Chemical Safety

Chemicals are part of modern life, and we are likely to encounter them everyday - from the chemicals used at work, to products in the home such as paint, and detergents and pesticides used in the garden. Identify and managing the risks from chemicals is extremely important.

Chemicals are a part of everyone's life. There are five to seven million different chemicals known in the world. At least 400 million tonnes of chemicals are produced worldwide each year including agricultural chemicals, food additives, pharmaceuticals, fuels for power production, chemical consumer products, etc. The frightening reality is that, for the vast majority of the chemicals used and being developed, little or nothing is known about their possible immediate or long-term effects on the health of the workers who produce them or use them at work. Yet workers continue to be required to work with potentially toxic (poisonous or harmful to the worker) substances. In some countries, workers are required to work — with little or no protection — with chemicals that are known to be hazardous to human health. Workers in some developing countries are often required to work with toxic chemicals that have been banned in developed countries because of their hazardous effects. Similarly, agriculture workers in developing countries (and in non-union agriculture jobs in some developed countries) often spray herbicides and pesticides without any form of protection. In most developed countries, workers using those same chemicals dress up almost like spacemen in protective clothing to avoid contamination from the chemicals, and are provided with washing facilities and regular medical check-ups.

In many countries chemicals are literally dumped into the environment, often with serious human and environmental consequences. Depending on the chemicals dumped, the results can be serious health problems for the workers (who usually do not know about the dangers from the chemicals) and the community, and permanent damage to the environment. In other countries the laws about chemical disposal are strict in order to protect people and the environment.
Nearly all workers today are exposed to some sort of chemical hazard because chemicals are used in every type of industry, from mining, welding, mechanics and factory work, to office work, etc. In fact, chemical hazards are the most serious health hazard for workers today. Your first line of defense against chemicals is to learn as much as possible about the substances you work with and to prevent exposure to them, no matter how "safe" you may think they are, or how "safe" you have been told they are!

Not all sound is noise — noise is sound that people do not like. Noise can be annoying and it can interfere with your ability to work by causing stress and disturbing your concentration. Noise can cause accidents by interfering with communication and warning signals. Noise can cause chronic health problems. Noise can also cause you to lose your hearing.

Hearing loss from exposure to noise in the workplace is one of the most common of all industrial diseases. Workers can be exposed to high noise levels in workplaces as varied as construction industries, foundries and textile industries. Short-term exposure to excessive (too much) noise can cause temporary hearing loss, lasting from a few seconds to a few days. Exposure to noise over a long period of time can cause permanent hearing loss. Hearing loss that occurs over time is not always easy to recognize and unfortunately, most workers do not realize they are going deaf until their hearing is permanently damaged. Industrial noise exposure can be controlled — often for minimal costs and without technical difficulty. The goal in controlling industrial noise is to eliminate or reduce the noise at the source producing it.

Routes of entry/health effects

There are a variety of chemicals that are commonly used in industry. Industrial chemicals can be described in a number of ways, for example by their effect on the worker (whether the chemical is corrosive or causes dermatitis, etc.), or by the physical form of the chemical (that is, whether it is a dust, fume, vapour, gas, etc.). Chemicals can enter the body (**routes of entry**) by:

- **inhalation** through the lungs;
- **absorption** through the skin;
- **ingestion** through the mouth.

Chemical can enter into body as , Dust, fumes and gases, solvents, metals, acids and bases, pesticides. Once toxic chemicals get into your body, they can cause a variety of harmful effects, including immediate (acute) effects or long-term (chronic) effects which may not show up for a number of years after the exposure occurred. Toxic chemicals can also produce local and systemic effects, depending on the nature of the chemical and the route of exposure.

What kinds of effects can a toxic chemical have?

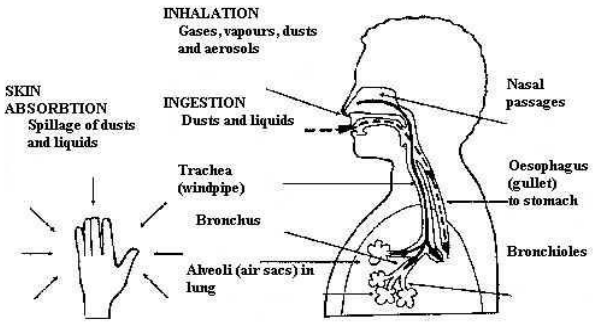
There are a number of factors that determine the type of toxic effect a chemical can have on you. These factors include:

- the chemical composition of the hazardous substance (certain substances are more harmful than others because of their chemical structure);
- the physical form of the chemical (dust, vapour, liquid, etc.);
- the route of entry by which the chemical gets into the body (chemicals have different routes of entry. Some chemicals can enter the body in more than one way. Different health effects can occur depending on the route of entry);
- the particular tissues and organs in which the chemical collects or localizes;
- the frequency, concentration, and length of exposure; and
- the worker's individual response to the chemical, which can vary a great deal from person to person.

