Heat Stress: cool solutions

Version 3.0

Global climate change demands many responses. Few now argue against their absolute necessity. As Ontarians experience increasingly hot summers though, the need for some responses seems more immediate than others. Workers certainly require increased protection to prevent occupational heat stress.

The shock of one bakery worker's death galvanized health and safety activists' on this issue. Kim Douglas Warner, 44, died from heat stroke in Barrie, Ontario during a 12-hour day shift where temperatures were estimated at 49°Celsius. Lack of water and rest breaks also contributed to the fatality. Warner's core body temperature rose to a staggering 42.5° C at time of death. The employer was fined $215,000 under the *Occupational Health and Safety Act*.

What is heat stress?

Heat stress is our body's biochemical response to extreme heat or to a hot environment. Heat comes from hot working environments, but it also comes from within the body itself. The harder the work, the more metabolic heat is generated inside the worker's body.

It is this combination of hot working environments and heavy manual work that poses the greatest health threat.

Heat transfer

In order to stay healthy, the body must maintain a constant core temperature of approximately 36°C to 38°C regardless of external conditions. The body does this by gaining heat from food (calories) and muscular work or losing it through radiation and sweating. Rates of heat gain and heat loss must balance to maintain this constant body temperature.

Most people feel comfortable when the air temperature ranges from 22°C to 25°C and the relative humidity is about 45 per cent. This range is neither too hot nor too cold.

As the body warms up after exposure to heat and/or exertion, blood is circulated to the skin, which increases skin temperature and allows the body to give off its excess heat through the skin as sweat. Evaporation of sweat cools the skin, eliminating large amounts of heat. Unfortunately, sweating does not cool the body unless the moisture is removed from the skin. Under conditions of high humidity, the evaporation of sweat is decreased and the body's efforts to maintain an acceptable core temperature may be significantly impaired. Maintaining an acceptable core temperature is also difficult for workers exposed to excessive radiant heat (e.g. from a furnace or the sun), or those workers required to perform extremely physical work. Either way, when this happens we say the individual is experiencing "heat stress."

Who is at risk?

Kim Warner's death is not an isolated incident. His is but one of an estimated 220 workers in Canada and the United States who die annually from occupational heat stress. Moreover, scientists tell us the worst is yet to come. A study released by Toronto Public Health and Environment Canada predicts heat-related deaths will double by 2050 and triple by 2080 as a result of global warming.

Workers most at risk include those employed in bakeries, food processing, canneries, restaurants, laundries, mines, smelters and foundries, where temperatures can rise to extreme levels, particularly in the summer months. Outdoor workers, such as roofers, road crews, farm workers, parks and recreation, landscapers, and surface miners are also susceptible to heat stress during the summer.

Even workers employed in Ontario schools can be confronted by heat stress at the close and opening of the school year. Poorly ventilated, aging classrooms with no access to air conditioning have seen indoor temperatures rise to hazardous levels.

Older workers, those with medical conditions and individuals taking certain types of drugs are also at higher risk. For example, workers who take medications for blood pressure control may have problems when exposed to high temperatures.

What are the health effects?

Too much exposure in a very hot work environment can cause a variety of **acute health effects.** They include the following:

- ***Heat stroke*** is the most serious consequence. It occurs when a person's own temperature-regulating system fails, and sweating becomes inadequate to keep the body temperature within normal range. The body's core temperature rises. Signs and symptoms include hot and unusual dry skin that is red or spotted, a temperature above 41°C, mental confusion, delirium, convulsions or unconsciousness. If heat stroke is not treated immediately, permanent damage to organs (such as the heart, brain, kidneys) or even death can occur, as in the case of Warner.

- ***Heat exhaustion*** is caused by the loss of large amounts of fluids by sweating (and sometimes excessive loss of salt) from continuous work in high temperatures. A worker suffering from heat exhaustion still sweats, but experiences some or all of these symptoms: extreme weakness, dizziness, headache, nausea, vomiting, muscle cramps, breathlessness and numbness of the hands or feet.

- ***Heat cramps*** are sharp muscle spasms that occur in those who sweat copiously in heat, drink plenty of water, but do not adequately replace the body's loss of salt.

