Institute of Corrosion partnering with Graham Greenwood Sole of CORROCOAT Ltd.

6th October 2020

Graham Greenwood Sole
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About Me

• **Graham Greenwood Sole**
  
  • Graham graduated from Bradford University with a degree in Chemistry.
  
  • After 4 years at Allied Colloids in Bradford, Graham joined Corrocoat Ltd, a Leeds based leader in Glass Flake coatings and corrosion engineering in 1989.
  
  • Graham initially managed Corrocoat’s laboratory and coating production departments, before moving into technical services in 1993.
  
  • He was promoted to the board in 2003 and is currently the Managing Director of Corrocoat’s UK operations.
  
  • Graham is a member of the Oil and Colour Chemists Association, NACE, ICorr and a Chartered Chemist.
About US

- CORROCOAT Ltd
  - Corrocoat has been providing cost effective anti-corrosion methods, materials and engineering rehabilitation expertise for over 30 years and enjoys a proven track record in solving corrosion-related problems throughout industry, operating across five continents from more than thirty locations worldwide. It’s business is extremely diverse dealing heavily with the oil, power, mining, marine, petrochemical and many more industries that encounter corrosion issues. The presentation will outline the benefits and function of glass flake within high performance linings, options for the technology using differing resin systems, for the protection of equipment operating in harsh process environments. The presentation will discuss the advantages of this long-life technology and the critical importance of the right application techniques in pipework especially. Further, as the industry looks to shorter-term solutions to corrosion prevention, the use of surface tolerant epoxies (which has recently become more prevalent) and the development of single container two pack epoxy aerosol technology will be discussed, as this may well prove an ideal solution for holding back corrosion ahead of major intervention programmes by plant operators.
Company Profile

- Over 30 locations across 6 continents.
- Manufacture of Glassflake Coatings.
- Research & Development Driven.
- Application and Engineering Expertise.
- Protection and Refurbishment.
The cost of corrosion is very high, estimated at 3 - 5% of GDP. The NACE corrosion survey of 2002 estimated the cost in the USA as U$276,000,000,000.

Solutions to Corrosion:
- Coatings
- Change Potential
- Change Design
- Change Environment
- Change Material
Schematic diagram of granule diffusion path
Glass Flake Protection
The best filler which can be used to improve moisture vapour transmission resistance is corrosion resistant Glassflake

This effect is known as “the tortuous path”
The effect of only 2% Glassflake on moisture vapour transmission resistance
Glassflake History

- Now Blended into a carefully selected range of high performance resins. Including;
  - Polyester
  - Vinylester
  - Specialist Epoxy
  - High Temp IPN
Advanced Glassflake Technology

- The development of in-house Glassflake technology has allowed for the production of the inner more uniform and consistent Glassflake
- Glassflake can now be made at sub micron thickness
Glassflake Composition

- Composition
  ECR glass formulated to have extra chemical resistance.
- Aspect Ratio

<table>
<thead>
<tr>
<th>Typical Glass Composition</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1  SiO₂</td>
<td>64-70%</td>
</tr>
<tr>
<td>2  K₂O</td>
<td>0-3%</td>
</tr>
<tr>
<td>3  B₂O₃</td>
<td>2-5%</td>
</tr>
<tr>
<td>4  ZnO</td>
<td>1-5%</td>
</tr>
<tr>
<td>5  Na₂O</td>
<td>8-13%</td>
</tr>
<tr>
<td>6  MgO</td>
<td>1-4%</td>
</tr>
<tr>
<td>7  CaO</td>
<td>3-7%</td>
</tr>
<tr>
<td>8  Al₂O₃</td>
<td>3-6%</td>
</tr>
<tr>
<td>9  TiO₂</td>
<td>0-1%</td>
</tr>
</tbody>
</table>
Advanced Glassflake Technology.

**Unmilled Glassflake**

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Flake Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>GF100</td>
<td>0.6 – 1.3µm</td>
</tr>
<tr>
<td>GF200</td>
<td>1.4 – 1.9µm</td>
</tr>
<tr>
<td>GF300</td>
<td>1.9 – 2.5µm</td>
</tr>
<tr>
<td>GF400</td>
<td>2.5 – 3.5µm</td>
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</table>

**Milled Glassflake**

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Flake Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>GF100M</td>
<td>0.6 – 1.3µm</td>
</tr>
<tr>
<td>GF200M</td>
<td>1.4 – 1.9µm</td>
</tr>
<tr>
<td>GF300M</td>
<td>1.9 – 2.5µm</td>
</tr>
<tr>
<td>GF400M</td>
<td>2.5 – 3.5µm</td>
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</tbody>
</table>

**Micronised Glassflake**

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Flake Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>GF001</td>
<td>0.6 – 1.3µm</td>
</tr>
<tr>
<td>GF002</td>
<td>1.4 – 1.9µm</td>
</tr>
<tr>
<td>GF003</td>
<td>1.9 – 2.5µm</td>
</tr>
<tr>
<td>GF005</td>
<td>2.5 – 3.5µm</td>
</tr>
</tbody>
</table>