Toxic property	Part of body affected	Time scale of appearance	Effect	Example
Irritant or corrosive	Any, but usually the eyes, lungs and skin	A few minutes to several days	Inflammation, burns and blisters of exposed area. Frequently healed after acute exposure. Chronic exposure may lead to permanent damage.	Ammonia, sulphuric acid, nitrogen oxides, caustic soda
Fibrogenic	Generally lungs	Years	Gradual cumulative loss of lung function leading to disability and death if there is chronic exposure.	Bauxite dust, asbestos, bagasse
Allergic	Any, but frequently lungs and skin	Days to years	In lungs may lead to chronic asthma-like disease and permanent disability. In skin may produce industrial dermatitis.	Toluene, di-isocyanate (TDI), amine hardeners for epoxy resins.
Dermatitic	Skin	Days to years	Inflamed, peeling skin rashes. May result from chronic exposure to irritants, allergenic agents, solvents or detergents.	Strong acids, alkalis, detergents, carbon tetrachloride, trichloroethylene.
Carcinogenic	Any organs, bu frequently skin, lungs, bladder	10 to 40 years	Cancer in affected organ or tissue. Ultimately this may cause premature death.	2-Naphthylamine, certain tars and oils, benzidine, asbestos
Poisonous	Any organs but frequently liver, brain, kidney	A few minutes to many years	Death of cells in vital organis with eventula failure of organ to carry out important biological functions. Ultimately can cause death.	Carbon tetrachloride, mercury, cadmium, carbon monoxide, hydrogen cyanide.
Asphyxiants	Lungs	Minutes	Gases replace normal oxygen content of air	Acetylene, carbon dioxide

Types of toxic effects caused by industrial chemicals

The following figures help to explain how chemicals can enter the body and the effects they can have once they are in the body. *Figure 1* shows the different routes of entry by which chemicals can enter the body. *Figure 2* shows the different organs and tissues that can be affected by certain toxic industrial chemicals.



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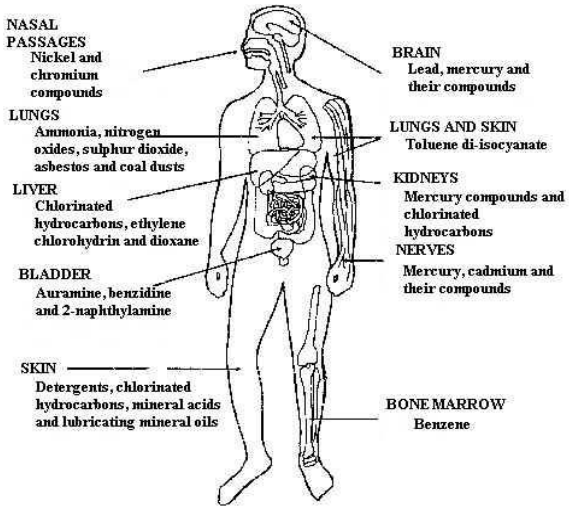


It is important to understand that workers may show different physiological responses to industrial chemicals, just as people may show varied responses to different medicines, foods, etc. Some people are more "resistant to hazards" (so-called "superworkers") than workers who show any signs of poor health. It is also common for employers to refuse to employ women of childbearing age on work processes that are known to affect the development of the foetus in the womb (such as work involving lead).

A workplace should be safe for all workers

Strategy and plan should be made to protect workers against chemical hazards so that working environment is safe for **all** workers .

Exposure to toxic chemicals can lead to accidents

Exposure to toxic chemicals can also lead to higher rates of accidents at work. For example, chemicals such as solvents and asphyxiants may slow your reaction time by affecting your nervous system or limiting the amount of oxygen that gets to your lungs. A slow reaction can be very serious (or even fatal) if you are in a dangerous situation that requires an immediate response. Unfortunately, when accidents occur in the workplace, management often blames the worker, claiming he or she was careless. The blame culture is restricts the development of a welfare culture in working society which ultimately results nonproductive for workers and employers

Types of chemicals found in the workplace

The physical form of a chemical can affect how it enters your body and to some extent, the damage it causes. The main physical forms of chemicals are solids, dusts, liquids, vapours and gases.

A. Solids

- Solids are the least likely of the chemical forms to cause chemical poisoning. However, certain chemical solids can cause poisoning if they get onto your skin or food and you then ingest them. Personal hygiene is important to prevent the ingestion of chemical solids.
- The greatest danger with solids is that some work processes can change them into a more dangerous form. For example, wood that is being cut can turn into wood dust which can then be inhaled. Welding rods can decompose into fumes and gases. Polyurethane foam

is safe in its normal solid form but gives off deadly gases if it burns.

