

How Chemicals Poison You

In order to understand information on chemicals you need to know how chemicals can enter and react in the body. The study of such reactions is called toxicology - the study of the nature and effects of poisons.

Every industrial chemical can cause a variety of bodily reactions depending on the type, amount and route of exposure. Some chemicals will have an acute effect on the body. This means that within minutes or hours of exposure to that chemical you will have signs of poisoning. Other chemicals will have a chronic effect, which means that in the long term, perhaps even as long as 20 or 30 years after exposure, you can have an incurable disease of the vital organs. Cancer can take 20 or 30 years to develop after the initial exposure.

For instance, a single exposure to high levels of carbon disulphide can result in unconsciousness, but repeated daily exposure for years at much lower levels can lead to damage to the central nervous system, as well as to the heart, liver and kidneys.

Routes of Entry into the Body

There are three major ways in which chemical substances can enter the body. These are:

- Inhalation - you can breath the substance in
- Skin - the substances can be absorbed through the skin
- Ingestion - you can swallow the substance

Not all chemicals can be absorbed in all these ways.

Inhalation

All substances can be breathed in if they are in the air. Hard blocks of chemicals can give off dust; liquid chemicals can vaporise. The human lung has an enormous surface of overlapping tissue and blood vessels which make it possible for the body to absorb many substances from the air at an extremely rapid rate. Some substances which dissolve easily in water (highly water soluble), such as soluble halogen salts and soluble chromates, can pass through the lungs so rapidly that there will be no trace of them left after the initial intake of breath.

On the other hand there are many commonly used industrial substances which, because they are extremely insoluble in body fluids or because they react rapidly with the tissues of the lung, remain imbedded in the lung for varying periods of time. This may result at first in irritation and inflammation of the lung tissue, or almost immediately or later, depending on the degree of toxicity of the substance, and the amount inhaled, in a number of chronic and progressive lung diseases. For instance some very soluble gases, such as sulphur dioxide and ammonia, are largely absorbed by the nasal passages and will not get far into the lungs. Other gases however, such as nitrogen dioxide, phosgene and ozone are readily absorbed deep into the lung where they can produce fluid on the lungs (pulmonary edema) within a few hours. Higher levels of exposure can cause other diseases such as emphysema and fibrosis, which irreversibly alter the lung tissue.

The vapours and gases of other substances which have low water solubility but high fat solubility, such as carbon di-sulphide, volatile hydrocarbons such as benzene and methanol, and some ketones such as methyl ethyl ketone, will pass through the lung with ease, enter the blood stream and affect the vital organs such as the liver and kidney.

Chemicals can also enter your body in the form of dust. The size of dust particles determine how hazardous they are. Dust is measured in microns (1,000 microns to a millimetre). The larger the dust particle, the less likely it is to enter the lung, although it will cause irritation which can lead to bronchitis. The smallest size of dust particles are those below 5.0 microns. These particles can behave like air and will easily enter deep into the lung, causing lung diseases all of which come under the general heading, pneumoconiosis.

Skin

It has been calculated that one in four of all industrial substances can affect your health by skin route entry. A substance can affect your body through the skin in the following ways:

- The substance can create a reaction and cause "primary irritation" or dermatitis.
- The substance can penetrate into the skin, react with tissue protein and result in skin sensitization -- a condition where your skin will react to any level of exposure of the substance.
- The substance can penetrate through the skin, enter the bloodstream and affect the vital organs of the body.

Human skin will absorb substances at different rates on different parts of the body. For instance the forearm and palm of the hand will absorb twice as much of a given amount of liquid chemical as the skin on the back of the hand or skin over the stomach. The scalp, skin over the angle of the jaw and behind the ears will absorb four times as much. The skin of the armpit will absorb four to seven times as much and the skin of the scrotum will allow almost total penetration of a liquid chemical. For this reason alone, cut or damaged skin should never come into contact with chemical substances as this allows for easy penetration.

Although one of the skin's principal functions is to act as a protective barrier against the entry of foreign substances into the body, some chemicals are so readily absorbed that serious and even fatal poisonings have occurred from only brief exposure to such highly toxic substances as parathion, aniline, phenol and hydrocyanic acids. For some chemicals such as benzidine the skin provides the major route of entry.

Also, most substances that can dissolve both in water and fat, such as amines and nitriles, penetrate so rapidly that the rate of absorption into the body is the same as it would be through the lungs or swallowing the substance.

- The skin will absorb toxic substances in certain conditions more readily than others:
- High temperatures causing sweating will increase the likelihood of skin absorption
- Gases and vapours will mix easily with sweat and increase the risk of absorption
- Sweating increases skin fats so increasing the risk of absorbing fat soluble substances
- Sweat will also help the development of some allergic conditions such as that from chromium and nickel

Ingestion

Some metals, (e.g. cadmium, lead and mercury) and some organic chemical (e.g. organochlorine pesticides and PCBs) can gradually build up in the body after swallowing or ingesting them. You should not eat in the vicinity of these (or any other chemicals). This includes garage attendants and motor mechanics who come into contact with manganese added to gas. Also you should not chew gum or smoke when handling toxic substances, or when you have reason to believe the air is contaminated. The droplets of vapours and gases can adhere to tobacco and gum and be ingested that way.

Ingestion is a route of entry through which a substance is less likely to harm you than through the lungs and skin. The reason for this is that the body does not easily absorb substances through the stomach wall into the bloodstream. Also substances are subject to both acid and alkali juices when passing through the stomach and small intestine, which can reduce their toxicity. However this does not mean that less care should be taken when exposure to a substance is likely through this method.

The Effect of Two or More Chemicals

Two or more chemicals can react with each other or in the body. Most workers are subject to exposure from more than one chemical in the workplace and it is essential that information is passed on when there is a possibility of one chemical reacting with another.

For instance hydrochloric acid and formaldehyde can produce BCME (Bischloromethylether) one of the most deadly human carcinogens. This happens, for example, when permanently pleated fabrics treated with formaldehyde are dipped in an acid wash.

Workers should be informed when two chemicals can react to make a third.

The effect on the body of exposure to two substances at the same time can be far more toxic than the two individually. For instance, some gases and vapours may not readily enter the body themselves but, if the atmosphere is dusty, they can adhere to the dust and be breathed in that way. Radon for instance is not easily retained by the body, but will enter it and remain there if the air is dusty.

Reproductive Hazards Information

Information about the effects toxic substances can have on the reproductive capacity of both men and women is often seriously neglected.

Safety reps should be aware that substances which can affect the foetus are also very often capable of causing one or a number of the following: sterility (in both men and women); interference with sexual drive in women and impotence in men; changes in the cell structure of the sperm or egg prior to conception, resulting in a miscarriage or deformed child. Substances such as lead can affect a foetus but will also cause sperm abnormalities and affect both men and women's reproductive organs.