

Hazards During Chemicals in Use and Safety Guidelines



Occupational Safety and Health Branch
Labour Department

This guidebook is prepared by the
Occupational Safety and Health Branch
Labour Department

This Edition December 2002

This guidebook is issued free of charge and can be obtained from offices of the Occupational Safety and Health Branch. Addresses and telephone numbers of the offices can be found in website of the Department at <http://www.info.gov.hk/labour/eng/tele/index.htm>.

This guidebook may be freely reproduced except for advertising, endorsement or commercial purposes. Please acknowledge the source as "Hazards During Chemicals in Use and Safety Guidelines", published by the Labour Department.

During Chemicals in Use

Chemicals are frequently used in our daily life and at work. Quite a number of the chemicals are dangerous substances by nature, and some are hazardous when heated, ground or mixed with other chemicals. Sometimes, even pouring chemicals from one container to another may be hazardous. Without adequate knowledge of the hazards or in the absence of appropriate precautionary measures, accidents may occur leading to casualties.

Numerous hazards exist when chemicals are in use. The hazards vary with the reactions involved. Especially in the cases of chemicals in contact with air and mixing of chemicals, there are lots of hazards with various causes that cannot be individually listed out. The purpose of this guidebook is to present some of the common hazards that may easily lead to accidents, and the safety measures that should be taken to ensure safety and health at work.

The Hazards and the Consequences

- Causing fire, explosion
- Releasing harmful/toxic gases or airborne particles
- Splashing of hot, corrosive or toxic liquid
- Resulting in injuries, ulcer, intoxication and even death
- Acutely/chronically injurious to health and even to next generation

Key Steps in Safe Use of Chemicals

*Know the hazards
and
take safety measures*

Know the Hazards

- Understand the hazardous properties of the chemicals involved
- Understand the reaction and the products during chemicals in use
 - May the process generate heat and/or gases ?
 - Is there any side reaction involved ? What are the side products ?
 - Are the products dangerous substances ? What are the hazardous properties ?
- Understand the effect of the environment to the reaction, the reactants and the products
 - May light, heat and shape of the container affect the reaction so that it will be out of control ?
 - May light, heat, air and water affect the reactants and the products so that other reactions will occur ?

Safety measures

- Select other safer substitutes or procedures
- Use engineering control measures
 - including ventilation and exhaust system, temperature control, stirring facility, appropriate container
- Wear appropriate personal protective equipment
- Understand and follow safe operating procedures
 - including procedures for use of engineering control and personal protective equipment and for waste disposal
- Understand contingency measures, and in case of accident follow emergency procedures
 - including procedures for fire fighting, evacuation, first aid, treatment of spillage

How can we obtain hazard and safety information ?

- Read the label and material safety data sheet (MSDS) of the chemicals
- Obtain information from other references, such as handbooks on chemical safety

Dos and Don'ts in Safe Use of Chemicals

Know the hazard before using the chemicals

Before using the chemicals, the hazardous properties of all chemicals involved and the possible hazards at every stage of the process should be fully understood. Appropriate safety measures can then be taken.

Use appropriate control measures and personal protective equipment

Appropriate control measures (such as engineering control) should be used to reduce the exposure to the hazard to the lowest level. Personal protective equipment should only be a supplement to, and not in lieu of, control measures, and should be selected appropriate to the hazards to be encountered.

Keep the work area well-ventilated, or even work under local exhaust ventilation

Always keep the work area well-ventilated to avoid accumulation of hazardous gas/vapour. Increase the ventilation by mechanical means if necessary. In case where more hazardous chemicals or processes are encountered, work under local exhaust ventilation.

Keep away from any ignition source when handling flammable substances

Ignition source may ignite the vapour of the flammable substance, and even lead to explosion.

Don't eat, drink and smoke

Dangerous substances can easily enter the body while eating, drinking or smoking during use of chemicals, and would be injurious to health.

Don't touch chemicals with bare hands. Wear protective gloves.

