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Effect of Chemicals on Human Beings Working in Various Industries

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ABSTRACT: 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. In North America alone at least 1,200 **new** chemicals are developed each year. 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 defence 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!

KEYWORDS: chemicals, human, health, industries, toxic, countries, workers, community, safety

I. INTRODUCTION

Chemicals are a part of everyone's life. At least 400 million tonnes of chemicals are produced each year worldwide and at least 1,200 new chemicals are developed each year in North America alone.[1,2] For the majority of chemicals used and developed, there is no information about their possible immediate or long-term health effects, yet workers are still required to work with potentially toxic substances. Many workers are required to work - without any protection - with chemicals that are **known** to be hazardous to human health. In many countries, chemicals are dumped into the environment, often with serious human and environmental consequences. The laws about chemical disposal in other countries are strict, to protect both people and the environment. Nearly all workers today are exposed to some sort of chemical hazard since chemicals are used in every type of industry. Therefore it is important to learn as much as possible about the chemicals you work with. 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.).[3,4]

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Chemicals can enter the body (**routes of entry**) by:

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

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. 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.[5,6]

Table 1 shows some of the types of toxic effects that certain industrial chemicals can cause. The table includes the toxic property of the chemical (for example, whether it is carcinogenic, poisonous, causes an allergic reaction, etc.), the part of the body affected by the chemical, how long it takes until disease develops, the type of effect the chemical causes, and some examples of chemicals that cause those effects.

Table 1.
Types of toxic effects caused by industrial chemicals

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	Strong acids, alkalis, detergents, carbon

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			irritants, allergenic agents, solvents or detergents.	tetrachloride, trichloroethylene.
Carcinogenic	Any organs, but 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 organ with eventual 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

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 employers may try to select workers who are more “resistant to hazards” (so-called “superworkers”) and remove 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).

II.DISCUSSION

A workplace should be safe for all workers

Any union strategy to protect workers against chemical hazards should try to create a working environment where it is safe for **all** workers — the average worker (male or female) and even vulnerable workers — to work without the job affecting their health. Regular medical examinations must never be used by the employer to eliminate “vulnerable” workers, such as women of childbearing age.

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. This tendency to “blame the victim” is yet another reason to learn about the substances you work with, to make sure the proper control measures are in place, and to know your rights![7,8]

1. Industrial chemicals can be described by their effect on the worker or by the physical form of the chemical.
2. Chemicals can enter the body by inhalation, ingestion, or skin absorption.
3. Toxic chemicals can cause a variety of harmful effects on different parts of the body, including acute, local, chronic and systemic effects.
4. There are a number of factors that determine the type of toxic effect a chemical can have on you, including the form of the chemical, route of entry, and individual response to the chemical.
5. Workers may show different physiological responses to industrial chemicals.

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6. Union strategies for protecting workers against chemical hazards should try to create a safe working environment for **all** workers, whether they are male, female, “vulnerable”, women of childbearing age, etc. Regular medical examinations should never be used to eliminate “vulnerable” workers from jobs.
7. Exposure to toxic substances in the workplace can also lead to higher accident rates.
8. It is important to learn about the substances you work with, make sure the proper control measures are in place, and to know your rights.

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.[6,7]

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.[4,5]
- 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.

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- 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

- A 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.[2,3]

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, these 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 you and your family live and work. Toxic chemicals which are improperly disposed of may eventually end up in your drinking water, in the places where your children play, in the soil where your 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. Your family can be exposed to your workplace hazards if you bring chemicals or other workplace contaminants home with you on your clothes, hair or skin. To prevent this “spreading the hazard”, if possible wash/shower and change your clothes

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when necessary before you leave work. Leave your dirty clothes at work or, if you must wash them at home, wash them separately — never with the family wash! Although you may think that the amount of contaminant you can bring home on your clothes or skin is very small and cannot hurt your family, in fact, a small exposure every day for months can add up to a big exposure and can lead to serious illness.[8]

Table 2 includes some detailed information on a number of common industrial chemicals. It includes the physical form of the chemical, route of entry, organ(s) that can be affected, type of toxicity, symptoms of disease and examples of industries where the chemicals are used.

Table 2. 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
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 and inks
	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				
Chloroform, Carbon tetrachloride Trichloro-	Vapour	Inhalation	Brain, liver, kidneys, skin	Poisonous. Carcinogenic? Chronic exposure may lead to liver	Drowsiness	Light engineering, heavy chemicals,

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ethylene	Liquid	Spillage on skin		and kidney failure	Dermatitis	cleaning, office workers
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	Dermatitic	Itching, burning of affected area	Metallurgical industries, heavy chemicals, laboratory workers
	Vapour	Inhalation	Lungs, nasal passages	Irritant in lungs (nickel carbonyl). Carcinogenic on chronic exposure	Breathlessness, fever	
2-Naphthylamine	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, dermatitis	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.

