Quantitative assay of the virucide efficacy of the air drier equipment Fusion (based on UNE-EN 14476)

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Introduction

Testing the virucidal capacity of disinfection systems must use non-pathogenic virues, sharing some characteristics with the pathogenic target virus (SARS-Co-V2). For this purpose, the use of non-pathogenic viruses that allow tests on their viability is recommended. Among these viruses there is the vMC0 strain of Mengo virus, whis has been genetically modified to make it harmless, and the bacteriophage MS2, a virus that infects bacteria (*Escherichia coli*) and, therefore, harmless to humans and that allows infectivity tests to be carried out.

Goal

To obtain a quantitative estimate of the virucidal capacity of the UVC systems included in the air hand drier Fusion® assayed at different treatment times and to know the experimental exponential decay rate, through an adaptation of the UNE-EN 14476 standard.

Test: Modified for quantitation

Summary of the test procedure

A total of $3,9 \times 10^5$ viral particles of Mengovirus VMC0 were spotted on an inert surface (glass slide) and located at 4 cms from the UVC light source ensuring that light intensity was equivalent for every spot on the slide.

At the indicated intervals (1 min, 10 min and 30 min) duplicate spots were recovered with cotton swabs soaked in PBS. The head of the swab was processed for RNA purification and extracts were further analyzed by RT-PCR using the MengoVir® Kit to quantify the viral particles remaining.

Samples are taken with the Sartorius 16757 Air Sampler, MD8 Airport with gelatin collection plates using a volumetric flow rate of 50 l / min for 5 minutes to a total volume per sample of 250 l (0.25 m^3).

A control experiment is carried out with air under turbulence and without the machine to obtain the baseline kinetics of virus decay. These kinetics are used as a reference to quantitatively evaluate the performance of the purifier equipment studied.

The plates with the samples are subjected to RNA extraction and then quantified using the qRT-PCR technique.

Table 1. Assay variables.

Organisms tested	Mengovirus VCM0
Dilution medium used	Phosphate buffer saline (PBS)
Neutralizing medium used	RNA later
Tested system	Air hand drier Fusion®
Disinfection method	Direct exposure to UVC light
Description of samples	Aquous viral suspension
Sample quantity	10 µl of 3,9 x 10^4 viral particles/µl
Treatment times	1 min; 10 min; 30 min
Deviations from the standard method	n.a.

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The results expressed below correspond exclusively to the samples tested.

Results aganist Bacteriophage MS2

The recovery of virus at the different test times is shown in Table 1.

Table 1. Viral load in the sampling volume at the different tested times for both control and treatment conditions.

Time (min)	Control GU*/µl	Treatment GU/µl	% vs control
0	3,90E+04	3,90E+04	
1	3,90E+04	7,21E+03	81,5%
10	3,90E+04	1,74E-02	99,6%
30	3,90E+04	0,00E+00	100,0%

* (GU: Genomic units)

Viruses are no longer detectable after 60 min with the loads used.

These results indicate that after 30 minutes of operation the air treatment mediated by the action of the ActivePure® machine is 94% more effective than the basal reduction.

Comparison of virus elimination kinetics between basal (control) and machine-mediated conditions indicates negative exponential kinetics with different rates. The rate of disappearance of the MS2 virus in the air in the presence of the machine is higher (Figure 2; Table 2) than that of the baseline conditions (without the machine).

