



**Applied
Graphene
Materials**

Tomorrow's Material. Today.

Advanced Engineering Show 2019

31/10/19 N A Blatherwick – Commercial Director

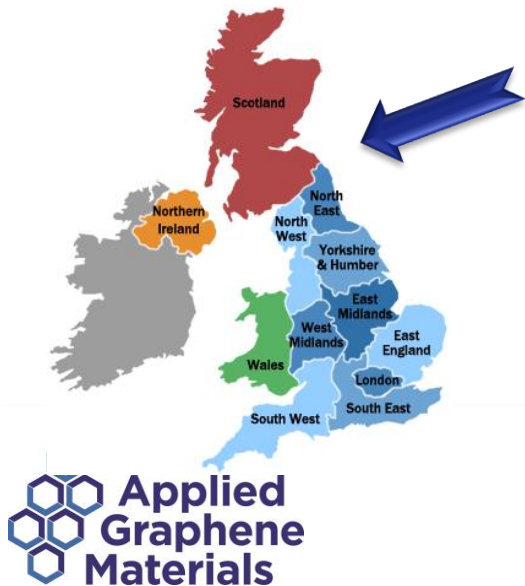
Graphene in a Commercial Automotive Paint Primer



Applied Graphene Materials

- “Bottom-up synthesis technology” for continuous and consistent manufacturing.
- Leading production ready *Genable*® dispersion range
- Focus on:
 - ✓ *Paints and Coatings* – Outstanding performance gains for barrier and anti-corrosion.
 - ✓ *Polymer Composites* – Enhanced interlaminar toughness, strength and fatigue performance.

Ultimate cost reduction is the drive behind vast majority of developments

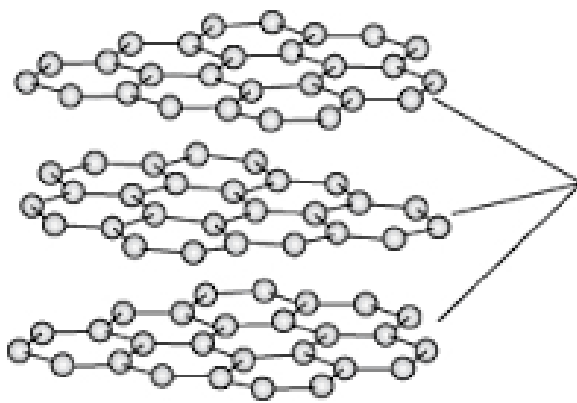


Graphene Manufacturing Plant

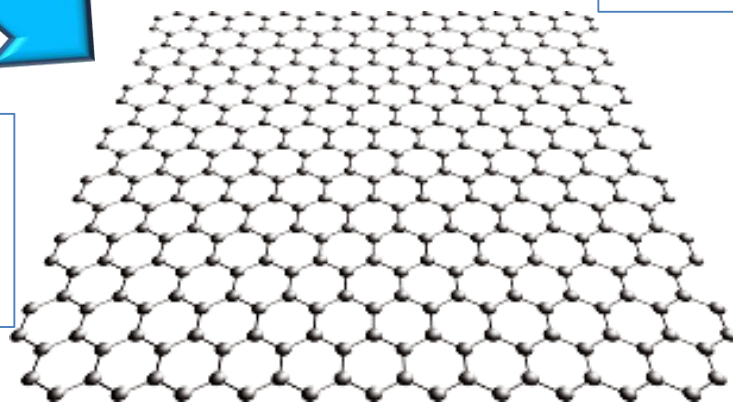
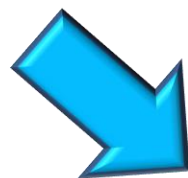
Extensive characterisation and testing capabilities

Graphene Manufacturing Routes

Graphite

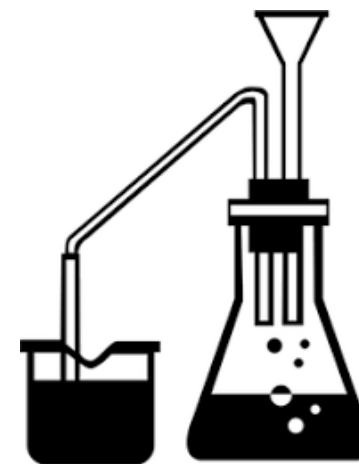
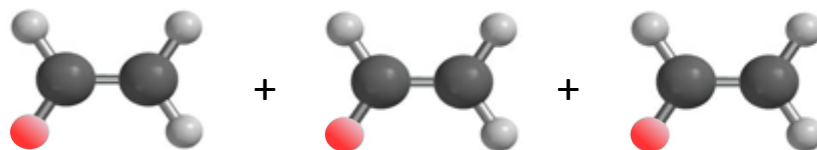
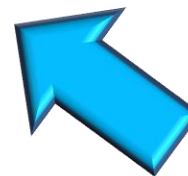


