soaked with saturated aqueous solution of  $\text{NaHCO}_3$ . After that, it is necessary to wash injury with diluted ethanol solution of 3%  $\text{KMnO}_4$

solution. In case of pouring concentrated  $\text{HNO}_3$ , a saturated solution of picric acid should be used, while injuries caused with concentrated  $\text{H}_2\text{SO}_4$  should be washed with water, and then with diluted  $\text{NaOH}$  solution. Wash  $\text{HF}$  injuries with water and then apply paste obtained by mixing glycerol and  $\text{MgO}$ . Eyes should be rinsed with water, and then with 3%  $\text{NaHCO}_3$  solution. After that, a few drops of a 2% ethyl-*p*-aminobenzoate in olive oil solution should be placed in the eye.

Injuries with *concentrated alkali solutions* repaired the as the previously described acid caused injuries, provided that appropriate  $\text{H}_3\text{BO}_3$  solution is used instead of  $\text{NaHCO}_3$  solution.

In case of injuries of halogen elements *bromine* and *chlorine*, the injured area is washed with big amount of water and then with saturated solution of  $\text{NaHCO}_3$  or  $\text{Na}_2\text{S}_2\text{O}_3$ . The injury should be covered with cream for burns. Area injured with *white phosphorus* washed with 2% aqueous solution of  $\text{CuSO}_4 \times 5\text{H}_2\text{O}$ .

Injuries with *dimethyl-sulfate* are repaired with a big amount of ethanol solution or ammonia.

Injuries caused by pouring *organic substances* are first washed with a solvent which mix well with that substance or in which it dissolves (usually ethanol or acetone), and then washed with soap and water and covered with burn cream. Chlorinated compounds or toxic solvents should not be used.

In case of poisoning due to *inhalation of volatile substances* or *ingestion of chemicals*, injured person should be immediately reported outside of laboratory to fresh air, and if possible, induce vomiting.

## Fire safety procedures

It is very important to get acquainted with basic rules for extinguishing fire, and it is desirable that the basic instructions be clearly displayed in a visible place in the laboratory, nearby the extinguisher.



If there is a fire in the laboratory, it is necessary immediately to turn off all gas and electrical installations and remove all flammable substances from a fire place. All persons that are not participating in the extinguishing the fire, should leave the laboratory. As a rule, *do not use water* for extinguish the fire caused by organic solvents or oils.



**Figure 3.** Instructions for handling the fire extinguisher

Smaller fires are extinguished by covering with cloth or sand. Bigger fires are extinguished with a carbon dioxide extinguisher, which must be located in the visible and easily accessible place. If a piece of clothing catches fire, the person should be covered with cloth or doused with larger amount of water.





**Figure 4.** Locations of fire extinguishers at the Chemistry Department