

# Antimicrobial coated ventilation filters for the control of *Legionella* bacteria

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# THOUSANDS AT RISK AS DOCTORS GO ON ALERT FOR SUSPECTED LEGIONNAIRES Health chiefs hunt for Legion bug in West End

Killer disease spreads

SHOP DEATH BUG DANGER

The New York Times | <http://nyti.ms/1fPOyEH>

N.Y. / REGION

## Legionnaires' Bacteria Regrew in Bronx Cooling Towers That Were Disinfected

By BENJAMIN MUELLER OCT. 1, 2015

The 15 water-cooling towers that were found to be contaminated this week amid a new cluster of Legionnaires' disease cases had been disinfected less than two months ago, New York City officials said on Thursday, raising questions about how successful the city can be in containing the disease.

After an outbreak of the disease killed 12 people in July and August in the South Bronx, the city required every building with cooling towers, a common source of the Legionella bacteria that cause the disease, to be cleaned within two weeks.

Prof. Erşahin klima kurbanı mı? - Sağlık - ntvmsnbc.com

<http://www.ntvmsnbc.com>

ntvmsnbc

İstanbul 28°C / 17°C değişir

Türkiye Dünya Ekonomi Bilim ve Teknoloji Eğitim Kültür Sanat NTV Spor Yaşam Sağlık Otomobil

Anasayfa Sağlık

Güncelleme: 13:21 TSi 20 Haziran, 2014 Cuma

Kategoriler

Türkiye Dünya Ekonomi Bilim ve Teknoloji Kültür Sanat Yaşam Eğitim NTV Spor Sağlık Ortak Gelecek Hava Yol Yeşil Haber Seçim 2014

Hızlı Menü kapat

Multimedya

Foto Galeri

Video Galeri

Bizi Takip Edin

Kısayollar

Anasayfa yap

**Prof. Erşahin klima kurbanı mı?**

Akciğer enfeksiyonu nedeniyle yaşamını yitiren Beyin Cerrahisi Prof. Yusuf Erşahin'in kanında kilmalardan bulaşan lejyoner hastalığı mikrobunun saptandığı belirtildi. Erşahin'in ölümcül mikrobu Adana'da kaldığı otelde kapıldığı iddiası üzerine dikkatler bir kez daha kilmalardaki tehlikeye çevrildi.



**TÜLAY KARABAĞ**  
ntvmsnbc  
Güncelleme: 13:21 TSi 20 Haziran, 2014 Cuma

İSTANBUL - Ege Üniversitesi Tıp Fakültesi'nde görevli Beyin Cerrahisi Prof. Dr. Yusuf Erşahin, akciğer enfeksiyonu nedeniyle 56 yaşında hayatını kaybetti. Prof. Erşahin'in kanında özellikle iyi temizlenmeyen kilmalardan hava filtrelerinde bulunan ve insanlarda pnömöni gibi hastalıklara yol açan Legionella pneumophila adlı bakterisi bulunduğu belirtildi. Erşahin'in bakteriyi geçtiğimiz hafta bir kongreye katılmak için gittiği Adana'da kaldığı otelde kapıldığı üzerinde durulduğu ve otelle ilgili inceleme başlatıldığı bildirildi.

Alert  
ak  
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reak

Race to find a killer legionnaires' virus



# Background



- American Legion Convention 1976
- Philadelphia, Belle Vue-Stratford hotel
- 182 cases with 29 deaths
- Discovered by Dr Joseph McDade
- Bacteria common in water and soil



*Pennsylvania Legionnaires attended a November 1976 consumer protection subcommittee hearing on Legionnaires' disease in Philadelphia. As news spread of 29 dead and nearly 200 taken ill, reporters named the disease after stricken Legion members. AP*

# What is Legionella?



- A naturally occurring bacterium
- Found in most water systems
- Often present in mains water
- Easily colonises most domestic water systems – hot and cold

*L. pneumophila* is a Gram negative, non-encapsulated, aerobic bacillus with a single, polar flagellum. The organism is approximately 2  $\mu\text{m}$  in length and 0.3-0.9  $\mu\text{m}$  in width, but in nutrient-deficient media, it may become long and filamentous.



# Requirements for Growth?



- Optimum temperature range of 20 - 45 °C
- Food source (other bacteria & sediments)
- Prefers stagnant conditions

**All Factors that Lead to Biofilm Formation**





# Typical Systems at Risk

- Cooling Towers
- Domestic hot & cold water systems
- Water features incl. ornamental fountains
- Equipment producing aerosols, mists or droplets from stored water sources including showers & humidifiers
- Equipment holding / circulating water at 20 – 45°C

- Misting equipment
- Dentistry tools,
- Mobile AC equipment with water
- Oil / water emulsions for lubricating lathes

