AGM CUSTOMERS FIRST TO MARKET

AGM has made major progress with its customers in helping them to launch several exciting "first to market" graphene enhanced products, each representing significant steps forward in the commercialisation of AGM technology. The regular AGM Newsletter provides an opportunity to update everyone on our customers’ latest activities and other exciting “in-house” graphene developments.

HYCOTE – THE PERFECT FINISH WITH NEW GRAPHENE ANTI-CORROSION PRIMER

James Briggs Limited (JBL), one of Europe’s largest consumer chemicals businesses, recently launched its Hycote Graphene anti-corrosion single component (1K) primer which has been specifically formulated to deliver exceptional corrosion protection and extended coat life (see below ASTM G-85-94 Prohesion). The new primer is also zinc-free and therefore less environmentally hazardous when compared against conventional anti-corrosive primers on the market.

ADVANTAGE GRAPHENE!

AGM customer Alltimes Coatings Ltd (Stroud, UK), a leading specialist in the supply and application of protective coatings for buildings, recently launched its ground-breaking Advantage Graphene liquid coating roofing system, with enhanced anti-corrosion performance.

The Advantage Graphene system is the result of extensive product development and a rigorous testing programme, and has ultimately produced a system that delivers an industry leading level of anti-corrosion performance, and life expectancy, for industrial and commercial roofs. AGM’s graphene technology has also helped enhance other key coating performance attributes and ultimately provides building contractors and owners with a highly cost-effective solution, Advantage Graphene being offered with an unparalleled 30-year product warrant.

Due to the outstanding results achieved in coating performance and the products commercial competitiveness, Advantage Graphene has already been promoted to targeted trade customers, with several industrial applications scheduled over coming months.
SIGNIFICANT Genable® TECHNOLOGY ADVANCE FOR WATER-BASED, ANTI-CORROSION COATINGS

Water-based coating development remains a key focus for industry formulators; this push driven by the ever tightening of regulations brought in to lessen the detrimental impact that solvent-based coatings have on both worker health and the environment. As the technology for water-based coatings continues to evolve, one of the key challenges that remains is to significantly improve their anti-corrosion performance. In doing so, this will fully extend their use away from decorative applications into broader industrial protective coatings.

Over recent years AGM has proven the outstanding barrier and anti-corrosion performance gains possible by incorporating graphene into solvent-based coating systems using its Genable® dispersion technology. However, effective incorporation of graphene into water-based systems has previously proven more problematic due to interrelated issues around materials compatibility and film formation. This water-based breakthrough is again based on AGM’s platform Genable® technology, a range of master dispersions that are designed to facilitate the easy incorporation of graphene into coating formulations and existing processes. Genable® dispersions are fully scalable industrial products and, based on initial findings, the addition levels required to significantly enhance anti-corrosion performance in water-based systems are low enough to ensure commercial viability, even in light industrial applications.

While the findings being shared publicly (see below) are in a commercial acrylic DTM (Direct-to-Metal) coating, AGM believes that water-based Genable® technology could, with considered formulating, equally well be adopted into epoxy chemistries and likewise into more complex formulated primer systems.

LOWER COST, HIGH-PERFORMANCE COMPOSITE TOOLING

AGM is currently collaborating with composite tool design specialists CTES Ltd, SHD Composites Ltd and GKN Aerospace on the exploitation of outcomes from a recent NATEP funded project.

The project’s goals were to develop new technologies, through the introduction of graphene materials that would enable the deployment of lower cost tooling solutions, enhance in-service performance and facilitate optimised tool designs. Ultimately delivering on the project goals has the potential to provide end-users with a superior composite tooling solution, supporting robust manufacturing processes and the continual drive for production cost reduction.

The project ended in mid-2019 with the manufacture of a novel tool demonstrator and broad dissemination of the teams’ developments are now underway.

NANO-ENHANCED AEROSPACE INTERIORS

AGM has partnered with composite development specialist Coventive Composites and Composites Evolution Ltd, an innovator in prepreg materials, to develop a new generation of composites for Aerospace interior applications. Focus of the 18 months NATEP funded project has been to capture the benefits of graphene materials within novel resin formulations, and to deliver combined improvements in mechanical properties, as well as critical fire, smoke and toxicity performance.

The project has now shifted to collaboration with Aerospace end-users and delivering early demonstrator applications. These demonstrators are essential to support early commercial exploitation and will provide NEAT end-users with “real-world” evidence that the improvements in material properties achieved to date, can be directly equated to reductions in final part production costs; these being realised through a combination of broader product applicability, optimised structural design, improved processing and enhanced surface finish.

