What the naked eye couldn’t see:

Visualizing the Antibacterial Effect of Silver-Based AlphaSan® in B/SH/ Refrigerators

Rik Langerock
Outline

- Milliken & Company
- Bosch und Siemens Hausgeräte GmbH
- Problem Statement
- Proof of Concept
- AlphaSan Mechanism
- Laboratory Testing
- Visualization
- AlphaSan – B/S/H/ Value Proposition
- AlphaSan Applications
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Milliken & Company

- Privately-held company (Spartanburg, SC, USA)
- Founded in 1865
- Manufacturing over 38,000 textile, chemical and coated products
- 12,000 associates worldwide
- 65 locations in 12 countries
- Well known for quality

European Quality Award

J.I.P.M. Award for TPM Excellence

Malcolm Baldridge National Quality Award
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Focusing Skills, utilizing Synergies

Robert Bosch GmbH

Siemens AG

1967

50% 50%

BSH Bosch und Siemens Hausgeräte GmbH
BSH - one of the world's leading home appliance manufacturers

BSH’s product range spans the whole spectrum of electrical home appliances, and offers the customer real added value in terms of efficiency, convenience and user friendliness:

- 14 brands
- more than 34,500 employees worldwide
- sales of approx. € 7.3 bill.
- 71 companies in 40 countries around the world
- 42 factories in Europe, the USA, Latin America and Asia
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Despite all measures currently in place, refrigerators can still be a **hotspot** for psychrotrophic bacteria that are a risk for **cross-contamination**.
Problem statement

- *Listeria monocytogenes* is a psychrotrophic species that is frequently reported as a food contaminant and a potential pathogen.
- Therefore, the presence and growth of this organism in refrigerators is of great concern.
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Proof of concept

- In a partnership with Milliken, Bosch und Siemens Hausgeräte developed AlphaSan® antibacterial inner liners in its entire range of refrigerators to tackle this concern.
- Whereas antibacterial liners are present in high end refrigerators, proof of concept was further developed in this study.
- This work widens the technical platform to support the antibacterial claims in B/S/H/ refrigerators.
Proof of concept

- **Purpose**
  - Prove the real life performance of AlphaSan in B/S/H/ refrigerators at low temperature by data and visualization

- **Process**
  - What is AlphaSan®?
  - 2 Studies:
    - Laboratory Data
    - Visualization
      - Spill simulation: Artificial contamination of the surface with *Listeria* sp.
      - Simulate cross contamination

- **Pay-off**
  - Generate a better understanding of the activity of the antibacterial coating in leading brand B/S/H/ refrigerators
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What is Antimicrobial AlphaSan®?

- White inorganic material
- Active ingredient is silver ion
- Carrier material is a zirconium phosphate based ceramic
AlphaSan® mechanism

- AlphaSan® serves as a reservoir for the controlled release of silver ions.
  - Ion exchange mechanism
  - The presence of water/moisture/vapor is key
  - Silver ions interact with microorganisms
AlphaSan® mechanism

- Reaction of silver ions with electron-donating groups e.g. Sulfur, Phosphorous
  - Proteins
  - Genetic material
- Conclusion: many different reaction sites
AlphaSan® mechanism

- Benefit of silver
  - Silver is very non-specific
  - Broad spectrum efficacy
  - Low concentrations are already effective
  - Microbial resistance is rare
  - AlphaSan silver is SAFE (FDA-EFSA)

Alexander The Great: Early Adopter of Silver Technology
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Lab Efficacy against *Listeria* (4°C – JIS Z 2801)

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<tr>
<th>Time of exposure (weeks)</th>
<th>Minimal count</th>
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Number of living cells (cfu/ml)

- **HIPS inner liner non-treated**
- **HIPS inner liner AlphaSan-treated**

1000000 100000 10000 1000 100 10

Microbes

Biofilm

AlphaSan

Cold Chain Management, 2nd Int. Workshop, Universität Bonn – May 9, 2006 by Rik Langerock, Milliken Chemical Europe
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Method

- Combine growth of *Listeria* at refrigeration temperature (4°C) with color
  - Bacteria cannot be seen with the naked eye: visualize bacterial growth directly on the surface of the refrigerator and of the food:
  - Most visualization techniques (dyes, fluorescent probes, …) require actions in the lab (swabbing, culturing, …) and do not distinguish between living and death cells:
    - **Minimize lab intervention and use of indicator**

- This is a qualitative technique (visual observation ↔ counting)
Method (ctd)

Step 1: Inoculate simulate spill

Step 2: Cover

Step 3: Prevent desiccation

Step 4: Visualize growth

- On fridge wall
- On cover film
- On food

3 weeks
Method (ctd)

- Tryptic Soy Agar
- Bacterial growth medium
- fluid > 40°C

- Chemical reaction by living bacteria
- Red complex

Bacterial growth = red discoloration
Method (ctd)

1. Apply directly on wall
2. Transfer cover film and food to Petri-dish
3. Apply IGM to Specimen
Results: Refrigerator liner

Control, non-treated

- treated

Red discoloration indicates high level of living and growing bacteria. Individual colonies are visualized.
Results: Cover film

Cover film in contact with untreated refrigerator wall

Red discoloration indicates high level of living and growing bacteria. Individual colonies are visualized.

Cover film in contact with AlphaSan-treated refrigerator wall
Results: Apple Slice

Apple slice in contact with untreated refrigerator wall

Apple slice in contact with AlphaSan-treated refrigerator wall

Red “swirls” indicate high level of living and growing bacteria.
Results: Lettuce Leaf

Lettuce leaf in contact with untreated refrigerator wall

Lettuce leaf in contact with AlphaSan-treated refrigerator wall

Red “swirls” indicate high level of living and growing bacteria.
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AlphaSan® Technology: 
Face the concern, create hurdles!

Incremental hygiene
The new hurdle does not justify the removal of any other hurdle that was already in place!
AlphaSan® supports the regular cleaning of refrigerator.

Industries and individuals take measures to reduce microbial proliferation.
Why do B/S/H/ and their customers benefit from AlphaSan®?

**Concern**
- Hygiene
- Safety
- Odor
- Aesthetics

**Problem**

**AlphaSan® will**
- inhibit bacterial growth
- and thereby reduce uncontrolled proliferation

**Solution**
- Effectively face the problem
- Additional safety
- Best Practice

**AlphaSan protects** the inner walls of the B/S/H/ refrigerators and helps in preventing them from becoming a hot spot for contaminants that could be transferred upon contact with food (cross-contamination).
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From concept to commercialization
From concept to commercialization

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Thank you for your attention!