Zukunft Bau

STRUKTUR / GLIEDERUNG KURZBERICHT

Title

Title of full paper: "Study on technical, energy-relevant and economic assessment of air-extraction and recirculating-air range hoods in residential kitchen in energy efficient buildings"

Reason/initial situation

kurze Beschreibung des Problems und des Lösungsansatzes
max. 450 Zeichen (mit Leerzeichen)

In the recent past, technical developments in the building sector have largely been determined by higher demands for comfort and energy efficiency requirements. Within the framework of this research project relating to cooker hoods in residential kitchen, the energy-relevant effects inside the building and the effectiveness of the systems in relation to the reduction of cooking fumes will be examined, particularly during exhaust air and circulating air operation.

Subject of this research project

Beschreibung der Arbeitsschritte und des Lösungswegs
max. 4.300 Zeichen (mit Leerzeichen)

This research project mainly concerns the following three subject areas. The first focus of the work was on determination of the normative and legal frameworks. The requirements resulting from these are fundamental for further investigations as well as for deriving planning recommendations. An overview of the essential normative, legal and other framework conditions for the use of cooker hoods was therefore prepared in the context of this project.

Apart from this, the research project dealt with the technical assessment of cooker hood systems. In this connection, the main evaluation procedures and labelling were subjected to a critical review. The purpose was to clarify to what extent the results adequately reflect the performance in practice, whether additional procedures seem expedient, or whether adjustments to the boundary conditions for tests are advisable. To clarify these issues, simulated calculations and test stand measurements were carried out with modified boundary conditions.

- No standardised procedures are yet available for evaluation of the efficiency of captured vapour from cooker hoods. Simulated calculations indicate that the odour reduction rate described in the test standard DIN EN 61591 is unsuitable for evaluation. Two evaluation methods were tested in the context of this research project. The results are promising.
- More detailed investigation of the energy efficiency labelling corresponding to EcoDesign showed that a major energy-relevant effect, that of additional ventilation heat losses, was not taken into account for the labelling. In addition, sample tests indicate that the fluid dynamic efficiency FDE parameter does not appropriately assess significant differences in the electrical efficiency of the systems. In this respect, labelling for end users should be reviewed.
- Testing of odour reduction of circulating cooker hoods showed a significant influence of the design of the active carbon filter – particularly of the capacity.

The third focus was on the interaction of cooker hood systems with the building and other technical systems. If cooker hood systems are used in the exhaust air mode, it must be ensured that sufficient outside air is supplied, otherwise critical underpressures may arise inside the dwelling. Special requirements apply if e.g. fireplaces are located inside the home. In addition, high differential pressures may affect opening of the exterior doors. With the help of parameter studies (airtightness of the building envelope, size of the dwelling and exhaust air flow rate) critical cases were identified and the necessary sectional diameters for adequate supply air intake were calculated and put together in a matrix.
The exhaust air volume flow must be compensated through (in winter cold) incoming outside air. The use of exhaust air cooker hoods therefore causes additional heat losses. Outside of the usage time, infiltration losses (via the exhaust air duct) and thermal bridge losses must also be taken into account. The heat loss due to exhaust air cooker hoods were calculated for different utilisation variants.

Furthermore, the findings from this study have been compiled in a guideline for users, designers and assessors. Besides recommendations for the operation of exhaust air and circulating cooker hoods in residential kitchen, the guideline provides planning recommendations and serves as an aid for advice, planning and decision-making for the relevant market participants (trades persons, kitchen designers, architects, property developers, flue gas inspectors, installation technicians and end users).

Summary

Beschreibung der geplanten Ziele und der erreichten Ergebnisse
max. 700 Zeichen (mit Leerzeichen)

In the context of this research project the intended objectives were achieved in respect of the thematic areas normative and legal framework conditions, technical evaluation of cooker hoods and interactions between cooker hood systems and the building. With reference to the technical evaluation, additions and modifications were elaborated which are expected to provide an appropriate assessment of the properties of the devices. Critical differential pressures may occur if exhaust air cooker hoods are used in new or retrofitted and therefore airtight buildings. Solutions were identified. The additional heat losses resulting from exhaust air operation have also been quantified.

Key data

Abbreviated title: Evaluation of range hoods in residential kitchen

Researcher / Project Manager:

- Researcher: Dipl.-Ing. Kristin Bräunlich (Passivhaus Institut) , Dipl.-Ing. Martina Broege (IHD GmbH), Dipl.-Ing. Alfred Bruns (Naber GmbH), Prof. Dr.-Ing. Thomas Hartmann (ITG GmbH), Dipl. Phys. Oliver Kah (Passivhaus Institut), Dipl.-Ing. Christine Knaus (ITG GmbH), Sven Knothe (IHD GmbH), Dipl.-Ing. Matthias Weinert (IHD GmbH), Dipl.-Ing. Julia Sophie Weiser (Passivhaus Institut), Enrico Zönnchen (IHD GmbH)

- Project Manager: Dipl.-Ing. Kristin Bräunlich (Passivhaus Institut), Dipl. Phys. Oliver Kah (Passivhaus Institut)

Total costs: 165,523.62 €

Federal subsidy: 103,523.62 €

Project duration: 18 months

BILDER/ ABBILDUNGEN:

5 - 7 Druckbare Bilddaten als **eigene Datei** (*.tif, *.bmp, ...) mit der Auflösung von mind. 300 dpi in der Abbildungsgröße (z.B. Breite 10 - 20cm). Bilder frei von Rechten Dritter.
Bildnachweis jeweils:

Illustration 1: Bild1.tif
Result of calculated odour extraction (based on DIN EN 61591) for air-extraction range hood depending on the capture efficiency of the range hoods for an air flow rate of 400 m³/h and different test room sizes (the standard test room has a size of about 8.8 m²).
Boundary condition: Result of a simulated calculation.

Illustration 2: Bild2.tif
Example odour extraction for a wall-mounted (left) and a head-free recirculating-air range hood (right) depending on age of filter and fan speed.
Boundary condition: Measurement during recirculation operation with additional extraction air flow based on DIN 1946-6

Illustration 3: Bild3.tif
Evaluation of capture efficiency by a visual method. Example "average value" evaluation of the capture efficiency. Each view shows the result for one fan stage. Every evaluated picture is generated from 50 individual photographs.
Boundary conditions: Height above the cooktop 60 cm, air-extraction range hood, cooktop on highest setting.

Illustration 4: Bild4.tif
Comparison of the pressure losses of the extract air duct between the values given in DIN EN 61591 and an extract air duct in actual use based on (AMK-MK-008).

Illustration 5: Bild5.tif

Example measured values for electrical power consumption of air-extraction range hoods. Although the Fluid Dynamic Efficiency FDE of the system is comparable, the power consumptions differ greatly.

Illustration 6: Bild6.tif
Diameter of the required cross-sectional area for supply air for air-extraction range hoods for different boundary conditions.

Illustration 7: Bild7.tif
Heat losses during the heating period due to operation of an air-extraction range hood for typical utilisation variants.
Assumptions:

- Climate data for Potsdam: Year-round operation, annual average outdoor temperature for Potsdam 9.5°C , indoor temperature 20°C.
- Based on DIN 1946-6, calculation of infiltration through an extract air duct with a damper with moderate airtightness (commercially available product). Differential pressure 5 Pa (low-wind location).
- Transmission heat loss through an uninsulated damper in extract air opening.