

ACCEPTED

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bioMet* 24 Antimicrobial Compound

bioMet* 24 is a new odorless antibacterial and antifungal formulation which provides effective control of gram positive and gram negative microorganisms when used as an additive to flexible polyvinyl chloride systems. In addition, bioMet 24 provides outstanding protection for PVC against mildew and discoloration even under the most severe conditions of soil burial. The broad spectrum antibacterial control provided by the addition

bioMet 24 to vinyl film affords this excellent protection for products such as:

well covering

~~upholstery (including auto seat covers)~~

~~clover curtains~~

~~swimming pool liners~~

rug undercoating

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These bioMet 24 treated products will control the growth of many disease causing bacteria including Staphylococcus aureus and Pseudomonas aeruginosa.

In addition to providing excellent compatibility with standard flexible vinyl systems, bioMet 24 protects the manufacturing area from the disagreeable odors generally associated with PVC processing. This odor protection is also afforded to the finished product. bioMet 24 provides protection against color in clear and white PVC films and will not alter its heat stability.

Physical Properties

Composition: 10% solution of Diphenylstibine 2-ethyl hexoate in epoxidized soybean oil.

Appearance: Clear, pale yellow liquid

Physical Properties (Continued)

Corrosiveness: non-corrosive to metal or glass
Density: 1.0184 at 25°C.
Refractive Index: 1.4820 at 25°C.
Pour Point: -22°C.
Freeze Point: -18°C.
Viscosity: 408.4 cs at 25°C.

The ability of bioMet 24 to inhibit the growth of many microorganisms is demonstrated below. The spectrum of control includes gram positive bacteria, gram negative bacteria, common molds, wood rotting fungi, active cellulose digesting fungi, and pathogenic fungi.

<u>Microorganisms</u>	<u>Min. Level Required for Inhibition (PPH - of Active Ingredient)</u>
<u>Gram Positive Bacteria</u>	
Staphylococcus aureus	8
Streptococcus faecalis	35
Micrococcus flavus	16
Bacterium ammoniagenes	20
Bacillus mycoides (spore former)	40
Bacillus cereus (spore former)	35
Bacillus subtilis (spore former)	30
Mycobacterium smegmatis	35
Sphaerotilus	25
<u>Gram Negative Bacteria</u>	
Aerobacter aerogenes	31
Paraclostridium aerogenoides	16
Salmonella typhosa	30

<u>Microorganisms</u>	<u>Min. Level Required for Inhibition (PPM - of Active Ingredient)</u>
<u>Gram Negative Bacteria (Continued)</u>	
Shigella dysenteria	30
Proteus mirabilis	20
Pseudomonas aeruginosa	31
Alcaligenes viscolactis	30
Escherichia coli	16
<u>Common Molds</u>	
Aspergillus terreus	63
Aspergillus oryzae	125
Aspergillus clavatus	31
Aspergillus flavus	63
Aspergillus niger	250
Penicillium piscarium	125
Penicillium expansum	63
Penicillium funiculosum	125
Penicillium fusco-glaucum	31
Trichoderma lignorum	63
Trichoderma viride	250
Pullularia pullulans	500
<u>Wood Rotting Fungi</u>	
Lentinus lepideus	16
Lenzites trabea	31
Peria monticola	16

<u>Microorganisms (Continued)</u>	<u>Min. Level Required for Inhibition (PPM - of Active Ingredient)</u>
<u>Active Cellulose Digesting Fungi</u>	
Hyothecium verrucaria	63
Chaetomium globosum	250
<u>Pathogenic Fungi</u>	
Candida albicans	31
Trichophyton mentagrophytes	16

Directions For Use

To achieve optimum antibacterial and antifungal control, it is recommended that bioMet 24 be added to PVC formulations at a concentration of 1.2% to 3.0% based on the weight of the film. A typical formulation is obtained by mixing the following ingredients and blending it on a 2-roll differential speed mill at 325°F. for 5 minutes.

<u>Ingredient</u>	<u>Parts</u>
PVC Resin	100
Plasticizer (Dioctyl phthalate)	45
Butyl Epoxy Stearate	5
Thermolite® 116 (Ba/Cd/Zn Phosphite Stabilizer)	2
Antioxidant (CAC-3)	0.1
Filler (TiO ₂)	0.0 - 10.0
Lubricant (Stearic Acid)	0.3
bioMet 24®	2.0 - 3.0

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Antimicrobial Properties of PVC Treated with bioMet 24

1. Bacterial Control

The antibacterial properties of PVC film treated with bioMet 24 are

1. Bacterial Control (Continued)

demonstrated by the standard agar diffusion technique (AATCC Method 90-192T) against *Staphylococcus aureus* FDA 209.