VERY LOW DENSITY, HIGH THERMAL CONDUCTIVITY ADHESIVES FOR SPACE

Following four years of development work AGM are now offering materials engineers, in the Space and Defence sectors, two unique thermally conductive epoxy paste adhesive systems, AGM TP300/400.

These novel epoxy adhesive systems exhibit high levels of thermal conductivity (between 3 and 6 W/mK), combined with excellent mechanical, adhesive and outgassing performance. Most significantly these properties are achieved with cured resin densities as low as 40% that of competitive conductive adhesives on the market. AGM TP300/400 products are therefore highly versatile, while providing end users with significant savings in both mass and cost.

Already being adopted within the industry, AGM TP300/400 systems are ideal for use where thermal management is critical in structural bonding or gap filling, across a range of satellite and general space applications.

Waterborne Coatings: Acrylic DTM (Direct-to-Metal) Creep Assessment following accelerated exposure testing (Neutral Salt-Spray (Fog) Testing - ASTM B117)

Note: Except for the 480-hour assessment of the coated Blasted Steel control panel all of the other control panels at both 480 hours and 1000 hours had substantial levels of corrosion emanating from the scribe and/or a complete failure in terms of corrosion. The panels have been denoted as having average creep corrosion of 50mm to aid pictorial representation in the graphs above.

Waterborne Coatings: Acrylic DTM (Direct-to-Metal) Creep Assessment following accelerated exposure testing (Neutral Salt-Spray (Fog) Testing - ASTM B117)
SUCCESS IN SPACE EXPLORATION WITH INFINITE COMPOSITE TECHNOLOGIES

Infinite Composites have successfully incorporated AGM's Graphene nanoplatelets into 2 resin systems for cryogenic pressure vessels being considered for use in multiple NASA spaceflight missions, including materials on the International Space Station Experiments (MISSE), Artemis, and Lunar Gateway. Subject of a recent prestigious SBIR NASA award, the Infinite Composites team are focused on the continuing development of their cryogenic pressure vessel systems for space applications.

The addition of AGM's GNP's has enabled the tanks to complete their first liquid oxygen loading test at -300°F pressurized to 600 psi. Analysis of the composite structure using Scanning Electron Microscope techniques indicated that the addition of GNP's eliminated nearly all microfractures in resin samples after exposure to the cryogenic environment versus the control samples. These results using AGM graphenes in real composites applications subject to extreme testing further underpin the performance and value of the use of GNP's for the effective management of attributes such as fracture toughness and robustness of composite structures for the long-term durability.

How is it done, visit ANS website www.appliednanosurfaces.com for more information

HIGH-RESOLUTION PRINTING OF INTERLAMINAR REINFORCEMENT

Further extended trials of Structural Ink® technology have demonstrated significant uplifts in composite fracture toughness levels across a range of commercial prepreg systems that are commonly specified for Industrial and high performance Sports applications.

AGM's Structural Ink® is an exciting new technology that enables the targeted uplift of interlaminar toughness in composite components by means of the high-resolution printing of graphene enhanced “structural” inks. The technology offers the ability to deploy graphene with high-precision, specifically reinforcing the regions of a composite structure that are most prone to interlaminar matrix failure over service life. Combining this capability with negligible overall weight penalty, provides end-users with the potential for a highly weight, cost and design efficient additive toughening technology.

AGM has recently embarked on an ambitious programme, working with selected industry partners, to increase the technology readiness level, AGM and its partners looking not only to optimise the graphene material properties but, in parallel, to prove-out a robust and scalable printing technology that could underpin wider exploitation along the entire composites supply chain.

Typical performance gains in fracture toughness are demonstrated below:

**Genable® TECHNOLOGY NOMINATED FOR INDUSTRY AWARD**

Genable® 3000 series; AGM's graphene based, active non-metallic, anti-corrosion additive, was nominated as a finalist in the Materials Performance Corrosion Innovation Awards for 2019. The MP Corrosion Innovation Awards program runs in parallel with NACE International and winners are selected by a panel of corrosion control experts and announced at the annual CORROSION Conference and Expo held in the USA.

Although Genable® 3000 series did not win the final award, the nomination represents significant recognition of Genable® technology within the industry. As an additive capable of offering metal-free systems with significantly extended durability, the Genable® 3000 is expected to find multiple coatings and lining applications in industrial areas subject to high humidity and aggressive atmosphere, including inshore areas of medium to high salinity.

