

Past and Recent Developments of Personalized Environmental Control Systems

Jun Shinoda^{*}, Ongun B. Kazanci, and Bjarne W. Olesen

*Technical University of Denmark
Nils Koppels Allé, Building 402
2800 Kgs. Lyngby, Denmark
^{*}Corresponding author: junshi@dtu.dk*

SUMMARY

Personalized Environmental Control Systems (PECS) condition the immediate surroundings of occupants, and they are expected to provide increased comfort, health, and productivity. Studies have reported on their benefits and limitations in addressing individual Indoor Environmental Quality (IEQ) factors, especially in terms of thermal comfort and indoor air quality. The COVID-19 pandemic and risks associated to climate change, such as heat waves, highlight the necessity for PECS that can address multiple IEQ factors. The new IEA EBC Annex 87 – Energy and Indoor Environmental Quality Performance of Personalised Environmental Control Systems aims to provide guidelines and frameworks necessary for the further development and deployment of PECS.

KEYWORDS

Personalized Environmental Control System, Thermal Comfort, Indoor Air Quality, Indoor Environmental Quality, Resiliency

1 INTRODUCTION

Personalized Environmental Control Systems (PECS) condition the microclimate of occupants instead of the ambient space indoors. Such systems provide each occupant individual control over their immediate surroundings, increasing comfort and satisfaction. A summary of past developments of PECS will be given, and next steps will be discussed in this topical session.

2 PAST DEVELOPMENTS

There have been several literature covering a wide range of studies conducted on PECS and its effect on indoor environmental quality (IEQ) factors, namely thermal environment, indoor air quality, luminous (visual) environment, and acoustic environment (Godithi et al., 2018; Rawal et al., 2020). PECS come in various forms and functions, such as fans, radiant heating/cooling, heated/cooled chairs, desktop air terminal devices (ATD), task lights, and sound masking systems. Each study reported on the benefits of personalized systems in terms of comfort, health, productivity, or energy. While there is substantial evidence on the capabilities of different PECS, limited number of PECS is available on the market. Some of the challenges in the development and deployment of PECS are the cost, maintenance, and responsibility in the stages of installation, operation, and maintenance. In addition, due to the diversity in the type of PECS, there is a lack of a unified performance evaluation scheme.

3 CURRENT STATUS AND DEVELOPMENTS

The COVID-19 pandemic had a significant impact on the building industry, especially in the field of ventilation. In terms of airborne infection, mixing ventilation has a higher infection risk compared to a personalized ventilation system, even with increased ventilation rate (Melikov, 2020). Hence, there is a need for PECS with a ventilation function to mitigate indoor infection risk for the current and future pandemics.

The change in climatic conditions over the years continue to be a challenge for buildings as well. With more frequent and severe heat waves, buildings need to be “resilient” against high temperature and disruptive events that follow (e.g., power outage) (Attia et al., 2021). PECS that can provide cooling at low power would provide more flexibility to a building in cases where the ambient mechanical system fails or cannot accommodate the thermal load during extreme weather conditions.

As shown in the two examples above, recent situations highlight the necessity for a system that can address thermal and air quality (ventilation) factors. Lighting and acoustics are equally important for the health and comfort of occupants, and studies to evaluate multiple IEQ factors are being reported (Wargocki et al., 2021). Therefore, development of PECS that can address multiple IEQ factors are needed, as well as a common evaluation and operation framework for them. The new IEA EBC Annex 87 aims to provide such guidance.

4 CONCLUSION

Past and current development of PECS, along with their relationship to current situations of the indoor environment of buildings were introduced. There is a need for PECS with functions that can address multiple IEQ factors, and guidance in the performance evaluation, installation, and operation of PECS.

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