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CARCINOGENS
— what are they?

Carcinogenic substances are relatively common in the workplace. Recent research has resulted in a strict classification and categorisation of many substances which may cause cancer. New legislation prohibits or restricts the use of many carcinogens in order to protect workers from exposure.

Cancer is a cell disease, presenting itself in the form of unnatural and malignant tumours. A tumour is built up by deformed cells in any body organ. The tumour grows as these unnatural cells split in an uncontrolled fashion, and at much greater speed than normal cells.

A BENIGN tumour has a relatively slow growth rate, and will not constitute any significant damage to the organ in which it is present. Benign tumours also lack the tendency to spread to other organs.

A MALIGNANT tumour (Cancer) often grows at a rapid rate, usurping, taking over, or destroying the healthy tissue in the organ where it grows. Cells from malignant tumours may easily spread to other organs, creating new tumours (metastases).

Benign tumours are usually completely removable through surgery. Malignant growths may also be fully reversible if acted upon at any early stage. In more serious cases, it is often possible to slow down the cancer by chemotherapy or other treatment, and to prolong the life expectancy of the patient. Nevertheless cancer remains one of the most common causes of death in our society.

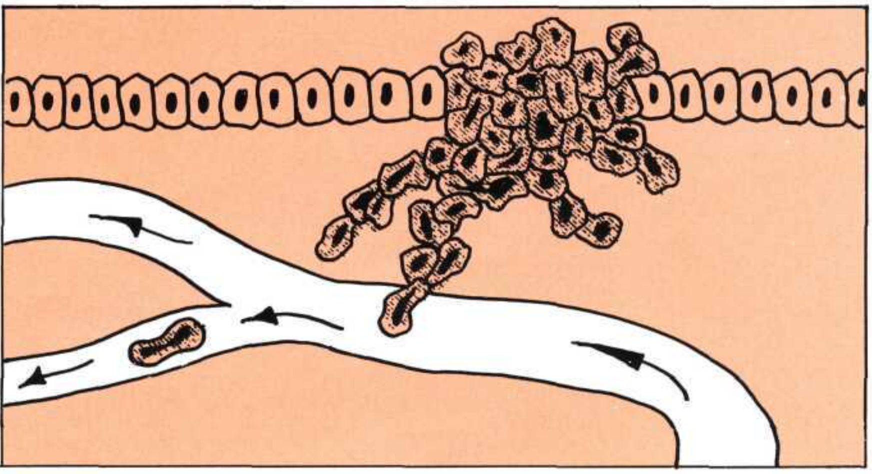
Many environmental factors constitute a risk of spreading the disease. Ultra-violet radiation, for instance, is well known in Australia as a major cause of skin cancer. Ionising radiation (such as X-rays and radioactivity) may produce a multitude of cancers.

In modern industry, chemical substances which may cause cancer are of the greatest concern.

Chemically Conditioned Cancer may be caused by an array of substances. Such compounds are called Carcinogens or Initiators. There are also a number of substances which do not cause cancer themselves, but rather increase the cancer-causing effect of other substances. Such compounds are called Co-carcinogens or Promoters.

Carcinogens affect those parts of the cell's chromosomes which carry the genetic information, and which regulate the splitting (reproduction) of cells. Therefore, the same substances may not only cause cancer, but also genetic damages.

One of the most frightening characteristics of cancer is its latency period. Usually, the disease does not appear until years or decades after initial exposure to the carcinogen. This delay between cause and effect means



CARCINOGENS (cont.)

that many carcinogens have not been discovered for many years, and may have become accepted for common widespread use in the meantime.

It stands to reason that minimal exposure to a carcinogen means a minimal risk of developing cancer as a result of that exposure. The effects of exposure to very low concentrations is, so far, impossible to establish. However, research shows that there is no real "safe level" or threshold under which the risk of contracting cancer is nil. Even in those cases where a TLV has been recommended, there is no certain way of saying that this level really is safe.

There are several categories of carcinogens. Some have been completely banned from use and production. Others may be used with explicit approval from government. Yet others have been labelled with a TLV, and may be used in concentrations below that level.

