

AN EXPERIMENTAL STUDY OF EXHALED SUBSTANCE EXPOSURE BETWEEN TWO STANDING MANIKINS

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Summary

Transmission of the exhaled substances from one person to another in indoor environment is influenced by many individual factors. The impacts of these factors for two face-to-face standing persons are investigated by evaluating the exposure of the substances in a room ventilated by displacement. Experiments employing two breathing thermal manikins are conducted in a full-scale test room. The geometry of the test room is 4.2 m (length) × 3.6 m (width) × 2.6 m (height). The distance between two manikins is 0.8 m, which is regarded as a common distance between two persons chatting in real life.

Smoke visualizations are conducted to show airflow pattern of instantaneous exhalation jets from two manikins. A tracer gas N₂O is used to represent the gaseous substances exhaled or coughed by the source manikin. The concentration of N₂O, air velocity and temperature profiles near the target manikin are obtained to compare impacts of following parameters, breathing mode (mouth or nose), respiratory activities (breathing or coughing), body plume (exist or not), human body height, etc. Under the conditions we setup, the target manikin inhales more N₂O when the source manikin breathes from mouth than that when the source manikin breathes from nose. However, when the source manikin is 0.15 m higher than the target manikin, the exhaled substances move upwards and travel to the upper part of the room above the target manikin. The target manikin inhales much less than that when they have the same height. When the target manikin is 0.15 m higher than the source manikin, more N₂O exhaled from the source manikin's mouth or nose is transported directly or along the boundary layer to the breathing region of the target manikin. The target manikin inhales more than that when they have the same height. Besides, the target manikin inhales more when the source manikin is coughing. The increase in exposure by coughing is based on an increase of release from the source manikin. The synchronization of the exhalation jets from the target and the source manikin also influences how much N₂O the target manikin can inhale. However, it is very hard to adjust the exhalation jets to be synchronized all the time during the experiment. Instead, we test the situation without the exhalation jet from the target manikin. It reveals that the target manikin inhales about 20% more when the source manikin breathes from mouth and about 120% more when source manikin coughs from mouth.

Keywords: *Exposure, Tracer gas, Displacement ventilation, Thermal manikin*