

Summary of Test Results

Scientific trials undertaken over a number of years by recognised and authoritative independent laboratories proving the effectiveness of the MicrogenixTM air purification system in killing airborne bacteria and viruses using the unique combination of both the Biogreen 3000TM activated matrix together with eradication by ultra violet light

including reports from

CAMR

**Centre for Applied Microbiology and Research
Porton Down, UK**

[dstl]

**formerly the
Defence, Evaluation & Research Agency
now the
Defence Science Technology Laboratory
Porton Down, UK
(part of the UK Ministry of Defence)**

[dstl]

DEFENCE SCIENCE TECHNOLOGY LABORATORY – PORTON DOWN, UK
formerly DEFENCE, EVALUATION & RESEARCH AGENCY (DERA)

Testing against Anthrax simulant

DERA was an Agency of the UK Ministry of Defence. It has recently changed it's name and is now known as **DSTL** (Defence, Science and Technology Laboratory)

Report prepared by: Principal Scientist, A.J.CLARK
 Report authorised by: Technical Manager, A.J. BELL
 Report approved by: Scientific Leader, J.M. CLARK
 Principal Authors: A.J.Clark, Principal Scientist
 H. Bird, Scientific Leader
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 D. Webber, Scientist
 P. Whatley, Project Manager

The aim of the scientific trials was to test the effectiveness of a prototype air purification unit against aerosolised simulant bacteria Anthrax.

RESULTS - SPORES SPRAYED – ANTHRAX SIMULANT

Flow rate (m ³ /hr)	Run	Filter	CFU/filter*	BG spores sprayed	Remaining	Average BG	Efficiency %
71	4	1	50	8.E+09	3.0	7.6E+09	100.0
71	4	2	100	8.E+09	3.0	7.6E+09	100.0
71	4	3	200	8.E+09	3.0	7.6E+09	100.0
71	4	4	26300	8.E+09	3.0	7.6E+09	99.9
140	5	1	600	8.E+09	3.0	7.6E+09	99.9
140	5	2	100	8.E+09	3.0	7.6E+09	100.0
140	5	3	500	8.E+09	3.0	7.6E+09	99.9
140	5	4	134500	8.E+09	3.0	7.6E+09	99.8
170	6	1	100	8.E+09	3.0	7.6E+09	100.0
170	6	2	150	8.E+09	3.0	7.6E+09	100.0
170	6	3	150	8.E+09	3.0	7.6E+09	100.0
170	6	4	50800	8.E+09	3.0	7.6E+09	99.9

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CENTRE FOR APPLIED MICROBIOLOGY & RESEARCH - PORTON DOWN, UK

Testing against Tuberculosis simulant - April 2003

Report prepared by: Scientist, W.D. Griffiths
Principal Scientist: Scientist, Alan Bennett

Clinical trials carried out by scientists employed at CAMR, Porton Down
(The full report is available upon request subject to security considerations)

Test Micro-Organism: *Mycobacterium vaccae* (ATCC 15483)

The performance of a Microgenix Air Purification System was determined under the manufacturer's standard operating conditions against aerosols of *Mycobacterium vaccae* (ATCC 15483), a mycobacterial model selected as a surrogate for *Mycobacterium tuberculosis*. The Microgenix Air Purification System was challenged with the *Mycobacterium vaccae* at 500 m³ hr⁻¹ in a controlled system with six UV lamps activated. The results of the tests are summarised below for each run as percentage (%) efficiency of the system:

Test Conditions	% Efficiency of the System
6 UV Lamps Activated (1)	>99.995
6 UV Lamps Activated (2)	>99.997
6 UV Lamps Activated (3)	>99.998

The mean % efficiency of the Microgenix Air Purification System is >99.997 ± 0.0015 (standard deviation).

The duct-mounted Microgenix Air Purification System operating at settings recommended by the manufacturer in a controlled system (6 UV lamps activated at 500 m³hr⁻¹) has an **efficiency in excess of 99.997 % (± 0.0015)** against airborne *Mycobacterium vaccae*.

