Microclimate

Introduction

Microclimate Definition

It refers to an atmospheric zone that has a climate distinct to the surroundings. A microclimate can be as small as a couple of meters squared (e.g. a garden bed) or as large as many square kilometers.

Thermal Comfort

Definition

Thermal comfort is a largely individual feeling. It is a condition of the mind, which expresses satisfaction with the thermal environment. Some people feel fine at ambient temperature ~17^{o}C, while other need up to 25^{o}C. Because of considerable individual differences in the population, we have to find, compromises in values of climatic factors (not only the thermal factor) for indoor spaces according to age of inhabitants. For this reason the range of recommended values for climatic factors are broad, for example air humidity ranges from 30-60%.

Factors Determining Thermal Comfort (3 groups):

1. Environmental Factors
2. Individual Factors - Objective
3. Individual Factors - Subjective

Environmental Factors

- Air temperature

The recommended range for air temp in apartments is 19 and 23oC in winter and less the 27oC in the summer. However different activities require different indoor temperature, e.g 21^{o}C may be considered too warm for exercising and a bit cold for a sedentary person. Comfortable air requirements also vary from day to day for the same individual

- Air humidity

Absolute air humidity is the concentration of water vapors in air (g/m^{3}) or partial tension. Relative air humidity is the ratio of the actual water vapor pressure to the saturation water vapor pressure at the prevailing temp. (usually expressed as a % rather than a fraction)

- Air speed or velocity

It is a measure of movement of air in space. People begin to perceive air movement at about 0,2m/s. Air speed less than 0,1m/s creates a feeling of stuffiness. Further more at higher air temperatures, increasing the air speed will help the evaporation of sweat thus leading to a cooling effect to achieve comfort of a person.

- Intensity of heat radiation

The principle of heat radiation is infrared energy exchange between a human body and surrounding surfaces. Thermal load of an organism is an issue mainly at hot workplaces (glassworks, blast furnaces)

Objective Individual Factors

- Cooling mechanisms of human body are convection, conduction, heat radiation and evaporation

Convection causes cold air that is in immediate contact with the skin to be warmed. Heated air molecules move away and cooler ones take their places. Conduction on the other hand, causes body heat to be lost through direct contact. When a temperature gradient exists between a body, the heat is transferred from the region of high temp to the region of low temperature. Further more heat radiation is a process of transfer of heat from one object to the surface of another without physical contact. Under normal conditions 60% of a person heat production is lost by radiation. To conclude, evaporation is a process in which a liquid changes to vapor. As the body perspires and the perspiration evaporates, the body surface is cooled. When air temp equals or exceeds skin temperature, evaporation is the only way the body has of losing heat. Evaporation rate is reduced when humidity levels are high and is also influenced by air movement.

- Total chemical energy transformed into heat depends on the activity level of physical work being performed

and the metabolic rate
- The total (gross) energy output = energy net (clear) output + basal metabolism, where the net (clear) output is determined by the physical activity. An energetic value of basal metabolism depends on sex and decreases with age.
- Thermal resistance of clothes depends on the number of cloth layers and the air speed.
- The higher the number of cloth layers the higher the number of thermal insulation layers among these layers.
- When normal clothes are worn (e.g. wool, cotton) the number of these insulation layers determines the so-called thermal resistance of clothes in dependence on air streaming.

Activity results in transformation of chemical energy into thermal energy. **Clothing insulation**, between an organism and the environment, results in thermal resistance of clothes

Subjective Individual Factors

- Adaptation and thermoregulation mechanisms (Sensitive Vs Resistant)
- Health state (Healthy Vs Sick)
- Mental condition (Comfort Vs Stress)
- Conditions of an organism (Rested Vs Exhausted, Satiety Vs Hunger)

Evaluation

The thermal comfort of the thermal environment is complex and is affected by the interaction of all these factors

- Tables and graphs are used to evaluate the suitability of factor combinations determining thermal comfort according to energy load
- **Optimal thermal load** is evaluated using a table for apartments or workplaces where moderately heavy work is performed. The table takes into consideration winter and summer periods and combines all thermal comfort factors except humidity.
- **Long-term feasible thermal load** is evaluated using graphs for work places where heavier work is performed (energy load, temperature). The graphs combine all thermal comfort factors.
- **Short-term feasible thermal load** is evaluated using graphs from workplaces where heaviest work is being performed (energy load, temperature). They combine all thermal factors. They also include time limit for non-interrupted work in such conditions.

Links

Related Articles

- Health Risks in Indoor Environment

Bibliography

- BENCKO, Vladimír, et al. *Hygiene and Epidemiology : Selected Chapters.* 2nd edition. Prague. 2004. ISBN 80-246-0793-X.

References