

Chapter Five: Chemicals

5.1. Introduction

Chemicals affect every aspect of our working lives. Today over 400 million tons of chemicals are produced annually and, of the 5 – 7 million known chemical substances, over 80,000 are marketed. Over 1,000 new chemicals are produced each year. It is estimated that 5,000 – 10,000 commercial chemicals are hazardous, of which 150 –200 are thought to be carcinogens (cancer causing)¹. There is little awareness of the health and safety problems of using chemicals in the workplace. Unlike physical hazards which tend to be visible and the effects immediate, the health effects of chemical hazards tend to be more insidious and often take a period of time to have their impact on workers. As new chemicals are developed to meet the ever increasing demands of society, so the price is paid in terms of the health of the workers who are either involved in their production or in their use. There is also often a detrimental impact on the environment as hazardous chemicals are released or dumped into the atmosphere or rivers causing pollution and long-term damage.

Tragically, even where we do know of the toxic effects of certain industrial chemicals, it is not uncommon to find workers openly exposed to them with virtually no form of protection. Further, some of the chemicals which have been restricted or banned in many first world countries appear to be readily available in the developing countries of the region.

All occupations involve chemicals, some more obvious than others, for example:

- Agricultural workers are exposed to herbicides, pesticides, etc;
- Mine workers are exposed to chemical dust down the mines;
- Welders are exposed to metal fumes;
- Office workers are exposed to chemicals from the inks, photocopiers etc;
- Garment workers are exposed to chemical dust from the cutting, sewing and weaving sections and to chemicals used in the dyeing and spot cleaning processes.

5.2. Core Information

The effect of chemical hazards on workers depends upon a number of factors, including:

- The toxicity of the chemical, namely its potential to cause harm;
- The physical form of the chemical (dust, fume, vapour, solid, etc);
- The route of entry (inhalation, skin contact, ingestion);
- The body's tissues and organs in which the hazard collects or targets;
- The frequency, duration and concentration of exposure;

¹ ILO Manual – Safety and Health in the Use of Chemicals at Work, (93).

- The individual worker's response/susceptibility to the chemical (as not all workers respond in the same way to chemicals).

How do Chemicals Impact on the Body?

The main routes of entry for chemical hazards into the body are by:

- **inhalation** – breathing in workplace chemicals through the lungs;
- **skin contact** – getting the chemical/s on the skin where it can produce a local effect or be absorbed;
- **ingestion** – taking the chemical in when eating or smoking with contaminated hands. Similarly taking in the chemical when inhaled particles are swallowed.

Once there, the chemical can produce a number of effects:

- **an acute effect** – an “immediate” effect usually caused by a single short-term exposure to a chemical (e.g. an acid burn);
- **a chronic effect** – an effect usually caused by repeated exposure to a chemical over a long period of time. It may take a long time between the initial exposure and the onset of the disease – this is known as the **latent period**.
- **a local effect** – the chemical causes its effect/damage at the immediate site of exposure; and
- **a systemic effect** – after being absorbed into the body, the chemical is transported via the blood stream or the lymphatic system to other target organs where it causes its effect/damage.

The Impact of These Chemicals on Workers

The chemicals produce a variety of health effects on workers, including:

- **irritant or corrosive** – as the name implies, these chemicals can cause inflammation and/or blistering of the skin. Short-term exposure frequently heals whereas long-term exposure can lead to permanent damage (chemicals examples – ammonia, sulphuric acid, and caustic soda);
- **allergenic** – for susceptible workers, these chemicals produce asthma-like symptoms (lungs) or industrial dermatitis (skin) [examples include toluene diisocyanate - TDI, epoxy resins, formaldehyde];
- **fibrogenic** – these chemicals result in the gradual cumulative loss of lung function as “elastic” alveolar tissues are damaged by dust. Virtually any dust can have this effect;
- **asphyxiant** – these are chemicals which stop the normal absorption of oxygen by the body either by replacing the oxygen or inhibiting its uptake; The gases, carbon dioxide and carbon monoxide, are examples;
- **narcosis** – chemicals such as a number of solvents which depress the central nervous system and produce “light headedness” which can be a factor in accidents;

- **poisonous** – these chemicals cause damage/death of cells in vital organs leading to the failure of that organ to function effectively which can ultimately lead to death;
- **carcinogenic** – these chemicals cause cancer in exposed workers usually over a long period of time. Examples include – arsenic, asbestos, chromium, nickel, 2-naphthylamine, VCM;
- **teratogenic and mutagenic** – these chemicals affect the foetus in the womb or eggs/sperm for future generations.

