

Complementary method using thermal imaging to black-globe thermometer methods in the estimation of heat stress on a worker in industrial processes with time durations shorter than the typical response time of the instrumentation

Jovan Miočinović

TEHPRO d.o.o, Lole Ribara 120,
11250 Beograd-Železnik, Serbia

jovan.miocinovic@tehpro.rs, +381 11 2580 911

As a standard method to assess the influence of hot environments on a person in a work situation, measurement of the mean radiant temperature using the black-globe thermometer (ISO 7726 method) and estimation of the heat stress on the individual, based on the WBGT index (wet bulb globe temperature, ISO 7243 method) are used, both based on black-globe thermometer measurements. The measurement duration is determined by the response time for a black-globe thermometer that is about 20–30 minutes according to the physical characteristics of the black globe and the environmental conditions. However, industrial activities include processes with shorter durations (e.g., metal casting and cupellation) where the worker is exposed to heat (e.g. opened cupellation furnace) for time periods shorter than the response time of the measurement instrumentation. In this paper, a method using a thermal imaging camera complementary to black-globe thermometer measurement is considered. The theory is that when the black globe reaches a final temperature dependent on the hot environment, the thermometer in the instrument needs additional time to reach thermal equilibrium with the black globe, mainly by the mechanism of conduction, so the thermal imaging camera would measure the temperature before the thermometer. In the experiment the black-globe thermometer was exposed to thermal radiation in a controlled environment while recording the black globe with the thermal imaging camera. The experiment shows that by using thermal imaging the measurement duration may be shortened by up to 15 minutes. Some predictions are made based on the temperature–time curve from the experiment for processes with short time-spans.

Keywords

Black-globe thermometer, heat stress, hot environment thermal environment, mean radiant temperature, occupational health and safety, thermal imaging, WBGT, work environment