Graphene sheets



Bottom Up Synthesis

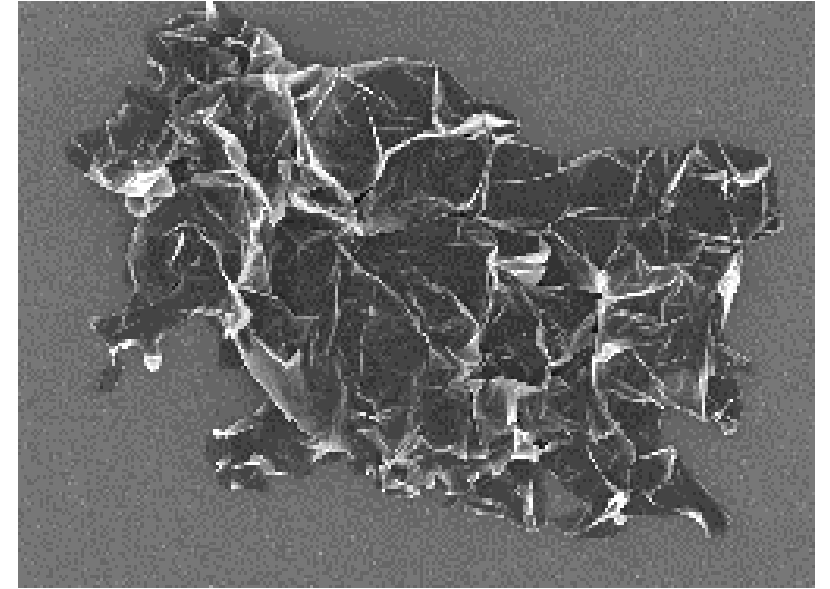
- Graphene produced by molecular growth from small molecular carbon precursors
- Number of layers controlled using different substrate catalysts and growing/reaction parameters
- Gives large surface area and high purity



AGM Graphene Nanoplatelets – Product Properties



A-GNP35



- Very thin, crumpled sheets, 5-15 atomic layers
- Very low density and high surface area, enabling very low loadings.
- AGM expertise to develop and scale up “production ready” dispersion
- Very low addition by % weight

Genable® Product Range Overview

Genable® 1000 series

- *Additives to enhance barrier / anti-corrosion, especially in synergy with existing active ingredients*