What Form do These Chemicals Take?²

Solids: In the workplace, solids, as the name implies, are unlikely to enter the body accidentally, so they are the least likely to cause industrial poisoning (though some solids can contaminate skin or food). The main danger from solids is that they can change their form while being worked. For example, wood can be turned into dust which can be breathed. Similarly, welding rods can become molten and give off metal fumes and gases.

Dusts: These are tiny particles of solids. You can be exposed to dust in the workplace when handling materials that normally exist in a dust form (e.g. cement) or when solids are being worked, as for example in the case of wood being sawn giving off sawdust, or, as occurs in garment factories, when layers of cloth are being cut giving off cotton dust. The main danger from harmful dusts is that you can breathe them into your lungs. The larger dust particles (the ones you can normally see) are usually filtered out by the hairs and mucus of the nose and windpipe. It is the tiny dust particles (those you cannot see and are less than 5 microns in size) that are the most dangerous. These tiny particles can be breathed into the deep parts of the lungs (the alveoli) where they can directly damage the lung tissue or be absorbed into the bloodstream and affect other parts of the body.

Fumes are like dusts in that they are solid particles formed from condensation of substances from the vapour state. Fumes are normally associated with molten metals where the vapours from the metal are condensed into solid particles in the space above the molten metal as in the case of welding fumes.

Liquids: Many chemicals in the workplace exist in liquid forms at room temperature (e.g. solvents and acids). Some of these liquids can directly damage the skin when handled (as in the case of an acid burn). Others are able to pass through the skin, enter the bloodstream and damage other parts of the body. One of the main dangers from liquids is that they can give off vapours when handled which are breathed in by workers.

Vapours: They are the gaseous form of a liquid at room temperature. Vapours can be inhaled by workers and, in some cases, will irritate the eyes and skin. Some vapours are flammable or explosive.

² Adapted from ILO Manual – Occupational Safety and Health in the Caribbean – A Workers' Education Manual, Le Serve.

Gases: Some substances are gases at normal temperatures whereas others are liquids or solids which become gaseous when heated. Some are easy to detect by their colour and smell whereas others are odourless and colourless and much more difficult to detect unless you have specialised equipment. When gases in the workplace are inhaled, they can produce a variety of health effects ranging from irritation to asphyxiation.

SOME KEY POINTS:

Do you know how waste chemicals in your workplace are disposed of? Are they disposed of in an approved manner or are they dumped along with other materials in the surrounding environment (see picture 36). Remember that workers and their families live in the local area and any dumped waste can affect their health and pollute the environment!

Your family can also be exposed to workplace hazards if you take your contaminated work clothes home. If possible, wash/shower and change your clothes when necessary before you leave work.



Picture 36: Look at the waste from this garment factory. See the proximity of the houses.

What can you do to Improve Chemical Safety at Work?

As we have indicated, all workplaces have some potential chemical health and safety problems. The logical approach to dealing with such problems is:

- **recognise** the nature of the hazard;
- **evaluate** or measure the risk;
- **control** the hazard by introducing the most effective and economic control strategy.

Let us look at these strategies in more detail.

1. *Recognition*

It may sound obvious but how do you know if you have a chemical problem in your workplace? As we have already described some chemical hazards are obvious as in the case of an acid burn, accordingly you can come up with various control strategies for handling the acid. However, many chemical hazards are more insidious in their effect. They do not produce any immediate, obvious effects on the workers and you may not be aware of the slow onset of any occupational disease. You may have a suspicion that something is wrong but be unsure about what to do. In such cases, there a number of ways of ways to look into the problem:

- **Direct health indicators** - Are specific workers off sick more than others? Has the company nurse or doctor seen an increase in ill health in certain groups of workers? Do any workers have obvious health effects from working with a specific chemical? Have the workers complained when using a specific chemical?.
- **Experience/knowledge of a specific chemical** – Managers should have approved Material Safety Data Sheets (MSDSs) for all chemicals used in their workplaces. These MSDSs are produced by the chemical manufacturers and, in many countries of the world, are required by law³ (see picture 37 and Appendix 4 for a typical MSDS example)



³ MSDSs should contain information in the following areas – 1. Description of the chemical; 2 Effects of short-term exposure; 3 Effects of long-term exposure; 4 Fire and explosion risks; 5 Chemical reactivity – how it reacts with other chemicals; 6 Recommended personal protective equipment; 7 First aid requirements; 8 Storage and handling; 9 Clean up and disposal.

