TECHTIPS
Sales and Marketing Information on Airguard Air Filtration Products

AIRGUARD
a CLARCOR company

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Life Cycle Testing Verifies Effectiveness of Antimicrobial Treated Air Filters

The use of air filters treated with an antimicrobial agent is a relatively new concept in the HVAC industry. While a great deal of publicity has been generated regarding the use of these filters, there has been some misunderstanding and uncertainty over exactly what their function is, how the antimicrobial agent works, and does it remain effective over a period of time as the dirt load builds on the media.

Purpose of Antimicrobial Treated Filters

The presence of microorganisms in buildings of all types has been well documented. Common microbes include Staph, Strep, Serratia marcescens, Klebsiella, Cladosporium and Aspergillus.

The effects of microbial growth in humans can be anywhere from discomfort, such as headaches, nausea, fatigue, coughing, sneezing or irritated eyes to fatal conditions such as Legionnaire's disease. The sources of microbes are many and varied.

Obviously the elimination of microorganisms is a desirable objective to improve indoor air quality for the occupants. Elimination is not practical except in highly sensitive and controlled areas. However, any reduction in microbial growth is a positive step, not only from a human health and comfort standpoint, but also from a liability issue. The courts have taken the position that it is the owner's/manager's responsibility to take the appropriate steps to provide a healthy indoor environment.

Antimicrobial treated filters help reduce the proliferation of microbes by inhibiting their growth on the media. This is one of the biggest areas of misunderstanding regarding antimicrobial treated filters. They are not designed to destroy microorganisms on a single pass basis. The antimicrobial functions by interrupting the reproductive cycle of the microorganisms trapped in the filter. The microbes must come in contact with the agent applied to the media in order to be effective.

How effectively the filter will catch microbes is a function of their size. Generally, the smaller the size, the greater the microbial penetration through the filter as with any airborne particulate. Conversely, larger microbes are more readily caught.

Use Treated Prefilters and Final Filters

Correlating the size of the microorganisms with the particle size efficiency of the filter explains why Airguard recommends that both prefilters and final filters should be treated.

Prefilters serve as the first line of particulate removal. Microorganisms caught here are not distributed throughout the air handling system. However, some percentage of microorganisms, especially smaller microbes, will penetrate the prefilters and reach the final filters. Therefore, treating both filters provides two opportunities to catch microorganisms and inhibit their growth. This results in less contamination on the filters and throughout the HVAC system.

It is important to recognize that treated filters do not totally prevent microbial growth. They substantially reduce it, and equally as important, they prevent microorganisms from growing through the filters to continue downstream. Any microorganisms that come in contact with a treated fiber do not reproduce. But as the dirt load builds, microbes that are caught on the upstream surface may not come in direct contact with the media. These microbes can reproduce with the dirt as food. However, as they grow into the media, their reproductive cycle is retarded.

Life Cycle Effectiveness

One of the most common questions regarding treated filters is do they continue to inhibit microbial growth as they become loaded with dirt? Airguard recently conducted a series of tests to measure the amount of microbial growth on treated versus untreated filters over a period of time in operation in a hospital HVAC system.

Test Procedure - An air handling system containing nine 24 x 24 x 2 pleated filters was installed with five treated and four untreated filters. The filters were alternated in the frames to assure equal exposure of both sets of filters to air flow and dirt loading.

A Microbial Enumeration Analysis was performed on a clean set of treated and untreated filters to determine the initial amount of growth. A set of treated and untreated filters was removed from the system and tested at 30 day intervals.

The Microbial Enumeration Analysis is performed by analyzing the media in 25 cm² sections. The samples are incubated to accelerate microbial growth on the media. After an appropriate incubation period, the samples are viewed under a microscope to accurately count the number of colony forming units (CFUs) of bacteria and fungal cells. A number of media samples are analyzed using this procedure for each filter. The average number of CFUs per 25 cm² area is reported per filter.

Two series of tests were performed, one in the fall and one in the winter:

Test No. 1 (Fall) Test duration - 60 days

Both clean filters exhibited very little growth. After 30 days and 60 days, the treated filters showed significantly less microbial growth than the untreated filters (78% and 74%, respectively).

