

Solution

Master's degree in environmental science and engineering

Occupational and environmental health

3.2 Physical agents - thermal

1) Hot wash

A workplace in a clothing cleaning company (laundry) has a wet temperature of 32°C and a radiation temperature of 30°C. Calculate the WBGT.

The employee at this workstation is responsible for loading and unloading laundry. She spends about half of her workday doing this activity, with the rest of her time spent on administrative tasks (order entry). She has been with the company for approximately 12 years. Is the WBGT obtained acceptable under these conditions?

The formula to use is: $WBGT = 0.3 t_g + 0.7 t_{nw}$
That is 31.4 °C

This temperature is barely tolerable for light work (31.5°C), but not for medium or more intense work (considering ISO 7243). This is also true according to the recommendations valid in Switzerland, as long as 50% of the work is done in a "cool" area.

2) Merry Christmas

A mechanic working for a ski lift company has to make an urgent repair at the top of a gondola tower (3000 m altitude). He is wearing a warm suit, but his face is partly uncovered. The temperature is -10°C and the wind is 40 km/h. What is the apparent temperature? How much time does he have (in theory) before risking frostbite?

Can you explain the physical phenomenon that causes the apparent drop in temperature?

The Wind Chill Chart is used. If there is no column corresponding to a temperature of -10°C, the nearest conservative value of -12°C will be used. At this temperature and with a wind speed of 40 km/h, the apparent temperature is close to -34°C and the skin on the face can freeze in a few minutes (if not protected from the wind).

The apparent lowering of temperature is produced by the increase in convection. The increase in air velocity results in a decrease in the thickness of the boundary layer (the area of still air in the immediate vicinity of the skin) and thus an increase in heat exchange.

3) Stressors and thermal comfort factors

What factors (physical, physiological) contribute to thermal stress or discomfort in the following situations:

- a) A baker makes pretzels in an industrial bakery. He supplies the ovens with dough (10 to 20 kg balls of dough) and supervises the baking process on all ovens (4-5 x per hour).

High radiant temperature, moderate physical activity

- b) A miner in a potash mine maintains and monitors the network of belt conveyors coming from different workings (850 m) deep. He has to ensure the alignment of the conveyors at all times.

Intense physical activity, High relative humidity, High air temperature

- c) A worker is scraping flocking from the ceiling of an office space. The asbestos-containing plastering is being scraped in full protective suit and respiratory protection mask.

High garment-related thermal resistance (Clo), breathing resistance, convective heat dissipation and evaporation severely limited.