Picture 37: This chemical sack in a garment factory clearly specifies that you “should read the MSDS” before handling. Unfortunately, the MSDS was not available – it was not included with the order. The MSDS must be in a language and format that can be read and understood by managers and workers.

- **Observation** – this usually means undertaking a walkthrough survey and should involve the workers. The basic observations should include:
 - (a) any process using chemicals and the number of workers involved;
 - (b) how the materials are stored, handled, used and disposed of;
 - (c) whether MSDSs are available for all chemicals used in the workplace and whether workers have been trained in their use;
 - (d) what engineering controls or personal protective equipment is being used.

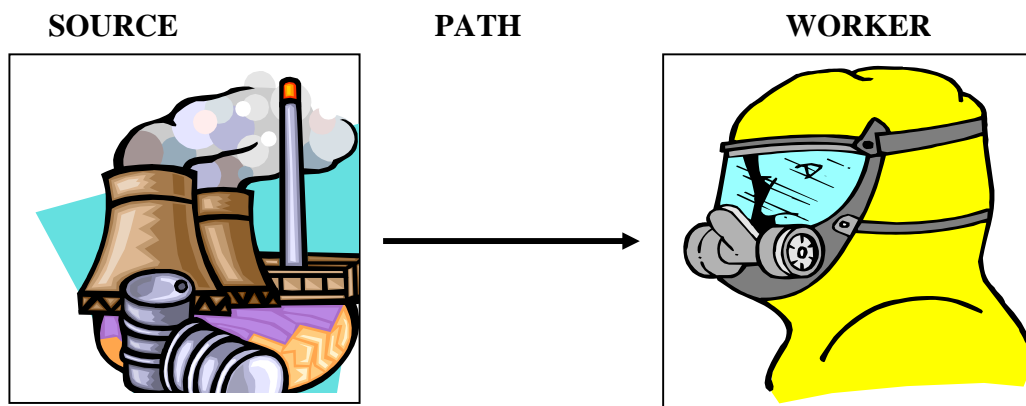
2. Evaluation

Evaluating or measuring the risks of chemicals is difficult. This normally involves taking air samples and comparing the level with recognised exposure limit standards. This is often time consuming, expensive and open to different interpretations. Often the equipment gives only a “qualitative” snap-shot value. Evaluating the risk means ranking them as low, medium or high depending upon the toxicity of the chemical, duration of exposure, type of exposure, use of PPE etc. Even though there are legal requirements in Cambodia relating to Air Pollution Control⁴, which specify the maximum allowable concentration of hazardous substances in ambient air, the enforcement agencies do not have the requisite equipment to measure chemicals in the workplace.

3. Control

Once you have recognised that you have a problem with a chemical hazard in the workplace, what can you do about it? For all health and safety problems, including chemical hazards, there is a logical, systematic strategy or sequence for dealing with them ranging from *elimination* to the use of *personal protective equipment*.

Figure 9: Methods of Control



⁴ Sub-decree 42 on Air Pollution Control specifies the maximum allowable concentration of hazardous substances.

**Elimination
Substitution**

**Enclosure
Isolation
Ventilation**

**Protective equipment
Administrative controls
General cleanliness
Personal hygiene**

As the name implies, the most effective way of controlling chemical hazards, is by *eliminating* them from the process or by finding a *safe substitute*. Obviously if you can remove the chemical hazard from the workplace, you have solved the problem. This however rarely occurs as the chemical in question is usually a vital part of the process or a natural by-product. The next best method is to use a safer substitute for the original chemical (this is best done by seeking advice from the competent authorities and by comparing the information for the different chemicals on their specific MSDSs). Some examples of safe substitution could include:

- Use less hazardous solvents instead of toxic ones;
- Use water and detergents instead of solvents for cleaning;
- Use leadless glazes and paints.

Using safer substitutes does not mean the new chemical is safe – all it means is that it is safer than the original hazard.

There are a number of engineering measures (including *enclosure*, *isolation* and *ventilation*) that can be used to control chemical hazards either by partially or totally enclosing the process. Highly toxic materials that may be released into the workplace atmosphere should be totally enclosed, usually by using a mechanical handling device or a closed glove system that can be operated from the outside. If the process is particularly hazardous, it can also be isolated to other parts of the factory or separate rooms where there are fewer workers. When using enclosure and isolation it is important to consider all aspects of ventilation. As we saw in the section on ventilation, general ventilation can be used to “dilute” chemical hazards in the workplace and local exhaust ventilation/partial enclosures can be used to remove more toxic chemical hazards to the outside of a factory.