**Unmilled Glassflake Particle Size Distribution**

- 30% or more: >50-150 microns
- 35% or less: <50-150 microns
- 5% or more: >150-300 microns
- 10% or less: <50-150 microns

**Milled Glassflake Particle Size Diameter**

- 10% or less: >100-1600 microns
- 65% or more: 50-100 microns
- 25% or less: <50 microns

**Micronised Glassflake Particle Size Diameter**

- 26% or more: >150 microns
- 74% or less: <50 microns
- 10% or less: 50-150 microns
Comparisons Between Glassflake

- The optimum percentage of glass will vary depending on the type of glass, percentage of other fillers and type of resin.
- Too much glassflake can be worse than not enough.
Benefits/Properties of Heavy-duty Glassflake Coatings

- Excellent temperature resistance
- Excellent chemical resistance
- Excellent dry and immersed adhesion
- Low permeation rate
- Applicable over a wide range of substrates
- High abrasion resistance
- Machinability
- Dimensional stability
- Repairability
- Impact resistance
- High tensile strength
- High resistance to cathodic disbondment
- Durability, very long service lives
- Very low VOC
- Cost effective
Off-Shore Jacket Coating
Cooling Water Systems

Fully pressure tested to 1.5X maximum working pressure.
Oil Storage Tanks

45m diameter sour crude surge tank coated with Vinyl Ester Glassflake in 1989 with a 5 year warranty. Tank had previously been lined with a coal tar epoxy which has failed within 5 years, the tank had suffered from SRB attack. The sister tank to this was coated in 1991, both tanks are still in excellent condition. (30 YEARS SERVICE!)
Vinylester glassflake lined separator inspected August 2006, after 14 years service in sour crude at 71°C
Pipe Coating Equipment.
Insitu lining of an Offshore Production Manifold

Lined with vinyl-ester acrylic glassflake in 1989 as a temporary solution.
FPSO Pipework.
Offshore Riser Pipes After 21 Years Service.
A Changing Market

- Aging Assets.
- Less Reliance on Metallurgy.
- Time to End of Life.

- Single Coat.
- Shorter Term Solutions.
- Easy to Apply Maintenance/Holding Coats.
Bridge Support Beams Coated With Polyglass Zipcoat.

Norsok Approval for Structural Steel and Ballast Tanks
Glassflake Epoxies for Structural Steel

- High Solids Full Glassflake Epoxies.
- Maintenance Coatings including Surface Tolerant Materials.
- New Two Pack Epoxy Aerosols, for Quick Easy Fixes
## Zinc Phosphate MIO Glassflake Epoxy Performance

<table>
<thead>
<tr>
<th>Test Parameter</th>
<th>Panel N°</th>
<th>Blistering (ISO 4628-2)</th>
<th>Rusting (ISO 4628-3)</th>
<th>Cracking (ISO 4628-4)</th>
<th>Flaking (ISO 4628-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclic Ageing (ISO 20340)</td>
<td>238904-01</td>
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<td>Seawater Immersion (ISO 2812-2)</td>
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<tr>
<td>Cathodic Disbondment (ISO 15711)</td>
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<td></td>
<td>238904-09</td>
<td>0(SO)</td>
<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>
Zinc Phosphate MIO Glassflake Epoxy Performance.

Easily met the performance criteria for Norsok System 1, 3B and 7A.

When applied as a two coat system at only 250 microns.

Cathodic Disbondment Resistance Exceptional.
Benefits Of Using Glassflake Linings

- Corrosion Protection for new and old components (often preventing the need for expensive metallurgy or spare parts)
- Increased flexibility of process systems
- Ability to reinstate scrap components and to apply coatings retrospectively.
- Reduced refurbishment times
- Long term service
- Excellent cost benefits
New Aerosol Product – For Temporary Protection
Epoxy Two Pack Aerosol

- Originally developed as a holding material where no other work was possible.
- The kind of work which would normally be ignored.
- Minimal surface preparation.
- No additional equipment.
- By skilled and unskilled teams.
Epoxy Two Pack Aerosol

- Video 1
- Video 2
- Video 3
- Video 4

You Tube Link: https://www.youtube.com/watch?v=6kmaOkZtbIk
Two Pack Single Aerosol Technology

- Two pack zinc phosphate glassflake epoxy lining can offer excellent corrosion resistance.
- Combining this technology with new two pack single aerosols offers products which can be applied with minimum preparation.
- Are easy to use for both professional and non professional applicators.
- Require no additional equipment.
- Allow short term repairs to be executed, quickly and easily where otherwise no work would have been possible.
THANK YOU FOR ATTENDING

This Webinar was brought to you by MCF working in partnership with ICorr and CORROCOAT Ltd