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CENTRE FOR APPLIED MICROBIOLOGY & RESEARCH - PORTON DOWN, UK

Testing against Smallpox simulant – December 2002

Report prepared by: Scientist, W.D. Griffiths
Principal Scientist: Scientist, Alan Bennett

Clinical trials carried out by Scientists employed at CAMR, Porton Down
(The full report is available upon request subject to security considerations)

Test Micro-Organism: MS-2 Coliphage (NCIMB 10108)

Stock suspensions of MS-2 were prepared by infecting host organism
Escherichia coli ATCC 12435 (NCIMB9481)

The performance of the Air Purification System was determined against viral aerosols of MS-2 coliphage (NCIMB 10108). The Microgenix Air Purification system was challenged with the MS-2 coliphage at 500 m³hr⁻¹.

RESULTS – SPORES SPRAYED - SMALLPOX SIMULANTS

Test Conditions	Total Challenge to system (pfu/m ³)	Collected downstream of system (pfu/m ³)	% Efficiency of the System
1 - Microgenix MD	4.25 x 10 ⁷	7.45 x 10 ⁵	98.25
2 - Microgenix MD	4.29 x 10 ⁷	1.78 x 10 ⁶	95.85
3 - Microgenix MD	5.08 x 10 ⁷	1.06 x 10 ⁶	97.91

Following the above trials, small modifications to the internal workings of the system were implemented resulting in increased exposure of micro organisms to germicidal ultra violet within the alanod light chamber. This is giving an increase in efficiency in excess of **99.00 %**.



UNIVERSITY OF LEEDS TEST

Faculty of Biological Sciences, Division of Microbiology, University of Leeds

BIOGREEN 3000™ Activated Matrix Test

The ability of Ultra Violet light in killing micro organisms and spores is well documented.

The Microgenix air purification technology is based on a combination of both eradication by ultra violet light and eradication by Biogreen 3000™

The purpose of the test was to determine the effectiveness of Biogreen 3000™ in killing or inhibiting the growth of indicator micro-organisms.

Staphylococcus epidermidis

Consistent results were obtained from sixteen experiments with *Staphylococcus epidermidis* dosing at room temperature and 37°C.

The untreated filters did not kill or inhibit the growth of *Staphylococcus epidermidis*

The Biogreen 3000™ activated matrix inhibited growth and killed the dose of *Staphylococcus epidermidis* applied at room temperature and at 37°C

ROOM TEMPERATURE			INCUBATED AT 37°C		
SAMPLE	6 HOUR	24 HOUR	SAMPLE	6 HOUR	24 HOUR
Untreated filter material	1.20 x 10 ²	Confluent swarming colonies	Untreated filter material	No growth	Confluent swarming colonies
Biogreen 3000™ activated matrix	No growth	No growth	Biogreen 3000™ activated matrix	No growth	No growth

BIOGREEN 3000™

Biogreen 3000™ antimicrobial has been proven effective in controlling a wide range of gram positive and gram negative bacteria. The following list represents types of microorganisms against which Biogreen 3000™ has been specifically tested

