

**YILDIZ TECHNICAL UNIVERSITY**

**FACULTY OF CHEMICAL AND METALLURGICAL ENGINEERING**

**DEPARTMENT OF BIOENGINEERING**

 **LABORATORY SAFETY BOOKLET**

**2019**

**ISTANBUL**

1

**01. Laboratory Safety**

Achieving accurate and reliable analysis results, is possible, above all, by the clean, careful and organized work of the analyst. The aim is to perform the analysis safely, with minimal errors and as quickly as possible. This can only be achieved by being very careful and organized in the laboratory, by knowing the methods very well to be applied and by minimizing the sources of errors.

For this reason, strict compliance with the laboratory working principles stated below is important for both the analyst and other employees in the laboratory. In this section, generally, the points that should be followed and paid attention to in the laboratories where chemical analyses and experiments are performed are repeated. Also, detailed information is given about chemicals harmful to human health and first aid in laboratory accidents.

**02. Working Principles in Laboratory**

**02.01**. Administrative department, physical and chemical analysis laboratory departments should be planned as separate units.

**02.02.** Laboratories should be planned and worked in accordance with the characteristics of the doing analysis.

**02.03.** Bag, coat, cardigan, jacket, and unnecessary material should not be brought to the laboratory.

**02.04.** Laboratories should be planned in separate sections, equipped with instrument equipment to control these conditions, in analyzes requiring special environmental conditions.

**02.05.** Laboratories should be protected from negative factors such as dust, moisture, steam, vibration, electromagnetic factors, and harmful livings. Working areas should be kept constant at 20 ºC.

**02.06.** The analyzed sections should be planned in a width that will allow the staff to move freely.

**02.07.** Piping systems, radiators, lighting systems, and its connections and other service points should be designed to be easily cleaned, walls, floors, and ceilings should have the property that easily cleaned and disinfected when necessary.

**02.08.** Lighting, heating and ventilation systems should not be such as to affect the analysis to be carried out directly or indirectly.

**02.09.** There should be a first-aid instruction and a cabinet with the necessary medicines and materials for first aid in the laboratory.

**02.10.** Necessary precautions should be taken against fire in the laboratory, and a certificate of conformity must be obtained from the fire department in this regard.

**02.11.** There should be no suitable environments for the settlement of garbage, waste piles, puddles and harmful creatures around the laboratory building.

**02.12.** It should be ensured that the personnel uses appropriate clothing and equipment for work safety. The lab coat must be worked with. The lab coat should preferably be of non-combustible fabric, normal length, and appropriate size.

**02.13.** *Long hair* should be picked up, made a bun or put into a fireproof hair restraint. Shoes should be suitable for working in the laboratory, and shoes with open toe should not be worn.

**02.14.** Nothing should be eaten or drunk in the laboratory (especially cigarettes), hands should not be put in the face while working, and nothing should be taken into the mouth.

**02.15.** Cleaning, sanitation, disinfection procedures should be done periodically in every part of the laboratory according to the written instructions and their records should be kept.

**02.16.** After use, every item, tool or device should be cleaned in accordance with its method and placed in their locations.

**02.17.** The entrance and exit of the laboratories should be supervised and people, other than employees, should be prevented from entering the analyzing departments.

**02.18.** The wastes generated according to the subjects in which the laboratory operates should not be given directly to the receiving environment and should be neutralized in accordance with the technique and legislation.

**02.19.** Solid substances to be thrown should be thrown to the trash. Glass containers to be cleaned, such as beakers, flasks, and tubes, whose work is finished and containing liquids should be placed in the sink and not left on the table.

**02.20.** Water, gas taps and electrical switches should be turned off when not in operation.

**02.21.** Attention and care should be prioritized in studies.

**02.22.** No noise should be made considering that others are working in the laboratory. Never should be a joke.

**02.23.** Any incidents that occur in the laboratory should be informed to those who manage the laboratory immediately.

**02.24.** No substances and materials should be stick out of the laboratory without the permission of those who manage the laboratory.

**02.25.** Solid substances should always be taken from the bottles with a clean spatula or spoon. The same spoon should not be inserted into another substance without cleaning. Bottle caps should never be placed on the table with their bottom side. Otherwise, when the cap is placed in the bottle again as the cap will be contaminated with foreign substances, these foreign substances may come into contact with the pure substance or solution in the bottle and spoil it.