Dangerous substances can easily enter the body through the skin while touching chemicals with bare hands, and would be injurious to health. If the chemical is corrosive, the hands will suffer from chemical burn. Appropriate protective gloves should be worn.

Don't suck chemicals with your mouth. Use appropriate liquid delivery tools.

Dangerous substances can easily enter the body during sucking chemicals with mouth, and would be injurious to health. If the chemical is corrosive, the mouth will suffer from chemical burn. Appropriate liquid delivery tools such as hand pumps should be used.

Don't use container with narrow opening for a process that evolves heat and/or gases

As the opening of the container is narrow, the releasing gas bubble may carry along hot liquid out of the container. At the same time, the heat and gas generated may tremendously increase the pressure inside the container which consequently burst. It will be more hazardous if dangerous substances are involved.

Don't mix oxidizing agents with flammable / combustible substances

When oxidizing agent such as potassium permanganate is in contact with flammable / combustible substance, including sulphur powder, carbon powder, zinc dust, wood dust, etc., vigorous oxidation reaction may occur spontaneously evolving large amount of heat and possibly gases. This may also lead to fire and explosion.

Don't mix acid with bleaching solution

When bleaching solution is mixed with acid, reaction occurs spontaneously liberating toxic gases.



Beware of Hazards During Chemicals in Use

Grinding solids into powder form: Beware of inhaling dangerous substances and causing explosion

During grinding solids, the chemical in powder form may become airborne and easily enter the human body by inhalation. If the chemical is a toxic/harmful/irritating substance, it will be injurious to health. In addition, during the grinding process some explosive chemicals (such as peroxides) can cause explosion under friction or shock.

Safe practices

- Never grind explosive substances !
- Operate under local exhaust ventilation to vent away hazardous airborne particles.
- Wear personal protective equipment such as respirators and gloves as appropriate.



Pouring powdered chemicals into another container: Beware of inhaling dangerous substances and causing fire/explosion

During pouring powdered chemicals into another container, the chemical in powder form may become airborne and easily enter the human body by inhalation. If the chemical is a toxic/harmful/irritating substance, it will be injurious to health. In addition, airborne particles of combustible chemicals and easily oxidisable metals form flammable mixtures when mixed with air. The flammable mixtures catch fire in the presence of an ignition source and even lead to explosion.

Safe practices

- **No source of ignition is allowed nearby during operation !**
- Operate under local exhaust ventilation to vent away hazardous airborne particles.
- Wear personal protective equipment such as respirator, gloves as appropriate.



Using a sprayer to spray chemicals: Beware of inhaling dangerous substances and causing fire/explosion

During spraying, the chemical in aerosol form may enter the human body by inhalation or skin contact. If the chemical is a toxic/harmful/irritating substance, it will be injurious to health. Besides, propellants used in common aerosol cans are flammable substances, and if the chemical being sprayed is a combustible substance, the aerosol of the chemical may form flammable mixtures with air. The flammable mixtures catch fire in the presence of an ignition source and even lead to explosion.

Safe practices



- No source of ignition is allowed nearby during operation !
- Operate under local exhaust ventilation to vent away the hazardous aerosol as far as practicable. If this is not practicable and the work with less hazardous chemical is of short duration, ensure that the place is well-ventilated.
- Wear personal protective equipment such as respirator, face mask, protective clothing, gloves as appropriate.

Heating liquids: Beware of splashes of superheated liquid and inhaling hazardous vapours

In the absence of nucleus for bubble formation in the container, the liquid under heating may not appear to boil even though the temperature exceeds the boiling point. This is the superheating phenomenon. However, when the liquid is disturbed such as lifting the container bubbles form spontaneously and rush out, leading to splashing of the hot liquid. In addition, if the chemical involved is a dangerous substance, the hazardous vapour evolved during heating will be injurious to health when inhaled.