Genable® 1200 series

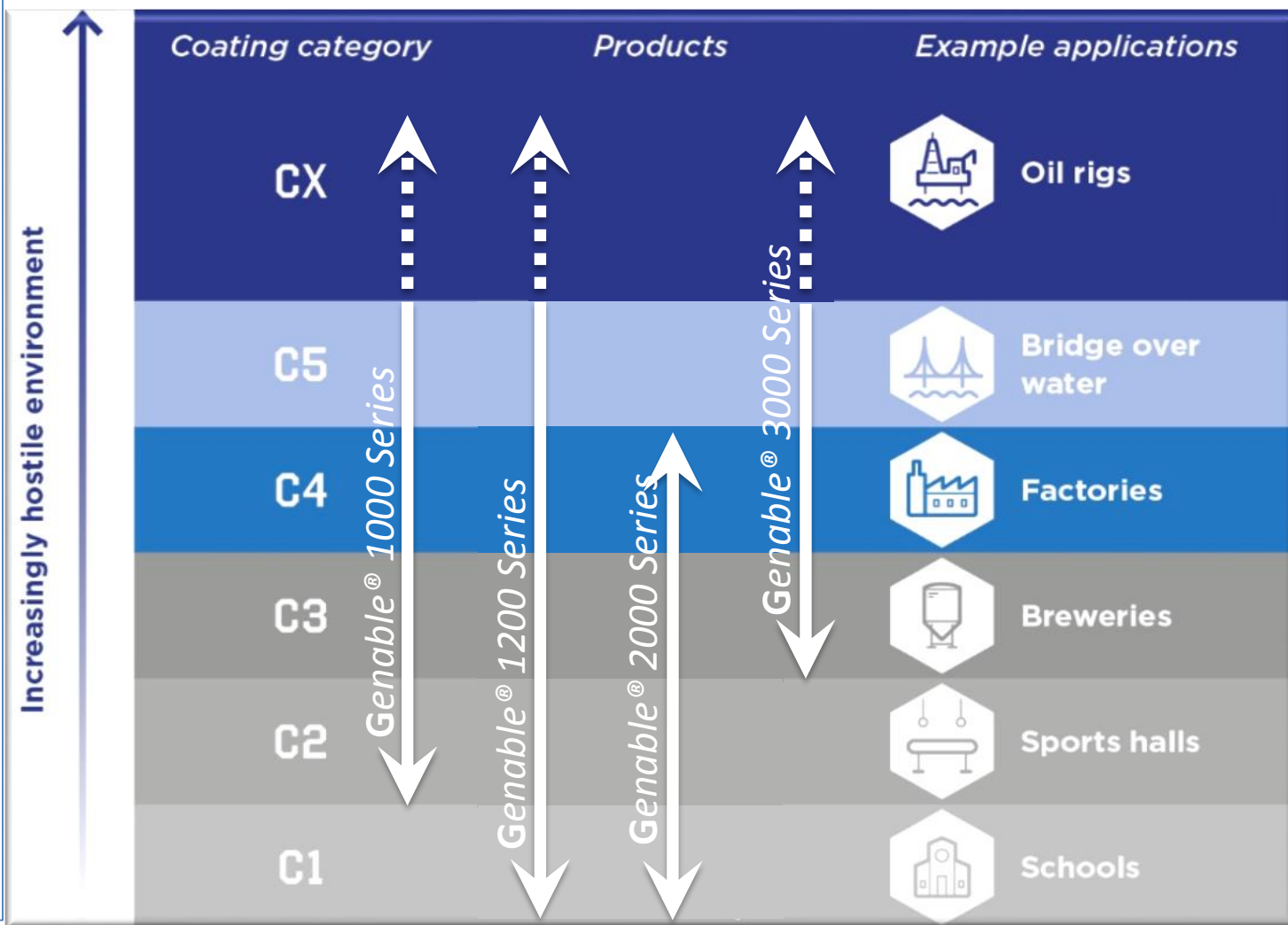
- *Cost effective additives to enhance barrier / anti-corrosion performance at very low loading*

Genable® 2000 series

- *Delivers outstanding active anti-corrosion performance on aluminium substrates*

Genable® 3000 series

- *Active, non-metallic, anti-corrosion additives with industry leading performance*



James Briggs Ltd

- Founded in Manchester in 1830
- Employ more than 250 people in the Manchester area
- Manufacturing aerosol products since 1972
- Producing 60m aerosols / 10m litres liquid fill p.a. on 2 sites
- Offer a fully integrated service; technical (laboratory & analytical), regulatory, design, manufacture and delivery
- Portfolio of over 16,000 product formulations in our IP library



- 12 aerosol lines and 7 liquid fill lines
- Markets: Automotive, Industrial, Hygiene, Decorative, Craft & Game
- A number of house brands, including market sector leaders Hycote and Nilco
- 120+ Private Label customers including household and High St names
- ISO 9001, ISO 14001, OHSAS 18001 accredited
- Sales and Technology lead business
- Market leading quality and lead times
- Innovation is key

AGM's Strategy – Collaboration is the key to successful early adoption



Automotive Spray Primer Development - Objectives

Improve existing primer paint for automotive repair applications.

Current system an industry standard vinyl/acrylic based paint with good anticorrosion performance.

Applications are typically single coat with low film thicknesses.

Key Target Benefits:

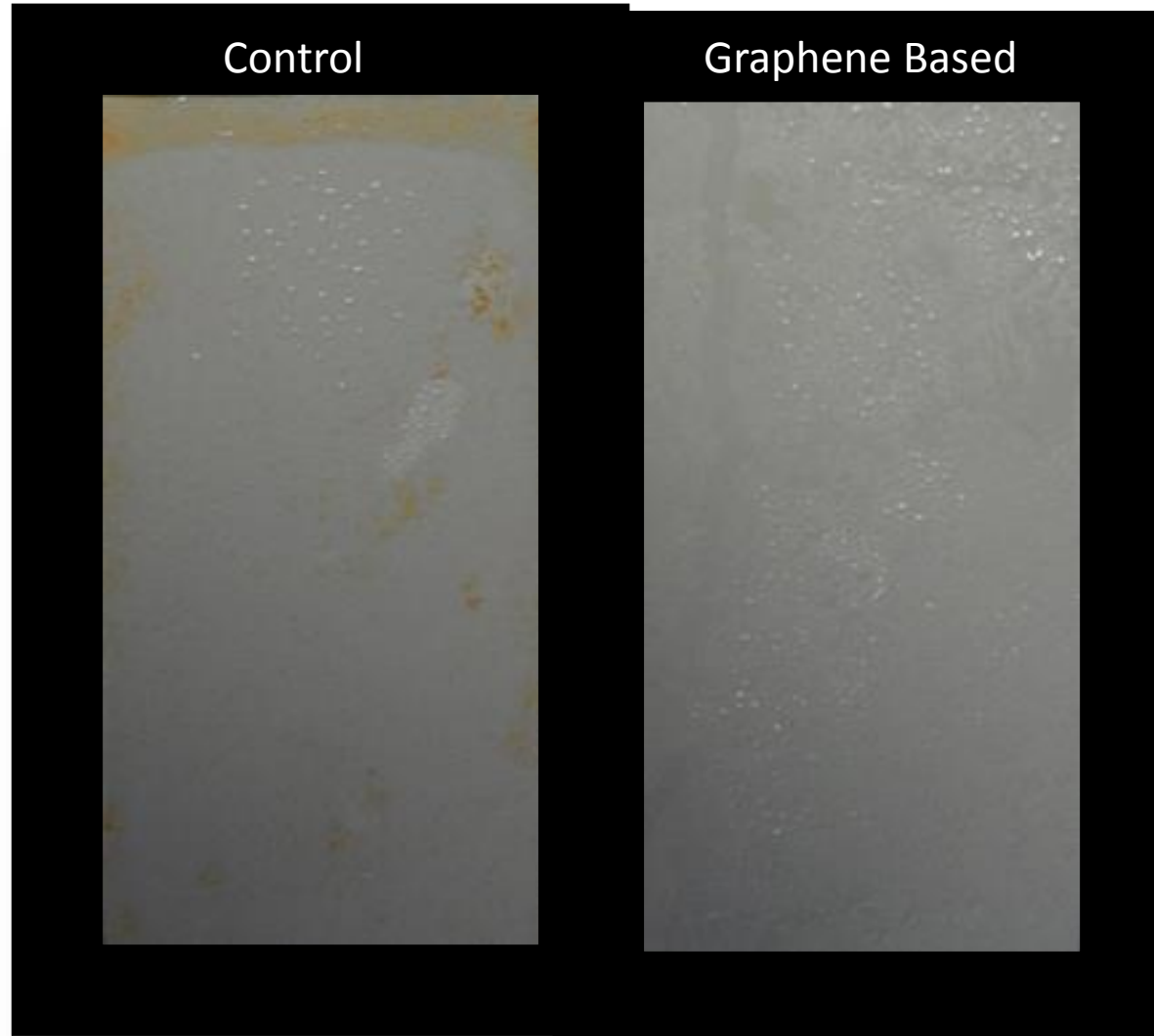
- **Significantly improve corrosion performance**
- **No impacting on other physical properties**
- **Ensure the paint remains economically viable for the repair market, both trade and retail**

Graphene within anticorrosive coatings ?

- Mechanisms proposed in literature
 - physicochemical process (restricting uptake of water/oxygen and salts).
 - electrochemical activity (conductivity dependent on Graphene type and loading level)
- Materials like glass flake/micas historically used as barrier pigments to provide a tortuous path in anticorrosion primers.
- Graphene offers an economically viable step change delivering:
 - High surface area
 - Extremely low density
 - Performance gains without the negatives