**02.26.** If the glass-cap bottles are not opened, in such cases, the bottle cap is tapped with a piece of wood and loosened. If this does not benefit, the bottle is rotated under a small flame to warm the lid, or the bottle carefully is left immersed in water for a while to expand the glass. The substance in the containers with caps and stoppers should never be heated. Containers that do not carry a fire-resistant sign must not be heated or boiled.

**02.27.** The label side should be kept upward while the liquid is flowing from the bottles. Otherwise, drops flowing from the mouth of the bottle will spoil the label and the text on it. It is most convenient to wipe the last drops left in the mouth of the bottle with the bottle's own cap.

**02.28.** Chemicals should not be mixed randomly; they can pose great danger.

**02.29.** Some chemicals react with each other, causing fire or violent explosions, or create toxic products. Such substances are called incompatible chemicals. These should always be stored separately. These chemicals are given in Table 1.

**02.30.** Labeling bottles with the solution is necessary to avoid both appearance and inaccuracies. If paper labels are used, it will be good to use tile ink to prevent the writing from wiping when wet. The back of the labels should not be moistened by applying them to the mouth and tongue.

**02.31.** Chemicals should be stored in separate rooms, cabinets, or warehouses with ventilation systems according to risk groups and storage conditions. The location of the chemicals must be locked, and the key must be with the custodian responsible.

**02.32.** Timing is very important in the laboratory. If things are planned at the beginning, time can be saved. For example, some tasks, such as evaporation of water, require little attention, and another analysis can be done during this time.

**02.33.** Organic solvents should not be poured into the sink.

**02.34.** Weighing or titration results should not be written on small papers. These papers may be lost, and the analysis may have to be repeated. A special notebook should be kept for work in the laboratory. Studies and observations made must be recorded.

**02.35.** It should be known what is in the medicine cabinet, how the extinguisher works. This issue should be given to education.

**02.36.** Volatile liquids should not be poured into the sink.

**02.37.** The caps or plugs of the bottles should not be changed. As the solution is filled into bottles, up to a quarter of it is left as the expansion margin.

**02.38.** No chemicals are placed in a bottle or container without a label. In addition, when a chemical substance is placed in the empty container, the label should be attached immediately, and all bottles should be labeled. Chemicals in bottles without labels must never be used in experiments.

**02.39.** In the case of glass cutting and cork insertion, special gloves or cloth should be used to avoid cutting hands. It should not be inserted into pointed, broken glass tubes and pipes. Such ends; the gas stove should be leveled with sandpaper or file.

Table 1. List of chemicals that should be stored separately in laboratories

|  |  |
| --- | --- |
| **Chemical** | **Other Chemicals not to be mixed with** |
| Active Carbon | Calcium hypochlorite, oxidant substances |
| Alkali Metals (Na, K.etc.) | Hydrocarbons and their aqueous solutions, water |
| Ammonia | Mercury, chlorine, iodine, bromine, calcium |
| Ammonium nitrate | Powdered metals, flammable liquids, sulfur, chlorates, all acids, nitrites |
| Aniline | Hydrogen peroxide, nitric acid |
| Acetic acid | Chromic acid, nitric acid, hydroxyl-containing compounds, ethylene glycol, perchloric acid, peroxides, permanganates |
| Acetylene | Fluorine, chlorine, bromine, copper, mercury, silver |
| Asetone | Concentrated nitric acid, concentrated sulfuric acid |
| Copper | Acetylene, hydrogen peroxide |
| Bromide | Ammonia, acetylene, butane and other petroleum gases, turpentine |
| Mercury | Acetylene, ammonia |
| Fluorine | All the other chemicals |
| Silver | Acetylene, oxalic acid, tartaric acid, ammonia, carbon dioxide |
| Hidrofluoric acid | Amonnia |
| Hidrogen peroxide | Copper, chrome, iron, metal and metal salts, flammable liquids, aniline, nitromethane |
| Hydrogen sulfide | Nitric acid, oxidant substances |
| Hidrocarbons | Fluorine, chlorine, bromine, chromic acid, sodium peroxide (benzene, ether) |
| Hydrocyanic acid | Nitric acid, alkalis |
| Iodine | Asetylene, amonnia |
| Calcium oxide | Water |
| Chlorine | Ammonia, acetylene, butane and other petroleum gases, turpentine |
| Chlorates | Ammonia, powdered metals |
| Chromic acid | Acetic acid, glycerin, some alcohols, flammable liquids, turpentine |
| Sulphurous hydrogen | Nitric acid, oxidant gases |
| Nitric acid | Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, |
|  | flammable liquids and gases |
| Oxygen | Oils, grease, hydrogen, flammable liquids, flammable solids and flammable |
|  | gases |
| Oxalic acid | Silver, mercury |
| Perchloric acid | Acetic anhydride, alcohols, carbon tetrachloride, carbon dioxide |
| Potassium permanganate | Glycerin, ethylene glycol, benzaldehyde, sulfuric acid |
| Sodium nitrate | Ammonium nitrate, other ammonium salts |
| Sulfuric acid | Chlorates, perchlorates, permanganates |
| Flammable liquids | Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, halogens. |
| Active Carbon | Calcium hypochlorite, oxidant substances |
| Alkali Metals (Na, K, etc.) | Hydrocarbons and their aqueous solutions, water |
| Ammonia | Mercury, chlorine, iodine, bromine, calcium |