# Infection and symptoms

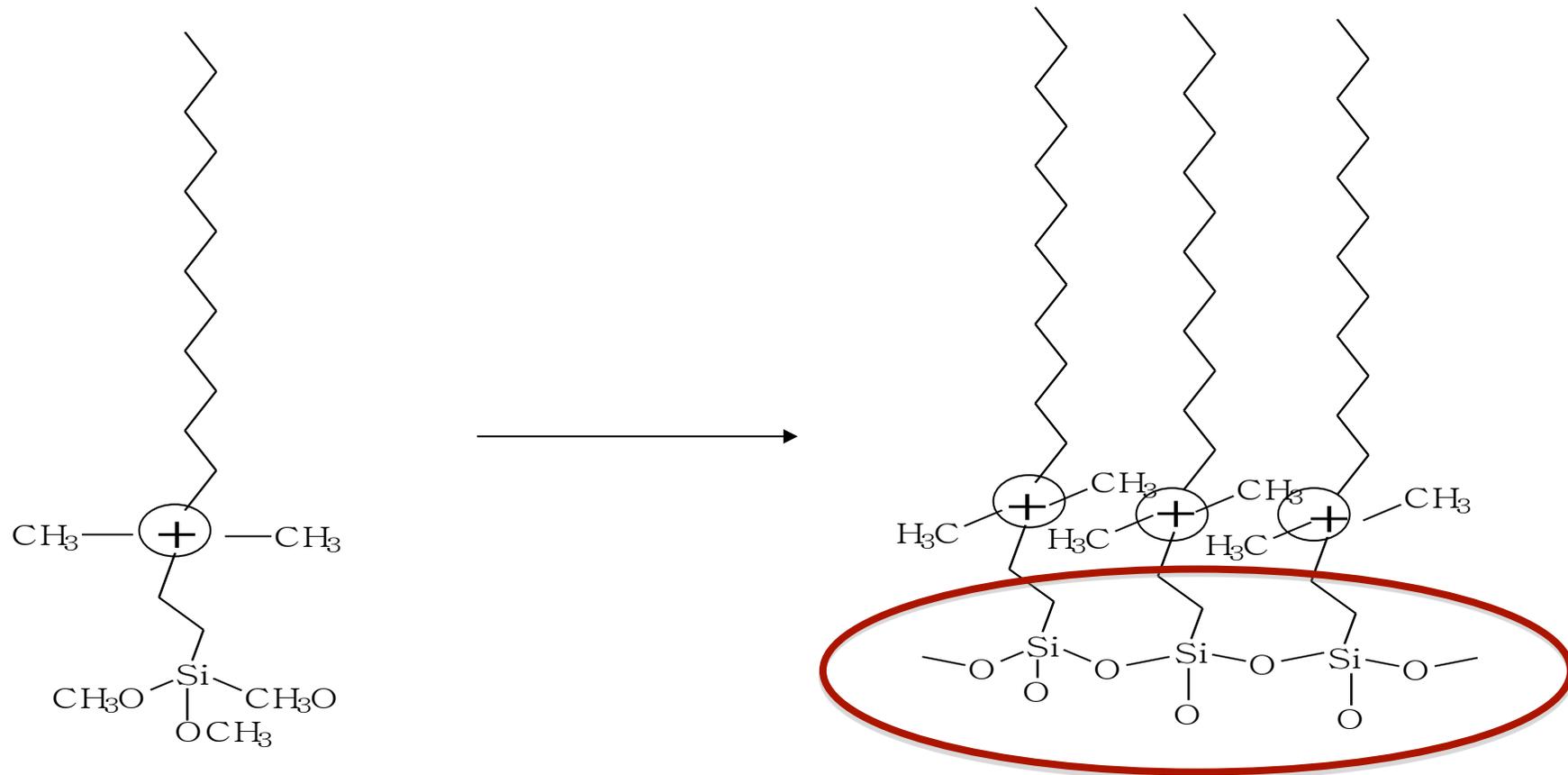
- Inhalation of Bacteria, size is important
- Incubation Period 2-10 Days
- Can be diagnosed but difficult to
  - severe pneumonia: dry cough, diarrhoea, vomiting, breathing difficulty, high fever, chills,
  - headache, some become confused or delirious
- Fatality rate is about 12%
- Can be treated effectively with antibiotics

# Susceptibility of Individuals

- Increasing age, especially over 45
- Men, Smokers, alcoholics
- Chronic respiratory or kidney disease
- Diabetics, cancer sufferers

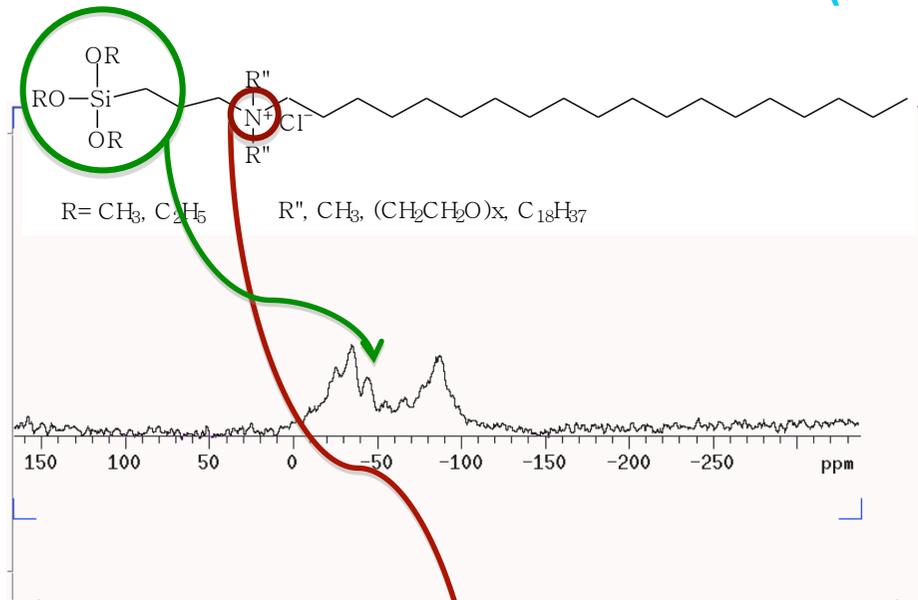


Alkyl Alkoxysilane Quarternary Ammonium Salt utilizes a sol gel chemistry, to adhere on surface, and carry a positive charge which creates an "electromagnetic" attraction between the negative charged microorganisms.

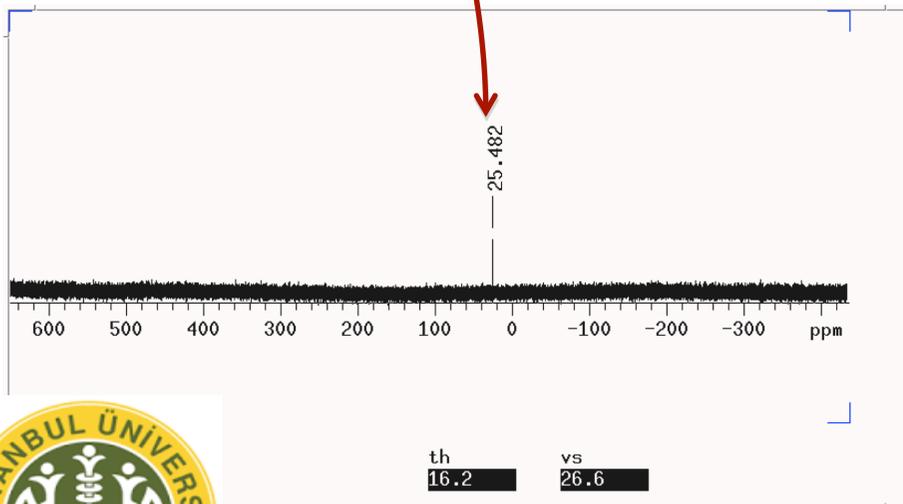


Schematic structural depiction of covalently immobilized used as microbicidal coatings.