LIST OF COMMON CARCINOGENS
(Includes prohibited, restricted, recognised and suspected carcinogens)

- 1,2-dibromo-3-chloropropane (DBCP)
- 1,2:3,4-diepoxybutane
- 1,3-propane sultone
- 2,4-diaminoanisol
- 2,4-diaminotoluene
- 2-acetylaminofluorene
- 2-nitropropane
- 20-methylcholantren
- 3,3'-dimethoxybenzidine
- 4-aminodiphenyl
- 4-dimethylaminoazobenzene
- 4-nitrodiphenyl
- Acrylonitrile
- alpha-naphthylamine
- Arsenic
- Asbestos
- Auramine
- Benzalchloride
- Benzene
- Benzidine
- Benzoapyrene
- Benzoetrichloride
- Benzylchloride
- Beryllium
- Beta-butyrolactone
- Beta-naphthylamine
- Beta-propiolactone
- Bis (2-chloroethyl) sulphide
- Bis-chloroethyl ether
- Bis-chloromethyl ether
- Cadmium
- Carbon tetrachloride
- Chloroform
- Chromates
- Chromic acid
- Crocidolite
- Diazomethane
- Diethyl sulphate
- Dimethylhydrazines
- Dioxane
- Epichlorohydrine
- Ethyl methane sulphonate (EMS)
- Ethylene dibromide
- Ethylene dichloride (1,2-dichloroethane)
- Ethylene oxide
- Ethylenethiourea
- Ethylenimine
- Hexamethylphosphotriamide (HMPA)
- Hydrazine
- Methyl iodide
- Methylchloromethyl ether
- Methylene bis-(o-chloroaniline) (MOCA)
- Methylmethane sulphonate MMS
- MNU
- N-nitrosodimethylamine
- Nickel compounds
- o-tolidine (3,3'-dimethylbenzidine)
- p-aminoazobenzene
- PCB
- Phenyl-beta-naphthylamine
- Propylenimine
- Thioacetamide
- Thiourea (thiocarbamide)
- Tris(2,3-dibromopropyl) phosphate
- Urethane (ethyl carbamate)
- Vinyl chloride
- Wood dust

BREATHING
how to choose

There are two major factors to consider when it comes to breathing protection equipment: USING it . . . and CHOOSING it. In this issue we will talk about the selection of appropriate breathing gear — what to look for in a mask, and what to expect from a filter.

The main aim in the selection of breathing equipment is to achieve a balance between under- and over-protection. The "trick" is to choose the SIMPLEST gear possible which gives effective protection in the particular conditions. Using a full face mask with compressed air at a saw mill would be over-protection. Walking into a lacquer mixing booth with a disposable paper mask would leave you under-protected.

Let us now assume that you have established that your work place contains a certain amount of hazardous substances, and that you also have discovered that there is no feasible engineering or re-building solution to the problem. Here are a few guidelines which may help you make the right choice of personal breathing protection:

The selection of safety equipment depends on a number of circumstances. All of these circumstances must be taken into consideration before making a decision.

I: CHEMICAL ENVIRONMENT

It is important to list all potentially harmful substances present in the atmosphere at any one time. This is usually a simple matter. Most industries use the same processes or chemicals all the time. Containers are usually clearly marked, and all the required information should be obtainable from the label. If not, Chemical manufacturers should be glad (and are indeed under obligation) to give all the required data about their products.

The next step is to find out as much as possible about these substances, whether they are dusts, fumes, vapours, gases or aerosols. The substances should be classified either as dust hazards or chemical (gas) hazards. For instance, a wood polishing plant would be concerned mainly with dust hazards, whereas workers in a paint mixing booth would need protection against harmful vapours.

Chemical hazards must be further specified in terms of concentration levels. This must be done rather precisely — the selection of breathing gear will depend very much on the amounts of harmful substances in the air.

II: PHYSICAL ENVIRONMENT

A few considerations:

Is work performed in enclosed areas (tanks, reservoirs, cisterns, etc.)?

How far from the safety of fresh air is the work performed?

How are the chemicals stored, handled and used?

Once these factors have been determined it's time to start looking at various types of breathing protection. There are four major categories of breathing gear:

1. Particle filtering systems
2. Gas filtering systems
3. Remote supplied air systems
4. Self-contained breathing apparatus.

MASKS
WHAT TO LOOK FOR

Here are a few desirable points common to all types of masks:

1. A high protection factor.
The protection factor is the relation between the concentration of a contaminant outside the mask and the concentration inside it. In other words, the protection factor expresses the total leakage in a mask. Double-flanged rims, high efficiency valves, and correctly mounted straps will help to increase the protection factor significantly. Needless to say, a soft rubber rimmed mask has a higher protection factor than a disposable paper mask.

2. Low breathing resistance.
Soft, high efficiency inhalation and exhaust valves are important.

3. Easy adjustment.
Neck straps should be simple and fast to adjust. The mask should be kept securely against the face without slipping, even during vibration or sudden head movements.

4. Good sound transmission.
Inadequate sound transmission forces the user to remove the mask while giving instructions, etc.

5. Easy maintenance.
Masks should be easy to clean outside and in. Valves should be simple to remove and replace. The mask should be made from a chemical resistant material.

