

# News

MARCH-APRIL 2020

TOMORROW'S MATERIAL. TODAY

## AGM CUSTOMERS FIRST TO MARKET

### MAJOR RETAIL CHAIN ADOPTS AGM GRAPHENE

A graphene enhanced automotive primer is now on sale at Halfords, the UK's leading retailer of motoring, cycling and leisure products and services, with 465+ retail stores.

The standout advantage of the new aerosol primer is the exceptional corrosion protection (1750+ hours ASTM G-85), that has resulted from the incorporation of AGM's graphene dispersion. As a zinc-free primer system, the paint also has positive environmental and performance features, significantly out-performing current industry standards



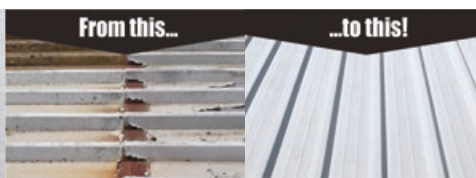
# halfords

### 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. AGM's graphene technology also enhances other key coating performance attributes such as weathering and ultimately provides building contractors and owners with a highly cost-effective solution. **Advantage Graphene is being offered to the market with an unmatched 30-year product warranty.**

**Advantage  
Graphene**  
Solvent, Isocyanate and VOC Free



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.

**STOP  
PRESS**

AGM's prototype tie-coat demonstrates quick, low risk and environmentally friendly access to graphene's outstanding anti-corrosion performance (**see page 3**)

### Genable® PROTECTING HIGH VALUE ASSETS IN HARSH ENVIRONMENTS

Blocksil Ltd (Lichfield, UK), a leading coatings innovation company, has recently launched its Graphene Enhanced Top Coat MT, a ground-breaking high performance, anti-corrosion coating for applications across a range of harsh industrial environments.

Blocksil's new graphene-enhanced coating system delivers leading mechanical and physical properties and is sustainable, VOC free and easily applied. Retaining full flexibility and adhesion, the enhanced product delivers excellent UV resistance alongside improved levels of toughness and fire resistance.

Blocksil is actively engaged with end users and specifiers across industries with high value assets and infrastructure operating under harsh environmental conditions. One early example is the product's recent approval as part of a corrosion resistant coating system to be supplied to Avanti Communications plc. Avanti are a pioneering satellite technology business, with a global network of high-value ground stations, some in the most remote and demanding of locations. The selection of the Graphene Enhanced Top Coat MT will **deliver significant long term cost savings in repainting and maintenance** across Avanti transmission dish structures.



## LATEST NEWS

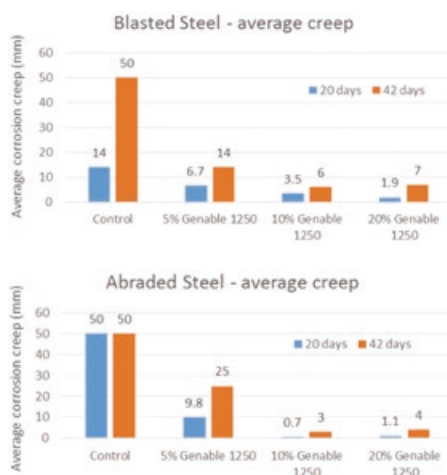
**AGM EXTENDS GLOBAL  
REACH** (SEE PAGE 4)

## SIGNIFICANT *Genable*<sup>®</sup> TECHNOLOGY ADVANCE FOR WATER BASED ANTI-CORROSION 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*<sup>®</sup> 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*<sup>®</sup> technology, a range of master dispersions that are designed to facilitate the easy incorporation of graphene into coating formulations and existing processes. *Genable*<sup>®</sup> 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.**

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.

## MAJOR TOOL DEMONSTRATION POINTS TOWARDS LOWER COSTS FOR THE AEROSPACE INDUSTRY



Partners in a recent NATEP technology programme Composite Tooling and Engineering Solutions Ltd (CTES), SHD Composites Ltd (SHD) and Applied

Graphene Materials plc (AGM) have subsequently made a significant step forward in demonstrating the viability of a new materials development that has the clear potential to offer significant time and cost savings to aerospace composite tool designers.