- ***Fainting, heat rash and transient heat fatigue*** are also consequences of prolonged exposure to hot conditions. 'Transient' heat fatigue is a short and temporary state of physical and mental/emotional discomfort, and can cause a decline in performance, alertness and safe working habits.

Safety problems

Heat stress can also trigger safety problems, including incidents resulting from fogging of safety glasses, sweaty palms and dizziness. Mental alertness and physical competency also may suffer as the temperature goes up, with increased discomfort promoting anger, irritability and other negative emotions that can spark incidents.

Chronic health effects

Heat stress can also have long-term chronic health effects. Workers who have suffered heat stroke or exhaustion are often less able to tolerate heat, sometimes for the rest of their lives. After labouring for long periods in a hot environment, some workers will experience chronic heat exhaustion, while others may suffer from hypertension (high blood pressure), heart muscle damage, reduced libido, or sexual impotence.

What is the law?

Ontario does not have specific regulations governing heat exposure and resulting heat stress under the *Occupational Health and Safety Act*. In the absence of clearly prescribed standards, the Ministry of Labour, Immigration, Training and Skills Development (MLITSD) applies Threshold Limit Values (TLVs) for heat stress as outlined by the American Conference of Governmental Industrial Hygienists (ACGIH). MLITSD inspectors use these TLVs as a guideline for enforcing the legislation's general duty clause, which requires employers to take every precaution reasonable to protect workers' health and safety.

The heat stress TLVs refer to heat stress conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse health effects. Unfortunately, the limits are not set up to prevent worker discomfort, a significant

WHSC WORKERS HEALTH & SAFETY CENTRE
Training for What Matters Most

Information Bulletins for health, safety and environmental representatives

Resource Lines

and unaddressed issue in many Ontario workplaces. The TLVs are based on the assumption all workers are fully clothed (e.g. lightweight pants and shirt), with adequate water and salt intake. They also differentiate between acclimatized and unacclimatized workers.

These assumptions are problematic at best. First of all, not all individuals will react in the same way to heat stress. And secondly, few workers become acclimatized. Acclimatization is a series of measurable physiological changes a person undergoes over a period of about five to 10 days that supposedly enables the body to rid itself of excess heat. Once acclimatized, the body will begin to sweat at lower skin and body temperatures, and that will result in a lower accumulated heat load — and less stress. According to the MLITSD though, "hot spells in Ontario seldom last long enough for most workers to acclimatize." Only those workers performing "heavy work" (e.g. shoveling dry sand) or exposed to significant radiant heat could possibly be considered acclimatized once the warm weather season arrives.

This isn't to say our experience of hot spells won't shift over the longer term. A recent report from Canada's federal and provincial auditors' general states by 2100, the number of days above 30 degrees Celsius is expected to double in Canadian cities.

Regardless, another problem with ACGIH TLVs is that they rely on the Wet Bulb Globe Temperature Index (WBGT), which requires use of a black globe thermometer, a natural (static) wet bulb thermometer and a dry-bulb thermometer. Using these instruments can be confusing, expensive and time consuming.

What can be done?

To help simplify matters, the Occupational Health Clinics for Ontario Workers (OHCOW) devised a ***Humidex Heat Stress Response Plan*** based on ACGIH TLVs. Adopted by many workplaces, the plan among other things consists of a table listing Humidex measurements with corresponding recommended responses. It assumes the work to be moderate, with little or no radiant heat (although instructions for adjusting the Humidex value for radiant heat indoors and outdoors are provided), and that workers are wearing regular summer clothing, in good physical health and are unacclimatized.

To arrive at the Humidex, a combination of temperature and relative humidity measurements, OHCOW recommends using a thermal hygrometer (type of thermometer) which costs $10 to $400 in a hardware store. They also provide a chart to help calculate the final Humidex value. For those with online access OHCOW has also developed an electronic calculator to do this part of the job for you.

What more can be done?