PROTECTION
the right gear

6. Practical construction.
Can the mask be used with other safety equipment? Try it on with a pair of splash goggles, ear muffs or a helmet.

7. Comfort
The last but perhaps most important consideration. Uncomfortable breathing gear will always stay in the locker room, giving no protection at all. Non allergenic or low irritant materials are important, as is a soft rim. Light weight is another factor. Put on the mask. Shake your head. Adjust the straps. Imagine wearing it for a few hours running.

FULL FACE MASKS
— SPECIAL FEATURES
- Large field of vision.
- Minimum dead space inside mask (eliminates re-inhalation of exhaust).
- Ori-nasal construction (helps prevent perspiration and minimises condensation).
- Is the mask constructed for use with both filters and air supply?
- Speech membrane.

FILTERS
- WHAT TO LOOK FOR

PARTICLE FILTERS
Particle filters come in many shapes and sizes. The choice will depend on the performance and construction of the filter.

- **Particle size**

A very important consideration, Some filters separate only the coarsest of particles from the air. Others are so fine that not even viruses or bacteria can penetrate the filter. If the atmosphere contains anything but the largest particles, look for a separation size down towards 0.5-0.3 microns (0.0003 millimetres).

- **Filter construction**

There are several types of particle filters, all creating a "mesh" which catches the particle and lets the clean air through. The most common type is the rosinated wool filter. There are also other types of specially treated fibrous materials.

- **Filter life**

How long does a filter last? One of two things may happen to a particle filter and render it useless. Its fibres are broken down and start letting particles through, or the filter "clogs up" and becomes difficult to breathe through. It is a case of weighing unit cost against life span. Beware that certain particle filters do not perform adequately in specific atmospheres (see warning below).

- **Breathing resistance**

The most important point. A filter which is hard to breathe through could jeopardise an entire breathing protection system.

Is the filter easy to breathe through over long periods of time? Does it clog up in moist atmospheres (such as spray painting)? The filter area plays a major role. A small filter gives more resistance than a large one.

WARNING
It has been established for a long time, but is not commonly known, that rosinated wool filters do not perform adequately In atmospheres containing any of the following:
— Oil Mists (hydraulic machines, mining drills, oil cooled machines, etc.)
— Very small particles
— High humidity or moisture

Rosinated wool filters rely on electrostatic charges within the wool fibre. The aforementioned atmospheres cause these charges to disappear, and the filter breaks down. Few particle filters are designed to cope with these atmospheres. It is essential to select one that does.

GAS FILTERS
Gas filters come in various designs, but all rely on gas absorption through active carbon. Most manufacturers produce certain gas filters for certain chemicals. Make sure your filter is suitable for your particular situation, and that it will work effectively at your concentration levels.

- **Performance**

Absorption surface area plays an important role. A large surface area ensures effective protection and long filter life. Some filters give a staggering surface area — up to around 100,000 square metres. Others provide much less than that.

- **Construction**

There are only two options here: crushed carbon or granulated carbon. A crushed carbon filter is simpler to produce and therefore less expensive. Granulated (shaped) carbon, however, has a larger absorption area and less tendency to pack together in vibration or shaking.

- **Breathing resistance**

Again, a most important point.
A small filter area means that the air travels through the filter at greater speed, and the depth of the carbon must increase. This, in turn, may lead to increased breathing resistance. A large area filter permits the air to travel slowly and evenly through the carbon, assisting absorption and keeping resistance to a minimum.

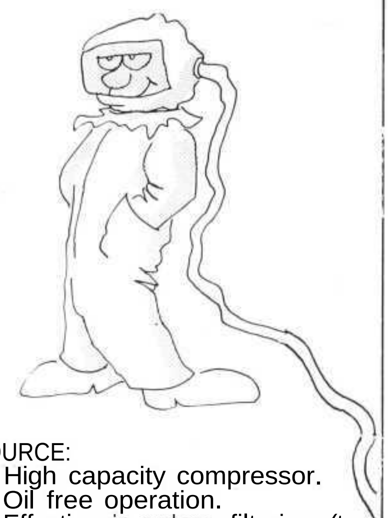
WARNING!
Always remember that gas filters are designed only for vapours, fumes and gases — if the chemical hazard is in aerosol form, a particle filter is also required.

(Com.)

BREATHING PROTECTION (cont.)

SUPPLIED AIR
- WHAT TO LOOK FOR:

There are many instances when supplied air is preferable or necessary. For instance where concentration levels are higher than the capacity of filtering systems, where there is a risk of oxygen deficiency, or where the contaminant has a low detection level (cannot be detected by smell). In certain instances, workers may prefer to use supplied air instead of a mask with filter — for instance when performing tasks which don't require movement around the location.



