Evaluation of the performance of UV device for the reduction in airborne microorganisms.

By
Dr Louise Fletcher

2nd February 2017

Contents

Objectives of the Study

The aim of the experiments was to determine the performance of an ultraviolet light device for the for the reduction in the concentration of airborne microorganisms.

The test microorganisms

The experiments were performed using pure cultures of *E. coli* and *Bacillus subtilis* both of which were grown up in nutrient broth prior to the start of the experiments.

Experimental methodology

The test chamber was set up and the device positioned in the centre of the room with a flexible tube through which the microorganisms are nebulised close to the inlet to the device. The chamber door closed and locked and the ventilation fans were switched on and room was ventilated at 1.5 AC/hr and nebulisation of the bacterial culture then began and the concentration in the test chamber was allowed to stabilize for 30 minutes. A total of ten replicate samples were then taken onto sterile TBX Agar (*E. coli*) and tryptone soya agar (*B. subtilis*) during which time the UV device remained switched off and these are the control samples. Once all ten samples had been taken the device was then switched on remotely and left for 30 minutes for the UV lamps to warm up and the concentration of bacteria in the air inside the chamber to reach steady state once again. A further ten replicate samples were then taken as described above.

Once all the samples had been taken the device and the nebuliser were switched off the agar plates were incubated at 37°C for 48 hours after which the number of colonies on each plate were counted. All the counts were then subjected to positive-hole correction in order to account for multiple impaction (Macher 1989). The corrected counts for each set of plates (stages 5 and 6) were added together to give a total count and multiplied to give a count per m^3 of test chamber air. Each set of samples represents ten replicates taken during steady state, the first ten being the concentration without the device operating and the second ten with the device switched on. The mean was taken of the ten replicate samples to give a mean concentration with and without the device. This allowed the mean reduction in concentration to be calculated used to give an indication as to the efficacy of the device

Results

Impact of the device on the concentration of airborne E. coli.

Figure 1 shows the concentration of airborne *E. coli* in the test chamber during the test carried out UV device and Table 1 shows a summary of the data. The concentration of *E. coli* during the control period ranged from 7221 up to 14680 cfu/m^3 with a mean concentration of 11119 cfu/m^3. The concentration dropped dramatically when the device was switched on and the concentration during this period ranged from a low of 0 up to 53 cfu/m^3 and had a mean concentration of 25 cfu/m^3. This represents a reduction of 11094 cfu/m^3 which is 99.8%.

