Milliken®

Antimicrobial AlphaSan® Textile Processing Guidelines

Guidelines for Fiber Manufacturing / Processing

How to Use It

Antimicrobial AlphaSan® RC 5000 and RC 2000 are antimicrobial additives especially designed to withstand the high temperatures in the manufacture of plastics, films, fibers, polymeric materials and ceramics. They can be compounded into resin as a master batch form and blended prior to fiber spinning, or can even be added back with the raw materials in the CP unit prior to polymer formation. The small, uniform particle size and stability make Antimicrobial AlphaSan especially suited for fiber spinning.

What Yarns Can be Made

Most all yarns can be spun containing AlphaSan RC 5000 or RC 2000, but as discussed in the Physical Property section of this bulletin, as the manufacturing process moves towards micro denier production filament breaks will increase.

Usage Rates

Antimicrobial AlphaSan RC 5000 or RC 2000 may be incorporated into the finished product from 0.1% to 2.0% by weight. The actual amount of additive chosen to be incorporated into the fiber depends on a variety of factors ranging from the polymer being used to the specific fiber construction (cross section, dpf, filament count, core sheath design, etc.), the amount of bioburden to be overcome, and even to the length of durability of antimicrobial properties to be maintained.

The efficacy of Antimicrobial AlphaSan depends on the surface area of a treated fiber. At a given dose (by weight), fibers with a higher surface will exhibit higher efficacy. For a selected total fiber denier, a higher number of filaments at a lower denier will yield stronger antimicrobial properties.

In general, increased usage levels of Antimicrobial AlphaSan will be necessary when a high rate of efficacy is necessary, when long-term durability of the antimicrobial properties is desired or when the treated fiber will be blended down with non-treated fibers.

Interaction with Other Polymer Additives

While most fiber additives do not interact with Antimicrobial AlphaSan, there are some additives that can bind up (or neutralize) the activity and/or interact with the additive to cause undesired color formation.

In general, it is advised to avoid the use (or minimize the use) of the following classes of compounds whenever possible:

- **Sulfides**
- **Sulfites / Sulfite Esters**
- **Thiol Esters**
- **Chemicals with cationic species such as Na+, K+, Ca++, etc.**

Effects in Recycle / Regrind

Fiber containing Antimicrobial AlphaSan can be recycled / extruded multiple times without harming the efficacy of the material. The actual regrind use rate will be a factor of the polymer stability, additives in the polymer, and other additives such as fiber finish applied to the surface of the fiber. In general, it is preferred to wash and dry the polymer being recycled prior to extrusion. Refer to the section on polymer additives for deleterious effects that may be observed when recycling fiber.

Effects of AlphaSan on Fiber Physical Properties

Aside from possible color formation, the main physical property of the fiber that may be affected due to the use of AlphaSan is tenacity. This is primarily due to the ceramic nature and size of the AlphaSan particle. AlphaSan does not melt at fiber processing conditions, and does not chemically bind into the polymer structure of the fiber. Therefore the end result effect is the same of that of a void in the fiber filament. Thus the amount of polymer in the cross section of the fiber is lowered and the tenacity is effectively reduced. Below is presented a table of expected tenacity reduction as a function of the dpf of the fiber due to this effect.

Fiber Size, dpf	Expected Tensile Strength Reduction	
	AVERAGE	MAXIMUM
0.5	2.4 %	49 %
1.0	1.2 %	24 %
2.0	0.6 %	12 %
3.0	0.3 %	6 %

NOTE: For a single filament, the maximum strength reduction may be observed. As more filaments per fiber are added and/or the fabric is constructed, the properties of the yarn / fabric will move more towards the average listed.

General Guidelines For Textile Processing

Much research has been conducted (and is continuing to be conducted) on the various steps involved with textile manufacture, and the effect that it may have on the properties of fiber containing Antimicrobial AlphaSan. While the AlphaSan particles themselves do not migrate or diffuse from the treated polymer, it has been found that there are some steps encountered during the processing of textile articles where the additive may release silver ions prematurely, thus reducing it's performance in the final application. The following observations are given as guidelines to aid in optimizing the antimicrobial properties of these fibers:

Fiber Finish Effects on Fiber containing AlphaSan

It has been observed that the finish oil employed to lubricant fiber containing Antimicrobial AlphaSan can affect the efficacy, durability, and/or color stability of the additive in the fiber. Contact your fiber finish supplier about specific design constraints and proper selection of processing oils to be used on fiber containing this additive.

