Living Lab Trials

Brendan Duffy

20th March 2018
Brief Introduction to CREST

Servicing Industry needs through product development, inspection, specification and applied research.

Consultancy (Direct Contact) → Centre for Research in Engineering Surface Technology → Industrial R&D

Academic Research (PhD Programmes) → International and EU Framework Programmes

20th March 2018
New Campus: Grangegorman
Research Themes

Protective Coatings
- Conversion Coatings
- Anodising
- Galvanising
- Electroplating
- Thermal Spray
- Organic Paints

Environmental Coatings
- Functional Additives
- Antibacterial
- Antifouling
- Self Cleaning
- Acoustic
- Thermal

Surface Treatments
- Cleaning Regimes
- Heat Treatment
- Passivation Treatment
- Adhesion Promotion

Medical Device Coatings
- Lubricious
- Hemocompatible
- Biodegradable
- Drug Delivery
- Conformal
Hygienic Coatings – Mode of Operation

• Coatings inhibit pathogen growth and prevent colonisation
  Bacteriostatic vs Bactericidal

• Antimicrobial coatings protect surfaces and reduce the formation of defects which can lead to coating failure
  Blistering, Cracks and Corrosion

• Simplest model involves addition of additives to paints (similar to in can preservatives)
  Metals, QUAT, Silanes
So what is the ideal coating?

- Depends on the application
  - Paint – Most Common
    - Functional – do the job, consistently
    - Active against a range of pathogens
      - (Gram –ve, +ve, fungal)
  - Active against a range of pathogens
  - Suitable for current cleaning regimes
- Glass – Most Profitable
  - Optically clear and non-hazing
- Metals – Least Known
  - Scratch Resistant

Source: N-Tech Research
Market Leaders – W/B & Powder Coatings

Competitive Market led by:

• Axalta Coating Systems - Alesta AM powdered coatings
• AkzoNobel - Interpon AM powdered coatings (with Biocote) – W/B Dulux Sterishield
• BASF – Range of binders and additives including Irgaguard (Special Glass/Zeolite design allow for controlled metal-ion release).
• PPG Industries - SILVERSAN™ antimicrobial-protected powder coatings
• Sherwin-Williams- W/B - Alkyl Dimethyl Benzyl Ammonium Chloride
Antibacterial Paint

- Waterbased chemistry market is growing due to environmental and customer pressure (architectural accounts for 70% global sales)
- Enclosed cans are ideal breeding grounds for bacterial and fungal growth so fungicides and in-can preservatives are added but can be inactive once cured so therefore a surface active chemistry is required

<table>
<thead>
<tr>
<th>Algaecide</th>
<th>In-can bactericide</th>
<th>Fungicide</th>
<th>Biologically Active Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terbutryn, Diuron</td>
<td>Formaldehyde, CMIT/MIT, BIT</td>
<td>Fungicide Blend, IPBC, DCOIT, Zinc Thiabendazole, Pyrithione</td>
<td>Silane Quats, Copper, Silver</td>
</tr>
</tbody>
</table>

20th March 2018
# Biocide Market

<table>
<thead>
<tr>
<th>Biocide</th>
<th>Americas ($M)</th>
<th>Asia Pacific ($M)</th>
<th>Europe ($M)</th>
<th>Global ($M)</th>
</tr>
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<tbody>
<tr>
<td>Benzisothiazoline (BIT)</td>
<td>10.0</td>
<td>8.0</td>
<td>7.0</td>
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<tr>
<td>BIT/MIT</td>
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<td>14.0</td>
<td>17.0</td>
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<td>Bronopol</td>
<td>1.0</td>
<td>2.0</td>
<td>3.0</td>
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<td>Carbendazim</td>
<td>3.4</td>
<td>7.0</td>
<td>4.0</td>
<td>14.4</td>
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<tr>
<td>Chlorothalonil</td>
<td>5.0</td>
<td>3.0</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td>CMIT/MIT</td>
<td>8.0</td>
<td>9.0</td>
<td>9.0</td>
<td>26.0</td>
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<tr>
<td>Copper</td>
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<td>2.0</td>
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<tr>
<td>Cybutryne</td>
<td>2.0</td>
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<td>1.0</td>
<td>4.0</td>
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<tr>
<td>DENPA</td>
<td>1.0</td>
<td></td>
<td>2.0</td>
<td>3.0</td>
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<tr>
<td>DCOIT</td>
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<td>3.0</td>
<td>9.0</td>
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<tr>
<td>Dichlofluanid/Tolyfluanid</td>
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<td>Formaldehyde Releasers</td>
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<tr>
<td>Glutaraldehyde</td>
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<td>Insecticides</td>
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<tr>
<td>IPBC</td>
<td>30.0</td>
<td>16.0</td>
<td>10.0</td>
<td>56.0</td>
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<tr>
<td>OIT</td>
<td>15.0</td>
<td>10.0</td>
<td>8.0</td>
<td>33.0</td>
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<tr>
<td>Phenolics</td>
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<td>1.0</td>
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<td>Propiconazole</td>
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<tr>
<td>Quats</td>
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<td>8.0</td>
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<tr>
<td>Silver</td>
<td>4.4</td>
<td>6.0</td>
<td>5.0</td>
<td>15.4</td>
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<tr>
<td>Tebuconazole</td>
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<td>2.0</td>
<td>1.0</td>
<td>3.0</td>
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<tr>
<td>Thiabendazole</td>
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<td>3.0</td>
<td></td>
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<tr>
<td>Terbutryn</td>
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<td>2.0</td>
<td>2.0</td>
<td>6.0</td>
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<tr>
<td>Tolsulfone</td>
<td>3.0</td>
<td></td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>Zinc Pyritihone</td>
<td>15.2</td>
<td>15.0</td>
<td>15.0</td>
<td>45.2</td>
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<tr>
<td>Other</td>
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<td>15.0</td>
<td>4.0</td>
<td>22.0</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>145.0</strong></td>
<td><strong>148.0</strong></td>
<td><strong>111.0</strong></td>
<td><strong>404.0</strong></td>
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</table>