Sample	Additive	Bacterial Control Zone of Inhibition (mm)
Clear PVC	1.23% bioMeT 24	3
Clear PVC	none	0
Pigmented PVC	1.23% bioMeT 24	3
Pigmented PVC	none	0

2. Fungal Control

The mildew resistance of PVC film treated with bioMeT 24 is demonstrated by the mixed spore agar plate method. This test is an adaptation of Mil-1-744A (Insulation sleeving, Electrical Flexible, dated 24 June, 1953) and Mil-1-631C (Insulation, Electrical Synthetic Resin Composition, Non-Rigid). The test organisms include *Aspergillus niger*, *Aspergillus flavus*, *Trichoderma viride* and *Penicillium piscarium* (luteum).

Sample	Additive	Mildew Rating*
Clear PVC	1.23% bioMeT 24	0
Clear PVC	none	3
Pigmented PVC	1.23% bioMeT 24	0
Pigmented PVC	none	3

* The mildew growth on the plastic film is rated as 0 = no growth; 1 = traces of growth; 2 = light growth; 3 = moderate growth; 4 = heavy growth.

3. Soil Burial Stability

The utility of PVC film treated with bioMeT 24 in decorative film and vapor barriers designed for below ground installation was

3. Soil Burial Stability (Continued)

demonstrated by conducting the soil burial test outlined in Federal Specification CCC-T-191-b. The vinyl coated fabric was obtained by blending the following ingredients and applying a 10 mil film to cotton fabric. The film was cured at 350°F. for 10 minutes.

	Clear	White
PVC Resin (Geon 121EP)	100	100
DOP (dioctyl phthalate)	30	30
DOZ (dioctyl azelate)	15	15
G-62 (Epoxidized Soybean Oil)	5	5
Filler (TiO ₂)	-	15
Thermolite® 119 (stabilizer)	2	2
bioMeT 24®	2	2

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Sample	Additive	Discoloration	Mildew
Clear	1.23% bioMeT 24	none	none
Clear	none	Pink and Yellow Staining	severe rotting
White	1.23% bioMeT 24	none	none
White	none	Pink and Yellow Staining	severe rotting

4. Heat Stability

Heat stability was determined by heating the bioMeT 24 treated PVC film for various periods of time and then testing the film for mildew resistance against a mixed spore inoculum. These results clearly indicate control under conditions incurred in calendaring PVC.

4. Heat Stability (Continued)

<u>% bioMeT 24</u>	<u>Mildew Resistance vs. Time (minutes)</u>				
	<u>0</u>	<u>15</u>	<u>30</u>	<u>45</u>	<u>60</u>
1.2%	+	+	+	0	0
3.0%	+	+	+	+	+

+ = mildew resistant
0 = inactive

5. Storage Stability

The storage stability of PVC film treated with bioMeT 24 was determined at temperatures alternating between 44°F. and 122°F. Mildew control is indicated under these conditions of storage stability.

<u>% bioMeT 24</u>	<u>Storage Time vs. Mildew</u>		
	<u>0</u>	<u>7 weeks</u>	<u>11 weeks</u>
1.2%	+	+	+
3.0%	+	+	+

+ = mildew resistance
0 = inactive

Toxicology-Hygiene of bioMeT 24

bioMeT 24 is very hazardous to the eyes. Upon contact it will cause damage. The effectiveness of an eye lavage with water is considerably less than that with most similar products. Therefore, it is advisable to wear chemical goggles and/or full-face shield for eye protection when handling this product.

This material is very irritating to the skin and is capable of producing damage. In addition to being irritating dermally, bioMeT 24 may be moderately toxic when absorbed through the skin. Therefore, it is advisable to wear

Toxicology-Hygiene of bioMeT 24 (Continued)

rubber gloves and protective clothing when using this product.

bioMeT 24 is toxic orally and care must be taken to avoid accidental swallowing.

Suggested First Aid

Eye contact with bioMeT 24 should be treated by immediately flushing with copious amounts of water for fifteen minutes. Preferably, a gentle continuously flowing stream of water should be directed into the open eye (held open if necessary) for fifteen minutes. A physician should then be consulted.

In the event of external body contact with bioMeT 24, the area should be washed thoroughly with soap, containing a builder with alkaline reserve action, and water followed by a thorough rinsing with water. Contaminated clothing should be removed and washed with soap and water before reuse.

Care should be exercised to prevent the spreading of bioMeT 24 to the eyes, nose, and mouth.

Toxicology-Hygiene of PVC Film Protected with bioMeT 24

Toxicological evaluations using PVC film protected with bioMeT 24 indicate that dermal contact will not cause irritation or sensitization. In tests performed with this vinyl film, no skin irritation was observed after repeated animal exposures of 10 and 28 days.