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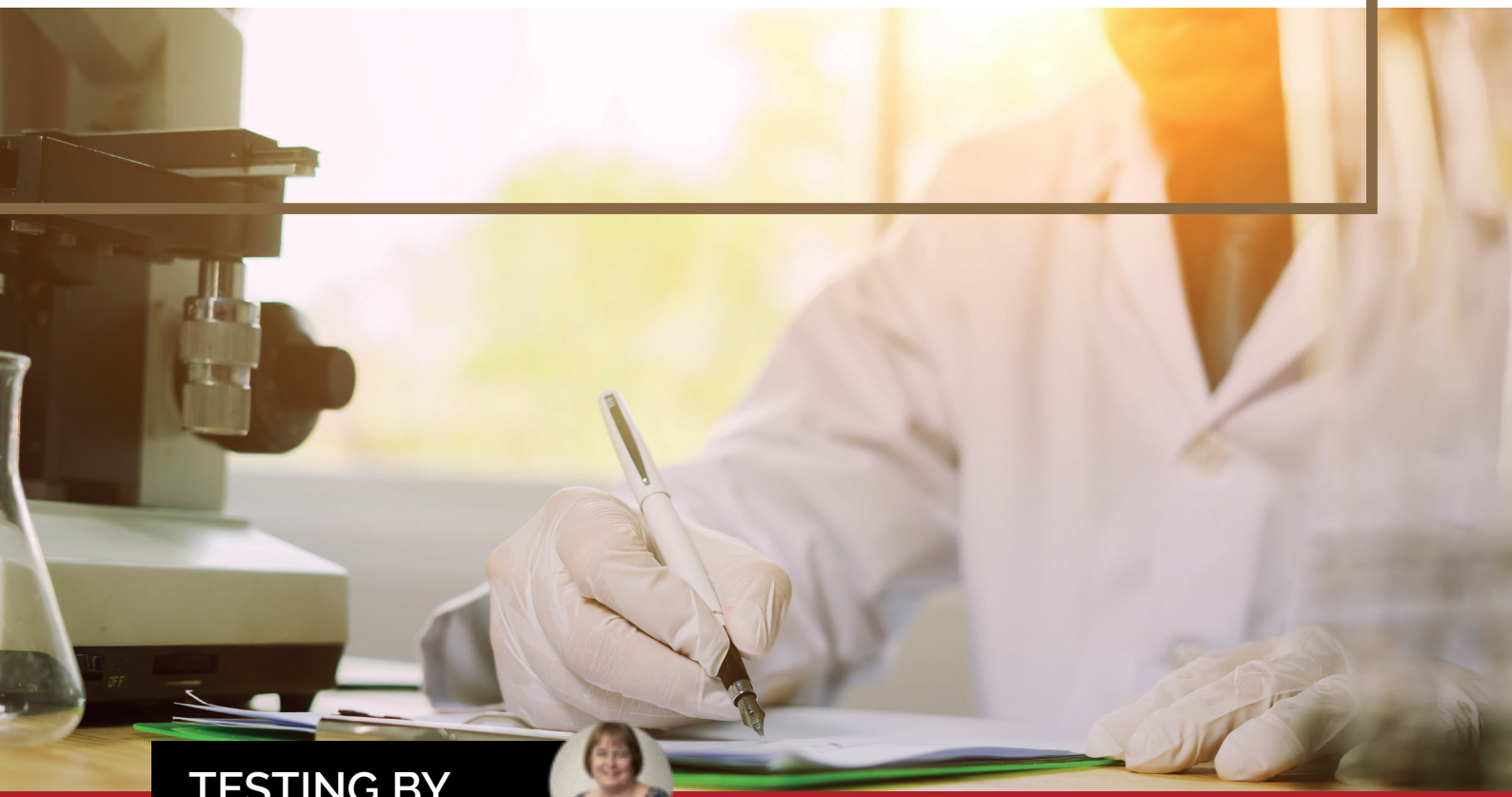
Evaluation of the air disinfection potential of the AIRsteril device