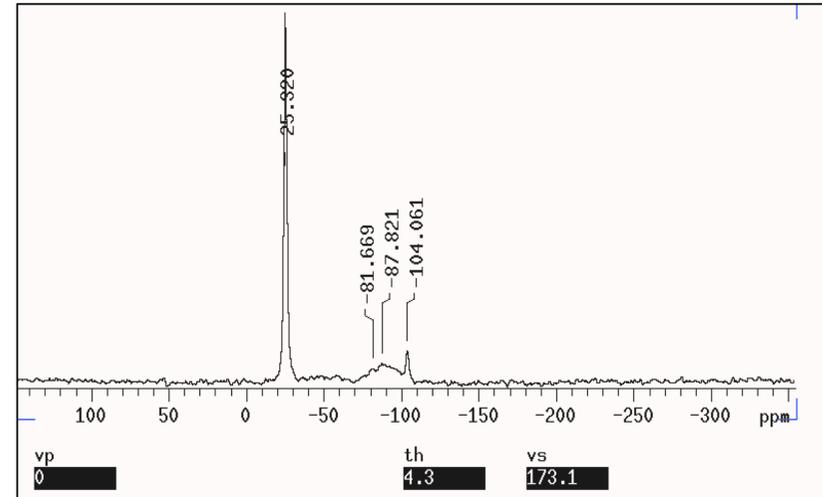
# Antimic Characterization ( $N^{15}$ $Si^{29}$ -NMR and TGA)



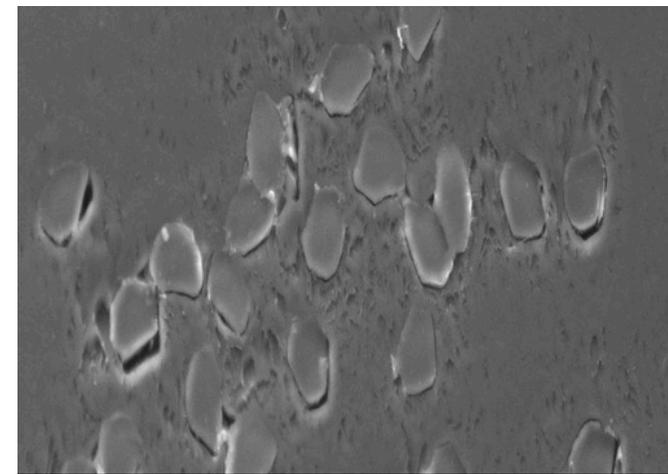
Antimic'e ait  $Si^{29}$ -NMR (Single Pulse-MAS) spektogramı



Antimic'e ait  $N^{15}$ -NMR spektogramı



Antimic kaplı fiberlere ait  $Si^{29}$ -NMR (Single Pulse-MAS) spektogramı



Mag = 1.50 K X     20µm     EHT = 20.00 kV     Signal A     Photo N



## Determination of Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC)

- **A- ASTM E645 – 13 (Standard Practice for Evaluation of Microbicides Used in Cooling Water Systems) Test Method**

50 and 40 ppm Antimic provide > 99.999 % kill *Legionella pneumophila* ATCC 33152 at zero contact time.

30 and 20 ppm Antimic provide > 99.999 % kill *Legionella pneumophila* ATCC 33152 at 1 hour contact time.

10 ppm > 99.999 % kill *Legionella pneumophila* ATCC 33152 at 3 hours contact time

- **B- BS EN 13623:2010 Test Method**

According to EN 13623 (2008), when Antimic®, diluted at 50, 40, 30, 20 and 10 mg/l in both hard water and sterile tap water, possesses bactericidal activity against the referenced strain of *Legionella pneumophila*, serogroup 1, ATCC 33152.

# Features of Antimic<sup>®</sup>

- ✓ Highly effective against pathogenic bacteria,
- ✓ Virucidal and fungicidal,
- ✓ Is effective with Gram(+)/Gram(-) bacteria, fungi, molds and mildew,
- ✓ Offers greater protection against infections,
- ✓ Rapid absorbency, high absorbent capacity,
- ✓ Hemostatic effect,
- ✓ Launderable,
- Has a permanent antimicrobial effect,
- Helps reduce transfer of bacteria
- Inhibits the growth of bacteria on and in surfaces
- Stops microbial formation of odours in surfaces,
- Eliminates fungi that cause foot fungus and mildew.
- Eliminates bacteria that cause food/body odors,
- Improves hygiene.



# Antimic<sup>®</sup>, Non Toxic and Biodegradable

Docket Numbers EPA-HQ-OPP-2013-0095; EPA-HQ-OPP-2013-0096; EPA-HQ-OPP-2013 - 0085  
www.regulations.gov



## Trimethoxysilyl Quaternary Ammonium Chloride Preliminary Work Plan

Registration Review: Initial Docket  
Case Numbers 3148, 5100, 5113

March 2013

### Toxicity Class I-most toxic

*Class I materials are estimated to be fatal to an adult human at a dose of less than 5 grams (less than a teaspoon).*

### Toxicity Class II-moderately toxic

*Class II materials are estimated to be fatal to an adult human at a dose of 5 to 30 grams.*

### Toxicity Class III-slightly toxic

*Class III materials are estimated to be fatal to an adult human at some dose in excess of 30 grams.*

### Toxicity Class IV-practically nontoxic

no Signal Word required since 2002

## Appendix A Toxicology Profile Acute Toxicity for Product Labeling

As listed in Table 9, acute toxicity data for a 50% formulation of 3-(trimethoxysilyl) propyl dimethyl octadecyl ammonium chloride show low acute toxicity for single exposures by the oral, dermal, and inhalation routes (Categories IV, III, and IV respectively). However, severe acute toxicity is observed with respect to skin and eye irritation of this active ingredient.

Table 9 - Acute Toxicity Studies for Trimethoxysilyl QACs

Guideline No./ Study Type	MRID No.	Results	Toxicity Category
870.1100 (81-1)	40385201	Oral LD <sub>50</sub> > 5000 mg/kg	IV
870.1200 (81-2)	40385201	Dermal LD <sub>50</sub> > 2000 mg/kg	III
870.1300 (81-3)	Not Available	Inhalation LC <sub>50</sub> > 2.0 mg/L (1 Hour)	IV
870.2400 (81-4)	403385201	Severe irritant to ocular tissue	I
870.2500 (81-5)	Not Available	Severe irritant to skin	I
870.3250	41339403	Dermal and Systemic NOAEL > 1000 mg/kg/day	Acceptable
870.3100	46280411	NOAEL ≥ 240 mg/kg/day (HDT)	Acceptable
870.3700	41438003	Maternal and Developmental NOAEL ≥ 1000 mg/kg/day	Acceptable
870.5100	46280412	No evidence of mutagenicity	Acceptable
870.5300	46280413	No evidence of mutagenicity	Acceptable
870.5375	46280414	No association with the induction of structural chromosomal aberration	Acceptable
	41296803	No evidence of compound induced cytotoxicity	Acceptable