SHD has developed a prototype tooling material that combines cure at initial low temperatures (80-90°C), with the ability to be post-cured to achieve a maximum service temperature of in excess of 300°C. This cure flexibility enables the use of low cost pattern materials and progression to a final production tool, without the need for an expensive, time consuming and accuracy-losing intermediate tool phase, or manufacture of an expensive, metallic master model.



The tooling resin chemistry has been enhanced by the addition of AGM's A-GNP35 graphene nanoplatelets, significantly boosting matrix toughness and providing extra resilience against variations in processing conditions and resin micro-cracking over repeated production cycles. The graphene can be applied into the tool structure by addition into the bulk tooling material or discreetly targeted at critical regions by means of AGM's Structural Ink<sup>®</sup> printing technology.

The new material has been developed with cost savings to major aerospace programmes in mind and the demonstrator was a 10m long CFRP AFP mandrel tool (see below), engineered by CTES (manufactured by Retrac Tooling, Swindon) and was purposely chosen as highly representative of the industry's latest and demanding requirements.

Although still at the prototype/prove-out stage, the project partners are already actively engaged with interested parties

keen to access the benefits of the system. As well as proving out production robustness, development work has also progressed to the processing of the material "out of autoclave", as well as the potential for applications in prototype tooling for high performing thermoplastic materials.

## AGM'S EXTENSIVE DEVELOPMENT AND TESTING CAPABILITIES



The recent introduction of the *Genable*<sup>®</sup> dispersion range has provided coating industry formulators with a valuable "toolbox" of production-ready graphene additives, all proven to deliver exceptional improvements to barrier and anti-corrosion properties. However, AGM's innovation partners also benefit greatly from an "end to end" approach to product integration support, providing access to a team of experienced coatings formulators and an array of industry leading characterisation and testing equipment.

First step in any programme is AGM's technical support team which boasts extensive experience in coatings formulation and know-how in integrating novel materials into existing manufacturing processes. AGM's team always work closely alongside partners and ensure all development and scale up programmes remain on track to clearly defined technical and commercial objectives.

Supporting the technical service team, is a comprehensive assortment of materials characterisation and testing equipment. **Within AGM's laboratories customers have access to a full coatings testing capability ranging from dispersion stability assessment, mechanical property measurements and a range of accelerated barrier performance testing equipment including electrochemical impedance, salt spray (neutral salt spray and Prohesion), immersion testing and QUV weathering testing. All testing is completed to industry standards and to precise customer needs.**







## 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.

## MICRO-CRACK PREVENTION IN SPACE-BOUND PRESSURE VESSELS



Infinite Composites have successfully incorporated AGM's A-GNPs 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.

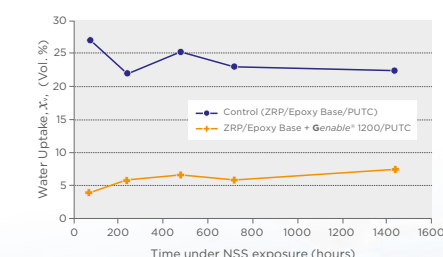
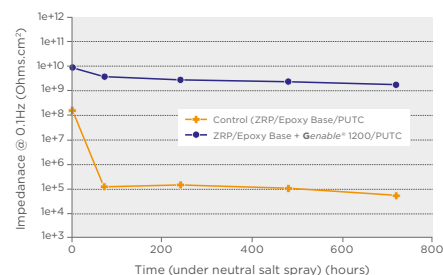
The addition of A-GNP's, via bespoke dispersions, has enabled the tanks to complete their first liquid oxygen loading test at -300°F pressurized to 600 psi. Analysis of the composite structure using Scanning Electron Microscope techniques indicated that the addition of GNP's eliminated nearly all micro-fractures in resin samples after exposure to the cryogenic environment versus the control samples. These results in an application subject to extreme testing, further underpins 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.

## Genable® TIE-COAT DEMONSTRATES QUICK, LOW RISK AND ENVIRONMENT FRIENDLY ROUTE TO GRAPHENE ADOPTION

A prototype graphene enhanced tie-coat developed by AGM, and deployed into a typical 3 coat system with zinc rich primer (applied direct to substrate), epoxy tie-coat in the intermediate layer and polyurethane topcoat, has demonstrated exceptional anti-corrosion performance in comparative testing against industry standards at C5 high levels.

