



A Cleaner World...

...with Engineered Antimicrobial Solutions

AgION[™]
ANTIMICROBIAL

Excellence In Antimicrobial Solutions

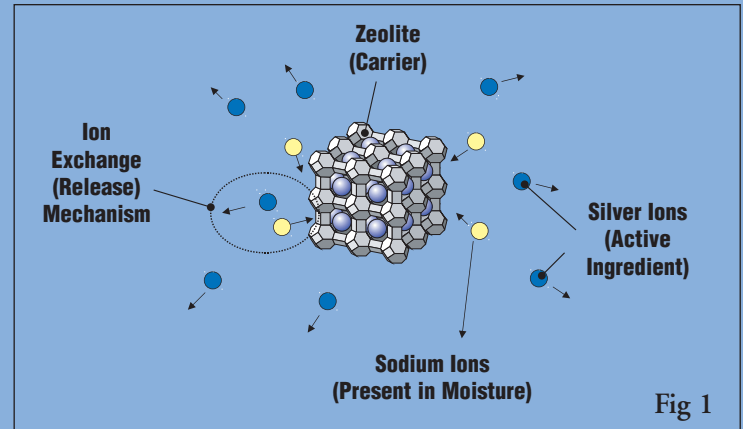
Technical Data

AgION™ antimicrobials are a breakthrough in technology that combines silver ions with a patented delivery process. Only AgION Technologies provides customers with a full range of products for every processing need. The product line offers an active metal ion complex of silver alone or in combination with zinc or copper to meet specific application challenges. Processors can choose products based on particle size,

particle size distribution and moisture level. Through supply chain partners, AgION antimicrobials are available in numerous polymer concentrates, powder, and epoxy and acrylic coating. AgION's product line includes a water-based slurry formulation, glass, zinc oxide, and microencapsulated resin carriers to meet the requirements of substrates that range from acetals to urethanes.

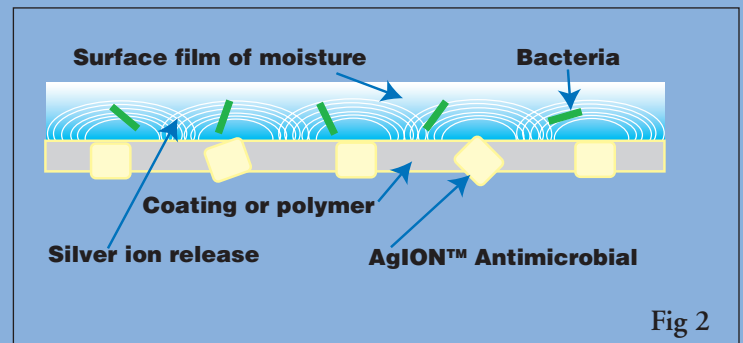
Core Technology

AgION antimicrobials are based on an ion exchange technology that is not only safe, effective and durable but also provides an alternative to a vast array of synthetic organic chemicals. What makes our product unique is the delivery system. The multi-faceted zeolite crystal carrier (see background photo on cover) provides a three dimensional release mechanism (Figure 1) that provides efficient release of silver ions independent of particle orientation in the substrate.



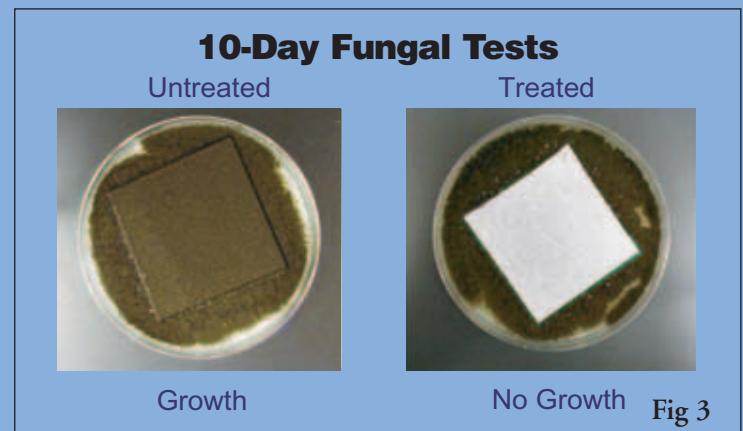
Activation

Silver is a powerful antimicrobial metal ion. Figure 2 shows the ion exchange process. Zeolite crystals containing silver ions are randomly oriented and distributed through the surface of a polymer or coating. In conditions that support bacterial growth, the sodium ions, in ambient moisture, exchange with silver ions at reversible bonding sites on the zeolite. The exchanged silver ions are now available to control microbial growth.