**02.40.** The ends of the glass pipes to be inserted into rubber stoppers should be wetted with water or lubricated with glycerin or vaseline. Glass pipes should be inserted by rotating, not by directly pressing the rubber stopper.

**02.41.** When a liquid in the tube is heated, the tube should be heated from the top down slowly, and the tube should be shaken very gently. The mouth of the tube should not be held towards you or the person working with you, and should never be leaned over and looked down from above. It can splash on the face.

**02.42.** Toxic and caustic solutions should not be drawn by mouth from the pipette.Vacuum or pad should be used for this process.

**02.43.** Even chemicals that are generally known to be non-toxic should not be tasted.

**02.44.** Very volatile substances such as gasoline, ether, and carbon sulfide should not be used in an open flame laboratory, no matter how far away. Ether vapors can burn from the flame at 5 meters or even further, and those burning vapors can spread the fire.

**02.45.** Sulfuric acid, nitric acid, hydrochloric acid, hydrofluoric acid, as well as acids containing poisonous gases such as bromide, hydrogen sulfide, hydrogen cyanide, chloride should be worked on the fume hood.

**02.46.** All acids and alkalis should always be poured over the water slowly while diluting, never vice versa.

**02.47.** If mercury is poured in any way, it should be collected with vacuum source or foam type synthetic sponges. If there is a trace amount that cannot be collected, powdered sulfide should be sprinkled on it and it should be turned into sulfur by making it harmless.

**02.48.** The mercury parts or mercury residues of thermometer fractures should never be thrown into the trash or sink, they should be buried in the ground.

**02.49.** When dealing with electricity, the stepped and the printed area should be dry, not metal, and the electrical plugs should not be pulled out of the cord. In order to be able to perform certain operations immediately when necessary, sufficient electrical knowledge should be obtained and major repairs should be made to qualified technicians.

**02.50.** It should not be used alone in a laboratory, especially in a locked place. Against all kinds of possibilities, the person who works alone should tell someone else about his work in advance and constantly inform him.

**02.51.** Two hands should be used when carrying chemicals, one hand holding firmly by the lid, and the other one under the bottle. While carrying the desiccator, the cover and the main part should be kept together. Desiccator covers should be occasionally lubricated with vaseline.

**02.52.** While leaving the laboratory, dishes should be washed, all chemicals should be secured, and gas taps should be closed from the main tap.

**02.53.** The eyes should always be protected, except for operations such as weighing on a sensitive balance. It is useful to wear safety glasses. In order to prevent this from any irritation of the eyes due to gases, it is often necessary to wash the eyes with cold water or rinse with plenty of water.

**02.54.** Abrasive caustic substances such as acid and base should be washed with plenty of water immediately when dripping or splashing on the skin.

**02.55.** Materials such as tube, petr box with culture inside should not be left open on the table, the tubes should not be carried in the apron pocket and should not be placed randomly on the table. Tubes should be kept in the rack

**02.56.** While working, laboratory doors and windows should be kept closed, and unnecessary and sudden movements that would spread microorganism or spores should be avoided.

**02.57.** If the cultures are poured on the floor or on the table or the culture vessels are broken, the situation should be reported to the laboratory manager immediately and the spilled culture should be immediately covered with a suitable disinfectant solution (eg 10% hypochlorite solution) and then cleaned for 15-30 minutes.

**02.58.** It should never be blown while pipetting.

**02.59.** Flammable substances, such as ethyl alcohol, should be kept away from the flame of the Bunzen burner.

**02.60.** If there are cuts, wounds and similar conditions on the hands, they should be worked only after they are covered with a waterproof tape, otherwise they should not be worked and the last situation should be communicated to the responsible.