Graphene Anti-Corrosion Primer

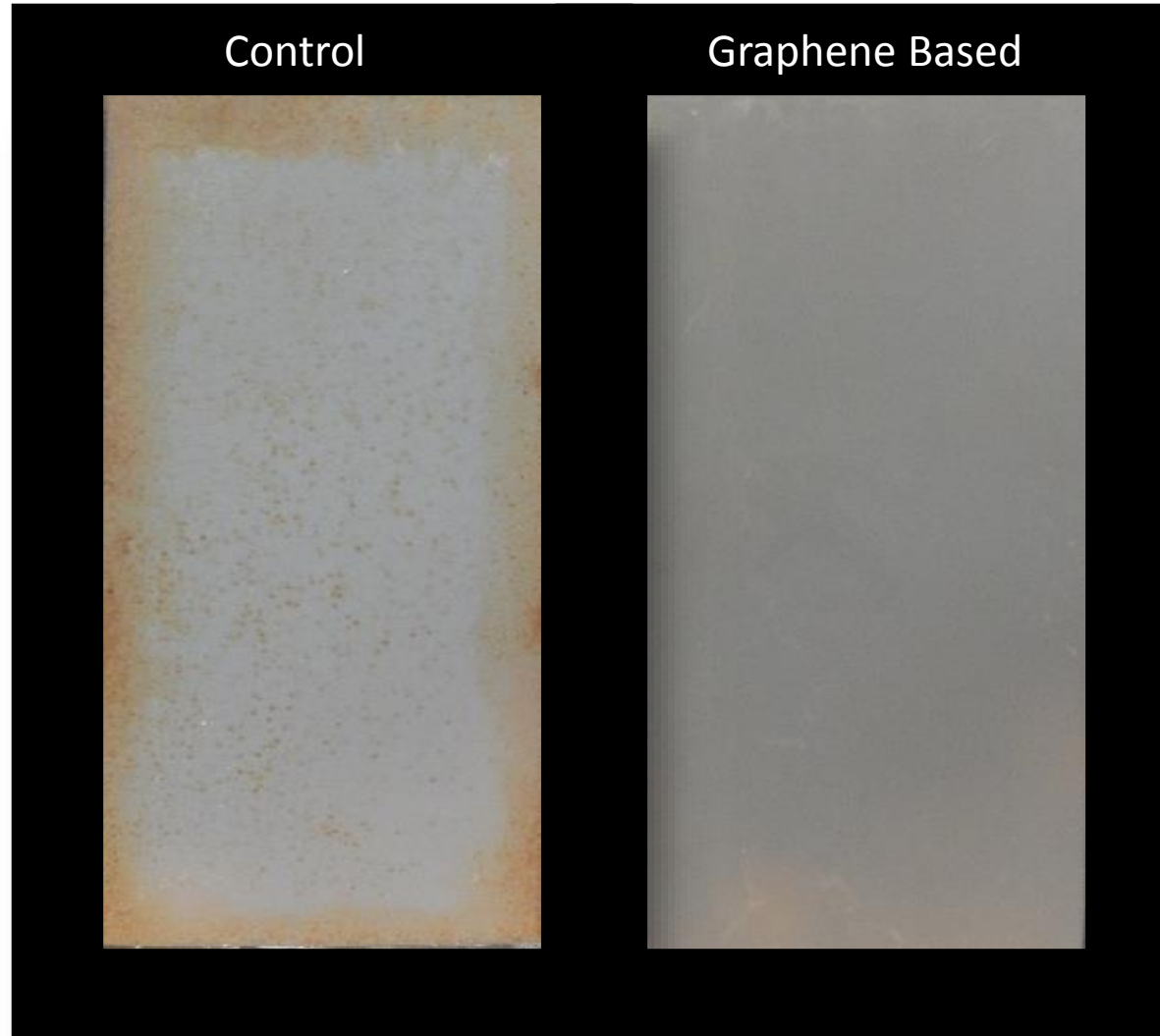
Salt Spray Testing - after 168 Hours



Prohesion Testing
ASTMG85 annex 5

Graphene Anti-Corrosion Primer

- Salt Spray Testing - after 432 Hours

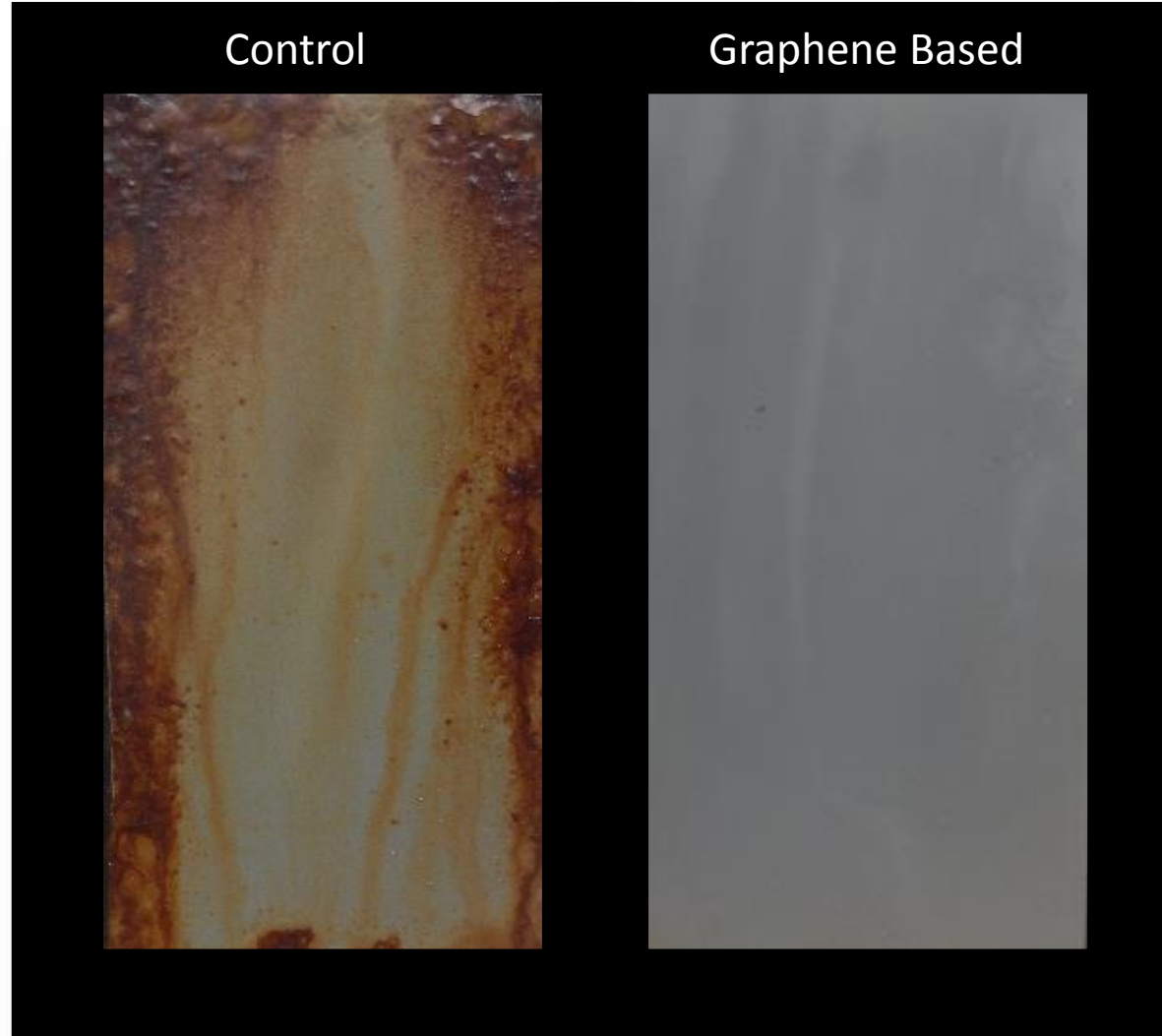


Prohesion Testing

ASTMG85 annex 5

Graphene Anti-Corrosion Primer

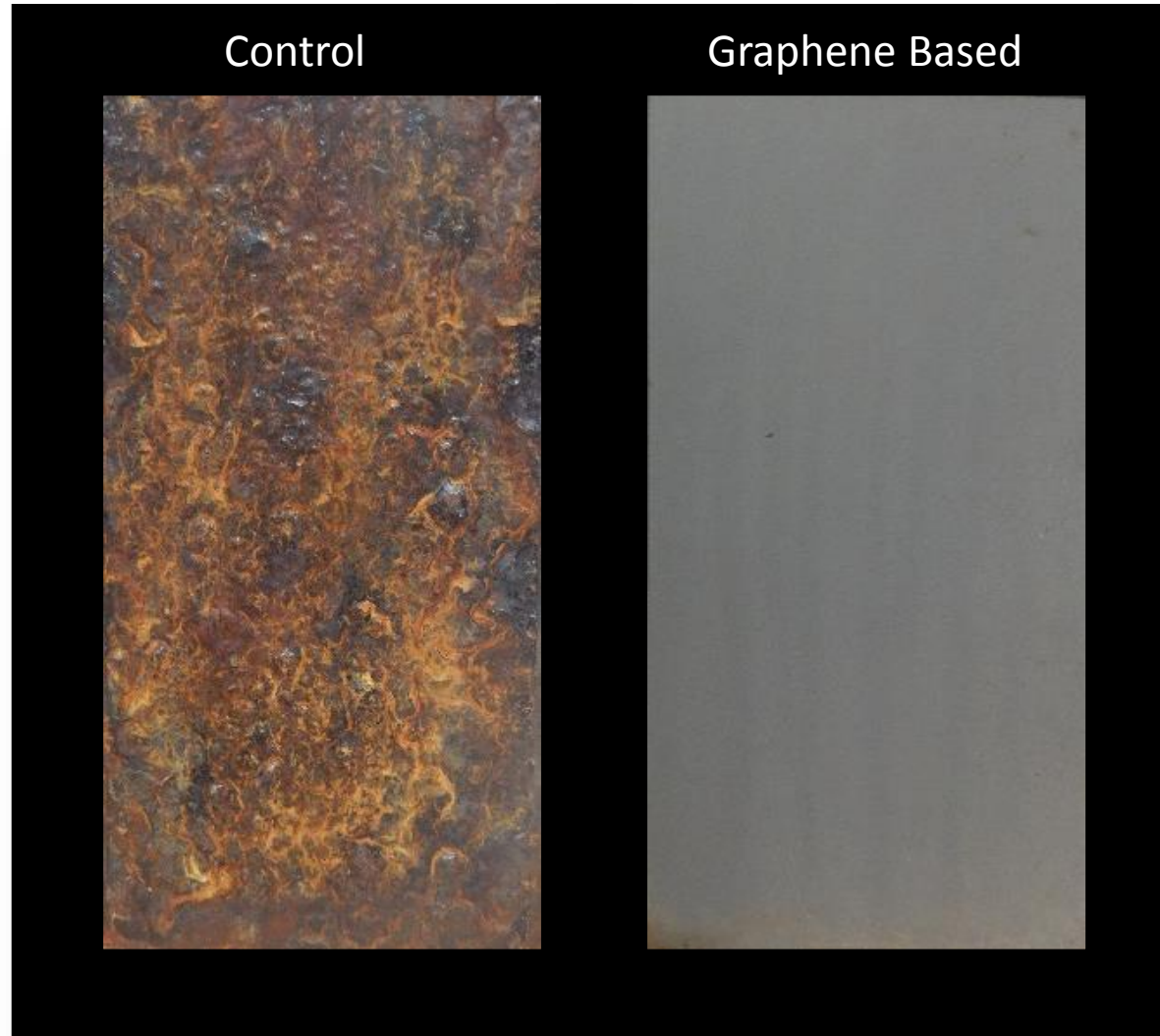
Salt Spray Testing - after 1000 Hours