Like many other dangers, indoor heat stress hazards at least can be controlled at the source; along the path; and at the worker. Controls made ***at the source*** of the hazard are the best way to reduce or eliminate heat stressors. Better building design and air cooling systems using renewable energy sources reduce worker risk and hot weather-promoting green house gas emissions. Air cooling systems also have the effect of reducing the compounding problem of humidity, as do dehumidifiers, and the elimination of open hot water baths, drains, and leaky steam valves. Mechanizing or automating some work procedures and installing better insulation for equipment like stoves and furnaces, are two more ways to curb heat stress.

Exhausting hot air and steam produced by operations, and installing fans will help address heat issues ***along the path***. However, fans have little benefit when relative humidity levels rise above 70 per cent, as very little evaporation occurs. Further, if air and skin temperatures are the same (36°C) or higher, moving air may actually heat up the body, especially if humidity is high.

When it comes to most hazards, controls applied ***at the worker*** are the least desirable. When it comes to heat stress though, particularly for outdoor workers, controls applied at the worker are often the only option. These controls include:

- Loose-fitting, light clothing in less extreme heat, water-cooled jackets and air-cooled space suits for extreme heat, and reflective clothing in high radiant heat situations;
- Administrative controls that seek to schedule heavy work during the coolest time of day, assign extra workers to heavy tasks, slow the pace of work or postpone nonessential work altogether;
- Avoidance wherever possible of work in direct sunlight;
- Frequent breaks in cool locations; and
- Provision of cool drinking water (slightly salted water in extreme heat) in reach of workers.

In the case of firefighters, a Workplace Safety and Insurance Board (WSIB)-funded study also found forearm submersion in water 18°C or cooler to be an effective intervention during rest periods.

All interventions of course should be in the context of a proper heat stress monitoring and control policy and procedure developed by the joint health and safety committee, ideally in advance of a heat wave. **Worker training, including training on the signs and symptoms of heat stress and a buddy system to help identify them is also essential.**

In the absence of proper heat stress controls and lack of response to expressed concerns, as a last resort, workers should exercise their right to **refuse unsafe work** under the *Occupational Health and Safety Act*. This isn't just good advice — it may literally save lives.

NOTE: The Workers Health & Safety Centre offers training on heat stress and its control. To learn more visit our web site at **www.whsc.on.ca** or contact a training services representative near you.

Also, special thanks to staff of Hamilton's Occupational Health Clinics for Ontario Workers (OHCOW) for their assistance in preparing this bulletin.

OHCOW Humidex Heat Stress Response Plan

Humidex	Response
25-29°C	Supply water to workers on an "as needed" basis.
30-33°C	Post "Heat Stress Alert" notice. Encourage workers to drink extra water. Start recording hourly temperature and relative humidity.
34-37°C	Post "Heat Stress Warning" notice. Notify workers that they are drinking extra water. Ensure workers are trained to recognize symptoms.
38-39°C	Provide 15 minutes relief per hour. Provide adequate cool (10-15°C) water, at least 1 cup (240 mL) of water every 20 minutes. Workers with symptoms should seek medical attention.
40-42°C	Provide 30 minutes relief per hour in additiion to the provisions listed previously.
43-44°C	If feasible provide 45 minutes relief per hour in addition to the provisions listed above. If a 75% relief period is not feasible then stop work until the Humidex is 42°C or less.
45°C or over	Stop work until the Humidex is 44°C or less.

Humidex calculator: http://www.ohcow.on.ca/menuweb/heat_stress_calculator.htm

Note: OHCOW cautions against using weather/media reports of the Humidex. For a fuller explanation of this plan visit www.ohcow.on.ca

WHSC WORKERS HEALTH & SAFETY CENTRE
Training for What Matters Most

Resource Lines

Published by the
Workers Health & Safety Centre

675 Cochrane Drive, Suite 710
East Tower, Markham,
Ontario L3R 0B8

416-441-1939
Toll free: **1-888-869-7950**

whsc.on.ca

contactus@whsc.on.ca

Executive Director: **Andrew Mudge**
Director, Policy and Programs:
Loretta Michaud
Editor: **Charlotte McMorrow**

Submissions are encouraged.

@WHSCtraining

cope:343