Safe practices

- **Don't use microwave oven to heat liquids !**
- Add pieces of stones to the liquid prior to heating as far as practicable, or constantly stir the liquid during heating. This helps bubble formation and avoids superheating.
- Operate under local exhaust ventilation to vent away hazardous vapours as far as practicable. If this is not practicable and the chemical is less toxic, ensure that the place is well-ventilated.
- Wear personal protective equipment such as gloves, eye protection, respirator as appropriate.

Pouring flammable liquids to another container: Beware of fire/explosion

Pouring flammable liquids (such as petrol, acetone, etc.) from one container to another activates vaporization of the flammable material. At the same time, friction between the liquid flow and the container as well as air may generate static electricity. Spark forms when discharge occurs. The spark ignites the flammable vapour in the vicinity. Consequently the flammable liquid will be on fire and may even lead to explosion.

Safe practices

- **No source of ignition is allowed nearby !**
- Operate under local exhaust ventilation to vent away the flammable vapour as far as practicable. If this is not practicable and the chemical is less hazardous, ensure that the place is well-ventilated.
- Connect the containers to earth by a conducting wire so as to avoid spark discharge.
- Any clothing contaminated with flammable substance during the process should be taken off and should be properly treated, such as venting off the flammable contaminant by exhaust ventilation.
- Wear personal protective equipment such as respirator, protective clothing, gloves as appropriate.

Wiping off flammable liquid spills or leakage: Beware of fire

Friction from wiping off flammable liquid (such as petrol, acetone, etc.) spills or leakage using a piece of cloth may generate static electricity. Spark forms when discharge occurs. The spark ignites the flammable vapour in the vicinity, and consequently the flammable liquid will be on fire.

Safe practices

- No source of ignition is allowed in the vicinity of any place where flammable substances are stored or handled !
- Increase the ventilation in the place to avoid accumulation of flammable vapour whenever any flammable liquid spill or leakage is found.
- Remove the flammable liquid spill or leakage by absorbent materials to avoid generation of static electricity due to friction.
- Wear personal protective equipment such as respirator, protective clothing, gloves as appropriate.



Dissolving caustic soda: Beware of splashes of superheated corrosive liquid



Caustic soda (sodium hydroxide) pellets dissolve in water to form alkaline solution and evolve heat. The process may cause localized heating and even superheating. When the solution is disturbed such as lifting the container, bubbles form spontaneously and rush out, leading to splashing of the hot corrosive liquid.

Safe practices

- Don't add water to caustic soda pellets or strong alkaline solutions!
- The correct method is to add caustic soda or other strong alkaline solutions slowly to water. Constantly stir the solution to prevent localized heating, and to help bubble formation in avoiding superheating. Cool the outside of the container by cold water or ice if necessary.
- Wear personal protective equipment such as gloves, eye protection as appropriate.



Diluting acids: Beware of splashes of corrosive liquid and emission of acid fumes

In general, diluting acids (such as hydrochloric acid, nitric acid, sulphuric acid, etc.) is an exothermic process. During dilution the acid solution may experience localized heating and evolves gas bubbles and acid fumes, or even be superheated. Bubbling can easily lead to splashing of hot corrosive liquid.

Safe practices

- **Don't add water to concentrated acid !**
- The correct method of dilution is to add acid slowly to water and constantly stir the solution. Cool the outside of the container by cold water or ice if necessary.
- Operate under local exhaust ventilation to vent away acid fumes.
- Wear personal protective equipment such as gloves, eye protection as appropriate.

Useful Information

If you wish to enquire about this guidebook or require advice on occupational safety and health, please contact the Occupational Safety and Health Branch of the Labour Department through:

Telephone : 2559 2297 (auto-recording after office hours)

Fax : 2915 1410

E-mail : enquiry@labour.gov.hk

Information on the services offered by the Labour Department and on major labour legislation can also be found by visiting our Home Page in the Internet. Address of our Home Page is <http://www.info.gov.hk/labour>.



Occupational Safety and Health Branch
Labour Department

12/2002-2-B57