REPORT

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Testing the particle-reducing capability of an air cleaner

(1 appendix)

Item tested

Air cleaner: Vitalair (September 2001) with aluminum collector (diameter 129 mm) was delivered to SP on September 26, 2001 by Ionics Air AB. The air cleaner is of ionization type (carbon brush) and is equipped with a collector. The test results apply only for the item tested.

Place and date of testing

The tests of particle reduction efficiency were carried out at SP's Energy Technology / HVAC laboratory in Borås on October 2, 2001.

Test procedure

The test of particle reduction complies with the SP-method 2378 and was performed as follows:
The air cleaner was placed in an unventilated test chamber, 5,0 x 4,2 x 3,0 m^3 in size, the air in which was cleaned by an air cleaner prior to the start of the test. The tested air cleaner had been running in the test chamber for more than 24 h before the test. By lighting a cigarette (Red Prince) particles were generated. Meanwhile four fans circulated the air in the chamber. When the cigarette had created a sufficiently high particle concentration in the room, it was extinguished and the air cleaner was started. The four fans ran during the test to create normal air movements in the chamber. A particle counter was then started every minute, counting the number of particles over a 45-second period. The measurement proceeded until enough data for an appropriate decay curve was achieved. The temperature and humidity in the room were also measured during the test. The test was preceded by measurement of the natural rate of particle decay, i.e. without the air cleaner being in operation. The particle counter sampling probe was mounted at a height of 1,5 m above floor level in the test chamber ca 1 m from the test object. The air cleaner was placed on the floor (ionisation point 87 cm above the floor).

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Results

The particle-removing capacity of the cleaner is expressed as an equivalent cleaning ratio, ECR, corresponding to the ventilation flow rate of particle-free air that is needed to produce the same reduction in particles. This equivalent cleaning ratio is shown in table 1 for particle sizes 0,3-0,5 and 0,5-1,0 µm. The relative humidity of the air in the test chamber was 52 %, the temperature was 22 °C and the atmospheric pressure was 979 mbar.

	ECR [m³/h] (0,3-0,5 µm) **(0,4 µm)**	**ECR [m³/h]** (0,5-1,0 µm)
Vitalair (September 2001)	52	50

Table 1. The equivalent cleaning ratio.

	For room size	
	[m³]	**[m²]** [1)]
Vitalair (September 2001)	26	11

Table 2. Calculation of the room size is based on the following prerequisite: 0.5 ACH (air changes per hour), 80 % reduction for incoming particles of size 0,4 µm. [1)] *For a room height of 2,4 m.*

Calculations

Equivalent cleaning ratio, ECR:

$$q_{equivalent} = V_{room} \cdot (k_{ac} - k_n)$$

$$k = -\frac{(\sum_1^n t_i \cdot LnC_{t_i}) - \frac{(\sum_1^n t_i)(\sum_1^n LnC_{t_i})}{n}}{\sum_1^n t_i^2 - \frac{(\sum_1^n t_i)^2}{n}}$$

where:

$q_{equivalent}$	Equivalent cleaning ratio, ECR [m³/h]
V_{room}	Volume of the room (63 m³) [m³]
k_{ac}	Decay constant with the air cleaner [t^{-1}]
k_n	The natural decay constant (without the air cleaner) [t^{-1}]
t_i	Time at each measurement point [h]
C_{t_i}	Number of particles at time t_i [number]

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Measurement equipment

- Particle counter Climet CI-7300 (SP's inventory no. 201 384)
- Temperature and humidity meter TESTO 610 (SP's inventory no. 201 392)
- Barometer Druck DPI-260, (SP's inventory no. 201 637)

Estimated uncertainties of measurement

- Equivalent flow ± 5 m³/h (< 50 m³/h) and ± 10 % (> 50 m³/h)
- Relative humidity ± 3 %-RH
- Dry temperature ± 1 °C

Appendix

Appendix 1. Decay of particles in the chamber during test

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Decay of particles during test of Vitalair (September 2001)
(unventilated test chamber, 63 m³)