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Efficiency test on the filter system in a Smoke Free Systems Cabinet model SF400, regarding 3-vinylpyridine and nicotine from tobacco smoke

Work requested

The commission was to evaluate the performance of the Smoke Free Systems smoking cabinet in terms of its capability to purify air from 3-vinylpyridine and nicotine, two typical components in tobacco smoke. The method used for measuring these VOCs corresponds to the standard method EN ISO 16017-1 "Indoor, ambient and workplace air -- Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography -- Part 1: Pumped sampling". SP is accredited for the analysis of VOCs.

Test item

A Smoke Free System Smoke cabinet, model SF400, was on the 16th of may 2005 set up at SP by the contractor. It was equipped with a two sets of fans and filters, working in parallell. Each of the sets contained a pre filter, two gas filters and a fine particle filter. The test were performed on one of these air systems.

Test performance

Gas samples were taken at the air inlet at the top of the cabinet and, simultaneously, at the air outlet after the filters (at the back of the cabinet, close to the floor). A cigarette holder was set up at the table inside the cabinet to represent actual smoking. Five cigarettes were lit simultaneously and left in the holder to produce tobacco smoke. The cigarettes were then regularly replaced with new ones in order to continuously have five burning cigarettes over the whole measuring period of approx 55 minutes. A total of 30 cigarettes were used during the test.

The exhaust fan was set at position 1 (out of 5). According to the contractor this corresponds to an air flow rate of 456 m³/h.

Sampling of volatile organic components were performed using Tenax® adsorbent tubes (of Perkin Elmer type). In order to measure only *gaseous* VOC components, a small glass fiber filter was used as a pre-filter on the Tenax tubes, both at the upstream and downstream measuring point. (Nicotine are easily particle adsorbed).

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VOCs were analysed by a GC-FID/MS system after thermal desorption of the Tenax tubes. The method includes VOCs in the boiling point range of approx. 70 to 320°C. (This corresponds to the hydrocarbon boiling point range of hexane to octadecane).

In the analysis two major tobacco smoke constituents were studied, *3-vinylpyridine* and *nicotine*.

Results

The levels of these compounds were calculated from the upstream and downstream samples. The results are summarised in the following table. In the sample from after the filter, no traces of them could be detected. Not even when searched for using ion search on the MS system. The detection limit were therefore calculated and used to express the filter reduction (see also Comments).

Figures for VOCs are expressed as toluene-equivalents. This is due to the fact that calibration of the GC analysis using the accurate substances would be extensive, without changing the results when calculating the filter efficiency. In other words, the filter function expressed as reduction rate will be the same with toluene equivalents as when using the accurate concentrations. (Reduction percentage are calculated as the adsorbed concentration divided by the upstream concentration).

<i>Measuring point</i>	<i>3-vinyl-pyridine</i> [$\mu\text{g}/\text{m}^3$] *	<i>Nicotine</i> [$\mu\text{g}/\text{m}^3$]*
Upstream gas filter	152	330
Downstream gas filter	<0,12 **	<0,12 **
<i>Filter reduction (percent)</i>	>99,9%	>99,9%

* as toluene ** achieved detection limit during test procedure

Comments and conclusion

Since the selected smoke constituents could not be found in any quantitative amounts downstream the filter, the detection limit has been used to express the downstream level as "less than...". Consequently, the corresponding efficiency or reduction percent figures are given as "better than...".

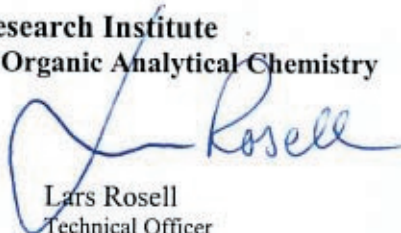
To sum up, for typical tobacco smoke effluents as 3-vinylpyridine and nicotine, the filter efficiency is very high.

The revision is made on August 22, 2005.

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