# Atmospheric Air filters

## MPS COARSE FILTERS

- POCKET FILTERS WITH 100% POLYESTER MEDIA
- HIGH DUST LOADING CAPACITY
- AVAILABLE IN GALVANIZED AND PLASTIC FRAME

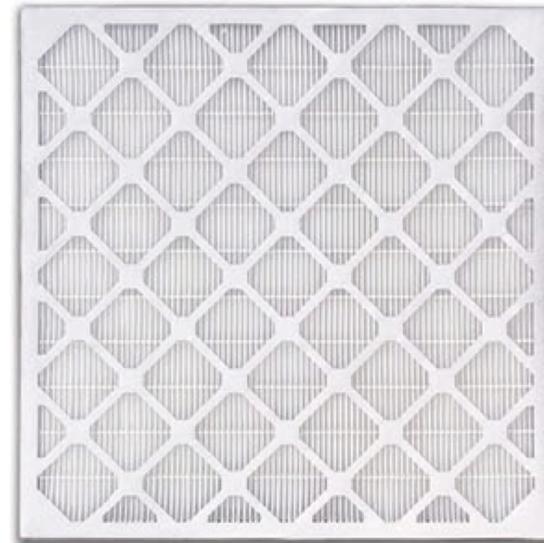
**EFFICIENCY: G3-G4**



## MMP FILTERS

- DISPOSABLE MINI PLEATED FILTERS WITH WATER RESISTANT CARDBOARD FRAME
- HIGH EFFICIENCY LOW RESISTANT
- MICROGLASS FIBER MEDIA

**EFFICIENCY: M5-F9**



## Test Fractional Efficiency



### Filter

Title: Pocket filter sample  
 Manufacturer:  
 Part-No:  
 Face Area: 0.0000m<sup>2</sup>  
 Flowrate: 2250.0m<sup>3</sup>/h

### Sample

Sample-No.: 00 00 06 98  
 Test-No.: 00 00 49 92  
 Serial-No: S-698  
 Filter Area: 0.0000m<sup>2</sup>  
 Status:  
 Comment:

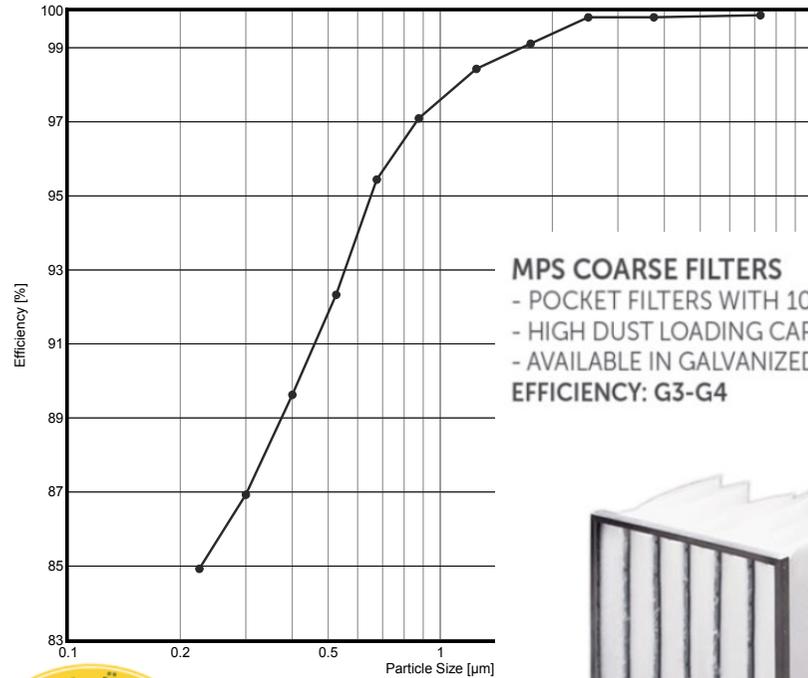
### Test

Filename: Antimic Hegza 1 pocket star Operator: op

Date: 18/06/15 Temperature: 22.9°C +/- 0.0°C  
 Time: 11:55:10 Humidity: 56.6% +/- 0.1%  
 Atm. Pressure: 917.0hPa +/- 0.0hPa

Flowrate: 2249.81m<sup>3</sup>/h  
 Dust: DEHS  
 Concentration: 1.0mg/m<sup>3</sup>  
 Tare Pressure:

Time	Duration	dP1	dP2	WG
[hh:mm:ss]	[hh:mm:ss]	[Pa]	[Pa]	[%]
11:55:10 AM	00:03:02	95	96	91.1



**MPS COARSE FILTERS**  
 - POCKET FILTERS WITH 100% POLYESTER MEDIA  
 - HIGH DUST LOADING CAPACITY  
 - AVAILABLE IN GALVANIZED AND PLASTIC FRAME  
**EFFICIENCY: G3-G4**



## Test Fractional Efficiency



### Filter

Title: Pocket filter sample  
 Manufacturer:  
 Part-No:  
 Face Area: 0.0000m<sup>2</sup>  
 Flowrate: 2250.0m<sup>3</sup>/h

### Sample

Sample-No.: 00 00 06 98  
 Test-No.: 00 00 49 94  
 Serial-No: S-698  
 Filter Area: 0.0000m<sup>2</sup>  
 Status:  
 Comment:

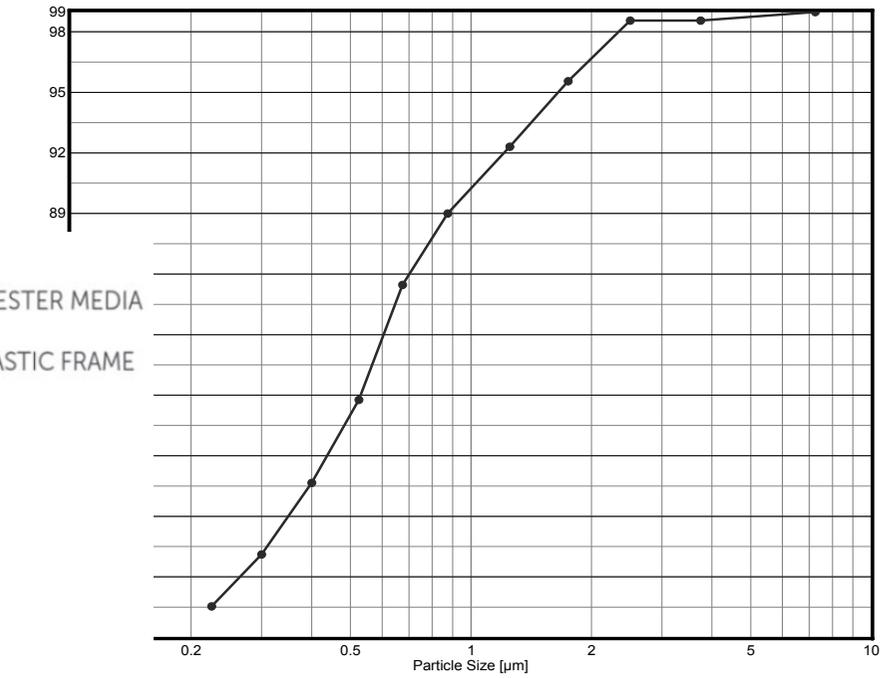
### Test

Filename: Antimic Hegza 1 pocket fina Operator: op

Date: 18/06/15 Temperature: 23.2°C +/- 0.0°C  
 Time: 12:34:26 Humidity: 56.1% +/- 0.2%  
 Atm. Pressure: 916.6hPa +/- 0.0hPa