**02.61.** The lens and ocular part of the microscope should be cleaned with fine lens paper or a cheesecloth carefully and without damaging the lens before and after each use.

**02.62.** After the work is finished, dirty materials should be placed in their own containers. For example; used pipettes, slide and coverslip should be immediately transferred to special containers containing disinfectant solution.

**02.63.** Microscope lamps should be turned off before leaving the laboratory. Unnecessary lights should be turned off.

**02.64.** The materials should be used as if they were your own.

**02.65.** After the work is finished, hands should be washed with soapy water and, if necessary, an antiseptic liquid.

**02.66.** Culture and similar materials should not be taken out of the laboratory.

**02.67.** Confidentiality must be observed for all test results.

**02.68.** The nearest healthcare provider and lifeguard telephones should be hanged in a visible place.

**02.69.** It should not be studied alone in the laboratory.

**In biological or microbiological studies;**

**02.70.** In biological studies, hygiene conditions must be observed in the laboratory. It should be remembered that the risk of infection is high, especially in studies with blood and blood products.

**02.71.** It is possible to get infections in small cracks in the skin and cultivation areas. Therefore, it should be worked with gloves in routine work. In case of doubtful contact, hands should be washed with suitable antiseptics and an infectious diseases specialist should be consulted if necessary.

**02.72.** All laboratory wastes should be separated on site and placed in RED, BLUE, BLACK bags in accordance with the conditions accepted by the infection committee.

**02.73.** In case of biological spills, it should be reported to the laboratory manager by the laboratory supervisor and the spilled culture should be immediately covered with a suitable disinfectant solution (for example 10% hypochlorite solution) and kept for 15¬30 minutes and then cleaned.

**02.74.** Cultural plaques should be discarded after being decontaminated through autoclave.

**03. Chemical Substances Harmful to Human Health**

In laboratory studies, chemical substances harmful to human health are used. In terms of the health of the worker, by recognizing these substances, it is possible to know the harmful effects that may occur in contact with these substances in advance and to prevent possible accidents. What to do in case of an accident must be kept in writing in the laboratories, the person who has been injured in the accident should be taken to a health institution. A list of these chemicals is given in Table 2.

Table 2. Chemicals harmful to human health

|  |  |
| --- | --- |
| Heavy metals | Hydrogen peroxide |
| Aromatic nitro compounds | Hydrogen sulfide |
| Aldehydes | Hydrogen cyanide |
| Alkaline metals | Inorganic amides |
| Alkaline salts (NaOH, KOH) | Carbon disulfide |
| Ammonia | Carbon tetrachloride |
| Benzene | Chlorinated hydrocarbons |
| Mercury | Xylene |
| Ethers | Methyl alcohol |
| Phenols | Nitrates and nitrites |
| Fluorinanted hydrocarbons | Nitric acid |
| Formaldehyde | Oxalic acid |
| Phosphorus | Perchlorates |
| Halogens | Toluene |



**03.01. Chloric acids**

They react easily. When these acids splash somewhere, necessary precautions should be taken. Three factors are important during cleaning:

1. Reaction of the molecule with water,
2. Corrosive properties of chemical substance and decomposition products,
3. The irritations on human.

Therefore, water should not be used to clean the chloric acids (However, if it splashed on the body, it should be washed with plenty of water). The heat generated at the end of the reaction evaporates the chlorinated substance. The smell of steam is irritating.

When chloric acids spread somewhere, sand, sodium bicarbonate or mixture of the two should be poured on it first. It should be scraped with a metal or plastic spoon, after waiting a little. The stain left by the sand is very light and light colored.

**03.02. Alkaline metals**

1. Being flammable,
2. Reactions with water,
3. Contact with moist skin should be avoided.

The place in contact with the body with alkaline metals should be washed with plenty of water. Hydrogen is revealed as a result of their reactions with water. If the temperature is high in the studied laboratory, hydrogen explodes. These metals should be stored in either inert gas or carosene, as their contact with air immediately explodes.If there's water in the carose used, it's still dangerous.

Alkaline metal fires are very difficult to put out. It is recommended to use dust graphite to extinguish fires.

**03.03. Ethers**

1. Skin contact has a drying effect. Dermatitis occurs as a result of prolonged contact.
2. They are flammable under certain conditions. For example, it is well known that ethyl ether begins to burn at 45 ° C. Static electricity can also cause burning (steam). CO2 is used to extinguish ether fires. The work to be done when ether splashes somewhere is to absorb the ether into the sponge and evaporate it under a fume hood.

