Thermal comfort of organism

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Thermal comfort of an Organism:

Mankind have been always striving towards finding thermal comfort, from ancient history to the present day. Look at the buildings around you...

But what is thermal comfort? The thermal comfort of an organism is defined as “the condition of mind which expresses satisfaction with the thermal environment.” Psychologically, it is the mental state that describes how hot or cold a person is feeling. Thermal comfort is different for all people, and there are numerous environmental and personal factors that affect it. Most sources say that thermal comfort is attained as long as 80% or more people feel comfortable in the climate of a certain area.

Thermal comfort is comparable to the new nature of proteins that make up the human body. The same way that proteins are slightly denatured and unable to function optimally when they are not at optimum temperature, neither can humans if they are not thermally comfortable. If it is slightly cold the person may start to shiver, or their body may start to produce more thermal energy unconsciously. Although, if the thermal comfort is too distant from equilibrium, the person will consciously assess the situation and to put on a jacket of turn the thermostat up.

In the photos on the right, both people are likely to be thermally comfortable, even though they are tin completely different environments, hence temperature is only a small factor that contributes to thermal comfort, that has to be taken along with alot of other factors....

Why is it important?

There are three major PHYSICAL subcategories that can occur when the thermal comfort zone is not reached. These are cold stress, heat stress and dehydration. The first two occur when the body’s way controlling its internal temperature starts to fail. Heat stress can be a result of air temperature, factors such as work rate, and humidity. Also dehydration can affect an persons rational way of thinking under thermal stress. For this reason, it is maintaining a thermal environment is important wherever we go in everyday life. Whether it is at home, at work, or when people are simply outside.

A workplace is a good example. If people aren't in an environment that suits them well, they might take shortcuts, be unable to focus, become nervous and behave unsafe. Also if they do not feel thermally comfortable their working performance will inevitably suffer. Thus thermal comfort will also have an impact in their work efficiency.

By illustration,when not thermally comfortable, the risk of errors occurring increases, and that also decreases in their efficiency. This is because the employee wont be able to focus on working, but rather his attention will be turned to how cold or hot he is feeling. On the other hand a good thermal comfort increases the performance, sadness and health of the workers. If workplaces have a good thermal environment, the people will be able to focus well and not have to devote their attention to staying in homeostasis.

Physiological mechanism of temperature regulation And the thermal neutral zone:

Thermal comfort has been reached if the organism is in its thermal neutral zone. Everybody has their own individual thermo neutral zone, which describes a range of temperatures where a person feels content. They don't have to use energy that exceeds the normal metabolic rate. For a naked man in still air, this would be about 27 degrees Celsius. At this temperature the human is not shivering, sweating nor moving. With clothing, radiation and convection losses are reduced, and the thermal neutral zone is changed. Humans normally produce 100 watts of heat energy from metabolic processes in the body. This includes digesting, breathing, circulating blood, anabolism of molecules and more. Therefore, if the body would not give off any energy, the core temperature would continue to increase until the body became extremely overheated. Overheating, or heat stress can result in fainting, heat exhaustion, muscle cramps and inability to concentrate. This rarely happens because there is usually colder air

around us and much of our thermal energy is absorbed by surroundings. In order to maintain core temperature, the body must find a effective way to lose 100 watts of energy through the skin. This heat must be lost to warm environments, and cold ones. In colder ones the body must make sure it does not lose too much over 100 watts.

How Organisms reach thermal comfort:

There are several ways that people adapt to an environment. When it is hot, it is not uncommon to see people, for example students slouching at a lecture. Although, in colder environments there are more likely to sit up and listen intently. This is an example of postural changes that go along with thermal comfort. One of the most prominent insulators of the body is subcutaneous fat and skin, which that adjusts blood flow to the periphery. Veins can vasoconstrict or dilate depending on the conditions. For example if it is cold, blood flow is reduced to the skin, so that heat loss is reduced. These conditions between the artery and vein which are controlled by the sympathetic nervous system.

Some other adaptions that people can do include removing clothing, changing the heating settings and moving away from hot and cold sources such an air conditioner. Adaptation can only be done to a certain extent. For example, if a person removes their jacket and it is still hot, they may no longer be able to adjust. Thermal comfort can also be influenced by the processes that people do in a job, to which sometimes people can never adapt to. A possible solution is to change the schedule and shorten the hours that a person does that task. This is an example of thermal stress.

