OSH Brief No. 3b

A worker's ability to do his/her job is affected by working in either hot or cold environments. One of the most important conditions for productive work is maintaining a comfortable temperature inside the workplace normally within the range of 20 to 25 degrees celsius. Of course the temperature inside the factory varies according to the season and several methods can be used to address the problem. There are two main ways in which heat (or cold) gets into the factory:

- **Directly** – through windows, doors, air bricks etc; often excess heat is being generated by steam or engine exhausts escaping into the working environment, so-called "hot spots".
- **Indirectly** – by conduction through the actual fabric of the building namely the roof, walls and floor. These warm up throughout the day as the sun shines and the heat is transferred to the internal environment often making it hot and sticky for the workers.

There are a number of options that management can take to try to reduce the sun's heat from entering the factory. These include:

- ensuring that the external walls are smooth in texture and painted in a light colour to help to reflect the heat;
- improving the heat reflection of the roof;
- improving heat insulation of walls and ceilings (investigate the possibility of dry lining walls or adding an insulated ceiling below the roof. Although this is an expensive option it should be considered in the plans for all new buildings and local, cheap materials should be used as far as possible);
- ensuring that the factory is shaded as far as possible by natural means (trees, bushes, hedges etc.) or with shades on windows, doors etc., (note that any shades should not inhibit access/egress for safety reasons). In very expensive offices, you can see that the windows are darkened or have sun-reflecting glass. This is not an option for most factories because of expense. A simple, cheap option is to whitewash the top part of windows;
- spraying the roof with water which can be re-cycled to reduce costs *(See Figure 1).*

Figure 1: Spraying a roof with cold water to reduce the temperature

How does heat affect workers?

For workers, too much heat can result in the following safety and health problems.

Safety

- Fatigue and dizziness
- Sweating palms (become slippery)
- Fogging of safety glasses
- Possible burns
- Lower performance/alertness
- Increased irritability

Health

- Heat stress/strain (distress)
- Heat cramps
- Heat exhaustion/heat stroke
- Heat rash (prickly heat)
- Fainting (syncope)

The safety problems tend to be more obvious than the health issues. For example, there is always the risk of burns for workers next to boilers, steam pipes etc., through accidental contact with hot objects. There also tends to be an increased frequency in accidents as workers lose concentration, get more fatigued, and become more irritable. Tools/equipment can also slip through sweaty palms and fingers thereby adding to the safety problem. The health problems associated with hot working environments tend to be more insidious and affect workers more slowly.

How the body handles heat

In hot, humid conditions, workers can lose heat and cool down naturally in a number of ways:

- by **evaporation** – by sweating[1];
- by **radiation** – by increasing blood flow and the temperature of the skin surface - it needs cooler objects nearby for this method to be effective;
- by **convection** – exchange of heat between the body surface and the surrounding air - it needs air movement to be effective; and
- by **conduction** – direct exchange of heat between the body and cooler, solid objects.

How do you control heat in the workplace?

There are a number of basic approaches to tackling heat hazards in factories. All these approaches involve reducing exposure by keeping heat away from workers through:

- engineering controls;
- changing work practices; and
- use of personal protective equipment (PPE) as a last resort.

Engineering controls include:

- the use of increased general ventilation throughout the factory by opening windows, by ensuring that air bricks, doors, etc., are not blocked;
- the use of “spot cooling” by the use of fans to reduce the temperature in certain sections of the factory (the correct placement of fans is essential);
- the use of local exhaust ventilation systems in hot spots to directly remove the heat as close to the source of the heat as possible; and
- the use of air conditioners/coolers.

[1] The cooling effect of sweating is considerable – it is estimated that evaporating 100 ml of sweat has the same cooling effect as consuming 0.5 kg of ice or drinking 1.6 litres of a very cold drink.

Changing work practices include:

- increasing the number and duration of rest periods;
- introducing job rotation so that workers are not always doing so-called "hot work";
- doing "hot work" in the coolest part of the day;
- providing more workers to reduce the workload so that workers spend shorter times in hot environments.

Whatever method is used to reduce workplace temperature, it is important that adequate supplies of drinks are made available to workers. These drinks should maintain water and electrolyte balance in the body – water alone will lead to muscle cramps etc.

Although regulations often do not specify explicit standards for maximum temperatures, there are some international guidelines that outline some suggested regimens for work and rest periods in hot environments. One such set of guidelines from the American Conference of Governmental Industrial Hygienists (ACGIH) gives examples of the balance between suggested work and rest periods at various temperatures for light, moderate and heavy work:

Work/rest periods	Light work	Moderate work	Heavy work
Continuous work	30.0	26.7	25.0
75% work: 25% rest	30.6	28.0	25.9
50% work: 50% rest	31.4	29.4	27.9
25% work: 75% rest	32.2	31.1	30.0

These ACGIH temperatures, given in degrees centigrade, are measured using the Wet Bulb-Globe Temperature Index [WBGT} which gives a more accurate measure of heat conditions than ordinary mercury or alcohol thermometers which only measure temperature and not humidity or radiant heat[2].

REMEMBER:

It is important to know the humidity inside the factory. If the factory is very hot and humid, the process of sweating for cooling the body is not effective and the workers are in danger of overheating.