Flowrate: 2250.32m<sup>3</sup>/h  
 Dust: DEHS  
 Concentration: 1.0mg/m<sup>3</sup>  
 Tare Pressure:

Time	Duration	dP1	dP2	WG
[hh:mm:ss]	[hh:mm:ss]	[Pa]	[Pa]	[%]
12:34:26 PM	00:03:02	94	94	78.8



## Test Fractional Efficiency



### Filter

Title: V Filter Sample  
 Manufacturer: Mikropor (Material Control)  
 Part-No: MV-F9-03  
 Face Area: 0.3500m<sup>2</sup>  
 Flowrate: 4250.0m<sup>3</sup>/h

### Sample

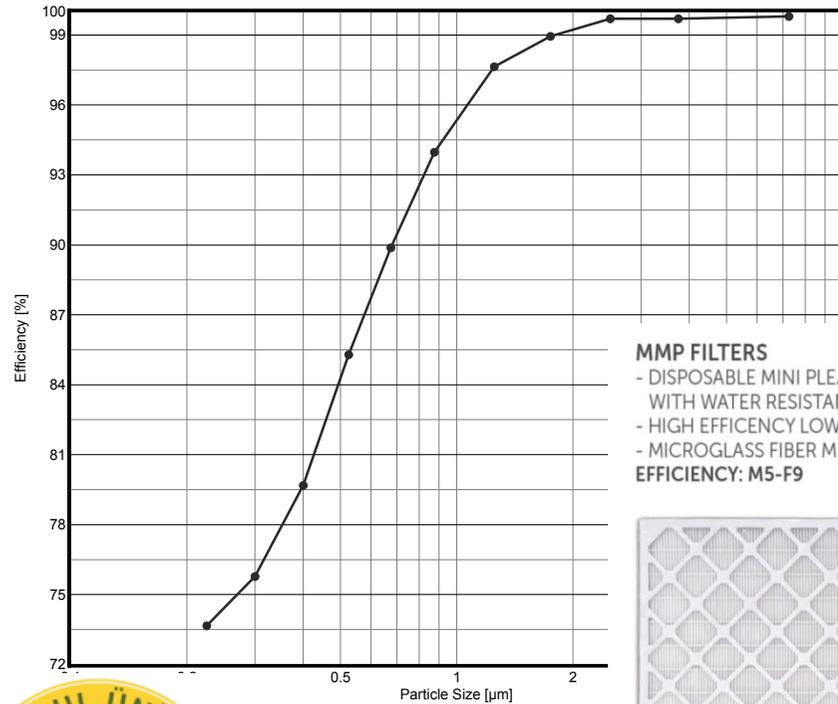
Sample-No.: 00 00 10 38  
 Test-No.: 00 00 49 88  
 Serial-No: S-1038  
 Filter Area: 18.0000m<sup>2</sup>  
 Status:  
 Comment:

### Test

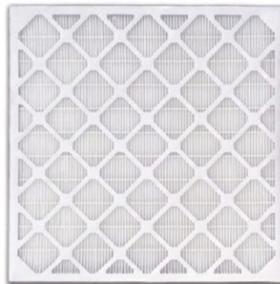
Filename: Antimic Hegza 1start.tfg Operator: op  
 Date: 18/06/15 Temperature: 21.7°C +/- 0.0°C  
 Time: 10:56:25 Humidity: 60.0% +/- 0.3%  
 Atm. Pressure: 917.5hPa +/- 0.0hPa

Flowrate: 4251.78m<sup>3</sup>/h  
 Dust: DEHS  
 Concentration: 1.0mg/m<sup>3</sup>  
 Tare Pressure:

Time [hh:mm:ss]	Duration [hh:mm:ss]	dP1 [Pa]	dP2 [Pa]	WG [%]
10:56:25 AM	00:03:02	159	159	83.0



**MMP FILTERS**  
 - DISPOSABLE MINI PLEATED FILTERS  
 WITH WATER RESISTANT CARDBOARD FRAME  
 - HIGH EFFICIENCY LOW RESISTANT  
 - MICROGLASS FIBER MEDIA  
**EFFICIENCY: M5-F9**



## Test Fractional Efficiency



### Filter

Title: V Filter Sample  
 Manufacturer: Mikropor (Material Control)  
 Part-No: MV-F9-03  
 Face Area: 0.3500m<sup>2</sup>  
 Flowrate: 4250.0m<sup>3</sup>/h

### Sample

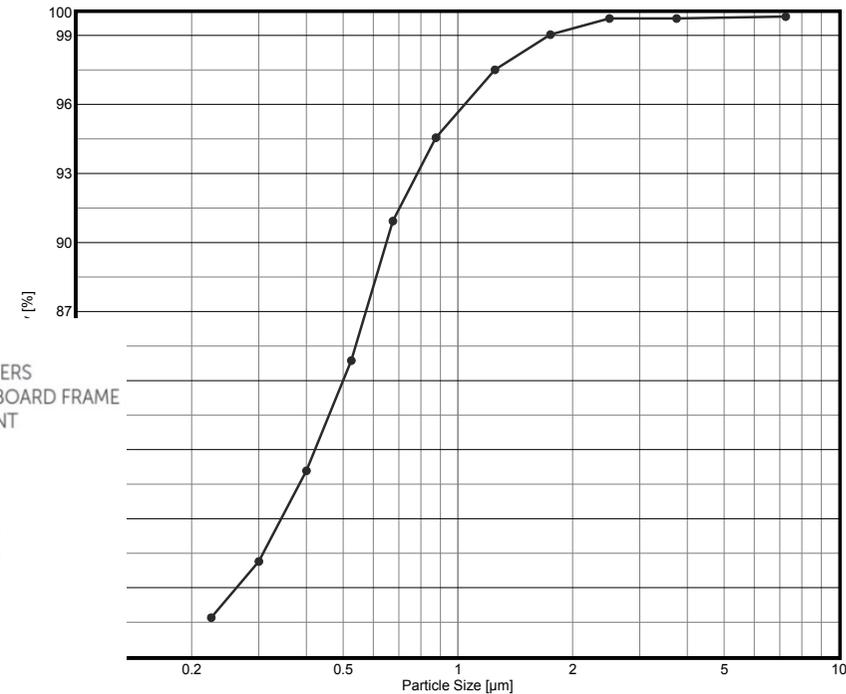
Sample-No.: 00 00 10 38  
 Test-No.: 00 00 49 90  
 Serial-No: S-1038  
 Filter Area: 18.0000m<sup>2</sup>  
 Status:  
 Comment:

### Test

Filename: Antimic Hegza 1 V final 15dk Operator: op  
 Date: 18/06/15 Temperature: 22.7°C +/- 0.0°C  
 Time: 11:38:21 Humidity: 57.6% +/- 0.1%  
 Atm. Pressure: 917.1hPa +/- 0.0hPa

Flowrate: 4254.91m<sup>3</sup>/h  
 Dust: DEHS  
 Concentration: 1.0mg/m<sup>3</sup>  
 Tare Pressure:

Time [hh:mm:ss]	Duration [hh:mm:ss]	dP1 [Pa]	dP2 [Pa]	WG [%]
11:38:21 AM	00:03:02	156	156	83.1



s GmbH



## Test Fractional Efficiency



### Filter

Title: Hepa Filter Sample  
 Manufacturer: Mikropor  
 Part-No:  
 Face Area: 0.0000m<sup>2</sup>  
 Flowrate: 1100.0m<sup>3</sup>/h

### Sample

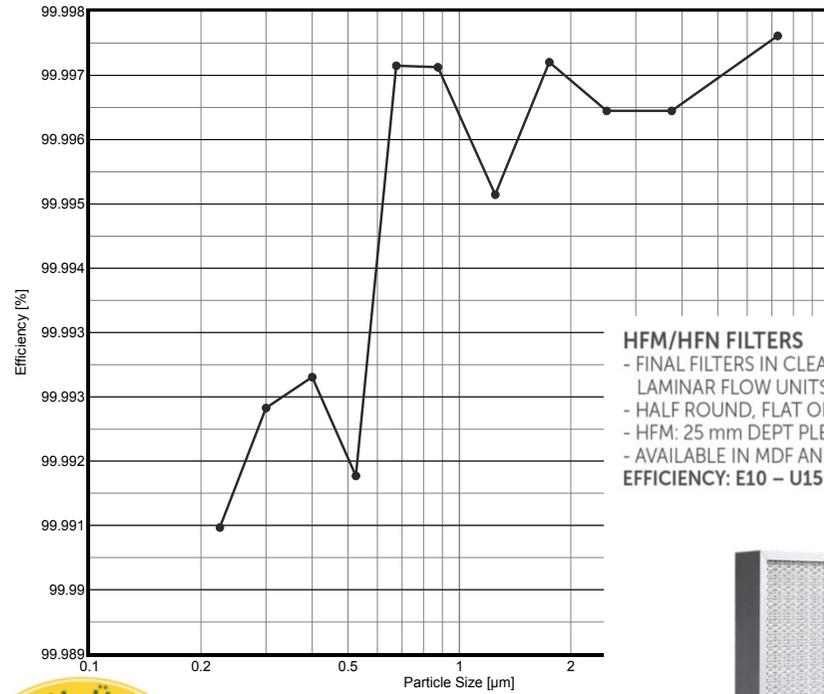
Sample-No.: 00 00 06 85  
 Test-No.: 00 00 49 89  
 Serial-No.: S-685  
 Filter Area: 0.0000m<sup>2</sup>  
 Status:  
 Comment:

### Test

Filename: Antimic Hegza 1 Hepa start. Operator: op  
 Date: 18/06/15 Temperature: 22.5°C +/- 0.0°C  
 Time: 11:23:13 Humidity: 57.6% +/- 0.1%  
 Atm. Pressure: 917.2hPa +/- 0.0hPa

Flowrate: 603.23m<sup>3</sup>/h  
 Dust: DEHS  
 Concentration: 1.0mg/m<sup>3</sup>  
 Tare Pressure:

Time [hh:mm:ss]	Duration [hh:mm:ss]	dP1 [Pa]	dP2 [Pa]	WG [%]
11:23:13 AM	00:03:02	133	132	100.0



### HFM/HFN FILTERS

- FINAL FILTERS IN CLEANROOMS, OPERATING THEATRES, LAMINAR FLOW UNITS etc.
  - HALF ROUND, FLAT OR U-PROFILE GASKET OPTIONS
  - HFM: 25 mm DEPT PLEAT PACK, HFN: 50 mm DEPT PLEAT PACK
  - AVAILABLE IN MDF AND ALUMINUM FRAME
- EFFICIENCY: E10 – U15**



## Test Fractional Efficiency



### Filter

Title: Hepa Filter Sample  
 Manufacturer: Mikropor  
 Part-No:  
 Face Area: 0.0000m<sup>2</sup>  
 Flowrate: 1100.0m<sup>3</sup>/h

### Sample

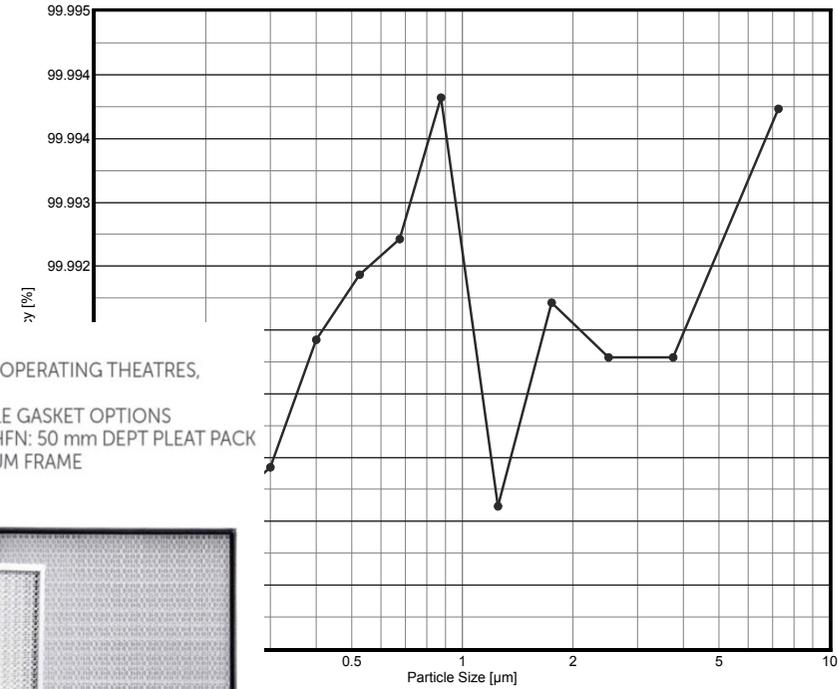
Sample-No.: 00 00 06 85  
 Test-No.: 00 00 49 93  
 Serial-No.: S-685  
 Filter Area: 0.0000m<sup>2</sup>  
 Status:  
 Comment:

### Test

Filename: Antimic Hegza 1 Hepa final.t Operator: op  
 Date: 18/06/15 Temperature: 23.0°C +/- 0.0°C  
 Time: 12:11:22 Humidity: 55.9% +/- 0.1%  
 Atm. Pressure: 916.8hPa +/- 0.0hPa

Flowrate: 604.14m<sup>3</sup>/h  
 Dust: DEHS  
 Concentration: 1.0mg/m<sup>3</sup>  
 Tare Pressure:

Time [hh:mm:ss]	Duration [hh:mm:ss]	dP1 [Pa]	dP2 [Pa]	WG [%]
12:11:22 PM	00:03:02	133	131	100.0





## TEST SONUÇ RAPORU

DOKÜMAN NO FR-8.2.4-06	YÜRÜRLÜK TARİHİ 02.01.2003	SAYFA NO 1/1	REVİZYON NO 00
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TEST EDİLEN ÜRÜN	FILTRE NUMUNELERİ
MÜŞTERİ/TEDARİKÇİ	Yusuf Menceloğlu (Sabancı Üniversitesi)
TEST TARİHİ	18.06.2015
TEST SIRA NO	15-51
TEST EDEN	Ali ALTUNBAŞ

### TEST SONUÇLARI:

Numune gelen Antimic Hegza 1 kodlu (Bakteri, Virüs, Küf ve Mantarlara karşı koruyucu) spreyin filtre materyalleri üzerindeki verim ve fark basınç etkileşim testleri yapıldı.

Test sonuçları tablodaki gibidir.

Filtre	Test Debisi (m3/h)	Başlangıç 0,4Mic. Verimi (%)	Başlangıç Fark Basıncı (pa)	Uygulama sonrası 0,4Mic. Verimi (%)	Uygulama sonrası Fark Basıncı (pa)
MV-F9-03-18m2	4250	79,8	159	80,2	156
HFN-610/610/70-14GD	600	1	132	1	132
MPS-8-8-600-03G	2250	89,7	95	75,8	94

Test sonuçlarına göre cam elyaf filtrelerin (V ,Hepa) verim ve fark basınç değerlerinde uygulama sonrası değişiklik görülmemiştir. Ancak sentetik esaslı filtrenin (pocket) fark basıncında uygulama sonrası değişiklik görülmezken, verim değerinde düşme görülmüştür.

Testlerle ilgili grafikler ekledeedir.

HAZIRLAYAN	ONAY
Ali ALTUNBAŞ	

## EN 1822



## EN 779:2012

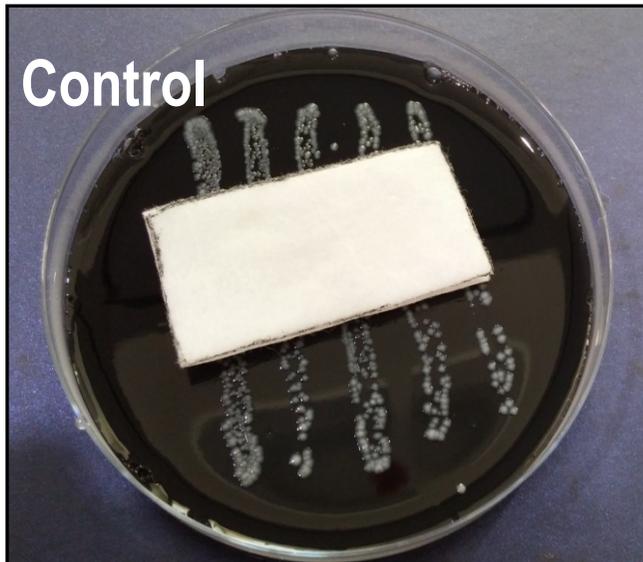


# Antibacterial Activity of Air Filters Tested with Modified Techniques

- AATCC Test Method 147-2004
  - Antibacterial Activity Assessment of Textile Materials: Parallel Streak Methods
- I.S. EN ISO 20645:2005
  - Textile Fabrics-Determination of Antibacterial Activity-Agar Difusion Plate Test
- AATCC Test Method 100-2004
  - Antibacterial Finishes on Textile Materials:Assesment of
- Fluorescence Staining (DAPI/CTC)

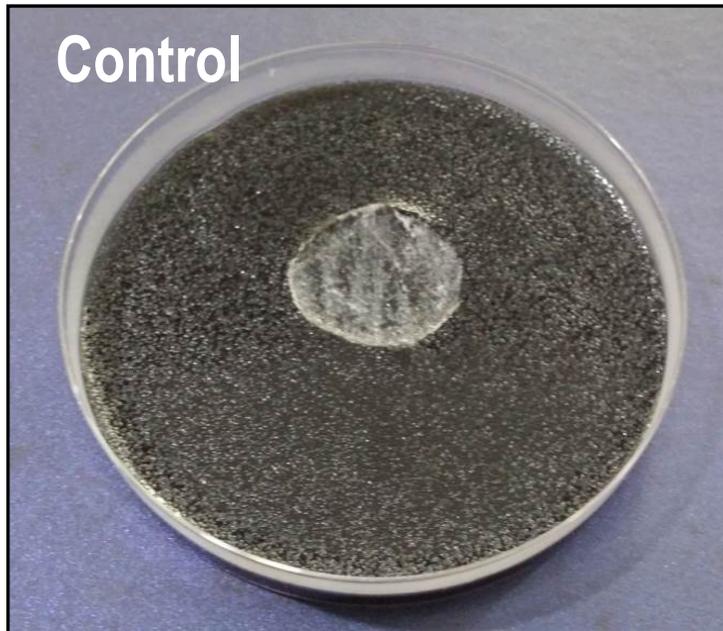


# AATCC Test Method 147-2004, Antibacterial Activity Assessment of Textile Materials: Parallel Streak Methods



Sample	T/ mm	D/mm	T-D/ mm	(T-D/2) mm	Average W/mm	Growth Under Sample
1	42	25	17	8,5	11,10	None
	47	25	22	11,0		
	48	25	23	11,5		
	49	25	24	12,0		
	50	25	25	12,5		
2	45	25	20	10,0	12,50	None
	47	25	22	11,0		
	47	25	22	11,0		
	55	25	30	15,0		
	56	25	31	15,5		
3	41	25	16	8,0	9,20	None
	41	25	16	8,0		
	45	25	20	10,0		
	45	25	20	10,0		
	45	25	20	10,0		