Fabric Dyeing and Finishing Procedures

Textile fibers containing AlphaSan are dyed and finished essentially the same as any other fiber, with no adverse effects caused by the inclusion of the new additive. There are however, a few steps that can be taken during the process that will optimize the antimicrobial properties retained by the textile after the dyeing process. These include:

Guidelines for Dyeing & Finishing of Polyamide (Nylon)

Polyamide Scouring Procedures

1. Increased pH (highly basic) in fiber/fabric scours negatively impacts the antimicrobial properties of fiber containing the AlphaSan additive. It is suggested to use non-ionic scours at neutral (or mildly basic) conditions whenever possible.
2. It has been observed that increased temperature with increased pH yields a negative secondary interaction with regards to the final antimicrobial properties of the textile being manufactured. If base is used in the scour procedure, it is suggested to minimize both the temperature and exposure time on temperature to prevent adverse effects.
3. In addition to the time / temperature / pH effect mentioned above, increased time that the fabric is exposed to the scour conditions should also be minimized.
4. If using base in the scour operation, it has been noted that NaOH is preferred over KOH.
5. It is suggested that scoured polyamide fabrics be neutralized in the final stage of a range scour operation (such as a mild acetic acid rinse).
6. Polyamide fabrics should not be stored wet.

Polyamide Dyeing Procedures

1. Avoid the use of pre-metallized dyes.
2. Minimize Cycle Time.
3. Minimize dyeing temperature.
4. Dry fabric as soon after the dying process as possible.
5. If an after-treatment for fastness is required, use a fixative of the aryl sulfonate type.

Nylon Heat Setting Recommendations

1. Steam Heat Setting should be avoided.
2. Low to moderate temperatures (250-275°F/121-135°C) are preferable.

Nylon chemical treatments (general)

1. Sodium dithionite and peroxide should be avoided. Mild acid neutralization is recommended after any alkaline post-dye treatment. Soda ash is the preferred base in the rare event such a post-dye treatment is necessary.

Guidelines for Dyeing & Finishing of Polyester

General

1. Use the mildest process conditions possible.
2. Minimize the concentration of sodium wherever possible.

Polyester Scouring Recommendations

FILAMENT POLYESTER

1. Minimize the temperature used to scour the fabric.
2. Avoid the use of sulfonated surfactants.
3. High pH may adversely affect AlphaSan performance, and for a given pH Na_2CO_3 is worse than NaOH for maintaining antimicrobial performance. The key phrase in this statement is "for a given pH". There is much more sodium ion present in Na_2CO_3 at pH 11, than in caustic at this pH.

SPUN POLYESTER

1. High temperature (180°F/83°C) is acceptable.
2. Avoid the use of sulfonated surfactants.

Polyester Dyeing Recommendations

FILAMENT POLYESTER

1. Avoid the use of increased dye dispersant. Many of these materials contain sulfonate groups that can extract or bind up the antimicrobial.
2. Minimize the use of leveling agents in the dye bath whenever possible.
3. Keep pH as close to neutral as possible.
4. It is not recommended to run a reductive after scour. If after scouring is necessary, avoid the use of sodium hydrosulfite. Thiourea dioxide is recommended as a suitable substitute.
5. Chelating agents can negatively impact performance.

SPUN POLYESTER

1. Chelating agents and sulfonated dye dispersants should be avoided.
2. Nonionic levelers should be used.

Polyester Heat Setting Recommendations

FILAMENT POLYESTER

1. Dyeing the fabric after heat setting is preferred but dyeing before heat setting is also acceptable.
2. Low to moderate temperatures (e.g. 300-350°F/149-177°C) are preferred.

SPUN POLYESTER

1. Chelating agents and sulfonated dye dispersants should be avoided.
2. Nonionic levelers should be used.

Polyester chemical treatments (general)

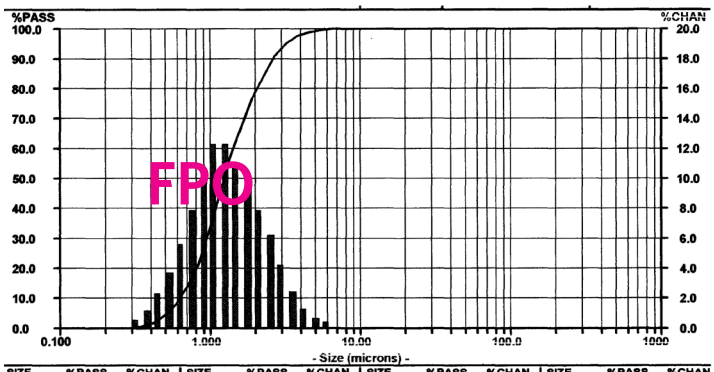
FILAMENT OR SPUN POLYESTER

1. Sodium dithionite should be avoided.
2. In a post-treatment it is preferable to keep the temperature below 200°F/93°C.

Antimicrobial AlphaSan RC 5000 Physical Properties

Melt Point	**> 1000 C**
Form	**White Powder**
Odor:	**None**
Specific Gravity	**~ 3**
Bulk Density	**~ 0.25 – 0.3**
Percent Volatile By Weight	**< 0.5% @ 300°C**
Vapor Pressure	**Nil**
Percent Silver	**3.8 % by weight**

