POLYDEF
LINE OF BIOCIDAL ADDITIVES FOR POLYMERS

ACTIVE SILVER PROTECTION by POLYDEF

Biocidal additives containing **silver particles** for polymers

# POLYDEF Ag+ LDPE

## PRODUCT DATA SHEET

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

The presence of silver 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 ≥ 99.98%), as well as enhances the safety and attractiveness of the product. The additive is also very stable at high temperatures and in high humidity compared to traditionally used biocides.

### General information

**POLYDEF Ag+ LDPE** 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

To achieve bactericidal results, it is recommended to use a dosage of 4-6% by weight in proportion to the final polymer composite. To obtain fungicidal effects, a 6% weight dosage is advised. It is advisable to validate the efficacy of the antibacterial additive before releasing the product to the market.

### 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.





PRODUCER:
**Smart Nanotechnologies S.A.**
Karola Olszewskiego 25,
32-566 Alwernia, Polska

smartnanotech.com.pl
phone: +48 12 25 89 395

# POLYDEF Ag+ LDPE

## POLYMER MATRIX DATA SHEET

**POLYDEF Ag+ LDPE** is a concentrated masterbatch formulated from silver particles (Ag) designed for HDPE and PP-based plastics that adds bactericidal properties to the finished polymer elements.
The presence of silver 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 ≥ 99.98%), as well as enhances the safety and attractiveness of the product. The additive is also very stable at high temperatures and in high humidity compared to traditionally used biocides.

| PHYSICAL PROPERTIES | | | |
|---|---|---|---|
| **Parameter** | **Standard** | **Value** | **Unit** |
| Density | ASTM D792 | 0,923 | g/cm³ |
| Melt Flow Rate (MFR) (190 °C/2.16 kg) | PN EN ISO 1133 | 20,0 | g/10 min |
| **MECHANICAL PROPERTIES** | | | |
| **Parameter** | **Standard** | **Value** | **Unit** |
| Tensile modulus | PN EN ISO 527-1, 2 | 164,0 | MPa |
| Tensile yield strength | PN EN ISO 527-1, 2 | 8,2 | MPa |
| **HARDNESS** | | | |
| **Parameter** | **Standard** | **Value** | **Unit** |
| Shore Hardness (Scale D) | PN EN ISO 868 | 49 | - |
| **THERMAL PROPERTIES** | | | |
| **Parameter** | **Standard** | **Value** | **Unit** |
| Vicat softening point (A50; 500C/h 10N) | ASTM D1525 | 93 | °C |



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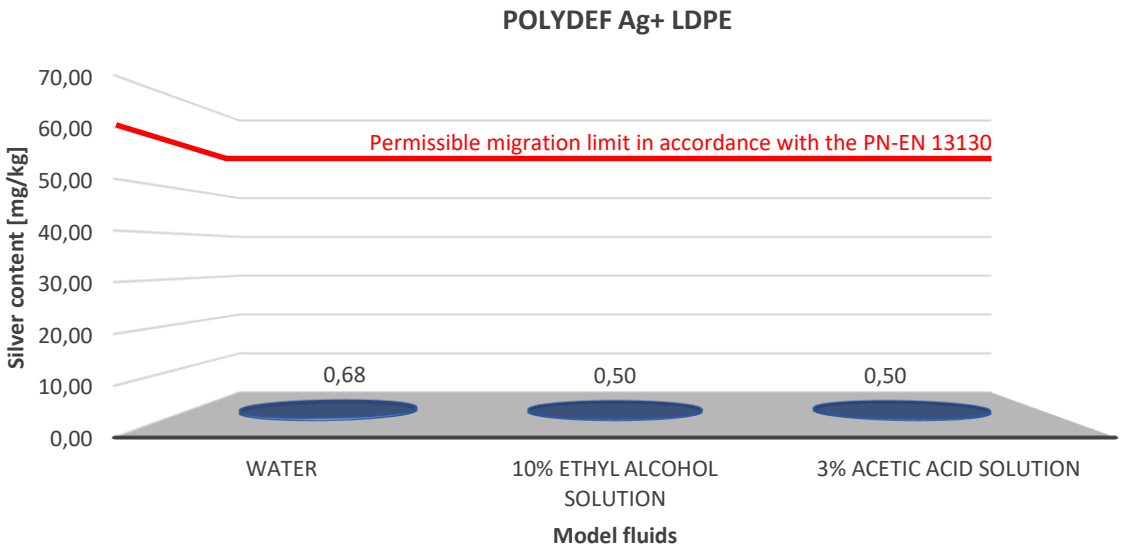
# POLYDEF Ag+ LDPE

## SILVER SPECIFIC MIGRATION

**POLYDEF Ag+ LDPE** is a masterbatch based on LDPE with a high content of silver particles (Ag). To ensure the safe use of the concentrated additive, specific migration tests of silver were carried out into model liquids - demineralized water, 10% ethyl alcohol solution and 3% acetic acid solution. According to the international standard **PE-EN 13130**, the general global migration limit for silver is **60 mg/kg**. For all tested fluids, values significantly below the permissible level were obtained (Graph 1). It is worth noting that the research was carried out on a masterbatch, which is dosed into the final product in an amount of 4 - 6%. This proves a very high level of security of the solution used.

