Recirculating cooker hoods – possibilities and challenges

Urban Home Ventilation Workshop Oslo / 6th May 2020
M. Oberhomburg / BSH Home Appliances

Mission for Ventilation

Design
Hoods with a harmonic design, integrated into the kitchen and the living environment.

Function
Low noise level for a quiet surrounding and without compromise on performance.

Air Quality
Pure air in kitchen environment for customer. (grease and odour)
Content

1. Grease Filter
2. Odour Filter
3. Catch Rate
4. Conclusion

Recirculating cooker hoods – possibilities and challenges

1st step: Grease Filter
Mesh Grease Filter

User Experience

Performance

<table>
<thead>
<tr>
<th>Handle</th>
<th>Frame</th>
<th>Exterior Layer</th>
<th>Interior Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>anodized Alum.</td>
<td>black anodized</td>
</tr>
<tr>
<td></td>
<td>Alu. extruded (8x8)</td>
<td>Alum.</td>
<td>Alum.</td>
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<tr>
<td></td>
<td>Steel Roll form. (8x8)</td>
<td>stainless Steel Wire Cloth</td>
<td>expanded Stainless Steel Wire Ω-mesh</td>
</tr>
<tr>
<td></td>
<td></td>
<td>expanded</td>
<td>black</td>
</tr>
<tr>
<td></td>
<td></td>
<td>stainless Steel</td>
<td>anodized</td>
</tr>
</tbody>
</table>

Measurement Method: DIN EN 61591 – *Grease Filtering Efficiency / GFE*

Measurement of weight increase after test
- Filter
- Hood
- 99.99 % absolute filter /Exhaust

\[
\text{GFE} = \frac{\text{Filter}}{\text{Filter} + \text{Hood} + \text{Exhaust}}
\]
Grease Filter Efficiency with Particle size

Volume/Mass Particle Distribution measured with Norm Conditions DIN EN 61591

=> Particles smaller 2,5 μm correspond to 5,5% of particle mass
Particle Size Distribution measured with Norm Conditions DIN EN 61591

=> Particles smaller 2,5 μm represent more than 95% of particle amount

<table>
<thead>
<tr>
<th>X [μm] (0,2μm bis einschließlich)</th>
<th>Anteil d. Partikelanzahl [%]</th>
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<tbody>
<tr>
<td>1,04</td>
<td>85,29</td>
</tr>
<tr>
<td>1,98</td>
<td>94,08</td>
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<tr>
<td>2,48</td>
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<td>3,05</td>
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<tr>
<td>13,83</td>
<td>99,96</td>
</tr>
<tr>
<td>15,97</td>
<td>99,997</td>
</tr>
</tbody>
</table>

Recirculating cooker hoods – possibilities and challenges

2nd step: Odour Filter
Recirculating cooker hoods – possibilities and challenges

Recirculation Filter Portfolio – Region Europe

"Starter Set" with Foam
- Smell Reduction: <<90%
- 6 Months Use
- 1st Cost

Clean Air → Clean Air Plus
- Smell Reduction: >90%
- 12 Months Use

Regenerative
- Smell Reduction: 80 - 90%
- 10 Years Use

Active carbon chemically treated against fish smell

!! New !!
active carbon chemically treated against fish smell incl. a fleece against pollen and a biofunctional layer against allergens

Premium active carbon in ceramic honey comb structures

Clean Air Plus

Odour Filter Clean Air Plus with Bio-functional layer

- Odour Reduction (MEK) > 90%
- Anti-Fish-Function: special impregnation against fish smell

Anti-Pollen-Function:
+ air floating pollens are withdrawn by the filter
+ in filter captured allergens are deactivated

Carrier layer
Filters Particles and Pollen (>10μm) >99%
Filter Class: ePM10 70%

Activated carbon layer
Eliminates odor >90%
Especially treated against fish smell

Bio-functional layer
Natural polyphenols inactivates allergens >99%
Honeycombs Technology → high potential for Recirculation Filter

- Charcoal-Ceramic-Honeycombs
- Regeneration in Oven at 200°C
- Same performance after regeneration
- Lifetime of filter 10 years

Odor Reduction Efficiency Measurement with “MEK” (DIN EN 61591)

MEK is representing VOC (volatile organic compounds C$_x$H$_y$)

MEK / Butanone / C$_4$H$_8$O

other names:
- Methylethylketone
- Ethylmethylketone
- 2-Butanone
- Butan-2-on
- Methylpropanon
- Methylacetone
Measurement Method: DIN EN 61591 – Odour Filter

Odour extraction measurement quantifies the performance in odour extraction of a hood based on Methylethylketone / MEK

C1: MEK concentration (ppm) without odour filter
C2: MEK concentration (ppm) with odour filter

\[ GR = \frac{C_1 - C_2}{C_1} \]

Odor Reduction Efficiency Measurement with “TMA” (not standardized)

=> TMA as representative molecule for “fish smell”

TMA / Trimethylamine / \( C_3H_9N \)

other names:

- \( N,N\)-Dimethylmethaneamine
- TMA (ambiguous)
- NMe₃
- Fagin
3. Catch Rate Evaluation

Visual Catch Rate Evaluation / Example

5 shots out of time row of 50 / Power Level 2
### Visual Catch Rate Evaluation / Example

**Average Value out of 50 Shots**

<table>
<thead>
<tr>
<th></th>
<th>OFF</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
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<td><img src="image5" alt="Image" /></td>
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</tbody>
</table>

### Visual Catch Rate Evaluation / Example

**Worst Case out of 50 Shots for different power levels**

<table>
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<th></th>
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<td><img src="image9" alt="Image" /></td>
<td><img src="image10" alt="Image" /></td>
</tr>
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</table>
Numerical Catch Rate Simulations with Water Vapour

Box Hood 440 m³/h | 100% / 100%

Inclined Hood 400 m³/h | 100% / 96%

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4. Conclusion
Summary

1. Grease Filter
   Expanded aluminum mesh filters can reach good level of grease capturing efficiency, but is not working as “fine dust” filter. It is Important to “protect” the charcoal filter.

2. Odour Filter
   Big variation of performance can be found in the market (depending on amount and quality of charcoal), but odour reduction rate bigger 90% is possible. Regular replacement or regeneration is needed for keeping good performance. Can work as pollen filter.

3. Catch Rate
   Very important for overall performance, but difficult to measure. Additionally, it depends a lot on kitchen design and ambient air flow.

4. Conclusion =>

The Main Opportunities & Challenges

OPPORTUNITIES

Recirculation = no loss of heated air via the cooker hood

Facilitates kitchen and ventilation planning

A technology revolution in the last decade has raised recirculation to high performance level

CHALLENGES

Requires extra maintenance to change/regenerate carbon filters

Great variety of performance from excellent to almost useless products on the market

Does not remove all emitted particles
Thank You!