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Healthy Indoor Environment

Wood smoke from neighbours in houses with mechanical ventilation

Previous versions of this brief were composed for Green Transition Denmark, while this updated version has been composed by Healthy Indoor Environment: www.healthyindoorenvironment.org

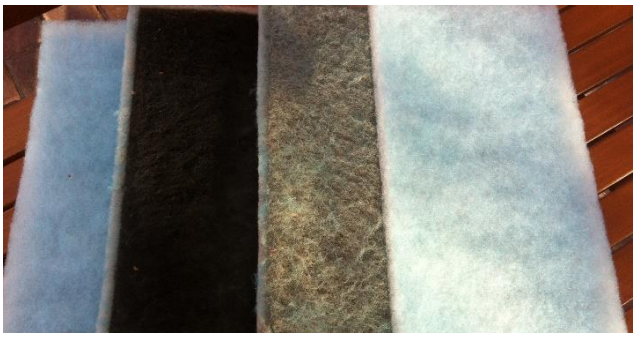
In new and energy-renovated houses, mechanical ventilation is often installed to improve indoor air quality. Mechanical ventilation increases ventilation and removes pollution generated inside the house. However, in residential areas, wood smoke in outdoor air can be led into houses through the mechanical ventilation and contribute to high levels of indoor air pollution. The intake of the ventilation system is typically placed on the roof in same height as chimneys of neighbouring houses. After a winter season, inlet filters in the ventilation system are covered with soot (figure 1).

Healthy Indoor Environment has received several enquiries from residents in new houses with mechanical ventilation who often smell that wood smoke from neighbouring houses with wood stoves is led into their houses through the mechanical ventilation. Smoke from wood burning contains the same health hazardous and carcinogenic compounds as tobacco smoke.

Pollution screening

In Copenhagen, a screening of pollution from wood smoke in the air entering a house through the mechanical ventilation (Nilan Comfort Ventilation system with a 300 Standard filter) was made in a house from 2011 in a residential area with district heating and wood burning (figure 2). The distance between the nearest chimney and the ventilation intake on the roof was around 18m. Pollution in the air ventilated into the house was measured in a room about 10m from the ventilation intake. Ultrafine smoke particles were measured with a P-Trak (Model 8525 Ultrafine Particle Counter) from TSI cross-calibrated before and after the measurements. Measurements were carried out, with and without smell of smoke in the inlet air flow, for an hour (3,600 measurements). However, minute averages are used in graphs (figure 3).

Figure 1: Ventilation filters before/after winter.

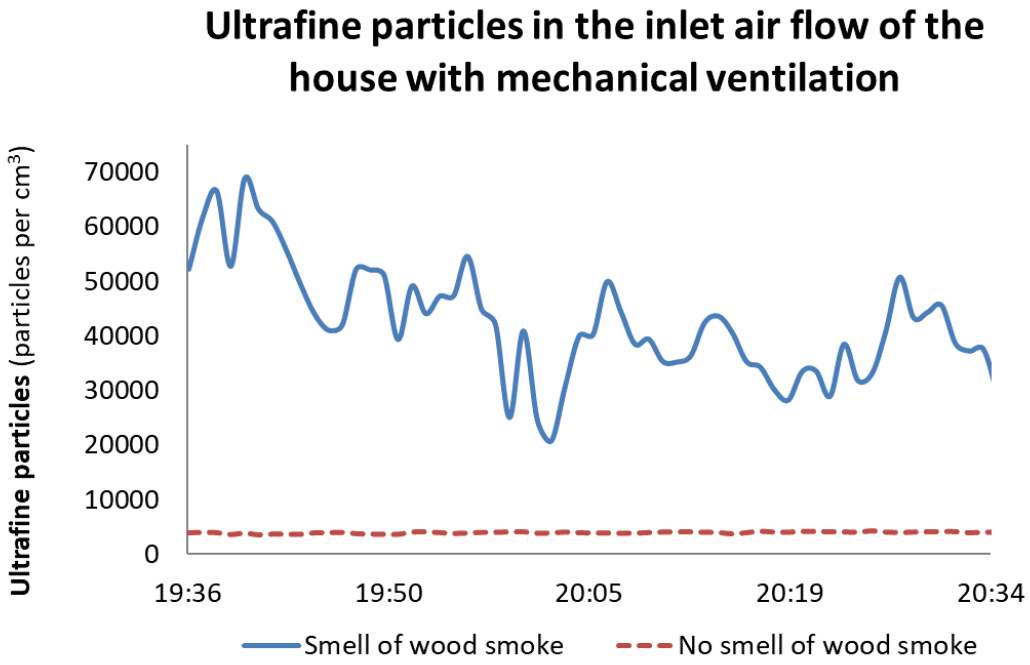


Blue-white filters: New filters before use.
Black filter: Filter from the inlet air channel.
Grey filter: Filter from the outlet air channel.

The filter in the ventilation inlet channel is black from soot after a winter season due to wood smoke in outdoor winter air, whereas the filter in the outlet air channel is grey from dust inside the house.

Figure 2: Measurements of the inlet air flow.

Figure 3: Ultrafine particles in the inlet air flow an evening with and without smell of wood smoke.



The pollution with ultrafine particles was found to be 20,000-70,000 particles pr. cm^3 and same levels of pollution was measured in the entire house (bedrooms, children's rooms, etc.). For comparison, the average concentration of ultrafine particles is around 15,000 particles pr. cm^3 alongside the most polluted street in Copenhagen during rush hour.

The World Health Organisation considers 20,000 ultrafine particles per cm^3 (measured as hourly average) as a high level that should be avoided. Figure 3 clearly shows that the family living in the house is exposed to a pollution level that is several times higher than the defined level of the WHO. Children suffering from respiratory disorders are particular sensitive to such levels of harmful air pollution.

Conclusion

The screening shows that significant indoor pollution with health hazardous and carcinogenic wood smoke can occur in houses with mechanical ventilation when outdoor air is polluted with smoke and the inlet air flow smells like smoke. Sufficient removal of the pollution is not possible with standard ventilation filters.

Recommendations

We recommend performing detailed measurements of indoor pollution with wood smoke on houses with mechanical ventilation both at the intake on the roof top and the inlet inside the house. Additionally, an investigation of the efficiency of various ventilation filters' ability to remove smoke particles from wood burning should be made. Authorities should consider banning wood burning within a 100m perimeter of houses with mechanical ventilation.

Further information

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