

Biocidal additives with **silver nanoparticles** for thermoplastic and chemically cured polymers

POLYDEF Ag+ HDPE

PRODUCT DATA SHEET

POLYDEF Ag+ HDPE is a concentrated masterbatch formulated from silver nanoparticles (Ag) designed for HDPE and PP-based plastics that adds bactericidal properties to the finished polymer elements.

The presence of nanosilver in the protected polymer ensures a biocidal effect by inhibiting the metabolic pathways of microorganisms, contributing to the elimination of sources of unpleasant smells and the extension of the lifetime of the material. The additive is environmentally friendly, does not affect the physical properties of the polymers and does not cause degradation of the protected material. The component provides long-lasting microbiological protection (microbiological efficacy of $\geq 99.98\%$), as well as enhances the safety and attractiveness of the product. The nano additive is also very stable at high temperatures and in high humidity compared to traditionally used biocides.

General information

Polydef Ag+ HDPE is added to the finished product during manufacture. The granules provide antimicrobial properties and should not affect the basic colour or surface finish of the product. The active substances do not degrade or leach. The additive is designed to exhibit constant activity throughout the product life cycle.

Recommended dosage

For microbial protection, it is recommended to apply a dosage of 2-6 wt.% relative to the weight of the finished polymer composite. It is advisable to validate the antimicrobial additive prior to product launch.

Test procedure

The analysis is a quantitative test designed to assess the performance of antimicrobial properties. Test samples are incubated with a bacterial suspension for 24 hours at 37°C. The average number of viable bacterial cells and the percentage reduction of the selected microorganism are then calculated.

Microbiological efficacy

Microbiological efficacy Microbiological properties were subjected to testing in accordance with ISO 22196 *Measurement of antibacterial activity on plastics and other non-porous surfaces*, against the following microorganisms:

- Escherichia coli ATCC 8739
- Staphylococcus aureus ATCC 6538

The reduction efficacy of more than 90% has been confirmed.

Storage

The granules have been developed in a manner that ensures the highest stability during storage and use.

Be aware that silver-containing materials may be sensitive to light and electromagnetic fields. Insufficiently mixed product may cause discolouration in the finished goods, which is why it is the responsibility of the manufacturer of the final component to fully assess it under normal conditions of use.

Before use

It is important, as with all chemicals, to read the product data sheet before use.

Before applying the product, always ensure that you have the latest information. For more information, contact us at kontakt@smartnanotech.com.pl.

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POLYDEF Ag+ HDPE

POLYMER MATRIX DATA SHEET



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PHYSICAL PROPERTIES			
Parameter	Standard	Value	Unit
Melt Flow Rate (MFR) (190 °C/2.16 kg)	ISO 1133-1	0.30	g/10 min
Density	ISO 1183-1	0.952	g/cm ³
Bulk density	ISO 60	>0.5 00	g/cm ³
MECHANICAL PROPERTIES			
Parameter	Standard	Value	Unit
Modulus of elasticity when stretched	ISO 527-1	1100	MPa
Yield point	ISO 527-1	25	MPa
Relative elongation at yield point	ISO 527-1	8	%
Izod impact strength, -30°	ISO 179/1eA	6	kJ/m ²
Shore hardness	ISO 868	62	-
Determination of hardness by ball indentation method	ISO 2039-1	51	MPa

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Evaluation of the biocidal properties of HDPE-based composites

Materials and methods:

The experiment was performed according to ISO 22196: Plastic - Measurement of antibacterial activity on plastics and other non-porous surfaces.

Test microorganisms:

- *Escherichia coli* (ATCC 8739)
- *Staphylococcus aureus* (ATCC 6538)

Number of viable bacteria in the inoculum:

- *Escherichia coli* – 7.5×10^5 cfu·cm⁻³
- *Staphylococcus aureus* – 7.5×10^5 cfu·cm⁻³

Contact time:

- 24 hours

Table 1 Number of viable bacteria on control and test samples.

<i>Escherichia coli</i>							
Assessed parameter	Control sample immediately after inoculation	Control sample after 24 h	Sample with 2 wt.% after 24 h	Sample with 4 wt.% after 24 h	Sample with 6 wt.% after 24 h	Sample with 8 wt.% after 24 h	Sample with 10 wt.% after 24 h
Average number of viable bacteria cells [cfu·cm ⁻²]	3.5×10^4	2.0×10^6	1.1×10^3	0	0	0	0
Average of the common logarithm of the number of viable bacterial cells	4.5	6.3	3.0	0	0	0	0
<i>Staphylococcus aureus</i>							
Assessed parameter	Control sample immediately after inoculation	Control sample after 24 h	Sample with 2 wt.% after 24 h	Sample with 4 wt.% after 24 h	Sample with 6 wt.% after 24 h	Sample with 8 wt.% after 24 h	Sample with 10 wt.% after 24 h
Average number of viable bacteria cells [cfu·cm ⁻²]	3.4×10^4	2.0×10^5	2.3×10^2	0	8.6×10^2	2.5×10^2	5.6×10^2
Average of the common logarithm of the number of viable bacterial cells	4.5	5.3	2.4	0	2.9	2.4	2.8



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Table 2 Antimicrobial activity and reduction of bacteria on tested surfaces.

Dosage	<i>E. coli</i>		<i>S. aureus</i>	
	Antimicrobial activity [log]	Reduction in number of bacteria [%]	Antimicrobial activity [log]	Reduction in number of bacteria [%]
2 wt. %	3.3	99.9	2.9	99.8
4 wt. %	6.3	100	5.3	100
6 wt. %	6.3	100	2.4	99.6
8 wt. %	6.3	100	2.9	99.8
10 wt. %	6.3	100	2.6	100

Graph 1. Antimicrobial activity and reduction of bacteria on tested surfaces.