Microbial Enumeration Analysis - Test No. 1

Colony Forming Units (Per 25 cm² of Media Area)

Filter Service Life	Untreated Filters	Treated Filters	% Reduction in Microbial Growth
Clean	4	6	—
30 days	457	100	78%
60 days	520	135	74%
Total	981	241	75%

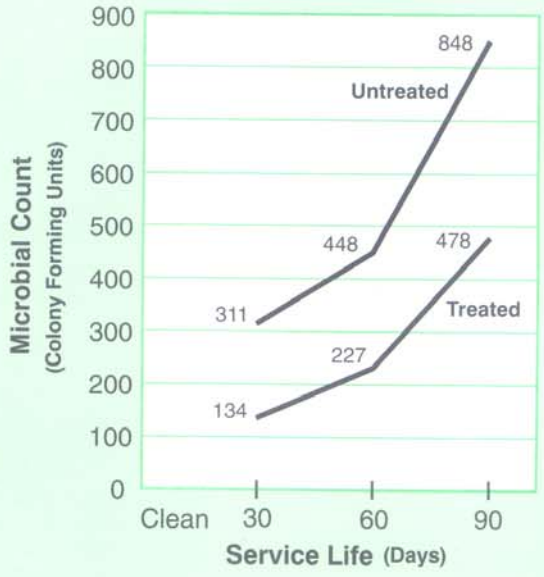
Test No. 2 (Winter) Test duration - 90 days

Similar results were observed in the second series of tests as in the first. The amount of microbial growth on the treated filters remained significantly below that of the untreated filters after each 30 day period (57%, 49% and 44%, respectively).
These tests demonstrate the effectiveness of treated filters to significantly reduce the biological contaminant load in an HVAC system for an extended period of time.

Microbial Enumeration Analysis - Test No. 2

Colony Forming Units (Per 25 cm² of Media Area)

Filter Service Life	Untreated Filters	Treated Filters	% Reduction in Microbial Growth
30 days	311	134	57%
60 days	448	227	49%
90 Days	848	478	44%
Total	1,607	839	48%



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Antimicrobial Treated Air Filters

Why Use Air Filters Treated with an Antimicrobial?

Ever since air filters were originally developed, one of the primary benefits presented by manufacturers has been to improve the quality of indoor air. While filters accomplish this purpose from the standpoint of reducing the amount of particulate present in occupied spaces, a shortcoming that has only recently become recognized is that filters can be a breeding ground for bacteria, mold, mildew and fungi.

Consider the conditions in which filters operate -- dark, damp, ambient temperatures. It is easy to see why microorganisms can multiply extremely rapidly under these ideal conditions. As the microbes reproduce they can grow through the media or shake loose and blow down stream to contaminate occupied areas. Unfortunately, due to the minute size of most microorganisms, this growth often goes unnoticed except in extreme cases.

Studies have shown that even clean media with no dirt load can develop microbial growth. This indicates how prevalent the existence of microorganisms is in the air around us. Even the best maintained air handling system, equipped with high efficiency filters, properly serviced, including clean coils and ducts can develop harmful microbial growth.

Once the potential for microbial growth is recognized, the value of applying an antimicrobial agent on air filter media is easy to understand. Preventing growth of these microorganisms on the filters and therefore reducing their distribution through the air handling system eliminates the filters as a source of contamination.

How Does an Antimicrobial Work?

In order for the antimicrobial to be effective, it must come in contact with the microbes. Some antimicrobial agents prevent the microorganisms from absorbing nutrients which inhibits their ability to multiply, while others break down the organisms' cell wall during reproduction. As a result, they die in their normal life span (typically several minutes up to 24 hours).

Technically, according to EPA regulations, antimicrobials do not "kill" microorganisms, but prevent their ability to reproduce. *It is important to avoid reference to "killing" microorganisms in your sales presentations on Bio•Pure products.*

Measuring Antimicrobial Effectiveness on Air Filters

"One Pass" Efficiency - First, the filter must catch the microbes on the media. This is a function of the efficiency of the air filter on whatever size the microorganisms happen to be. This is often referred to a filter's "one pass" efficiency. In other words, how effective is the filter at catching microbes of any given size as they are carried into the filter by the air stream? For example, if the microorganism is 1.0 micron in size, the first pass efficiency is the filter's efficiency on that size particle. This is important because the filter must catch the microbe in order to prevent its reproduction. Microorganisms that pass through the filter remain alive to multiply rapidly.

In most cases microorganisms are attached to other airborne particles. This presents larger particles to the filter media increasing the filter's effectiveness.

Initial Bioaerosol Removal Efficiency - This test takes the One Pass Efficiency test a step further. In a controlled environment the filter is challenged with a known concentration of microorganisms which are collected on membrane samplers placed upstream and downstream from the test filter. To insure accuracy ten sets of samples are collected. The samplers are then incubated for one to three days at 77 - 99° F. After this period the number of microorganisms (colony forming units) present on each sampler are counted and averaged. The initial bioaerosol efficiency is then calculated by comparing the upstream count to the downstream count.