Algaecide
In-can bactericide
Fungicide
Biologically Active Surface
Ideal qualities of a Antibacterial additive

- Broad spectrum antimicrobial activity
- Good toxicity profile
- Biodegradable
- Colourless, odourless and low volatility
- Low water solubility for fungicides e.g. good weathering
- Unaffected by solar radiation
- Chemically stable in paint
- Stable over a broad temperature and pH range
- Unreactive to heavy metals
- Compatible with paint ingredients
- Very low levels of impurities
2009 - Antibacterial Paint (HyGen)

Enterprise Ireland Big Ideas Award 2009

Beaumont Hospital*

20th March 2018
Technologies

KASTUS GLASS

KASTUS CERAMICS

KASTUS PLASTICS

KASTUS PAINTS
HYGEN with General Paints

- Product was developed in 2009
- Scrub trials with Kortol 200 and IPA
  - 2,000 scrub cycles and Log 5 maintained under JIS Z2801
- Trialled in Irish healthcare facility in 2009/2010
- Results showed that HYGEN gave better results with significant efficacy
- The choice of cleaning agents needs to be clarified
  - Chlorine rich leaching effects
  - The paint quality is critical
2009 On-Site Data

April 2009

Walls A, C: HYGEN
Walls B, D: Control

December 2009

Clinical Ward Evaluation

Colony Counts (CFU/cm²)

Wall A 1st Ward
0.0032

Wall B 1st Ward
0.104

Wall C 2nd Ward
0.005

Wall D 2nd Ward
1.114

MRSA
C. diff
Total Aerobic Colonies

20th March 2018
**Methodology**

- **Suggested checkerboard sampling pattern for each wall in each ward.**
- a) **Hygienic and non-hygienic paints are applied to separate walls in each ward.**
- b) **The suggested sampling pattern for each wall is shown.**
- c) **The total number of samples to be collected for this study was 200.**

<table>
<thead>
<tr>
<th>Sterile Wipes</th>
<th>Contact plates</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSA</td>
<td>MRSA</td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td><em>E. coli</em></td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td><em>E. coli</em></td>
</tr>
<tr>
<td>MRSA</td>
<td>MRSA</td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td><em>E. coli</em></td>
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<td><em>E. coli</em></td>
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</tr>
</tbody>
</table>
In 2016 Tallaght hospital had the largest outbreak of CPE in Irish history with 124 patients being affected. To date this outbreak is estimated to have cost €2 million and resulted in the cancellation of over 700 surgeries.

Although screening is now in place in Tallaght hospital it is still not in place in many Irish hospitals. Irish cases of CPE rose from 5 in 2012 to 327 in 2016 and there were 234 cases reported in the first half of 2017.

The recommended actions for control of a CPE outbreak are screening, contact isolation, enforcement of fastidious hand hygiene, equipment for single-patient use, restriction of staff/visitors, gown wearing for all staff/visitors, double-cleaning of vacated rooms with bleach and the use of vaporised hydrogen peroxide. There are many barriers to performing these recommended actions including staff shortages, time given to clean rooms (recently cut to 7 minutes per room) and general cleaning staff compliance.
### What is the problem? - MRSA, C. diff, E. coli

#### Everywhere!

<table>
<thead>
<tr>
<th>Objects</th>
<th>% Contaminated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bed linen</td>
<td>41</td>
</tr>
<tr>
<td>Patient gown</td>
<td>40.5</td>
</tr>
<tr>
<td>Overbed table</td>
<td>40</td>
</tr>
<tr>
<td>Floor</td>
<td>37</td>
</tr>
<tr>
<td>Bed/siderails</td>
<td>34.5</td>
</tr>
<tr>
<td>Furniture</td>
<td>27</td>
</tr>
<tr>
<td>Sinks, taps, basins</td>
<td>27</td>
</tr>
<tr>
<td>Room door handle</td>
<td>23.5</td>
</tr>
<tr>
<td>Flat surfaces</td>
<td>21.5</td>
</tr>
<tr>
<td>Blood pressure cuff</td>
<td>21.5</td>
</tr>
<tr>
<td>Infusion pump button</td>
<td>19</td>
</tr>
<tr>
<td>Bathroom door handle</td>
<td>14</td>
</tr>
</tbody>
</table>

Partnership


20th March 2018
Current Trials with Kastus

- ICU Rooms in hospital have been identified
- Initial data indicate high background CFU count
- Cleaning cycles need to be monitored
- Samples to be in place by April 2nd
- 3 month MSc trial with follow on 1 year project (subject to funding)
  - Door Handles
  - Push Plates
  - Wall Tiles
  - Trays
  - Bedside Lockers
  - Walls
Summary

• Trials are difficult to organise
• Local “Champion” required with shared goals
• All stakeholders to be consulted
• Regular meetings and future proofing
• The patient is the winner!

Thanks for listening