Prohesion Testing
ASTMG85 annex 5

Graphene Anti-Corrosion Primer

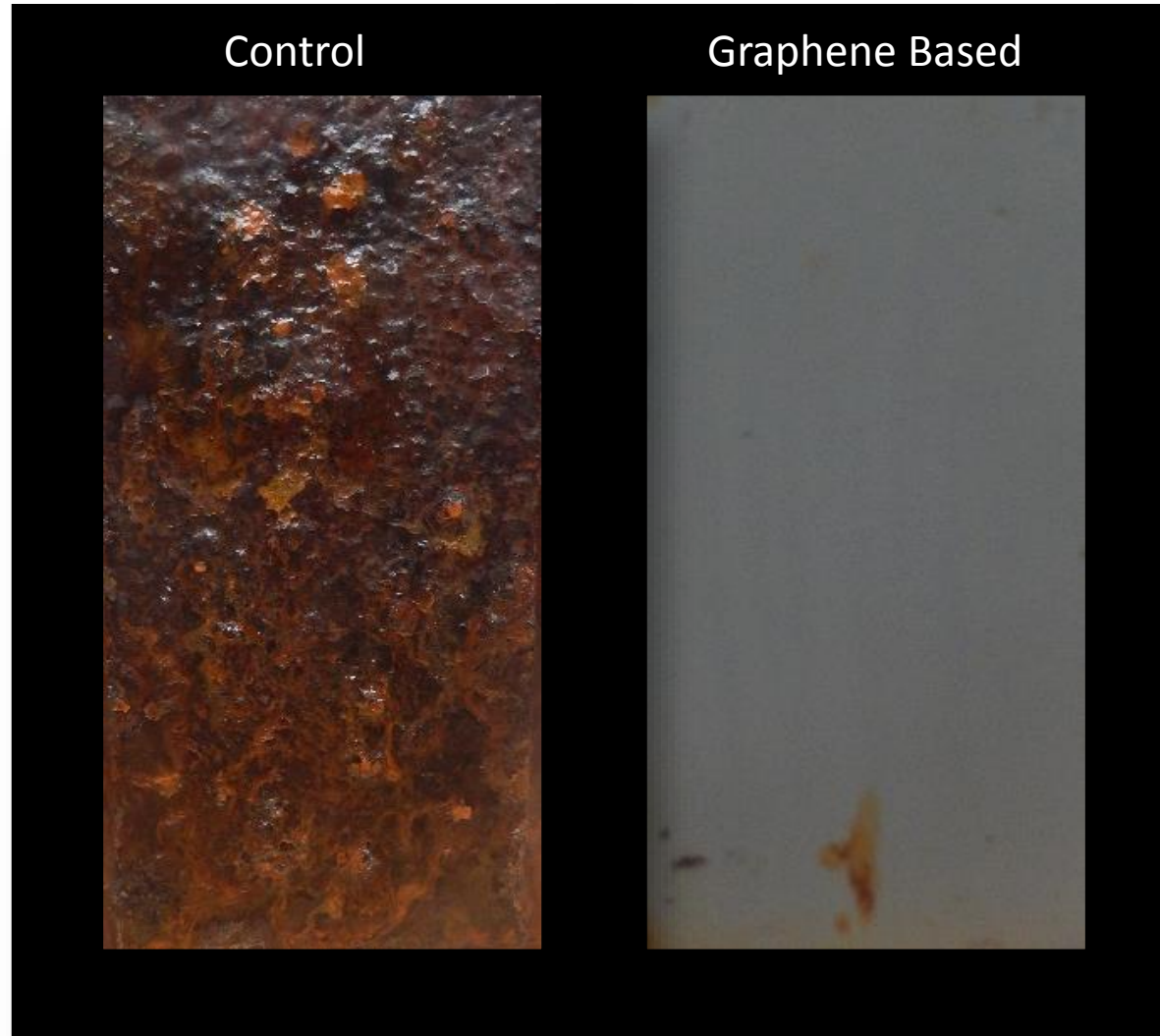
- Salt Spray Testing - after 2000 Hours



Prohesion Testing
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Graphene Anti-Corrosion Primer

- Salt Spray Testing - after 3000 Hours



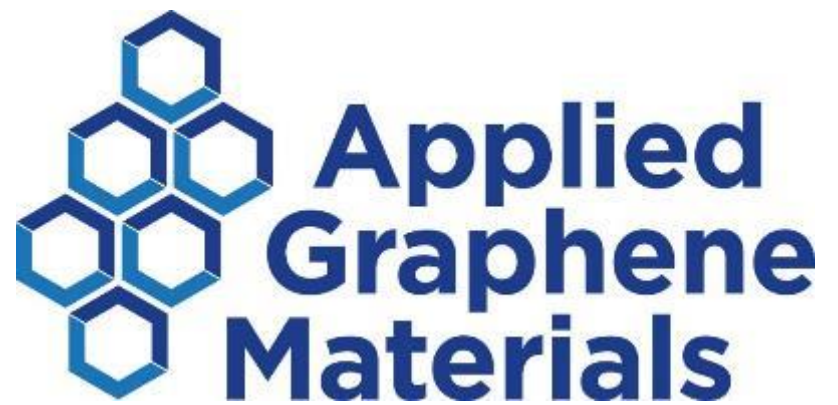
Prohesion Testing
ASTMG85 annex 5

Graphene Anti-Corrosion Primer



- ✓ Exceptional corrosion protection
- ✓ Zinc Free – Less environmentally hazardous vs conventional anti-corrosive primers.
- ✓ Excellent barrier properties to dramatically extend coating life.
- ✓ Extremely fast drying – Touch dry in 3-4 minutes, sand and top-coat after 20 minutes.
- ✓ Excellent adhesion to metallic surfaces – Mild Steel, Aluminium, Zintec.
- ✓ Excellent Flexibility – ASTM D522 Conical Mandrel - No cracking.
- ✓ Excellent anti-sag properties enable high coat depths to be achieved.
- ✓ Fills minor surface imperfections.
- ✓ Smooth matt finish with excellent sanding properties.
- ✓ Can also be applied to many rigid plastics





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...Graphene in products used by everybody, everyday