**Graph 1.** Specific migration of silver from masterbatches according to the PN-EN 13130 standard.



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**REPORT**

**Evaluation of the biocidal properties of LDPE-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.

| *Escherichia coli* | | | | | |
|---|---|---|---|---|---|
| **Assessed parameter** | **Control sample immediately after inoculation** | **Control sample after 24 h** | **Sample with 2 wt.% after 24 h** | **Sample with 3 wt.% after 24 h** | **Sample with 4 wt.% after 24 h** |
| **Average number of viable bacteria cells [cfu·cm$^{-2}$]** | 1,1×10$^4$ | 1,3×10$^6$ | 7,8×10$^1$ | 6,7×10$^4$ | 0 |
| **Average of the common logarithm of the number of viable bacterial cells** | 4,0 | **6,1** | **1,9** | **4,8** | **0** |
| ***Staphylococcus aureus*** | | | | | |
| **Assessed parameter** | **Control sample immediately after inoculation** | **Control sample after 24 h** | **Sample with 2 wt.% after 24 h** | **Sample with 3 wt.% after 24 h** | **Sample with 4 wt.% after 24 h** |
| **Average number of viable bacteria cells [cfu·cm$^{-2}$]** | 1,6×10$^4$ | 6,4×10$^4$ | 4,8×10$^3$ | 5,6×10$^2$ | 6,3×10$^2$ |
| **Average of the common logarithm of the number of viable bacterial cells** | 4,2 | **4,8** | **3,7** | **2,8** | **2,8** |



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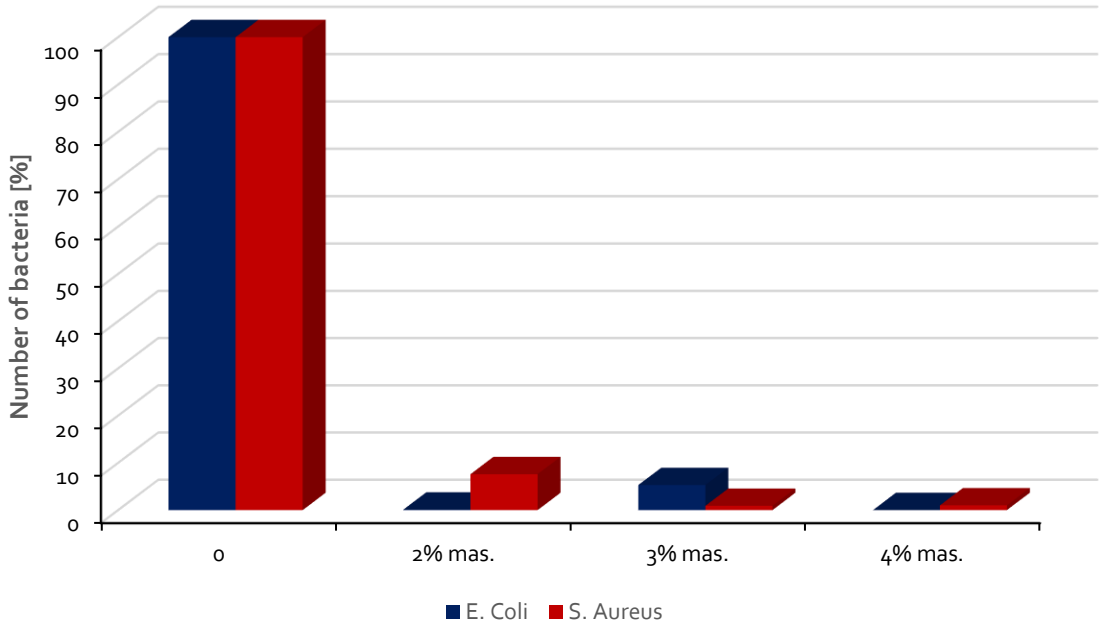
**Table 2** Antimicrobial activity and reduction of bacteria on tested surfaces.

| Dosage | *E. coli* | | *S. aureus* | |
|---|---|---|---|---|
| | Antimicrobial activity [log] | Reduction in number of bacteria [%] | Antimicrobial activity [log] | Reduction in number of bacteria [%] |
| **2 wt %.** | 4,2 | 99,9 | 1,1 | 92,4 |
| **3 wt %..** | 1,3 | 94,7 | 2,0 | 99,1 |
| **4 wt %.** | 6,1 | 100 | 2,0 | 99,0 |

**Graph 2.** Antimicrobial activity and reduction of bacteria on tested surfaces.



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