TESTING BY

Dr Louise Fletcher

Areas of expertise: waste management; aerobiology; environmental microbiology

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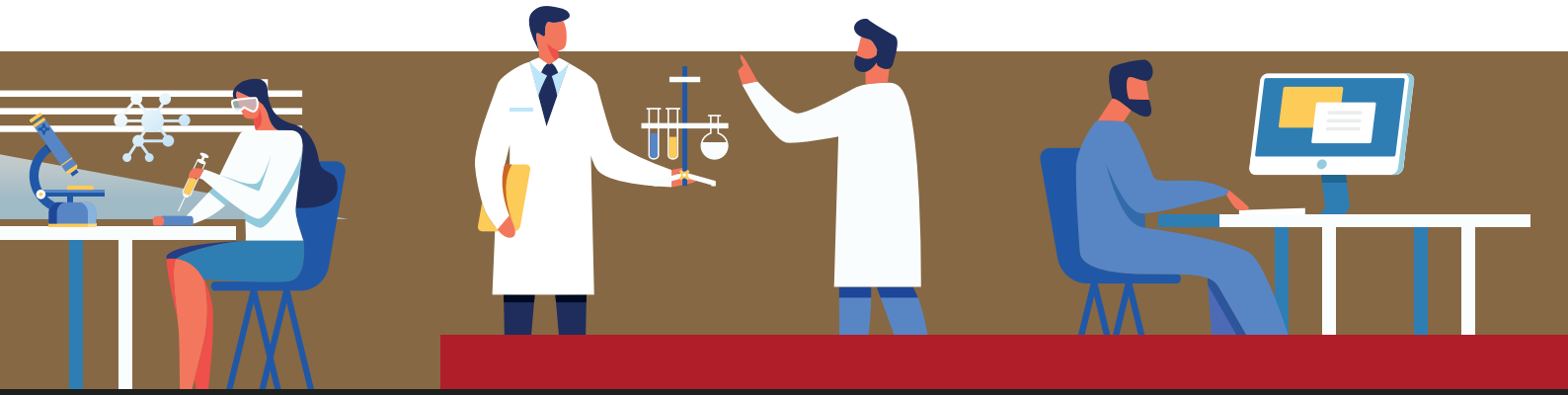

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1. AIR DISINFECTION POTENTIAL

1.1 Objectives of the Study
The objective of the experiments was to determine the efficacy of the device in terms of its ability to reduce the concentration of viable microorganisms in the air in a one cubic metre test enclosure.

1.2 Test microorganisms
The surface tests were carried out using pure cultures of three microorganisms as follows:
Staphylococcus aureus – ATCC6538
Escherichia coli - ATCC10536
Aspergillus fumigatus (isolated from green waste compost)

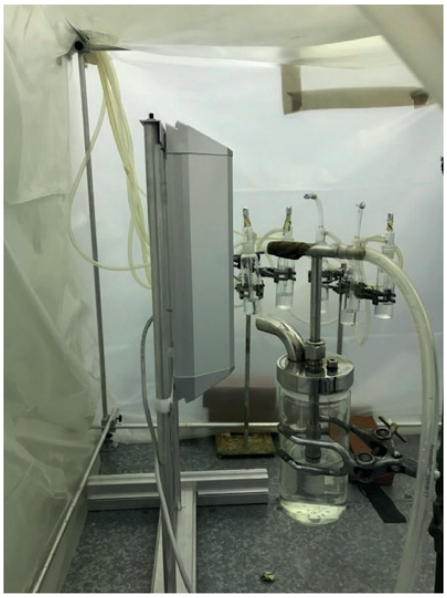
1.3 Culture preparation
The S. aureus and E. coli cultures were prepared by using the cultiloops to inoculate 50ml of sterile nutrient broth (Oxoid, UK). The broths were then incubated at 37˚C for 24 hours and shaken at 100rpm. The A. fumigatus stock was prepared by inoculating sterile malt extract agar plates and incubating at 40˚C for 48 hours. After incubation the plates were washed with sterile ringer's solution to harvest the fungal spores.

1.4 Preparation of the nebuliser
Initial tests carried out using the 3-jet nebuliser as per the PHE report (15/046 A) failed to yield significant colony counts and therefore the decision was taken to use the 6-jet nebuliser in order to increase the concentration of airborne microorganisms in the air inside the enclosure. The nebuliser was autoclaved and prior to the start of each test it was filled with 50ml of the test culture.