[2] **Wet-bulb temperature** is measured by a thermometer in which the bulb is covered by a whetted wick, effectively shielded from radiation and exposed to a current of rapidly moving air. **Dry-bulb temperature** is a measure of air temperature by an ordinary thermometer and shielded from radiant heat.

It is not only essential to provide a comfortable temperature inside the factory, you also must ensure:

- an adequate supply of fresh air;
- the removal of stale air; and
- the prevention of any build-up of contaminants (dust, chemicals, etc).

It is important not to confuse ventilation and air circulation inside the factory. What we tend to see inside many factories is air circulation, namely moving the air around inside the factory without renewing it with fresh air from outside. In the case of air circulation, fans are placed near workers to improve thermal comfort and, in some cases, remove dust etc. In essence this means that you are simply circulating stale air plus any contaminants around the factory. Ventilation refers to replacing stale air (plus any contaminants) with fresh air (or purified air in the case of air conditioners) at regular intervals. In an average workplace, the air needs to be changed between 8 and 12 times per hour and there should be at least 10 cubic metres of air per worker.

Many factories in the Caribbean rely on the principle of **general ventilation** by allowing the free flow of air through the factory from one side to the other – referred to as horizontal air-flow. This can be achieved by opening doors and windows and putting more air bricks in the walls to take advantage of any prevailing wind. However, it is all too common to find doors and windows etc., locked for security reasons or blocked with excess stock or boxes of finished goods awaiting export. As a result, ventilation is limited.

If you are trying to improve the general ventilation in your factory, here are a few simple suggestions that can help:

- if you have ventilation systems or free standing fans in the factory, make sure that they increase the natural flow of air through the factory and not try to blow air against any prevailing wind;
- ensure that hot, stale air that rises to the factory roof can easily be removed and replaced with fresh air *(see Figure 2);*
- make sure that all fans are well maintained and regularly cleaned so that they work efficiently;
- ensure that the air-flow to and from fans is not blocked; and

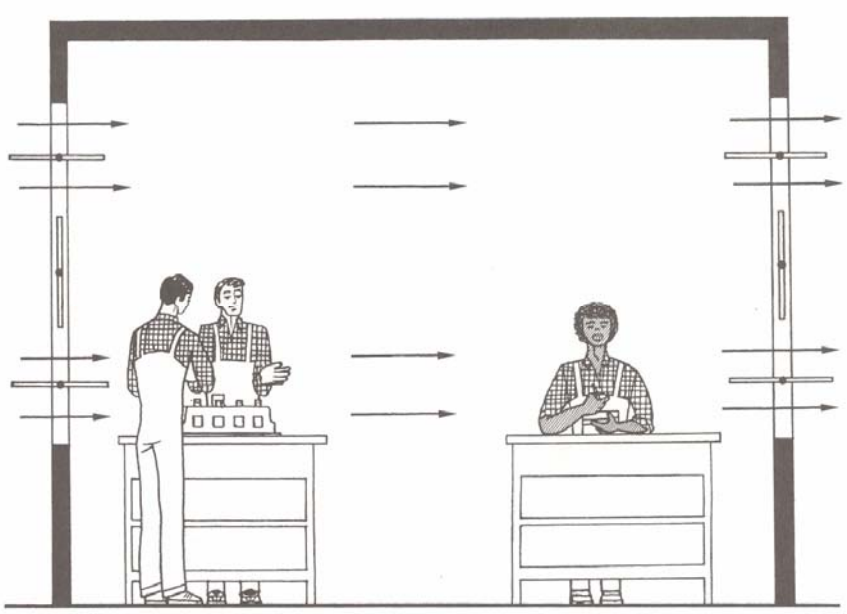
- try to ensure that any “hot” process is sited next to the “down wind” wall so that the heat is extracted directly outside rather than being spread around the factory.

In cases where there is a build-up of contaminants or heat in specific areas of the factory, **local exhaust ventilation** has to be used to remove the hazard. This type of ventilation uses suction and hoods, ducts, tubes, etc. to remove the hazard as close to the source as possible and extract it to the outside environment. It works on a principle similar to that of a vacuum cleaner but on a much larger scale.

Figure 2 : These cowls help to remove hot air *(There is a tendency for hot air to rise inside the factory)* and thus facilitate ventilation inside the factory. Note the asbestos roof however.

Checklist for temperature and ventilation:

	Yes	No	Action Required
Are temperatures in the factory maintained at comfortable working levels?			
Are there any hot or cold areas in the factory?			
Have any workers complained about these areas?			
Is there good natural ventilation (through open doors, windows, air bricks etc) in the factory?			
Are draughts avoided for those workers seated near windows, doors etc?			
Is this natural ventilation blocked when there are excess boxes of incoming/outgoing stock?			
Are fans provided where the natural ventilation is inadequate?			
Do the fans circulate any fumes, dusts or other harmful chemicals around the factory?			
In processes where fumes, dusts, etc. may be released, have any local exhaust ventilation systems been installed?			
Do these systems exhaust contaminated air safely outside the factory?			
Are the filters in these systems checked/changed regularly?			
Are the air flows in these systems checked regularly, for example, by a smoke test?			



Allow as much natural ventilation as possible to flow through the factory. Don't block windows, air bricks or doors.