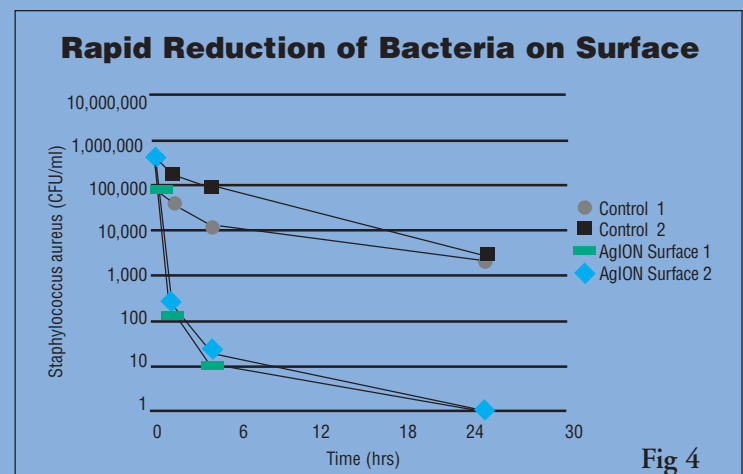
Method of Control

AgION antimicrobial attacks multiple targets in the microbe to prevent it from growing to a destructive population. The silver ions interfere with cell growth in three ways. They inhibit transport functions in the cell wall (respiration); they inhibit cell division (reproduction); and they interrupt cell energy generation (metabolism). This tri-modal efficacy is unique to inorganic metal ion antimicrobials and reduces the possibility of developing resistant bacteria.



Broad Spectrum Control

AgION antimicrobials are effective against gram positive and gram negative bacteria as well as a wide array of fungal organisms. Figure 3 shows the effectiveness of AgION AC10D in controlling fungus. After ten days, the untreated sample is overgrown while the treated sample has no growth. Figure 4 is a graphical presentation of AgION AJ10D and its ability to reduce the growth and population of staph aureus bacteria. Measurable results are seen within two hours while a log 5 or 99.999% reduction in the test is observed at the end of the twenty-four hour test protocol.



AgION Antimicrobials Are Effective Against Many Organisms*

Bacteria

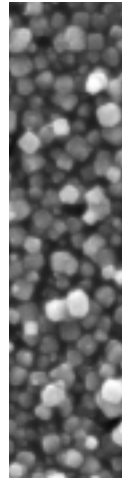
- Aureobasidium pullulans
- Bacillus cereus
- Bacillus thuringiensis
- Chaetomium globosum
- Enterobacter aerogenes
- Escherichia coli
- Gliocladium virens
- Klebsiella pneumoniae
- Legionella pneumophila
- Listeria monocytogenes
- Mycobacterium tuberculosis
- Porphyromonas gingivalis
- Proteus mirabilis
- Proteus vulgaris
- Pseudomonas aeruginosa
- Saccharomyces cerevisiae
- Salmonella gallinarum
- Salmonella typhimurium
- Staphylococcus aureus
- Staphylococcus epidermidis
- Staphylococcus agalactiae
- Staphylococcus faecalis
- Staphylococcus mutans
- Vibrio parahemolyticus

Yeast and Fungi

- Stachybotrys
- Aspergillus niger
- Candida albicans
- Penicillium funiculosum
- Trycophyton mentagrophytes

*Partial list

AgION™ Physical Properties



Properties of the Zeolite Carrier:

- Sodium aluminosilicate
- Ion exchange release mechanism
- Orthogonal 3D pore structure
- Pore size: 4Å
- Particle size: 2-3 µm mean
- Surface area: 600 m²
- Specific gravity: 2.1 g/cm³
- Bulk density: 0.5 g/cm³
- Temp stability: >800°C
- pH use range: 3-10

AgION antimicrobial crystals are a fine powder.

