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## Sensory Pollution from Bag Filters, Carbon Filters and Combinations

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### 1 Introduction

Used ventilation filters commonly emit sensory pollutants, which may negatively impact sick building syndrome symptoms and occupant performance. Organic compounds associated with the captured particles can chemically transform (e.g. be oxidized) and/or desorb to the airstream. Such processes are anticipated to contribute to the degradation of perceived air quality. The present experiment investigated the sensory pollution from different combinations of bag-type filters and activated carbon filters after several months of continuous operation.

### 2 Methods

Various combinations of new filters were placed in eight units containing one or more filter housings of 60 x 30 cm size and a fan. All units operated at the same outdoor location with a continuous airflow of 1300m<sup>3</sup>/h for 5 months.

The eight tested filter sets were:

- 1) Single EU7 glass fiber filter;
- 2) EU7 glass fiber filter protected by a EU4 pre-filter, which was exchanged monthly;
- 3) EU7 glass fiber filter with an activated carbon (AC) filter upstream, to limit ozone initiated reactions on the surface of the EU7;
- 4) EU7 glass fiber filter with an AC filter downstream to remove organics desorbing from the EU7 filter surface;
- 5) EU7 glass fiber filter with AC filters both upstream and downstream;
- 6) EU7 pocket filter with carbon-filled fiberglass media (moderate amount of AC);
- 7) EU7 synthetic fiber cartridge filter with a larger amount of AC than #6; and
- 8) Single EU5 glass fiber filter.

Thirty-two human subjects assessed the perceived air quality downstream of the 5-month-used filters at 130 m<sup>3</sup>/h airflow indoors

(21°C, 25%RH). They recorded their assessments using a continuous acceptability scale with a range of acceptability from -1 (clearly unacceptable) to +1 (clearly acceptable). A set of brand-new filters, identical to the used ones, was assessed in an identical manner.

### 3 Results

Table 1 shows the results of the sensory assessments for the used filter sets and the average acceptability of air (ACC) downstream of the same filter sets consisting of new filters.

Table 1. Mean acceptability of air and the 95% confidence intervals.

Filter set No.	Mean ACC ± 95%CI
1-used	-0.43 ± 0.14
2-used	-0.25 ± 0.13
3-used	-0.18 ± 0.14
4-used	0.34 ± 0.16
5-used	0.48 ± 0.11
6-used	0.33 ± 0.16
7-used	0.10 ± 0.17
8-used	-0.07 ± 0.15
All-new (aver.)	0.45 ± 0.12

See Methods section for filter numbering details.

### 4 Conclusions

The results indicate that activated carbon filters downstream of particle filters in HVAC systems can meaningfully improve indoor air quality as the upstream filters accumulate captured particles. In comparison with commonly used fibrous pocket filters, those with carbon-filled fiberglass media could reduce the degradation of air quality that occurs with increasing filter service and, at the same time, remove a significant fraction of ozone from the supply air. Further experiments are warranted to confirm these striking results, especially with filter sets 4, 5 and 6.