**03.04. Oxalates**

Since these are absorbed by tissues and blood, they precipitate calcium. The resulting calcium oxalate is insoluble. Acute inhalation of oxalates is harmful to human due to irritation and precautions should be taken. But if the oxalates are inhaled chronically, calcium oxalate stones are formed in the kidney tubules. As a result of chronic absorption from the skin, they create enough calcium oxalate in the blood and affect the blood circulation. It may result in gangrene.

**03.05. Sulfuric acid**

Contact with eyes is dangerous, regardless of concentration. Concentrated sulfuric acid is highly corrosive, causing severe burns on the skin. While diluting, the acid is always poured slowly and carefully into water, never vice versa.

**03.06. Nitric acid**

The damage and danger increase as its concentration increases. It should be worked on fume cupboard with high concentration of nitric acid. Smoky and concentrated nitric acid is dangerous for the body and especially the eyes. It gives highly toxic nitrogen oxide vapors at high temperature.

**03.07. Glasial acetic acid**

It's quite corrosive. Burns do not heal quickly, a health care organization must be consulted.

**03.08. Hydrofluoric acid**

It is extremely dangerous. Wherever it touches the body, it causes severe burns and does not get well soon. Vapor is also dangerous in breathing and excess can cause death. In this respect, it is used only in a well-functioning fume hood.

**03.09. Picric acid**

Since it is explosive when dry, it is always kept in at least 10% aqueous.

**03.10. Mercury**

If poured in any way, it should be cleaned immediately using the vacuum source. It can also be collected through foam type synthetic sponges. If there is a trace amount that cannot be collected, sulfur is sprinkled on it and thus it is turned into sulfur and rendered harmless.

**04. First Aid in Laboratory Accidents**

**04.01. First Aid in Burns**

Water should not be applied to burns and the bubbles should not be cut off. Vaseline should be applied and the burnt place should be wrapped to protect it, flour and olive oil could be applied on the burns if there is no vaseline. It is good to wash the burns with 5% tannin solution until the skin turns brown or put the cloth moistened with this solution on the wound. The place that is being burnt during a fire or the person should be covered with anything (such as a coat, blanket, etc.) that will cut off contact with air.

**04.02. First Aid in Alkali, Acid, Bromine or Phosphorus Burns**

Burns from bromine should be thoroughly washed with benzol or petroleum. The burned place due to phosphorus should be immersed in the bicarbonate solution and then exposed to the air to oxidize the phosphorus. This process is repeated several times. In contact with acetic acid, hydrochloric acid, phosphoric acid and sulfuric acid, contact area should immediately be washed with plenty of tap water and contaminated clothing should be removed. First, the contact areas should be washed thoroughly, then a soft alkaline solution such as soda or bicarbonate should be applied. If eyes are concerned, they should be washed immediately with warm water for at least 15 minutes. In the contact of hydrofluoric acid, contact area should be washed thoroughly, a magnesium oxide mud should be applied and the person should seek medical advice. In case of contact of chromic acid and dichromates with the skin, the contact area should be washed with 5% sodium thiosulfate. If the lesions appear, the person should seek medical advice. In contact of the alkalis with the skin, the skin should be washed with plenty of water and neutralized vinegar. In the case of splashes into the eyes, the eyes should be washed with plenty of running water immediately, by forcefully opening them if necessary, and the person should seek medical advice immediately.

**04.03. First Aid in Ingestion of Alkali and Acids**

When acetic acid, hydrochloric acid, phosphoric acid and sulfuric acid are swallowed, vomiting should not be allowed, and if the person is unconscious, nothing should be given by mouth. If conscious, the mouth should be rinsed with plenty of tap water, then milk mixed with egg white should be given. If this is not possible, water should be given as much as possible and a health institution should be informed. Vomiting should not be allowed in hydrochloric acid ingestion too, and plenty of water should be given. The injured person should be made lie down in prone position and should not be moved. In case of ingestion of chromic acid and dichromates, sodium bicarbonate solution should be given immediately, the wound should be kept warm and a healthcare provider should be informed. In case of ingestion of alkalis, a lot of water mixed with lemon juice or vinegar should be given, then a spoonful of salad oil should be drunk and medcal advice should be sought.

**04.04. First Aid in Poisoning with Gases Burning Lungs**

When vapors of chemicals such as chromium, bromine, HCl etc. are inhaled, they cause poisoning. In this case, a health institution should be informed immediately and full rest and open air should be provided until the physician arrives. Water or bicarbonate vapor and oxygen can be inhaled.

