Indoor Climate in the Spotlight: Between Health Protection and Energy Efficiency

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ABSTRACT

Indoor air quality has gained increasing attention as a key factor in safeguarding occupant health. At the same time, ventilation systems account for a significant proportion of a building's overall energy consumption. On the health-protection side, current findings highlight the importance of reducing infection risk, maintaining comfortable temperature and humidity levels, and effectively reducing pollutants. Equally vital is the need to conserve resources by deploying demand-controlled ventilation, leveraging heat-recovery technologies, and optimizing air-distribution designs. Taken together, these parallel research fields underscore the fact that a healthy indoor climate and energy efficiency cannot be treated as competing priorities; instead, they must be addressed jointly. By balancing health-driven demands with low-energy solutions, modern ventilation concepts can achieve sustainable, high-performance indoor environments for all. This presentation spotlights these two crucial areas of research – health protection and energy efficiency – to illustrate how ventilation strategies can safeguard indoor air quality while minimizing energy use.

A promising approach to ventilation strategies involves using CO_2 concentrations as an indicator of the infection risk and dynamically adjusting the volume flows based on real-time conditions. In this model, an algorithm calculates an optimal CO_2 target by weighing the costs of employee absences due to potential infections against energy costs for increased ventilation. In case of high transmissibility or vulnerability of viral pathogens, for example, air handling units automatically lower the CO_2 setpoint to reduce the infection risk - which leads to higher air exchanges and slightly higher energy consumptions. Conversely, if the risk of infection is categorised as low, slightly higher CO_2 values are set, while complying with further parameters of indoor air quality, which saves energy without significantly affecting health.

By integrating these factors into a single, monetary-based indicator, the historically static Pettenkofer value (defined as 1000 ppm) becomes a dynamic parameter. This shift not only aligns indoor air quality measures more closely with economic realities, but it also paves the way for adaptive and future-oriented ventilation strategies, heralding a new era in indoor climate technology.

KEYWORDS

Ventilation Strategies, Public Health, Infection Risk Assessment, Energy Efficiency, Ventilation Effectiveness