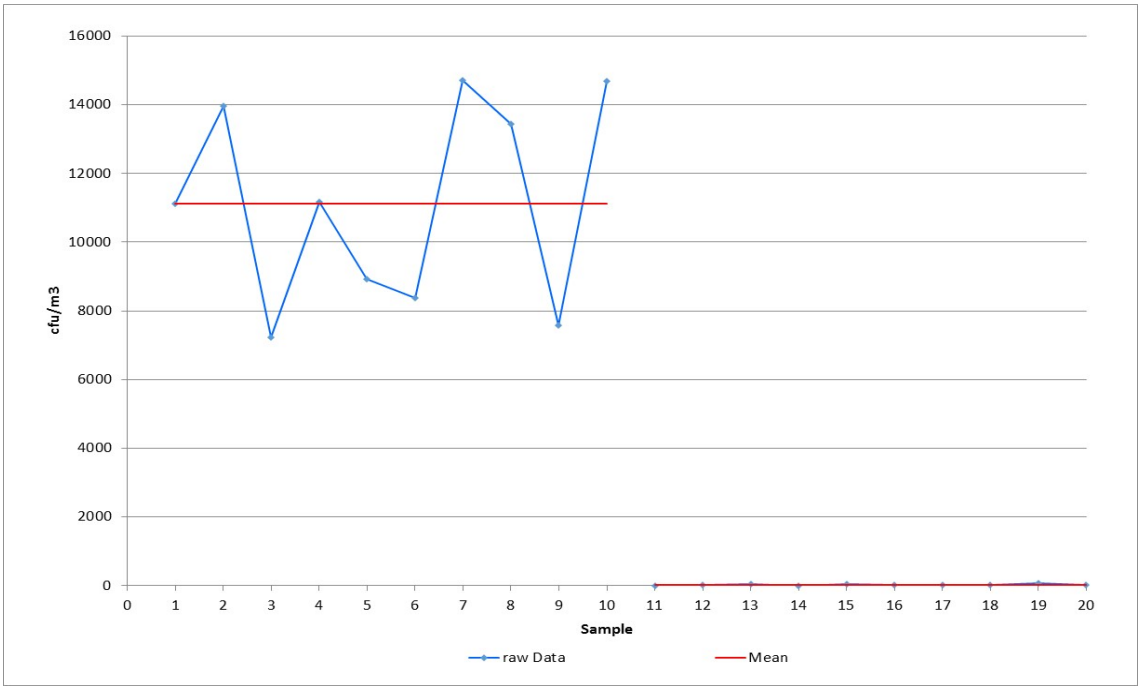

Figure 1 Impact of the UV device on the concentration of airborne E. coli

Impact of the device on the concentration of airborne B. subtilis.

Figure 2 shows the concentration of airborne *B. subtilis* in the test chamber during the test carried out UV device and Table 1 shows a summary of the data. The concentration of *B. subtilis* during the control period ranged from 26111 up to 36758 cfu/m^3 with a mean concentration of 29683 cfu/m^3. No B. subtilis was detected once the device was switched on and therefore 100% removal was achieved.

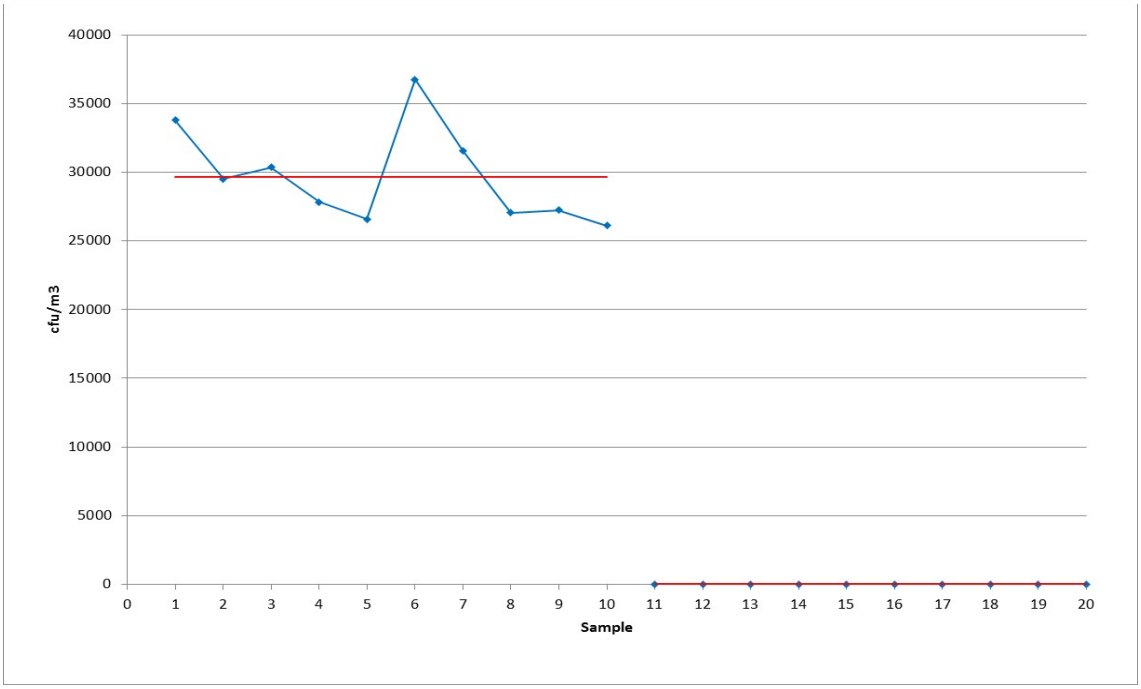

Figure 1 Impact of the UV device on the concentration of airborne B. Subtilis

Table 1 Summary data for E. coli and B. subtilis

Device	Concentration (cfu/m^3)				Reduction			p Value
	Before		After					
	Mean	SD	Mean	SD	cfu/m^3	%	Log	
E. Coli	11118.6	2965.6	24.7	22.3	11093.8	99.8	2.65	< 0.01
B. subtilis	29683.2	3489.1	0.0	0.0	29683.2	100.0	0.60	< 0.01

Conclusions

The UV device is capable of almost complete removal of the airborne microorganisms tested.