Only as a last resort should workers be required to wear *personal protective equipment* – after all, by the use of PPE, we have admitted that we cannot control the hazard at source or along the pathway between the source and the worker. The use of PPE is the least efficient, but often the cheapest, method of control. PPE is often uncomfortable to wear, especially in the hot, humid conditions found in many Cambodian workplaces and, it is not uncommon to find workers only wearing the PPE at the times of a visit by a Labour Inspector or a Brand Compliance Officer. Workers sometimes complain that wearing PPE inhibits their work performance and, in the case of hearing protection, can limit communication and prevent workers from hearing any warning signals. Examples of PPE include - safety glasses; ear muffs and plugs; respirators (different types for dusts, fumes, vapours etc.); gloves; safety shoes; helmets and hard hats; aprons and overalls.

It is important that workers are provided with the correct type of PPE for the specific hazard and given training in its correct use, namely, how to ensure the best fit; how to

avoid leaks; how to tell when it needs replacing; how to keep it clean and maintain the PPE etc. All too often however, you can see the workers wearing totally the wrong type of PPE or wearing it incorrectly e.g. dust masks only being worn over the mouth and not the nose as well. Another of the most common mistakes is to find workers wearing simple dust masks when dealing with a chemical vapour. This can actually make the situation worse as the vapour is actually absorbed into the fabric of the dust mask (rather like tissue absorbs a liquid or blotting paper absorbs ink) and then it remains in the worker's breathing zone for as long as he/she is wearing the mask.

It must be emphasised again that the choice of PPE depends upon the nature of the hazard as well as the route and duration of exposure. The PPE must be the best available and not necessarily the cheapest – and it should not be improvised (see picture 38).



Picture 38: At first sight this picture of a welder in Cambodia looks comical – he's made a mask out of a cardboard box, cut in some eye holes and attached sunglasses. This improvised PPE provides very little protection for the worker. Management must provide the correct PPE to counter the welding light, the metal fumes and the danger of being burnt.

Other control methods can include *administrative controls* which means limiting the amount of time workers spend at a hazardous job thereby reducing exposure. Job rotation, changing work schedules are typical examples. It must be remembered that the hazard still exists so that any administrative measures must be used with other forms of control. Linked to administrative controls are the *general cleanliness* of the workplace and *personal hygiene*, both of which can reduce the exposure to chemical hazards.

A POINT TO CONSIDER!

Some workplaces are full of safety signs and managers point out that this shows the company's commitment to occupational health and safety. Such signs are good ways of displaying information to workers, especially when they are first put up. However, after a few days or weeks, these safety signs tend to be ignored as workers don't notice them any more. If you use safety signs in your workplace, change them around frequently and introduce new ones. REMEMBER – a safety sign does not remove the hazard!

In general there are two main types of chemical hazard in garment factories. The first is the dust that comes from the cutting and sewing sections (see picture 39) and the second is the cleaning agents used in the spot cleaning areas (see picture 40).



Pictures 39 and 40:

Dust from the cutting section or chemical solvents used in the spot-cleaning areas can effect workers health. Note the use (or lack of) PPE.

Let us look first at the question of dust in the factory. The dust isn't confined to solely the cutting or sewing areas – it spreads all over the workplace through the general

ventilation, lack of local exhaust ventilation systems, improper cleaning techniques and general poor house keeping. You can see the dust everywhere – look at work surfaces; look at the lights; look at the extract vents; look at the clothes and hair of workers. As we have already seen, dust in the workplace can lead to a number of respiratory diseases, including byssinosis, and everything should be done to remove the dust from the working environment.

What control measures are available? Is it possible to control or limit the release of dust at source? Ideally there should be a local exhaust ventilation system which removes the dust as soon as it is produced. Very few machines in garment factories are fitted with such devices (see picture 28) as they tend to be found on newer, more expensive machines. Unfortunately, therefore, we have to accept that dust is released into the atmosphere in the factory and, through the haphazard placement of fans, the dust is spread everywhere, even to so-called clean areas. As a result, many more workers are exposed to high dust levels than should be. The situation is then made worse by the cleaning regimes followed by factory managements, namely using dusters/brooms or air blowers to “clean up” (see pictures 41 and 42).



Pictures 41 and 42:

The techniques of dusting or air blowing to clean up equipment, only spreads the dust around the workplace – it does not remove the dust. The dust has passed the breathing zone of workers once and, now, dusting or blowing is simply allowing this to happen again and again.