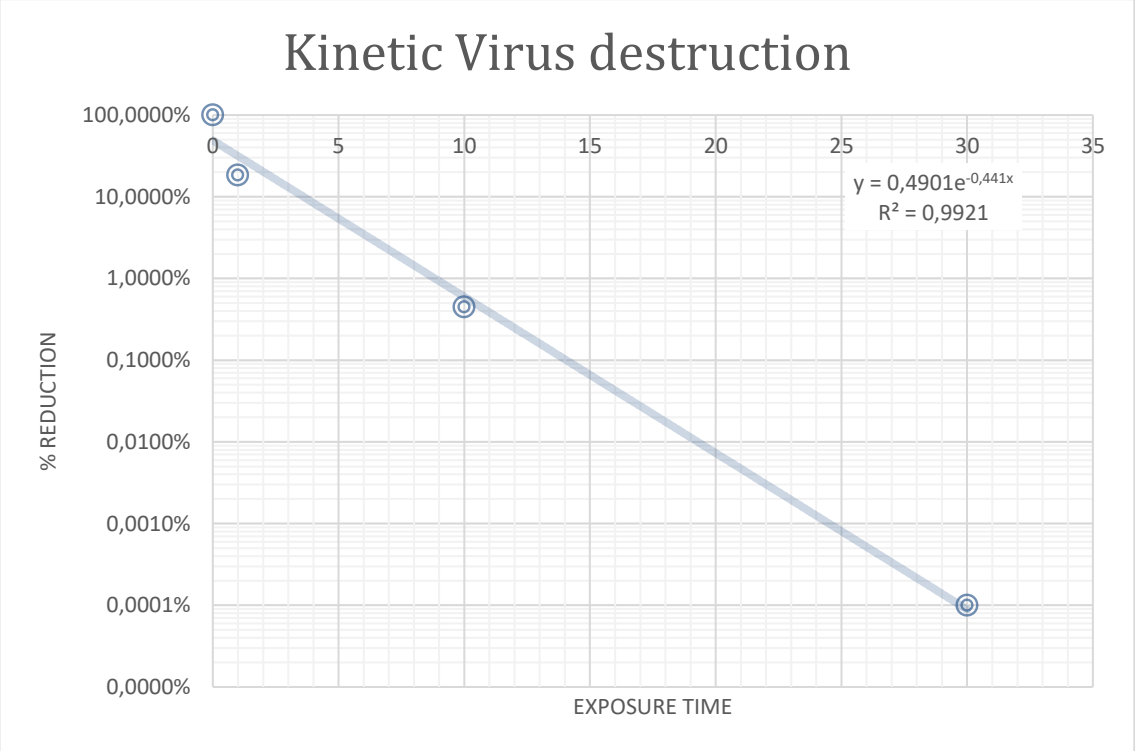

Figure 1. kinetics of Mengovirus VMC0 destruction as a result of UVC exposure

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Since data fit to an exponential kinetics model, the longer the treatment time, the grater the effect of the rate differential on the efficacy of the treatment. This is best expressed in short times, in which the measurement of viruses is possible, but it can be extrapolated by modeling the results under theoretical conditions (figure 2)

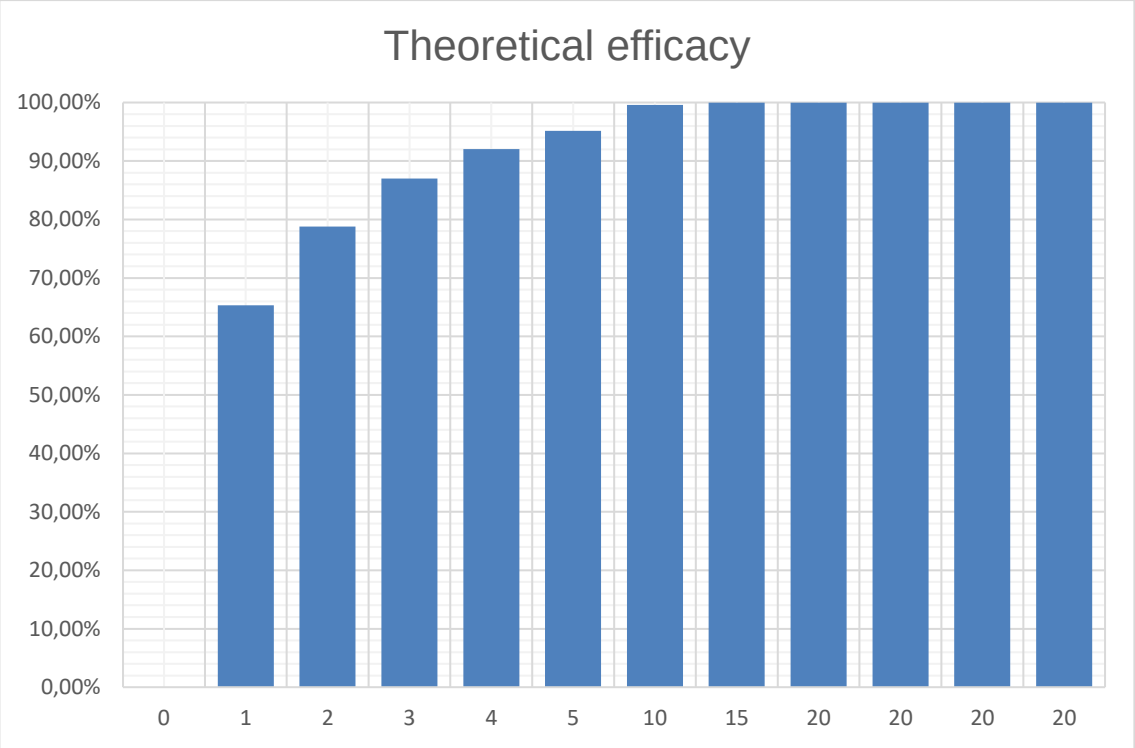

Figure 2. Theoretical efficacy of virus elimination calculated at different exposure times using the exponential rate (-0,441 min^{-1}) obtained

Table 3. Simulation of the virus disappearance kinetics using the parameters measured in the test.

Time	% Survival	% efficacy
0	100,0000%	0,00%
1	34,7012%	65,30%
2	21,2376%	78,76%
3	12,9977%	87,00%
4	7,9548%	92,05%
5	4,8684%	95,13%
10	0,4180%	99,58%
15	0,0359%	99,96%
20	**0,0031%**	**100,00%**

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Conclusions

The use of UVC destroys the virus control VMC0 at an exponential decay rate of -0.441 min^{-1}. With this value complete destruction of the virus is achieved after 20 min of functioning, which provides a disinfected environment inside the hand drier.

Simulation from the kinetics obtained experimentally indicates that the technology included in the hand drier Fusion® is effective for the purification of the UVC-affected air in terms of elimination/destruction of viral particles.

This efficacy increases exponentially with the exposure time, according to the following values:

Girona, February 12th, 2021

Signed:

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