External resources:

Some other ways to control thermal comfort zone are by controlling the environment of the person. This may mean changing increasing air flow or ventilation by the use of a fan, or opening the window.

Thermal comfort is more than just temperature:

To create thermal comfort for an organism, we must consider the factors that contribute to thermal comfort. At first glance temperature appears to be an accurate indicator of thermal comfort, however alone its is neither a valid nor accurate indicator of thermal comfort. Thus temperature should always be considered in relation to other environmental and personal factors when trying to create a comfortable thermal environment for an organism.

The six factors that contribute to thermal comfort are both environmental and personal, and act together in unity or independently of each other.

Personal factors: are factors pertain to the organisms in a particular environment.

Environmental factors: are conditions in a specific thermal enivronment.

Environmental factors:

Temperature: This is the dry ambient temperature of air, what id read of a thermometer.

Mean radiant temperature:

To understand the bigger picture, Thermal Radiation is heat that radiates from a hot object, this is by infrared radiation. If there is a hot object in the room there will be radiant heat, thus radiant temperature can be defined as the temperature that pertains to the individual object. and this certain temperature radiates heat or absorbs heat via radiation .A hot object will have a high radiant temperature and a cold object will have a low one.

Mean radiant radiant temperature is a measure of how much warming (or cooling) you get from the exchange of radiant heat , taking into account to ALL the objects in the room. So an oil heater, will raise the mean radiant temperature significantly, while a cold floor or window will lower the mean radiant temperature. Both will either emanate or absorb infrared radiation,thus altering hottness or coldness of the room.

Radiant temperature has a greater effect on how we lose or gain heat from the environment,as our skin absorbs almost as much heat as a black matte object, although this can be reduced by wearing reflective clothing.

Air velocity:

This is how fast air is moving through the room at a specific point in space. Also Air currents running on bare or exposed skin will have a greater cooling effect than air current blowing on clothing. On a similar note, moving air acts like convection: it can transfer heat very rapidly. Cold moving will cool you faster, while hot moving air can actually heat you faster rather than cool you. sweating removes a large quantify of heat, so as long as your perspiration can evaporate, even hot moving air will tend to cool you. Because of this you can generally tolerate a higher temperature if a fan is blowing on you, and even higher if you are naked in front of that fan .

Humidity:

humidity increases the thermal the amount of heat conduction to a certain body per certain temperature. so at the same temperature, cold air will seem colder and hot air will seem hotter. wet air has a greater heat capacity than dry air so it can remove more heat from you faster than dry air. moist hot air will heat you up by a higher degree, as per m square of air surface, the more air droplet in the air the more water they will be hitting your body per m^2 and if the water droplets are hot, they more water you'll have transferring that huge specific heat capacity of theirs on to your skin.

Personal factors:

Activity Rate: describes what you are doing ...noon nap, or playing football perhaps?

However metabolic rate is a more accurate description as it more closely related to how activity rate relates to thermal comfort. This is because

Metabolic rate describes the heat that we produce in our bodies when carrying out physical activity. The more physical/active of a activity you take part in the more heat we reproduce, . The more heat we produce, the more heat needs to be lost so we don't overheat. Thus the impact on metabolic heat affects thermal comfort.

The heat produced by the metabolism of the body is transported away by all available physical mechanisms of heat transfer (conduction, convection, radiation, evaporation). The equation of the balance is:

H - Ediff - El - Es - Epe = R + C

The meaning of the variables are (all units in Watt)

H: internal heat production of the body,

Ediff: latent heat transfer through the skin by diffusion,

El: latent heat transfer by breathing, Es: sensible heat transfer by breathing,

Epe: latent heat transfer by perspiration evaporation,

R: radiative heat transfer from the surface of the clothing,

C: convective heat transfer through the clothing.

Clothing Level: describes what you might be wearing while doing an activity. A thick garment will insulate your body more.

-Measuring whether someone is in thermal comfort is determined by asking their opinions via a 'thermal comfort checklist' on the 6 factors that compose it. If they are content with them, then it has been achieved and there is no need for taking measures to try to control thermal comfort levels.

Final impression:

Overall, whether people become conscious about thermal comfort correlates with the conditions that affect the thermal balance between the body and the environment. Being satisfied with a thermal environment is important for productivity and health, and is proved to be dependent on many physical and physiological factors. Therefore knowing the factors that contribute to thermal comfort we can correctly take measures to alter these factors to obtain a thermally comfortable environment.

Sources:

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2. [2]
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