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Computational Modeling of Time Resolved Exposure Level Analysis of a Heated Breathing Manikin with Rotation in a Room

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Abstract

With people spending most of their time indoor, the air quality in indoor environment has become a subject of serious concern. Of particular interest is the mitigation of transmission of airborne infectious diseases in indoor facilities. The airflow pattern in indoor environment is affected by the ventilation system, thermal plume around human bodies, human respiration, human walking and other activities. In the present study, the effects of thermal plume, respiration and motion of the body on the indoor air quality in a ventilated cubicle were investigated using a computational modeling approach. Attention was given to the transport and fate of particulate pollutant in a ventilated room in the presence of a heated, breathing and rotating manikin. The cases of displacement and mixing ventilations were studied. In particular, the concentration of pollutant in the breathing zone of the manikin under various conditions was evaluated. The simulation results indicated that the rotation of the manikin significantly distorted the thermal plume of the body and the associated transport of particulates. Furthermore, the rotation decreased the concentration of particles in the breathing zone of the manikin. It was also found that the thermal plume generated by the body was distorted by the airflow of the mixing ventilation system, while there is little if any distortion by the displacement ventilation system.

Keywords

Computational Fluid Dynamic (CFD), Indoor Air Quality (IAQ), Displacement Ventilation, Thermal Plume, Mixing Ventilation, Rotating Manikin

1. Introduction

In modern life most people spend 80 to 90% of their time in indoor environments. Thus, maintaining indoor air quality (IAQ) has become a concern for design of heating, ventilating and air conditioning (HVAC) systems. While consideration of the IAQ in HVAC systems may