The performance achieved combined with the relative ease of integration, points clearly to a quick, low risk and environmentally friendly route to introducing this new technology; end-users having the security of using their existing zinc rich primer and top coat, meeting regulatory requirement, yet opening up the potentials of significantly extended coating life and reduced levels of metal salts.

During the development work, a 3 coat system incorporating the graphene enhanced tie-coat was tested against an industry standard control (zinc rich primer (ZRP), epoxy base tie coat and PU topcoat system (PUTC)). The results (see below) of extended water uptake, electrochemical impedance spectroscopy and neutral salt spray testing (ISO 9227) showed a substantial uplift in barrier and anti-corrosion performance to a C5 high level.



The prototype tie-coat, was manufactured by the addition of very low and commercially viable levels of AGM's epoxy based Genable® 1200 dispersion, and is now readily available to industry formulators. The Genable® prototype tie-coat is supplied supported by a comprehensive set of processing and performance data, with AGM's experienced Technical Service team ready to field any further queries.

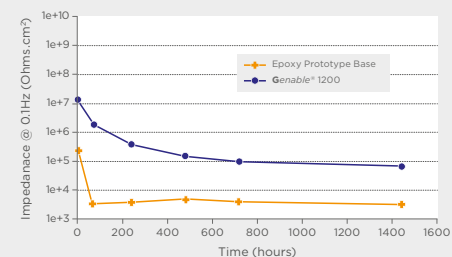
## EXCEPTIONAL SINGLE COAT ANTI-CORROSION PERFORMANCE

Continuing to push the boundaries of coating barrier technology, AGM has recently demonstrated exceptional anti-corrosion performance with a single coat, graphene enhanced epoxy primer. The AGM primer formulation has been characterised against a range of industry standard tests and the results clearly point to the great potential of graphene as a barrier additive into single coat/DTM (direct to metal) and multi-coat anti-corrosion paints.

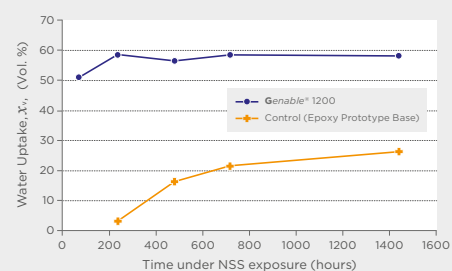
The single coat primer, formulated with very low addition levels of Genable® 1200, was measured against a well-established commercially available primer product. The tests performed included water uptake, electrochemical impedance, neutral salt spray (ISO9227) and Cyclic ageing test (ISO 12944 Annex B). The Genable® 1200 based primer comfortably passed a C4 high/C5 medium classification, almost achieving a C5 high ranking.

### Typically you might expect a 2 coat system to achieve this high level of performance!

Example results are given below (please refer to the relevant AGM Technical Application Notes for a full data sets)



50-60 micron DFT, impedance measurements carried out at 10 day intervals.



50-60 micron DFT, comparative water uptake under NSS exposure



## 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

## IK INABATA

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. AGM and Inabata have also recently worked together to complete the formal registration in China of one of AGM's unique **Genable**® dispersions, making it readily available to local coatings businesses.

## Global Reach

### Sales Offices

Head Office Wilton Centre, UK  
USA Sales Desks La Grange KY  
& Tulsa OK, USA

### Distributors

Tokyo, Japan  
Shanghai, China  
Cape Town, South Africa  
Athens, Greece  
Milan, Italy

### GREECE



Dichem Polymers has been established

for over 25 years and has a market supply lead into Greece's major paint, construction and epoxy system producers. In addition, the company is considered one of the top five suppliers of adhesives with a diverse range of customers and applications. The company provides a knowledgeable and responsive service to its customers from an Athens warehousing base.

### 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.

### 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:**

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## AIRBUS TP300 QUALIFICATION

We continue working with Airbus Defence and Space (Stevenage, UK) towards the completion of product and flight qualification for our TP300 thermal paste adhesive. Target completion for this work is now in the first half of 2020. It is Airbus's intention to offer this product thereafter on to their next-generation satellite platform, with first flight application and production sales now anticipated in the second half of 2020. TP300 is a very low-density, high-performance thermal paste adhesive that offers specific performance and commercial benefits against established competitor products