- **Genable® 3000 Series**
- **Control**

**Typical performance gains in fracture toughness are demonstrated below:**

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<thead>
<tr>
<th>Time (hours)</th>
<th>Control</th>
<th>Genable® 3000 Series</th>
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<tbody>
<tr>
<td>900 hours</td>
<td>200 J/m²</td>
<td>Increases Fracture Toughness</td>
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*Control is an in-house primer typical of a standard industrial C3 zinc phosphate based system

Over 5 times extension to the primer coating lifetime under cyclic salt spray (ASTM G-85-94 Prohesion) with the use of Genable® 3000, AGM's formulation-ready, active, corrosion inhibitor, in place of Zinc Phosphate

Genable® GRAPHENE DISPERSION QUALIFIED FOR USE IN APPLIED NANO SURFACES TRICOLIT®-GO

AGM has qualified its A-GNP nanoplatelets, applied through a bespoke Genable® dispersion for Applied Nano Surfaces (Uppsala, Sweden) highly innovative graphene-fortified low friction coating Tricollit®-GO.

Tricollit GO coating features low friction and high abrasion resistance, and can be supplied in bulk for professional use and in easy-to-use spray cans for DIY enthusiasts.

ANS Tricollit® is a series of thermoset surface coatings serving to reduce friction and wear. Tricollit coatings can be applied by spraying, dipping or brushing and are suitable for treatment of non-ferrous materials which cannot be tribococondioned. The coating gives the component great tribological performance at a competitive price.

The technology within the industry.

To support this programme, AGM recently expanded their in-house Structural Ink® printing capability, extending print bed coverage.

At the conclusion of the latest round of prove-out work, Structural Ink® demonstrated significant and repeatable uplifts in GIC fracture toughness over a broad spectrum of commonly used epoxy prepreg systems, with deposition loadings typical at or well below 1g per m².

Inshore areas of medium to high salinity.
GLOBAL REACH

Sales Offices
Head Office Wilton Centre, UK
EU Sales Desk Frankfurt, Germany
USA Sales Desks La Grange KY & Tulsa OH, USA

Distributors
Tokyo, Japan
Shanghai, China
Cape Town, South Africa
Milan, Italy

ABOUT AGM

AGM was admitted to AIM stock exchange in November 2013 and has its operations based at the Wilton Centre, Redcar, UK.

AGM has developed proprietary bottom-up manufacturing technologies which are capable of producing high-volumes of graphene nanoplatelets using continuous, repeatable and robust processes. These manufacturing processes are based on sustainable, readily available raw materials and do not rely on the supply of graphite.

AGM works in close partnership with its customers to provide custom graphene dispersions and material formats to deliver enhancements and benefits over a wide range of application in three core markets: coatings, composites & polymers and functional fluids.

For enquiries please contact AGM Sales Office on:
Tel: + 44(0)1642 438214 or Email: info@appliedgraphenematerials.com
www.appliedgraphenematerials.com

GLOBAL APPLIED GRAPHENE MATERIALS

AGM has recently secured several major new additions to its Distributor base, signing agreements with;

ITALY
CAME Srl, Italy, a leading international chemical distribution business, in Milan, also representing a wide range of international supply partners throughout Europe and the Middle East. AGM and CAME have been engaged in early market development over the last 18 months and the agreement represents a major commitment from both companies to exploit AGM’s exciting graphene technology.

JAPAN & CHINA
Inabata Europe GmbH (a European Headquarters of Inabata & Co Ltd, Tokyo Japan). This distribution agreement extends an existing partnership in Japan to now include China and brings AGM’s commercial reach directly into the coatings and chemicals sectors in two major Asian markets. AGM and Inabata have been engaged in early market development over the last 2 years, with good progress being made establishing AGM’s products in the Japanese market.

SOUTH AFRICA
Carst &Walker (C&W) are part of Hobart Enterprises Ltd, who operate across multiple global markets. C&W SA is the market leading supplier of key additives to the South African paints and coatings industry, providing proprietary technical expertise to this well-established customer base. They have offices and warehousing facilities in South Africa, Kenya and Australia.

AGM TAKES REGULATORY LEAD

AGM recently took a lead partner position in The GRAPHENE REACH REGISTRATION CONSORTIUM and was proud to announce that a Joint Registration Dossiers for Graphene and Graphene Oxide was submitted to ECHA.

Graphene and Graphene Oxide can now be used with 10 t/a without any restriction in Europe from manufacturers/ importers having participated in the Joint Registration. Work for dossier updates to higher tonnage bands (10 to 100 t/a) will start soon.

AGM are taking a similar proactive lead positions in other geographical territories, ensuring no regulatory barriers to customers as they start to increase their graphene usage in production applications. Please contact AGM Sales Office for more information specific to your geographical requirements.

TOMORROW’S MATERIAL. TODAY