Environmental Chamber Test - In this test treated and untreated media are placed in sterile jars which have been inoculated with a specific microorganism. The jars are kept at 105°F and 100% relative humidity for the duration of the test, typically four weeks.

The percent of media surface that is covered with microbial growth is measured after each week of exposure. The difference in the amount of media area exhibiting microbial growth provides a basis on which to assess the effectiveness of the antimicrobial on that specific microorganism.

Should Prefilters or Final Filters be Treated with an Antimicrobial?

For maximum effectiveness, both filters should be treated.

Prefilters are less costly and will do an excellent job of reducing the number of microorganisms passing through the filter. However, due to their lower "one pass" efficiency, prefilters will allow a higher percentage of these microbes to penetrate through the media and be carried down stream.

Final filters obviously will capture a higher percentage of microorganisms. Therefore, overall effectiveness at reducing microbial contamination will be optimized by treating both the prefilters and final filters.

EPA Registration

There are two levels of registration by the EPA for antimicrobials. The first is a more general registration under the Federal Insecticide, Fungicide and Rodenticide Act. The second registration is for a specific use such as on air filters. Airguard strongly encourages use of an antimicrobial registered by the EPA specifically for use on air filters.

Airguard Bio•Pure™ Antimicrobial Treated Air Filters

The Bio•Pure brand name is applied to all Airguard filters treated with an antimicrobial agent. Only antimicrobials registered by the EPA specifically for use on air filters are used. This assures our customers that they are getting the very highest level of effectiveness with Bio•Pure products.

Bio•Pure Product Line

Airguard initially introduced antimicrobial treated products on a wide range of prefilters, including:

- Ring Panel Filters
- Slip On Filters
- Synthetic Media Pads & Rolls
- Pleated Filters
- Cube Filters

The Bio•Pure product line has been expanded to high efficiency filters, including:

- 80 - 90% Clean-Pak
- 80 - 90% Vari-Pak Model S
- 80 - 90% Variflow
- 80 - 90% Variflow II
- 95% Vari+Plus
- 95% DOP Microguard
- 99.97% DOP Microguard

Effectiveness of Bio•Pure Filters

Bio•Pure filters are highly effective at inhibiting growth of a wide range of microorganisms, including:

Gram Positive Bacteria
Citrobacter freundii
Citrobacter diversus
Corynebacterium diptherias
Diplococcus pneumonia
Enterococcus aerogenes
Listeria monaestaens
Myxobacteria spp.
Pseudomonas pseudomalle
Staphylococcus albus
Staphylococcus aureus
Staphylococcus citrens
Streptococcus pyogenes
Streptococcus viridans

Gram Negative Bacteria
Enterobacter aerogenes
Escherichia coli
Klebsiella pneumoniae
Nisseria gonorrhea
Proteus mirabilis
Proteus morganii
Proteus vulgaris
Providence spp.
Pseudomonas aeruginosa
Pseudomonas fragi
Salmonella choleraesuis
Salmonella enteritides
Salmonella gallinarium
Salmonella paratyphi A
Salmonella shotmulleri
Salmonella typhimurium
Salmonella typhosa
Serratia marcesens
Shigella flexneri Type II
Shigella sonnei
Vibro cholerae

Fungi
Aspergillus niger
Candida albicans
Microsporum audouni
Trychophyton interdigitale
Trychophyton mentagrophytes

Viruses
Adenovirus Type IV
Feline Pneumonitis
Herpes Simplex Type I
Influenza A (Japan)
Influenza A2 (Aichi)
Influenza A2 (Hong Kong)
Parainfluenza (Sendai)
Polio Virus
Reovirus
Respiratory Syncytial
Vaccinia

Bio•Pure filters are effective against many other microbes and viruses not listed here. Contact Airguard for further information on specific microbial contaminants.

Initial Bioaerosol Efficiency of Bio•Pure Pleated Filters

Based on independent lab tests on Bio•Pure pleated filters compared to several competitive brands, Bio•Pure outperformed the competition:

	Initial Bioaerosol Efficiency on Staphylococcus aureus
Bio•Pure	78%
Fiberbond MicroSafe	61%
AAF AmAir with Intersept	56%

Microbial Identification Service

Through the services of Air Filter Testing Laboratories we can help customers identify the specific microbials present in their systems. Collection of the microbes can be captured in a petri dish or directly on air filter media. Contact Airguard for details on the exact procedure and cost.

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