III.RESULTS

1. The physical form of a chemical can affect how it enters your body and, to some extent, the damage it causes.

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2. The main physical forms of toxic chemicals are: solids, dusts, liquids, vapours and gases.
3. Solids are the least likely of the chemical forms to cause chemical poisoning. However, certain chemical solids can cause poisoning if they are ingested. Personal hygiene is important to prevent the ingestion of chemical solids. Some chemicals in solid form can give off toxic dusts or vapours which can be inhaled. Effective control measures should be used with chemical solids, especially during work processes that may change them into more hazardous forms.
4. You can be exposed to occupational dust from materials that normally exist in dust form or from work processes that create dust. The main danger from harmful dusts is that you can inhale them. Once inside your body, dusts can produce a variety of serious health problems. Under certain conditions dusts can also explode. Effective control measures should be used to keep occupational dusts at “safe” levels.
5. Some liquid chemicals give off vapours which you can inhale and which may be highly toxic, depending on the chemical. Liquid chemicals can be absorbed by your skin. They can also cause burns or eye damage due to eye splashes. If absorbed, they can cause skin damage and/or internal (systemic) health effects. Effective control measures should be used with liquid chemicals to eliminate or reduce the possibility of inhalation and skin exposure.
6. Vapours are tiny droplets of liquid suspended in the air. Vapours can be inhaled and, depending on the chemical, can be highly toxic. Some vapours irritate the eyes and skin. Certain vapours are flammable or explosive. Control measures should be used to prevent workers from being exposed to vapours from liquids, solids or other chemical forms.
7. Some chemicals are in the form of a gas when they are at a normal temperature. However, some liquids and solids **become** gases when they are heated. Some gases have strong odours or colours while others are odourless and colourless (and can be highly toxic). Gases can be inhaled. Certain gases can produce immediate irritant effects, while others produce noticeable effects only **after** serious damage to your health has already occurred. Gases can be flammable or explosive. Workers should be protected from the potentially harmful effects of gases with effective control measures.
8. 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.
9. Employers often “dump” waste chemicals into the environment. Chemicals that are improperly disposed of may eventually get into your drinking water and your food. Chemical wastes should only be disposed of in approved and well-maintained disposal sites.
10. To prevent bringing workplace chemicals home to your family, wash/shower and change your clothes when necessary before you leave work. Leave your dirty clothes at work. If you must wash them at home, wash them separately — never with the family wash![6]

IV. CONCLUSIONS

Types of exposure to chemicals and pollutants

There are 3 ways to be exposed to chemicals and pollutants:

- inhaling (breathing in)
- absorption (skin and eye contact)
- ingesting (eating or drinking)

Inhaling (breathing in)

You are exposed to chemicals and pollutants when you inhale (breathe in). You take over 20,000 breaths a day. This number can be much higher for infants and children. The chemicals and pollutants you inhale can end up in your lungs

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and blood stream. Sometimes, you can smell or taste harmful chemicals, but it isn't always so easy. Some chemicals, like radon or carbon monoxide, are odourless, tasteless and invisible.[7]

Absorption (skin and eye contact)

You can be exposed to chemicals and pollutants by coming into contact with them through your skin and eyes. These organs can be more sensitive to chemicals and may react more quickly than the rest of your body.

Ingesting (eating or drinking)

You're exposed to chemicals and pollutants when you eat and drink. Chemicals and pollutants are found in both our food and water sources.

Potential health effects

Accidents or incorrect use of household chemical products may cause immediate health effects, such as skin or eye irritation or burns, or poisoning.

There can also be longer-term health effects from chemicals. When these occur, they're usually the result of exposure to certain chemicals over a long period.

Depending on the chemical, longer-term health effects might include:

- cancer
- organ damage
- weakening of the immune system
- development of allergies or asthma
- reproductive problems and birth defects
- effects on the mental, intellectual or physical development of children

Follow these tips to lower your exposure and help protect yourself and your family from chemicals and pollutants.

Factors that affect health risks of chemicals and pollutants

The health risks of chemicals and pollutants depend on several factors, including:

- the amount you're exposed to
- the type of chemical or pollutant
- when and how long you're exposed
- your age and general state of health
- how you're exposed (through air, products, food, water and soil)

People that may be more sensitive to or more harmed by exposures from chemicals and pollutants include:

- children

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- seniors
- pregnant people
- Indigenous Peoples[8]

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