- Chemicals in solid form can give off toxic vapours which can be inhaled, and solids can be flammable and explosive, and corrosive to the skin.
- Effective control measures should be used with chemical solids, particularly during work processes which may change them into more hazardous materials.

B. Dusts

- Dusts are tiny particles of solids.
- You can be exposed to dust in the workplace from **materials** that normally exist in dust form (for example, bags of cement), or from **work processes** that create dust (for example, handling glass fibre can produce toxic dust).
- The main danger from harmful dusts is that you can breathe (inhale) them into your lungs. When breathed in, the larger dust particles are usually trapped by hairs and mucus and then removed by the body. Smaller particles, however, are more dangerous because they can get deep inside the lungs where they can have damaging effects, or they can be absorbed into the bloodstream and travel to other parts of the body where they can cause damage. They can also cause eye damage.
- Dusts can be hard to see — you often cannot even see a cloud of tiny dust particles except with special lighting.
- Under certain conditions dusts can explode. An example of this is an explosion in a grain silo or flour mill.
- Effective control measures should be used to keep dust in the workplace at "safe" levels.

C. Liquids

- Many hazardous substances, such as acids and solvents, are liquids when they are at normal temperature.
- Many liquid chemicals give off vapours which you can inhale and which may be highly toxic, depending on the chemical.

The physical form, route of entry, affected organ and type of toxicity of some common industrial chemicals

Chemical	Physical form	Method of entry	Organ(s) that can be affected	Class of toxicity	Symptoms	Examples of industry where it is used
Cadmium metal and some of its compounds	Dusts, vapours,	Inhalation	Lungs, throat, kidneys	Poisonous, causing damage to lungs, kidneys on chronic exposure.	Dry burning throat, chest pain, vomiting, headaches	Metal industries, welding processes, heavy chemicals
	Dusts	Ingestion				
Toluene di-isocyanate	Vapour	Inhalation	Lungs	Allergenic	Industrial asthma due to lung effects	Industrial processes involving polyurethane manufacture, paints
	Solid	Spillage on skin	Skin	Allergenic	Dermatitis	
Mercury and many of its compounds	Vapour (mercury itself) dust	Inhalation	Brain and nervous system, kidneys	Poisonous. Often irreversible damage to nervous system	Loss of muscular coordination, loss of mental ability.	Heavy chemicals, laboratory workers, engineering
	Liquids dusts	Spillage on skin, ingestion				
Cloroform, Carbon tetrachloride Trichloro-ethylene	Vapour	Inhalation	Brain, liver, kidneys, skin	Poisonous. Carcinogenic? Chronic exposure may lead to liver and kidney failure	Drowsiness	Light engineering, heavy chemicals, cleaning, office workers
	Liquid	Spillage on skin			Dermatitis	
Auramine	Dusts, vapour	Inhalation	Bladder	Carcinogenic to bladder.	Blood in urine	Dyes industry, pottery and glazing industries
	Dusts	Spillage on skin	Skin	Irritant	Inflammation, burns	
Nickel and some of its compounds	Dusts, powders	Absorption through skin	Skin	Irritant	Inflammation, burns	Metallurgical industries, heavy chemicals, laboratory workers
	Vapour	Inhalation	Lungs, nasal passages	Irritant in lungs (nickel arbonyl). Carcinogenic on chronic exposure	Breathlessness, fever	
2-Naphthyl-amine	Dust	Absorption through skin	Bladder	Carcinogenic to bladder	Blood in urine	Dye and rubber industries; use of chemical banned in many countries
Benzene	Vapour	Inhalation Absorption through skin	Brain, bone, marrow, skin	Poisonous. Possibly carcinogenic (leukemia?)	Headaches, nausea, loss of appetite, anemia, dermatitits	Many industrial activities, especially chemical industry, lacquers, adhesives, paints,etc.
Asbestos	Dust particles and fibres	Inhalation	Lungs	Fibrogenic, carcinogenic (blue and white asbests)	Breathlessness, loss of lung function	Many industrial activities involving manufacture or use of materials containing asbestos.

- Liquid chemicals can be absorbed by your skin. Some liquid chemicals may cause immediate skin damage (they may or may not be absorbed into the bloodstream as well). Other liquids pass directly **through** the skin into the bloodstream, where they can travel to different parts of the body and cause damaging effects.
- Effective control measures should be used with liquid chemicals to eliminate or reduce the possibility of inhalation, skin exposure and eye damage.

