

Summary

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TNO report

Decentralised smoke displacement system based
on recirculation and filtration

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Summary

Thyzo and Hiensch Engineering have developed a concept for a decentralised smoke displacement system based on recirculation and filtration. The concept is based on the displacement of polluted air from the respiration zone by means of purified air. Polluted air is extracted high up in the space, purified, and then blown back into the same space just above the floor. TNO was asked to conduct an exposure measurement in actual practice to test the concept. The measurement was carried out in the Jacobus Pieck restaurant in Haarlem on Monday 16 October 2006.

The measurements were carried out in a room for smokers with a smoke displacement system and a non-smoking room with and without the smoke displacement system. To determine the air quality, measurements focused on the levels of aldehydes, volatile organic compounds (VOCs) and nicotine. Readings of PM_{2.5} fine particulate matter were also taken. The collected chemical samples were analysed in TNO's laboratories in Apeldoorn. The PM_{2.5} fine particulate matter samples were weighed by RPS Analyse.

The present study shows a potential exposure reduction for catering/hospitality staff of 76 to 80% for the various components. A potential exposure reduction of 79 to 99% was established for guests of the restaurant. These percentages are well above the 30-50% specified in the RIVM/TNO report [1]. In addition to the specified reductions, the use of decentralised smoke displacement also has a positive effect on concentrations in the non-smoking room.

The readings were carried out in a restaurant which approximates the demands made by Dutch building regulations [Bouwbesluit] for new buildings in respect of ventilation. In many catering/hospitality establishments, particularly in pubs, the level of ventilation is a half or a quarter of that. It is expected that by deploying a decentralised smoke displacement system using recirculation and filtration, the reduction in exposure will be higher.

Conclusions

This study addresses the effectiveness of the technology of a decentralised smoke displacement system on the basis of recirculation and filtration in a restaurant with a smoking area. The concept is based on the displacement of polluted air from the respiration zone by means of purified air. Polluted air is extracted high up in the space, purified, and then blown back into the same space just above the floor.

To determine the air quality, measurements focused on the levels of aldehydes, volatile organic compounds (VOCs), and nicotine. Readings of $PM_{2.5}$ fine particulate matter were also taken.

The present study shows a potential exposure reduction for catering/hospitality staff of 76% for aldehydes, 80% for fine particulate matter and 76% for nicotine. The reduction of VOCs for staff could not be determined due to an equipment failure. Based on the ratio between the reduction for staff and the reduction for guests for the other compounds, the VOC reduction for staff is estimated to be approx. 80%.

The study also examined the potential exposure reduction for guests of the establishment. The study shows a potential exposure reduction for guests of 79% for aldehydes, 99% for fine particulate matter, 86% for nicotine and 91% for VOCs. The difference in reductions for guests and serving staff indicates that the desired displacement flow occurs.

The reduction percentages are well above the 30-50% specified in the RIVM/TNO report [2]. In addition to the specified reductions, the use of decentralised smoke displacement also has a positive effect on concentrations in the restaurant.

The readings were carried out in a restaurant which approximates to the demands made by Dutch building regulations (Bouwbesluit) for new buildings in respect of ventilation. In many catering/hospitality establishments, particularly in pubs, the level of ventilation is a half or a quarter of that. It is expected that by deploying a decentralised smoke displacement system using recirculation and filtration, the reduction in exposure will be higher in those establishments.