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Test Report

Investigation of the effectiveness of an ionizer for air disinfection using the bacteriophage Phi6 DSM 21518

Client: SAMCO Autotechnik GmbH

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Order number: QL-1081-21

Testing period: September-October 2021

Date of report: 12.10.2021

The results only relate to the selected test conditions

1 Background

The company SAMCO Autotechnik GmbH has developed a device for the disinfection of air and surfaces respectively. It is based on a Plasma Module PL1001A (by ERDWELLE Technologies Inc.) and intends to improve the hygienic conditions in rooms of different size.

2 Objective

The objective of the described investigations was to quantify the achievable disinfection effect of two different devices with an integrated Plasma Module PL1001A (by ERDWELLE Technologies Inc.) and flow rates of 40 m³/h and 80 m³/h regarding the bacteriophage Phi6 DSM21518 in an aerosol (airborne contamination).

3 Experimental procedure

The trials for the assessment of the air disinfection were conducted in an emergency car with a volume of approximately 10 m³ (Figure 1). The emergency car was outside while the experiments were carried out. No ventilation or air conditioning was operated during the tests. The temperature inside the car was between 12 °C and 22 °C, depending on the weather conditions.

Figure 1 Emergency car for the test trials.

The devices to be tested for air disinfection were fixed in the ambulance on a stainless steel frame near the ceiling (see Figure 2).

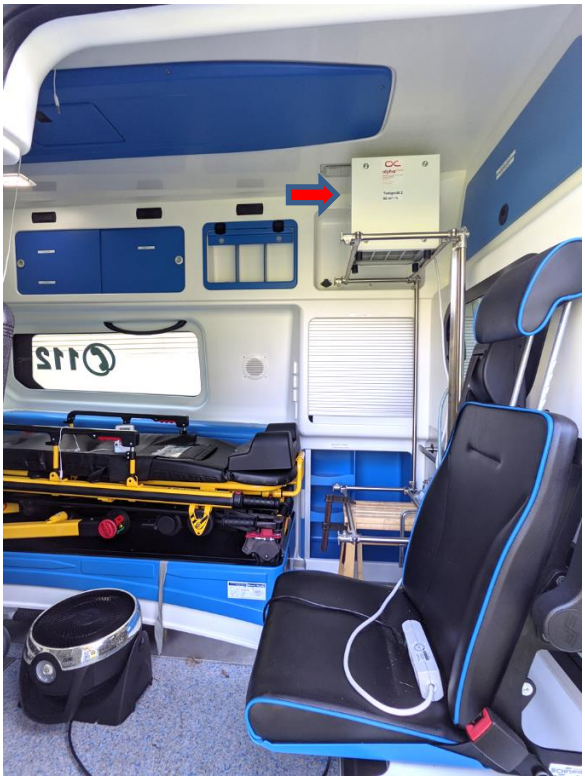

Figure 2 Experimental setup in the emergency car. The ionizer is located on the stainless steel frame (top right).

In order to determine the disinfection effect of the two test devices against airborne viruses, Phi6 bacteriophages were nebulized in a closed emergency car (volume approx. 10 m³) for 10 min with an aerosol generator (Palas AGK2000). A fan was operated continuously to ensure a homogeneous distribution of the phages in the room. After a defined period of time, the room air was sampled for 10 minutes with a Sartorius MD8 air sampler. During this period of time (10 min / 20 min / 30 min), the disinfection device to be tested was either switched off (reference sample) or in operation (treatment). A phage-containing aerosol was generated separately for each sampling (reference or treatment). Therefore, each test consisted of a reference sample and a treated sample. Plaque assays were used to determine the number of infectious phages in the reference as well as the treated samples. The logarithmic reduction of the number of infectious phages was calculated from the values of the reference and the treated sample from each experiment respectively. Each experiment was carried out three times independently (n = 3).

4 Results

Table 1 shows the results of the air disinfection trials. The logarithmic reduction for the air exchange rates 40 m³ / h and 80 m³ / h of three experiments with three treatment times respectively are shown as well as the mean percentage reduction. The determined reduction in the number of infectious phages turned out to be independent of the air exchange rate or the treatment time. No significant difference among the mean values of the determined logarithmic reductions in infectious phages under the selected test conditions was found (α=0.05). The number of infectious, airborne phages was reduced by more than 99.5 % in all cases during operation of the test devices.

Table 1 Results of experiments regarding air disinfection.

Flow rate [m³/h]	Treatment time [min]	Logarithmic reduction of infectious phages				Reduction of infectious phages [%]
		trial 1	trial 2	trial 3	Mean± SD	
80	10	2.12	2.57	2.75	**2.48**[a] ± 0.32	**99,67**
	20	2.09	3.53	3.05	**2.89**[a] ± 0.73	**99,87**
	30	2.48	2.33	2.15	**2.32**[a] ± 0.16	**99,52**
40	10	2.62	2.59	2.79	**2.67**[a] ± 0.11	**99,78**
	20	2.70	2.40	2.63	**2.57**[a] ± 0.16	**99,73**
	30	3.40	2.53	2.81	**2.91**[a] ± 0.44	**99,88**

a: Calculated mean values for different treatment times and air exchange rates are not significantly different (α=0.05).

5 Summary

The two tested devices (air exchange rate: 40 and 80 m³ / h) based on a Plasma Module PL1001A (by ERDWELLE Technologies Inc.) caused a significant reduction of airborne phage concentration. After a treatment time of 10 minutes at a flow rate of 80 m³ / h, a reduction of infectious phages by 2.48 orders of magnitude or 99.67 % was determined in a volume of 10 m³. At a flow rate of 40 m³ / h, a reduction of infectious phages by 2.67 orders of magnitude or 99.78 % was determined in a volume of 10 m³.

The investigations carried out did not include any testing of the devices with regard to safety-relevant issues such as the release of ozone.

6 Signatures

Fraunhofer Institute for Process Engineering and Packaging

Freising, October 12, 2021

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