# I.S. EN ISO 20645:2005, Textile Fabrics-Determination of Antibacterial Activity-Agar Difusion Plate Test



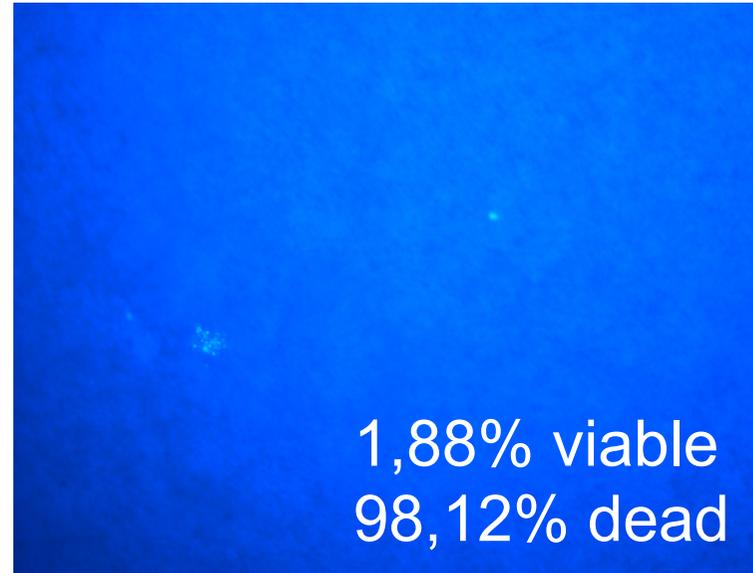
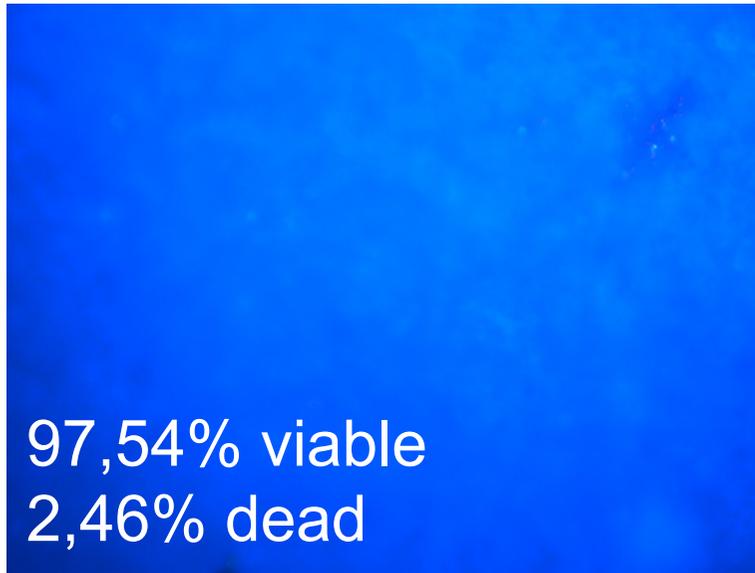
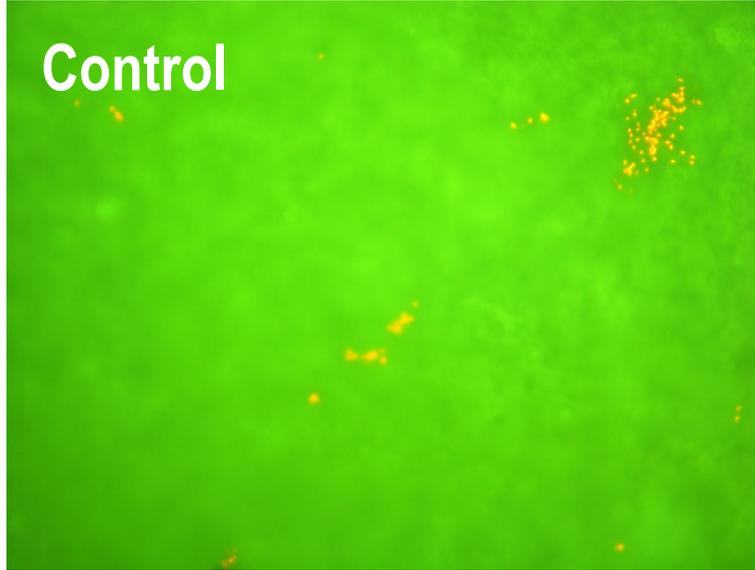
Sample	D/ mm	d/mm	D-d/ mm	$(D-d/2)= H$ mm	Growth Under Sample
<b>1</b>	31,75	25	6,7	3,37	None
<b>2</b>	30,50	25	5,5	2,75	None
<b>3</b>	32.00	25	7,0	3,50	None

# AATCC Test Method 100-2004, Antibacterial Finishes on Textile Materials: Assessment of % reduction of *Legionella pneumophila*

Sample	Control	Bacterial number	Kill Rate %
Polyester (0. hour contact with <i>L. pneumophila</i> )	4.75x10 <sup>5</sup>	5.33x10 <sup>4</sup>	88.76
Polyester (1 hour contact with <i>L. pneumophila</i> )	4.75x10 <sup>5</sup>	<100	> 99.978
Polyester (24 hour contact with <i>L. pneumophila</i> )	4.75x10 <sup>5</sup>	<100	> 99.978
Glass fiber (0. hour contact with <i>L. pneumophila</i> )	5.25x10 <sup>5</sup>	6.85x10 <sup>4</sup>	86.94
Glass fiber (1 hour contact with <i>L. pneumophila</i> )	5.25x10 <sup>5</sup>	<100	>99.98
Glass fiber (24 hour contact with <i>L. pneumophila</i> )	5.25x10 <sup>5</sup>	<100	>99.98



# Fluorescence Staining (DAPI/CTC)



Kırmızı sinyaller canlı, mavi sinyaller ölü bakterileri göstermektedir

# Summary



- **No pressure drop and effective air filtration**
- **Permanently bonds to the filter fibers to form a new durable antimicrobial surface.**
- **Non-migrating. It will not leach, off-gas or volatilize.**
- **Long-term, effective control of microorganisms which are commonly associated with building health problems.**
- **Controls the growth of microorganisms on the air filter surface and has been shown in laboratory testing to lower microbial contamination in recirculated air.**
- **Does not exhibit significant loss of activity over the normal lifecycle of the filter.**

# TEŞEKKÜRLER....



# Patented Technology

No documents available for this priority number.



**Espacenet**

## Bibliographic data: SG184970 (A1) — 2012-11-29

### PREPARATION OF SUBSTANTIALLY QUATERNIZED AMMONIUM ORGANOSILANE COMPOSITION AND SELF-STABILIZING AQUEOUS SOLUTION THEREOF

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**Classification:** - international:   
 - cooperative: **C07F7/1892**

**Application number:** SG20120007812 20100421

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#### Abstract of SG184970 (A1)



the preparation of a partially quaternized ammonium ion, and a self-stabilizing aqueous solution of said composition, antimicrobial polysilsesquioxane coating upon thermal curing. By aqueous solution is prepared, comprised in part by a partially

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