Product Comparison

Product	Food contact	Efficacy	Durability	Heat stability	Safety	Ease of use
AgION Antimicrobial	yes	★★★★	★★★★	★★★★	★★★★	★★★★
Triclosan	no	★★	★★	★	★	★★★
Silver Zircon. Phos.	yes	★★★	★★	★★★★	★★★★	★★★
Quat Salts	no	★★	★	★	★★	★★★

Product Selection Guide

AgION Grade	Substrate			Applications								Other Properties					
	Olefins, styrenics TPE, ABS, rubber	PU, nylon	POM (acetal)	White & clear plastics	Water-based coating	Solvent-based coating	Powder coating	Fibers	Water applications	Medical applications	% Ag	% Zn	% Cu	Mean particle size µm	Max. particle size µm	Moisture level	% Additive content
AW 10D	◆	◆		◆		◆	◆	◆	◆		0.6	14	-	3	15	s	100
AJ 10D	◆	◆			◆	◆	◆	◆	◆		2.5	14	-	3	15	s	100
XAW 50D			◆	◆			◆				0.6	14	-	3	15	s	20
AG 10D								◆	◆		2.5	-	-	3	15	s	100
AK 10D	●	●			●	●	●		●		5.0	13	-	3	15	s	100
AK 80H	●	●			●	●	●	●	●		5.0	13	-	2	8	l	100
AL 85H-M									●		10	10	-	2	8	l	100
AD 85H-M									●		20	-	-	2	8	l	100
AC 10D	●	●			●	●	●	●			3.5	-	6.5	3	15	s	100
WAJ 10N					◆				◆		2.5	14	-	3	15	n/a	20
AJ 10 D-E50	◆	◆	◆		◆	◆	◆		◆		2.5	14	-	*	*	s	50
LJ 10D	◆	◆			◆	◆	◆		◆		2.5	14	-	10	30	s	100
SL	●	●	●	●							1.8	-	-	15	40	s	100

Key ● = recommended ◆ = recommended and food contact approved * = various particle sizes available
 s = standard l = low



Safety and Regulatory

AgION™ antimicrobials are EPA-registered for a broad range of uses including food and water contact, HVAC and building products, appliances, fibers and textiles, and cosmetic and personal products. They are FDA-listed under the FDA food contact substance notification for use in all types of food contact polymers in 21 CFR, Parts 174 through 186. They are USDA-listed for non-food compounds maintained by NSF for food processing plants. And they have NSF 51 Certification for food processing /food service equipment and are deemed approvable under NSF Standard 42 for potable water/carbon block filter systems. Silver is listed as an active substance under the Biocidal Products Directive (BPD) 98/8 EC. AgION Antimicrobial—Notification No. 604

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Extensive Independent Lab Testing

The United States Environmental Protection Agency and regulatory agencies around the world mandate extensive independent laboratory testing to prove safety and efficacy before a registered product can be sold. The required battery of tests includes acute and chronic studies. The range of studies successfully conducted on AgION antimicrobials include:

Acute Studies:

Oral Toxicity	LD ₅₀ ≥ 5,000 mg/kg
Dermal Toxicity	LD ₅₀ ≥ 2,000 mg/kg
Inhalation Toxicity	LC ₅₀ ≥ 2.8 mg/l
Dermal Irritation	≥ 2,000 mg/kg
Dermal Sensitization	Non-Sensitizer
Ocular Irritation	Mild Irritant

Short Term:

Mutagenecity	Ames Mammalian Cell In Vivo & In Vitro Chromosome
Teratology	Rat
Subchronic	Rat and Dog

Long Term:

Carcinogenicity	Rat and Mouse
Chronic	Rat and Mouse
Two Generation Reproduction	Rat



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