Rather than spreading the dust around the factory, managers should introduce a regular cleaning regime that uses industrial vacuum cleaners rather than relying on brooms and blowers. Machines should be vacuumed after every shift – this will not only produce a cleaner and healthier working environment, it will also mean reduced maintenance costs. The cleaning regime should not be on an ad-hoc basis, but programmed into regular daily/weekly practices.

Some managers say that they cannot invest in the price of an industrial vacuum/s – it has been clearly demonstrated that the use of industrial vacuums “pays for itself” in terms of improved working conditions (and therefore increased productivity) and reduced maintenance costs as machines do not get clogged up with dust.

In some factories, the workers clean their own machines - in others, cleaners are full time employees (see picture 43).



Picture 43: Look at this picture from a garment factory in Sri Lanka. This company uses an industrial vacuum to clean the machines and reduce dust levels in the workplace.

Let us now look at the potential health problems of the spot cleaning process. If we use “safer substitutes” such as soap and water, then the problems are minimal. If however, solvents are used in the process, then a number of problems exist primarily as a result of the choice of chemical. For example, if you look closely at the contents on the container, one of the main ingredients is a chemical solvent called *trichloroethylene*. If we look at a

Material Safety Data Sheet for this chemical (see appendix 4), we see that various prevention methods are required including proper ventilation and the use of the correct PPE, including gloves, safety spectacles and a filter respirator suitable for organic gases and solvents. Few such preventive methods are in operation in garment factories (see picture 40). The MSDS also identifies the serious health effects⁵ of the chemical. (It is interesting to note that Cambodian sub-decree (42) on Air Pollution specifies a maximum allowable concentration for trichloroethylene and yet there is no equipment to measure this chemical).

Finally, let us return to the case study shown in picture 19. This worker is spot cleaning using a solvent from a container with no label. You can tell that the cleaning agent is not simply soap and water from its smell and the fact that it makes your eyes water when you are nearby – (Remember the workers doing the spot cleaning may no longer notice these effects as they “have got used to it”!).

There are a number of health and safety problems that need to be addressed, including:

- The process is taking place next to an open window where the prevailing wind is blowing the spray **back into** the workplace and over the worker;
- The spot cleaning device has an integral local exhaust ventilation system. The exhaust pipe, however, is directing the exhaust spray back into the workplace and onto the worker as opposed to ventilating it to the outside;
- There was no label on the solvent being used and none was available from the stores⁶ – accordingly, no one knows what the chemical is; what are the dangers; what preventive measures are required; what does the MSDS say, if indeed, one is available?
- The worker has absolutely no PPE;
- The chemical is likely to be absorbed into the worker’s clothing and taken home in this manner.

5.3. Checklist for Chemicals

	Yes	No	Action Required
Do any processes in the factory produce dusts, fumes or vapours (eg cutting and spot cleaning sections)?			
Are local exhaust ventilation systems in use to reduce the levels of dusts, fumes or vapours in the sections?			
Are MSDSs available for all chemicals used in the factory?			
Are the provisions of the MSDSs, in particular the safe use of the chemical, fully understood by the			

⁵ One major concern in the MSDS for *Trichloroethylene*, is that it is suspected to a potential carcinogen – see Appendix 4).

⁶ Often chemicals are stored in a haphazard manner. They should be stored in cool, well-ventilated areas away from possible sources of ignition. Locked metal cabinets with adequate ventilation are suitable and can be locked. MSDSs should be available for all stored chemicals.

workers who use them?			
Are the chemicals used and stored as directed in the MSDS?			
Is there any medical surveillance programmes undertaken with the workers who use these chemicals?			
Are other workers who are not involved in the process, eg spot cleaning, exposed to the chemicals?			
Have any workers who work in these areas complained of respiratory or skin problems etc?			
In the absence of engineering controls, are the workers provided with PPE?			
Is the PPE of the correct type for the hazard concerned according to the MSDS?			
Is the PPE regularly checked/changed at no cost to the worker?			
Do workers know what action to take in the case of spillage and disposal of the chemicals?			

5.4. Summary

Chemicals are used in virtually every occupation including the garment industry and can produce a variety of health effects. It is vital to know what chemical you are dealing with so that you can then consider a control strategy. If possible you should obtain a MSDS for every chemical used in the factory and that this information should be in a format and language that workers can understand.

One of the main problems when dealing with chemical hazards is the reliance on the use of PPE by the workers. Unfortunately, the type of PPE used is often not suited to the particular hazard.

The problems of dust and chemicals used in the spot cleaning process need special attention.