Acinetobacter calcoaceticus 1	Mycobacterium smegmatis
Bacillus cereus	Mycobacterium tuberculosis
Bacillus subtilis	Propionibacterium acnes
Brucella abortus	Proteus mirabilis
Brucella canis	Proteus vulgaris
Brucella suis	Pseudomonas aeruginosa
Citrobacter diversus 1	Pseudomonas aeruginosa
Clostridium perfringens	Propionibacterium acnes
Corynebacterium bovis	Proteus vulgaris
Enterobacter agglomerans 1	Pseudomonas cepacia
Escherichia coli 1	Pseudomonas fluorescens
Escherichia coli ATCC 23266	Salmonella Choleraesuis
Haemophilus influenzae	Salmonella typhosa
Haemophilus suis	Staphylococcus aureus (non pigmented) 1
Klebsiella pneumonia ATCC4352I	Staphylococcus aureus (pigmented) 1
Lactobacillus casei	Staphylococcus epidermidis 1
Leuconostoc lactis	Streptococcus faecalis
Listeria Monocytogenes	Streptococcus mutans
Micrococcus sp	Xanthomonas campestris
Biogreen 3000 has been proven effective in controlling all fungus including	
Aspergillus flavus	Oospora lactis
Aspergillus fumigatus	Penicillium albicans
Aspergillus niger	Penicillium citrinum
Aspergillus versicolor	Penicillium elegans
Aspergillus terreus	Penicillium funiculosum
Aureobasidium pullulans	Penicillium humicola
Chaetomium globosum	Penicillium notatum
Cladosporium herbarum	Penicillium variabile
Fusarium nigrum	Stachybotrys atra
Fusarium solani	Trichoderma flavus
Gliocladium reseau	Tricophyton interdigitale
Mucor sp.	Tricophyton mentagrophytes
Biogreen 3000™ has been proven effective in controlling yeast and algae including	
Anabaena cylindrica	Pleurococcus sp.LB11
Candida albicans	Saccharomyces cerevisiae
Chlorella vulgaris	Schenedesmus quadricauda
Gonium sp. LB 9c	Selenastrum gracile B325

ULTRAVIOLET

Eradication by Ultra Violet. It is the combination of both the Biogreen 3000™ activated matrix and eradication by ultra violet light which gives the Microgenix™ air purification system a unique edge over others on the market.

The approximate doses of UN 254nm energy required for the inactivation of micro-organisms up to 90% is shown below:

Doses of Ultra Violet – 254nm in mWsec/cm² (mJ/cm²)

Organisms	Dose	Yeasts	Dose
Bacterium coli in water	5.40	Bakers yeast	3.9
Bacillus anthracis	4.52	Brewers yeast	3.3
B.megatherium (<i>veg</i>)	1.13	Common yeast cake	6.0
B.megatherium (<i>spores</i>)	2.73	Saccharomyces ellipsoideus	6.0
B.parathyphosous	3.20	Saccharomyces sp.	8.0
B. subtilis	7.10	Saccharomyces cerevisiae	6.0
B. subtilis (<i>spores</i>)	12.00	Torula sphaerica (<i>found in milk & cream</i>)	2.3
Corynebact, diphtheriae	3.37	Various algae	
Dysentry bacilli	2.20	Diatoms	
Eberthella typhosa	2.14	Green algae – 360.0 – 600.0	
Escherichian coli	3.00	Blue algae	
Legionella pneu (<i>Legeionnaires</i>)		Protozoa	
Micrococcus candidus	6.05	Paramecium – 64.0 – 100.0	
Micrococcus piltonencis	8.10	Mould spores	
Micrococcus sphaeroides	10.00	Aspergillus amstelodami (<i>meat</i>)	66.0
Neisseria catarrhalis	4.40	Aspergillus flavus	60.0
Phytomonas tumefaciens	4.40	Aspergillus glaucus	44.0
Proteus vulgaris	2.64	Aspergillus niger (<i>bakeries</i>)	132.0
Pseudomanas aeruginosa	5.50	Cladosporium herbarum (<i>cold sores</i>)	60.0
Pseudomanas fluorescens	3.50	Mucor mucedo (<i>meat, bread & cheese</i>)	65.0
S. typhimurium	8.00	Mucor racemodus A	17.0
Sarcina luta	19.70	Mucor racemodus B	17.0
Serratia marcescens	2.40	Oospara lactis	5.0
Shigella paradyscenteriae	1.68	Penicillium digitatum	44.0
Spirillum rubrum	4.40	Penicillium expansum	13.0
Staphylococcus albus	1.84	Penicillium chrysogenum (<i>fruit</i>)	50.0
Staphylococcus aureus	2.60	Penicillium roqueforti	13.0
Streptococcus hemolytics	2.16	Rhizopus nigricans	111.0
Streptococcus lactis	6.15	Scopulariopsis brevicaulis (<i>cheese etc</i>)	80.0
Streptococcus viridans	2.00		
Tubercle bacillus	10.00		