

HVAC and VOCs: interaction between building systems and indoor VOC concentrations

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SUMMARY

HVAC systems in newly built or extensively renovated dwellings were all developed with the aim for energy saving with equal or better comfort. However, these systems (floor heating and DCV systems) have certain characteristics which increase the emissions of Volatile Organic Compounds (VOCs) and give VOCs the chance to accumulate to higher concentrations. This interaction is investigated based on dynamic simulations using a temperature and humidity dependent VOC emission model.

KEYWORDS

Indoor Air Quality, IAQ, HVAC, Floor heating, Demand Controlled Ventilation, DCV, Volatile Organic Compounds, VOC

1 INTRODUCTION

New technologies for the building and HVAC industry are being implemented in every type of building at a fast rate. These technologies typically aim for less energy but equal or better indoor comfort. Buildings are getting built more airtight, high temperature radiator heating is being replaced by low temperature surface heating and continuous flow ventilation systems make way for demand controlled ventilation (DCV) systems.

The assessment of the impact of such a system is typically only done based on potential energy saving and the comfort aspect of Indoor Air Quality (IAQ). E.g. in Belgium, the assessment method for DCV systems only considers CO₂, H₂O and a tracer representing smell from the toilet [1]. By doing so, the health aspect of IAQ related to VOC emissions to the indoor environment is neglected.

The relation of indoor VOC levels to humidity and temperature combined with the higher airtightness and (sometimes) lowered ventilation rates in DCV systems make it increasingly important to consider this additional aspect in order to be sure the long term health consequences do not pose a significantly higher risk

2 METHODOLOGY

A temperature and humidity based VOC emission model is implemented in the simulation software CONTAM [2]–[4]. Based on dynamic simulations with or without floor heating and with or without DCV systems, the interaction between the HVAC system and the VOC exposure of the occupants is analyzed.

3 MAIN RESULTS AND CONCLUSION

For DCV systems, the risk of prolonged exposure to high VOC levels is observed. Especially in spaces with limited occupation or spaces with long periods of absence like the bedroom. The impact of floor heating is also significant, heat is supplied directly to the floor, heating up the floor to temperatures higher than it would have been with radiator heating. The higher emission

rates due to the temperature dependence of the VOC emissions make for higher VOC exposure of the occupant.

VOC exposures are higher, but the energy saving potential of these new technologies should off course not be overlooked. The way the VOC exposure changes with regards to the new HVAC technologies are as expected, thus can be managed. By choosing low VOC-emitting surface finishing when floor heating is begin used, the VOC exposure could be reduced significantly and the new generation of DCV systems could be further developed taking into account this risk of exposure to higher VOC concentrations.

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