Particle Size Distribution

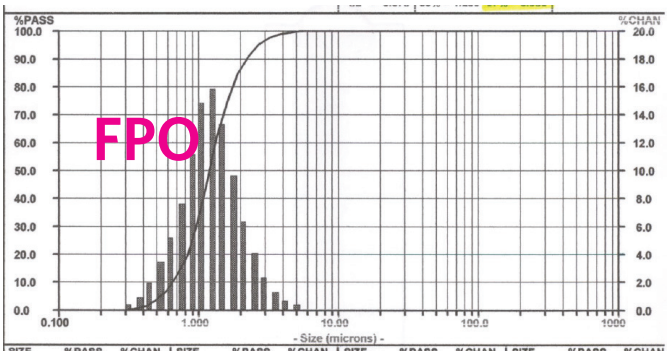


SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
704.0	100.00	0.00	9.250	100.00	0.00						
592.0	100.00	0.00	7.778	100.00	0.00						
497.8	100.00	0.00	6.541	100.00	0.39						
418.6	100.00	0.00	5.500	99.61	0.68						
352.0	100.00	0.00	4.625	98.93	1.29						
296.0	100.00	0.00	3.889	97.64	2.46						
248.9	100.00	0.00	3.270	95.18	4.26						
209.3	100.00	0.00	2.750	90.92	6.25						
176.0	100.00	0.00	2.312	84.67	7.88						
148.0	100.00	0.00	1.946	76.79	9.30						
124.5	100.00	0.00	1.635	67.49	10.92						
104.7	100.00	0.00	1.375	56.57	12.36						
88.00	100.00	0.00	1.156	44.21	12.40						
74.00	100.00	0.00	0.972	31.81	10.52						
62.23	100.00	0.00	0.818	21.29	7.88						
52.33	100.00	0.00	0.688	13.41	6.59						
44.00	100.00	0.00	0.578	7.82	3.76						
37.00	100.00	0.00	0.486	4.04	2.29						
31.11	100.00	0.00	0.409	1.75	1.20						
26.16	100.00	0.00	0.344	0.55	0.55						
22.00	100.00	0.00	0.289	0.00	0.00						
18.50	100.00	0.00	0.243	0.00	0.00						
15.56	100.00	0.00	0.204	0.00	0.00						
13.08	100.00	0.00	0.172	0.00	0.00						
11.00	100.00	0.00	0.145	0.00	0.00						

Antimicrobial AlphaSan RC 2000 Physical Properties

Melt Point	**> 1000 C**
Form	**White Powder**
Odor:	**None**
Specific Gravity	**~ 3**
Bulk Density	**~ 0.25 – 0.3**
Percent Volatile By Weight	**< 0.5% @ 300°C**
Vapor Pressure	**Nil**
Percent Silver	**10 % by weight**

Particle Size Distribution



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
704.0	100.00	0.00	9.250	100.00	0.00						
592.0	100.00	0.00	7.778	100.00	0.00						
497.8	100.00	0.00	6.541	100.00	0.00						
418.6	100.00	0.00	5.500	100.00	0.38						
352.0	100.00	0.00	4.625	99.62	0.68						
296.0	100.00	0.00	3.889	98.94	1.28						
248.9	100.00	0.00	3.270	97.66	2.37						
209.3	100.00	0.00	2.750	95.29	4.06						
176.0	100.00	0.00	2.312	91.23	6.46						
148.0	100.00	0.00	1.946	84.78	9.66						
124.5	100.00	0.00	1.636	75.12	13.40						
104.7	100.00	0.00	1.375	61.72	15.86						
88.00	100.00	0.00	1.156	45.86	14.87						
74.00	100.00	0.00	0.972	30.99	11.26						
62.23	100.00	0.00	0.818	19.74	7.70						
52.33	100.00	0.00	0.688	12.04	5.22						
44.00	100.00	0.00	0.578	6.82	3.43						
37.00	100.00	0.00	0.486	3.39	1.99						
31.11	100.00	0.00	0.409	1.40	0.98						
26.16	100.00	0.00	0.344	0.42	0.42						
22.00	100.00	0.00	0.289	0.00	0.00						
18.50	100.00	0.00	0.243	0.00	0.00						
15.56	100.00	0.00	0.204	0.00	0.00						
13.08	100.00	0.00	0.172	0.00	0.00						
11.00	100.00	0.00	0.145	0.00	0.00						

Antimicrobial AlphaSan RC 5000 / RC 2000 Powder Flow Characteristics

Flow Rate Indices	Flow Rate Index (FRI)	115.8 lb/min
	Feed Density Index (FDI)	24.2 pcf
	Bin Density Index (BDI)	40.2 pcf
	Spring Back Index (SBI)	1.5 %

Hang-Up Indices	**CONSOLIDATION TIME**	**0 HR**	**16 HR**
	Arching Index (AI)	1.2 feet	2.0 feet
	Ratholing Index (RI)	10.8 feet	12.2 feet

Hopper Indices	**INDEX**	**HOPPER (HI)**	**CHUTE (CI)**
	304-2B Stainless Steel	3°	90°
	304-#1 Stainless Steel	0°	90°
	304-#1 Electropolished	0°	90°
	Epoxy (Plasite 9122 TFE)	0°	90°

INDICES BASIS
D = Bin Diameter = 10.0 feet
d = Hopper Outlet = 12.0 inches
Φ = Hopper Angle = 20°

Please contact your Milliken representative for further product information including chemical registrations, food contact status, and other regulatory details.

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