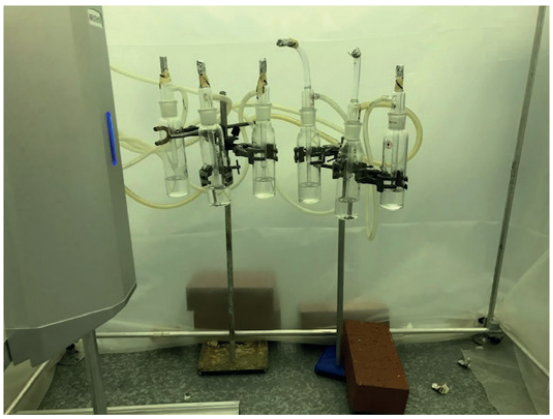
1.5 Preparation of the air samplers
The air samples were taken with six AGI-30 samplers which were weighed and then filled with 30ml of ringer's solution and autoclaved. The flow rate for the air samples was 12 l/min.

1.6 The test enclosure
The tests were carried out inside a 1 cubic metre enclosure that was made from aluminium laboratory scaffold covered in a double sheet of heavy duty plastic. During the experiments the plastic sheeting was sealed with tape to ensure no leakage of bioaerosols into the test chamber. The device was placed into the enclosure together with the nebuliser and six AGI-30 impingers. A fan was placed underneath the outlet of the nebuliser to ensure the microorganisms stayed in suspension. The arrangement can be seen in the photographs below.

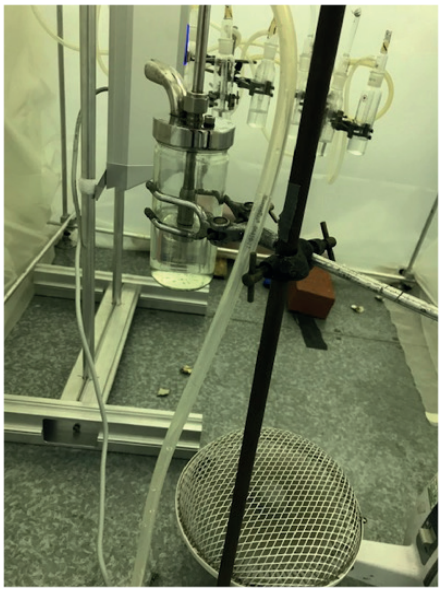
1. AIR DISINFECTION POTENTIAL



PLACEMENT OF THE DEVICE, NEBULISER AND IMPINGERS IN THE ENCLOSURE



ARRANGEMENT OF THE SIX IMPINGERS



LOCATION OF THE FAN UNDER THE OUTLET FROM THE NEBULISER

1. AIR DISINFECTION POTENTIAL

1.7 Air disinfection experimental methodology

Prior to the start of the experiment the enclosure, nebuliser and impingers were prepared as described above and were placed into the enclosure as illustrated in the photographs above. The enclosure was then sealed and the fan and the device switched on and operated for 2 hours. After 2 hours the nebuliser was switched on and operated for 5 minutes.

1.8 Enumeration of the bacteria in the impingers

After the end of the test the impingers were taken into the laboratory and weighed to determine the volume of ringer's solution in the samplers. Then using aseptic techniques an aliquot of 0.1ml from each impinger was plated out onto two sterile tryptone soya agar for E. coli and S. aureus and onto malt extract agar for the A. fumigatus. The E. coli and S. aureus plates were incubated at 37˚C for 24 hours and the A. fumigatus for 48 hours at 40˚C. After incubation the number of colonies on each plate was counted and was multiplied by 10 and then by the volume of liquid in each impinger (determined by the weights) to determine the number in the sampler. This was then multiplied up to determine the concentration per cubic metre.

1.9 Results and discussion

The results from the tests can be seen in Table 1 below which shows the mean concentrations after 5 minutes and 60 minutes together with the calculated percent reduction. After 60 minutes the airborne microorganisms are undetectable in the air inside the enclosure when Airsteril technology is in operation.

Elapsed	E. coli		S. aureus		A. fumigatus	
Time (mins)	Control	Airsteril	Control	Airsteril	Control	Airsteril
5	44609	47456	23168	20170	25348	26551
60	1844 (96%)	0 (100%)	17943 (23%)	0 (100%)	4095 (84%)	0 (100%)