Effect of ventilation strategies on air contaminant concentrations and energy consumption in buildings

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SUMMARY

Considering the diversity of indoor contaminant characteristics and generation patterns, finding an appropriate ventilation strategy that can secure acceptable indoor air quality with minimum energy consumption is a challenging task for HVAC system designers and operators. This study theoretically models and investigates the impact of various ventilation strategies on contaminant concentration behaviour and corresponding ventilation cooling energy requirements for a single-zone enclosure. Two types of contaminants are considered; carbon dioxide as an occupancy dependent and formaldehyde, which is independent of occupancy. An airflow model is used to predict space pressure and air leakage rates across the enclosure envelope, and an air quality model is used to predict time-varying contaminant concentrations. In addition, a building energy simulation model is utilized to predict the corresponding ventilation cooling energy requirements under hot climatic conditions. Results from this study show that acceptable contaminant concentrations during occupied periods can be achieved by different ventilation strategies but at substantially different ventilation energy requirements. More than 50 per cent reduction in ventilation energy requirements can be obtained while maintaining acceptable IAQ if proper ventilation strategy is employed.

KEY WORDS: ventilation strategies; energy; indoor contaminants; indoor air quality (IAQ)