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Enclosure(s)
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Title
Determination of the elimination capacity of the Aetaire air purification system for bacteria.

Introduction
At the request of the firm Aetaire International in Son, the department of Microbiology of TNO Quality of Life has investigated the elimination capacity of the Aetaire air purification system for two types of microorganisms (bacteria).

The Aetaire air purification system is made up of various components:
- a ventilator
- a filter: 3M-'High Air Flow'
- a UV lamp (60 W, 254 nm)
- an ionizer

Materials
- Aetaire air purification system
- 4-jet Collison atomizer
- Impinger; 30 ml Physiological Saline (PS) solution; 0.85% NaCl
- Microbial Cascade Sampler
- Peptone Physiological Saline (PPS) solution; 0.85% NaCl / 1% peptone
- Physiological Saline (PS) solution; 0.85% NaCl
- PTFE / Norprene antistatic hoses
- Tryptone Soy Agar (TSA) plates

Types of mechanisms tested:
- *Staphylococcus aureus* ATCC6538
- *Pseudomonas aeruginosa,* ATCC 15442

Procedures
The effect of the Aetaire air purification system without chlorine dioxide injection on the microbiological quality quality/status of air was investigated.
Two different microorganisms were tested: the Gram-positive bacterium *Staphylococcus aureus* and the Gram-negative bacterium *Pseudomonas aeruginosa*.

The microorganisms *Staphylococcus aureus* ATCC6538 and *Pseudomonas aeruginosa* ATCC 15442 were cultivated on a slant tube (slant-TSA). After cultivation the cells were rinsed off the slant with 9 ml PPS solution and then added to 100 ml PS solution. That PS suspension was used for atomization. The concentration of *Staphylococcus aureus* in the PS suspension was $1.8x10^7$ colony-forming units (cfu) per ml. The concentration of *Pseudomonas aeruginosa* in the PS suspension was $1.3x10^8$ cfu per ml.

By means of the Collison atomizer a defined quantity of the microorganism in question was atomized in the air flow sucked in upstream (connected via a connecting piece and PTFE hoses to the inflow Aetaire air purification system). Upstream and downstream of the Aetaire air purification system the concentration in the air of the microorganism in question was determined by means of the Impinger and the Microbial Cascade Sampler. The sampling time is 10 min for both the Impinger and the Microbial Cascade Sampler.

After sampling the PS solution in the Impinger was tested on the presence of the microorganism in question by plating on TSA plates. The TSA plates of the Impinger and the Microbial Cascade Sampler were incubated for 24—48 h at 37 °C prior to counting.

The measurements were done with the UV lamp switched off (blank measurements) and with the UV lamp switched on (elimination measurements). Three blank and three elimination measurements were conducted for each of both microorganisms tested. On the basis of measured cfu ratings, with the UV lamp switched on and off, the log reduction was calculated as a measure of the extent of elimination of the microorganisms.

The speed of the air flow produced by the Aetaire was 25 m^3/h (lowest position).

Results

At the speed of the air flow produced by the Aetaire lair purification system of 25 m^3/h elimination of the bacteria *Staphylococcus aureus* and *Pseudomonas aeruginosa* was observed. The results showed that, relative to the elimination level, the blank level already showed some reduction as a result of shear occurring during atomization of the microorganism. Elimination as a result of shear during atomization of the microorganism was excluded from calculations of the elimination efficiency of the Aetaire air purification system. Switching on the UV lamp led to further elimination.
The results of the microbiological measurements are shown in Table 1.

Table 1. Counts of cfu ands log reduction per microorganism tested.

Sample number	Load level in cfu	cfu per test	Log reduction
Staphylococcus aureus			
1 – elimination	4.9×10^6	<3*	
1a – blank	4.9×10^6	4.1×10^4	
2 – elimination	4.9×10^6	<3	
2a – blank	4.9×10^6	4.6×10^4	
3 – elimination	4.9×10^6	<3	
3a – blank	4.9×10^6	6.7×10^4	
Mean	4.9×10^6	<3 en 5.1×10^4	> 4 log
Pseudomonas aeruginosa			
4 – elimination	3.5×10^7	<3	
4a – blank	3.5×10^7	2.2×10^3	
5 – elimination	3.5×10^7	<3	
5a – blank	3.5×10^7	3.9×10^3	
6 – elimination	3.5×10^7	<3	
6a – blank	3.5×10^7	5.2×10^3	
Mean	3.5×10^7	<3 en 3.8×10^3	> 3 log

* <3 = below the limit of detection for the Microbial Cascade Sampler, which is 3 cfu per test.
The limit of detection for the Microbial Cascade Sampler depends on the sample volume.

Conclusion

The results show that the bacteria (*Staphylococcus aureus* and *Pseudomonas aeruginosa)* in air are eliminated with relative ease by UV-C radiation. The DNA of these microorganisms is readily damaged, with cell death as a result. Elimination is of such a nature that the numbers of colony-forming units fall under the limit of detection for the measuring equipment.
The results of these measurements indicate that the Aetaire air purification system has, under these testing conditions, an elimination capacity of at least 4 log for *Staphylococcus aureus* and at least 3 log for *Pseudomonas aeruginosa*.

Yours faithfully,

J. Kastelein