D. Vapours

- vapour is the gas phase of a material which is normally liquid under standard conditions.
- Tiny droplets of liquid which are suspended in the air are called mists.
- Many liquid chemicals evaporate at room temperature, which actually means that they form a vapour and stay in the air.
- The vapours from some chemicals can irritate your eyes and skin.
- There can be a variety of serious health effects from inhaling certain toxic chemical vapours.
- Vapours can be flammable or explosive. To avoid fire or explosion, it is important to keep chemicals that vaporize away from any sparks, sources of ignition or incompatible chemicals.
- Controls should be used to prevent worker exposure to vapours from liquids, solids or other chemical forms.
- Gasoline and water are two examples of liquids which generate vapour under standard conditions.

E. Gases

- Some chemical substances are in the form of a gas when they are at a normal temperature. However, some chemicals in liquid or solid form **become** gases when they are heated.
- You can detect some gases easily by their colour or smell, but there are other gases that you cannot see or smell at all — you can only detect them with special equipment.
- Gases can be inhaled.
- Some gases produce irritant effects immediately. The health effects of other gases may be noticeable only after your health has already been seriously damaged.
- Gases may be flammable or explosive. Extreme caution should be used when working around flammable or explosive gases.
- Workers should be protected from the potential harmful effects of chemical gases with effective control measures in the workplace.
- Some examples of gases are: nitrogen, nitrogen dioxide, carbon monoxide, carbon dioxide, and oxygen.

F. Effects of chemicals on the environment

Many employers are not aware of the hazards associated with toxic chemicals and often do not know how to dispose of chemical wastes safely. (Employers also need to be educated about chemical hazards.) As a result, the employers often simply "dump" waste chemicals into the environment. Convenient dumping grounds are the ocean, rivers, lakes, fields, roadsides, etc. Sometimes these dumping grounds are right in the community where family live and work.

Toxic chemicals which are improperly disposed of may eventually end up in your drinking water, in the places where children play, in the soil where food is grown, etc.

In reality, every country is struggling today with the problem of chemical waste and how to dispose of it permanently yet safely. The best solution to date is to use specially **approved** and **well-maintained** disposal sites that prevent chemicals from leaking into groundwater and into residential or farming areas. Dumping chemicals into the ocean is never a solution. In fact ocean dumping can have very serious effects - chemicals can get into the food chain, destroy marine life, wash back to shore, etc.

Material Safety Data Sheet (MSDS)

Formal document containing important information about the characteristics and actual or potential hazards of a substance. It identifies the manufacturer of the material (with name, address, phone, and fax number) and usually includes (1) chemical identity, (2) hazardous ingredients, (3) physical and chemical properties, (4) fire and explosion data, (5) reactivity data, (6) health hazards data, (7) exposure limits data, (8) precautions for safe storage and handling, (9) need for protective gear, and (10) spill control, cleanup, and disposal procedures. Mandated by the US Occupational Safety and Health Administration (OSHA), it is used also in many other countries in one form or the other. Called chemical safety data sheet (CSDS) in Europe.

A Material Safety Data Sheet (MSDS) is designed to provide both workers and emergency personnel with the proper procedures for handling or working with a particular substance. MSDSs include information such as physical data (melting point, boiling point, flash point, etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill/leak procedures. These are of particular use if a spill or other accident occurs, but should also be reviewed prior to working with a new product. When reviewing an MSDS for a substance, there are three key issues to be addressed:

- What are the hazards associated with the substance?
- How do I protect the environment, myself and those around me?
- How do I act if an accident occurs?

An MSDS does not have to be in a specific format.

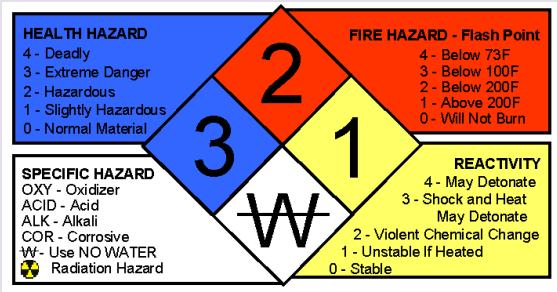
NFPA Diamond

The National Fire Protection Association (NFPA), USA, designed NFPA as a standard for the Identification of the Hazards of Materials for Emergency Response. This is commonly known as the NFPA diamond. The four section multicolor diamond shape indicates the health, flammability, instability and related hazards that are presented by short-term, acute exposure to a material during a fire, spill or other emergency-related condition. These identifiers in sign form are found on the outside doors or walls and the inside of many facilities that use chemicals in their daily processes.

The object of this standard is to inform responders to fires, spills or other emergencies of the hazards of the material contained in the facilities.

The numerical hazard rating system uses the numbers 0-4, with 4 denoting the highest hazard in that category and 0 indicating a non-hazard. The rating system has three categories, defined by their color. **Blue for Health, Red for Flammability and Yellow for Instability. The fourth space at the bottom of the sign is not colored and indicates special hazards.**

These hazards can include the W symbol with a line through it for water reactive or the OX symbol for materials that may be oxidizers. This space can also be left blank.



Generally used Chemical symbols

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