
**Silver Antimicrobials
in
Polymer Applications**

Plastic Additives
23.04.2002
Heinz Herbst

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IRGAGUARD® B (Silver based)

- Inorganic broad spectrum antimicrobial
- Active against Gram-positive, Gram-negative bacteria, mold & yeast
- High heat resistance – up to 800 °C
- Long life efficacy –
 - slow release of Silver-ions out of Zeolite or Glass matrix
 - Silver-ions are bounded via ion - ion interactions
- Highly effective & stable – Does not vaporize nor decompose
- Non toxic

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Silver antimicrobials

● 1st generation

- based on AgCl, AgO (+ TiO₂, ZnO, CuO,..)
- disadvantage:
 - not migratory
 - availability of Ag⁺-ion (efficacy)
 - photographic effect (discoloration)

* 3rd generation

- IRGAGUARD B 5000
- based on Ag-Zeolite +
- semi-migratory
- no/low discoloration

● 2nd generation

- based on Ag-Zeolite
- semi-migratory
- disadvantage:
 - photographic effect (discoloration)

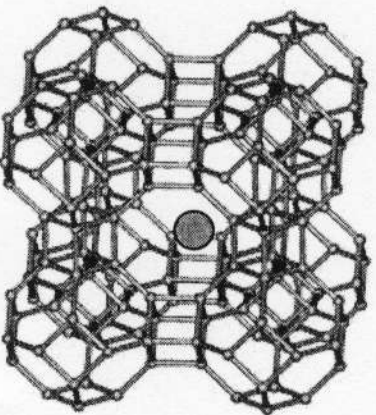
* 4th generation

- IRGAGUARD B 7000
- Silver/Glass antimicrobial
- semi-migratory
- no/low discoloration
- transparent systems



IRGAGUARD® B (Silver based)

proprietary Zeolite / Glass technology



- modified Alumino-Silicate framework
- specific structure controls slow release of Silver ions
- prevents discoloration (photographic effect)

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IRGAGUARD® B (Silver based)

- Mode of action – Bactericide

- active species is the Silver-ion (Ag^+)
- Ag^+ is taken up by the cell membrane and inside the cell
- Ag^+ interferes with R-SH, R-SS-R and R-NH groups
- these groups are part of proteins (e.g. enzymes) and nucleic acid (DNA)
- binding to DNA interferes with DNA replication
- binding and denaturation of bacterial respiratory enzyme system
 - osmotic pressure can not be maintained (cell leaks out)
 - enzymes are vital in the cellular generation of energy
- disruption of the bacterial cell



Regulatory Status

- General use for plastics
 - EC all components on EINECS
Products notified within European Biocide Product Directive
 - USA EPA / FIFRA registration in preparation
 - Asia : no specific approval needed

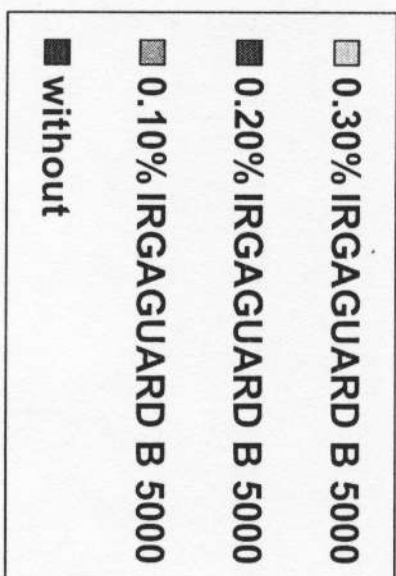
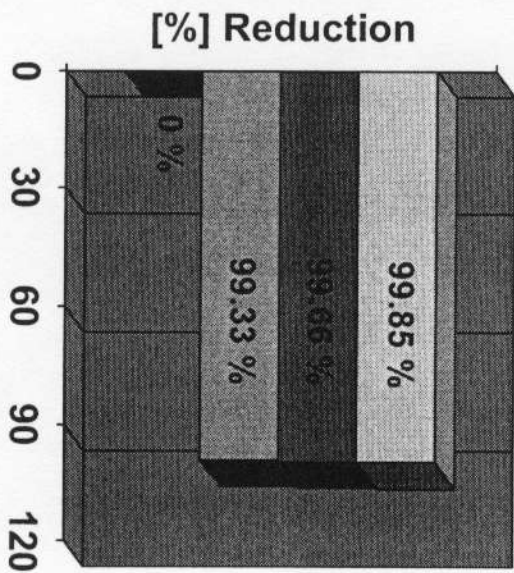
- Food contact approval
 - FDA : Irgaguard B 5000
Irgaguard B 7000 pending
 - EC : pending
 - Japan : pending



PP Injection / Film Covered Method

High Crystalline PP Polymer

Staphylococcus aureus IFO 12732



Film covered Test : After detergent treatment (8% Alkyl amine oxide)
High crystalline PP Polymer for toilet seat cover

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PP Spunbond / Shake Flask Method

Samples	Staphylococcus aureus IFO 12732	Escherichia coli IFO 3972
without IRGAGUARD B 7520	1.1 x 10 ⁵	2.8 x 10 ⁸
5 % IRGAGUARD B 7520	6.9 x 10	3.2 x 10

