

Master project:

How much does your inhaled air include your own exhaled air and the air exhaled from your nearby people?

Summary:

Human exhaled air contains CO₂, bio-effluents and droplet nuclei carrying probably infectious viruses. Considering that building materials are increasingly clean, human exhaled air would become the major source of indoor air pollution. The widely used total volume ventilation method (namely, mixing ventilation) is intended to create a well-mixing air distribution, but occupants (and their exhaled pollutants) are not uniformly distributed in a space. Obviously, the concentrations of exhaled pollutants decrease along the distance away from the mouth/nose, with the highest values occur immediately in front of the mouth/nose. Current ventilation standards recommend a minimum ventilation rate to control the average indoor concentrations and do not take into account the non-uniform distribution of pollutants indoors. This implies that people could expose to high concentrations of exhaled pollutants by themselves and by their nearby people and have an unacceptable inhaled air quality, even if the average indoor concentrations are controlled to be acceptable.

This project aims to quantitatively investigate people's re-inhalation of their own exhaled air and inhalation of air exhaled from nearby people. Full-scale experiments will be conducted in a climate chamber ventilated with mixing air distribution. The methods of measuring concentrations of inhaled and exhaled air of a breathing thermal manikin will be systematically evaluated and the best method will be recommended. Two breathing thermal manikins will be used to simulate two seated persons. One of the manikin will exhale tracer gas N₂O and another CO₂. The N₂O and CO₂ concentrations inhaled by both manikins will be measured using INNOVA gas monitor and Fast Gas Meter. The influence of several important influential parameters will be examined, which include distance between manikins, positioning of body, positioning of head, breathing mode, supply flow rate, indoor air temperature, desk fan and desk slot.

This project will first establish a method that can accurately measure concentrations of inhaled and exhaled air of a breathing manikin and second reveal the fractions of one's own exhaled air and air exhaled from nearby people in one's inhaled air under different conditions. It will provide fundamental information for indoor ventilation design and for formulating intervention measures to ensure an acceptable inhaled air quality.