SOURCE:

- High capacity compressor.
- Oil free operation.
- Effective in-system filtering (to eliminate bacteria and other pollution which forms within the air system).

CHANNELLING:

- Hoses should be sturdy and reinforced to resist pressure (trucks running over the air line, stepping on the hose etc.) and kinking.
- Connections (no accidental disconnection).
- Safe regulator (cannot shut supply completely, only vary the air flow rate).
- Connection between mask and regulator should not interfere with head, hand or arm movements.

OUTLET:

The outlet may be an air hood, a full face mask or a half mask.

HOOD - SPECIAL FEATURES:

A hood is used in various situations. For example, for bearded users, who cannot achieve adequate protection through a face mask.

- Size: large enough to accommodate helmet or ear muffs.
- Noise: some form of noise reduction is preferable (rushing air),
- Vision: as wide as possible in all directions.
- Construction: anti-condensation preferable.

SELF-CONTAINED BREATHING APPARATUS
— WHAT TO LOOK FOR

In certain circumstances, legislation stipulates the use of self-contained breathing equipment. Work in confined areas (tanks, cisterns, drums, shafts, etc.) and in highly toxic atmospheres with chemicals of very low detection level often requires this type of breathing protection.

- Positive pressure system. (Negative systems are now almost obsolete.)
- High sensitivity positive pressure valves.
- Well-fitting face piece.
- Large field of vision.
- Light weight cylinders.
- Even weight distribution.
- No protruding parts.
- Free arm and hand movement.

SEVEN STEPS TO EFFECTIVE PROTECTION:

1. **Establish the NATURE of the potential hazards.**
2. **Establish the AMOUNT of hazardous substances.**
3. **Evaluate the possibility of solving the problem through ENGINEERING or REBUILDING the workplace.**
4. **Determine the TYPE of protection required.**
5. **Select a SYSTEM - not a product.**
6. **Select HIGH PERFORMANCE - but not overkill.**
7. **Select COMFORT.**

WRITE TO US!

If you want to find out more about filters, protection, or substances in your own work environment, please write to Sundstrom Safety (Australia) for complete information.

Sundstrom Safety Pty Ltd
P.O. Box W 110
Warringah Mall NSW 2100

USEFUL WORDS AND ABBREVIATIONS

Aerosol
Liquid particles (droplets) suspended in the air (formed by spraying).

Carcinogen
Substance causing or promoting cancer.

Ceiling Value
A concentration which must not be exceeded even for a short period. Usually expressed in PPM.

Contaminant
Any impurity in a substance. Usually denotes chemicals which render pure air harmful or unbreathable.

Gas
Any substance which is not normally solid or liquid at room temperature.

IDLH
A concentration which is Immediately Dangerous to Life or Health.

Inorganic Dust
Dust derived from minerals or metals. May often cause Systemic damage.

mg/m^3
Milligrams per cubic metre. Weight concentration measurement. To calculate PPM, divide weight concentration by one 24th of the molecular weight of the substance.

ml/m^3
Millilitres per cubic metre. Volume concentration measurement.

Nuisance Dust
Dust causing general discomfort to eyes, skin or upper respiratory tract.

Organic Dust
Particles in the form of living organisms or materials containing carbon (flour, hay fibres, saw dust, mould, etc.).

PPM
Parts Per Million. The most common way of expressing concentrations. To calculate mg/m^3, multiply PPM by one 24th of the molecular weight of the substance.

Protection Factor
The efficiency of a face mask or hood. Calculated on the relationship between the surrounding concentration of a contaminant and the concentration inside the mask. The formula is thus:

$$\text{Prot. Factor} = \frac{\text{Conc. outside mask}}{\text{Conc. inside mask}}$$

Smoke
Particle dust formed in incomplete combustion.

STEL
Short Term Exposure Limit. Regular, daily work may not be carried out at this level. Brief, infrequent exposure, however, is allowed.

Systemic Toxin
Poisons which effect vital body organs (brain, kidneys, liver, etc.) by entering the blood stream.

TLV
Threshold Limit Value. The highest concentration which most humans can withstand in an 8 hour day, 40 hour week, day after day. Usually express in PPM.

Toxicity
The properties of a substance which may be harmful to the human organism.

TWA
Time Weighted Average. Same as TLV.

Vapour
The gaseous state of a substance that is normally liquid or solid.

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sundström
Safety (Australia) Pty. Ltd.

P.O. Box W 110, Warringah Mall NSW 2100
Unit 7A/3 Kenneth Road, Manly Vale
Phone: (02) 949 1311 Fax: (02) 94 2640