**04.05. First Aid in Oral Poisoning**

5% copper sulfate solution should be used. Since copper sulfate has an emetic power, the poison is removed from the stomach.

**04.06. First Aid for Cyanide Salts**

It should be washed thoroughly in contact with the skin, and if the wound is open, consult a health facility. If swallowed, the person should be made vomit immediately, hydrogen peroxide mixed with water is given, and immediate medical help should be provided.

**04.07. First Aid for Chlorinated Ingredients**

Skin should be washed thoroughly in contact with the ammonium chloride, cobalt chloride, iron chloride, when swallowed vomiting should be induced and plenty of water should be given. Epsom salts should be applied as laxative and medical aid should be provided. Skin should be washed thoroughly in contact with antimony chloride, nickel chloride, tin chloride, cadmium chloride and lanolin ointment should be applied. If swallowed, plenty of water should be given, and if irritation continues, medical attention should be sought.

**04.08. First Aid for Nitrates**

Skin should be washed thoroughly in contact with potassium nitrate, mercury nitrate, if there is itching or rash medical advide should be sought. If swallowed, sodium bicarbonate mixed with plenty of water should be given immediately. Then raw egg-skimmed milk mixture should be drunk and medical advice should be sought. In contact with silver nitrate, the contact area should be washed with brine. In swallowing it, after adding three tablespoons of salt to a glass of water and dissolving, this mixture should be given to the person to induce vomiting and medical advice should be sought.

**04.09. First Aid for Sulfates**

Aluminum, ammonium, cobalt, copper, magnesium, nickel, potassium, sodium, zinc, cadmium and sulfate should be washed thoroughly in contact with the skin, and if the skin reacts, apply to the health institution. In swallowing them, plenty of water should be given, and if any reaction occurs, apply to the health institution.

**04.10. First Aid in Poisoning with Hydrocyanic Acid, CO2, Sulfur Hydrogen, Phosphorous Hydrogen**

Clean air is important. In severe cases, artificial respiration is performed and oxygen is used if necessary. Especially in poisoning with hydrocyanic acids, 2 g of sodium thiosulfate and 0.5 g of sodium nitrite should be dissolved in 50 ml of water and immediately applied to the health institution.

**04.11. First Aid for Electric Shock**

Since the patient is electrically charged, current should be cut off from the main source or the plug should be removed from the socket before approaching. If this cannot be done, the patient should be approached with rubber boots or gloves or by pressing on a dry apron. After the contact with electrical power is cut, artificial respiration should be done in the fresh air and taken to the nearest hospital.

Table 3. List of important emergency phone numbers

|  |  |  |  |
| --- | --- | --- | --- |
| Fire Notice | **110** | Electric Failure | **186** |
| Emergency | **112** | Police Emergency | **155** |
| Alo Poison | **114** | Alo Environment | **181** |
| Health Consultation | **184** | Water Failure | **185** |
| Gas failure | **187** | Sanitary Consultation | **128** |

|  |
| --- |
| Table 4. Major Hazard Symbols |
| ImageExplosivesSelf-reactiveOrganic peroxides | ImageFlammableSelf-reactivePyrophoric liquids and solidsSelf-heating reagentEmits flammable gasesOrganic Peroxides | ImageOxidising |
| ImagePressure gasesLiquefied gasesChilled liquefied gasesDissolved gases | ImageCausticSkin corrosionSerious eye damage  | ImageAcute toxicity |
| ImageAcute toxicitySkin irritationEye irritationSkin sensitizationRespiratory tract irritationSpecial Target Organ Toxicity | ImageSensitization of the respiratory tractGerm cell mutagenicitycarcinogenicityToxicity in reproductive organsSpecial Targeted OrganRespiratory hazard | ImageDangerous for the aquatic environment |
| Universal Graphic Signs And Labels - Biohazard Caution Biological HazardBiological substances dangerous for human health |  |  |

**Kaynaklar:**

1. Kimya Mühendisliği Laboratuvar Güvenliği El Kitapçığı, Yıldız Teknik Üniversitesi, 2018.
2. Laboratuvar Güvenliği El Kitabı, Sağlık Bakanlığı Halk, Sağlığı Genel Müdürlüğü, Ankara, 2019.
3. United Nations Economic Commission for Europe (UNECE), Globally Harmonized System of Classification and Labelling of Chemicals (GHS), http://www.unece.org/, [Date Accessed](https://tureng.com/tr/turkce-ingilizce/date%20accessed): 24.09.2019