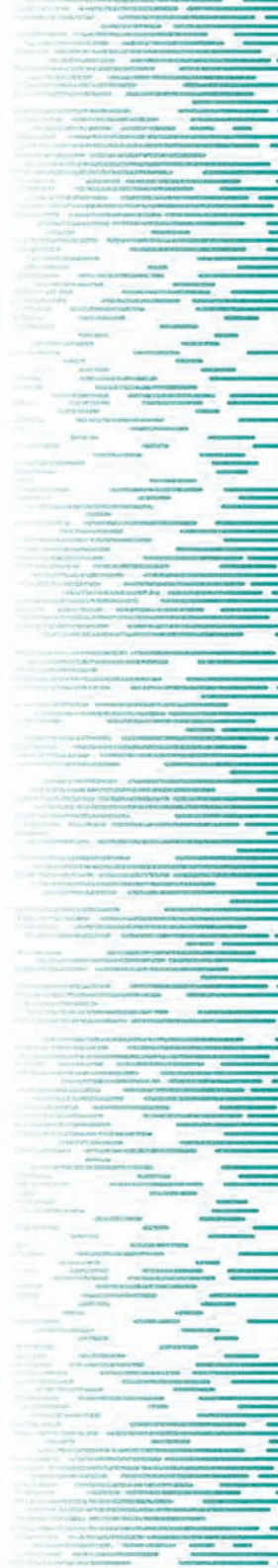




*New Dimensions
in Strength
and Stability*



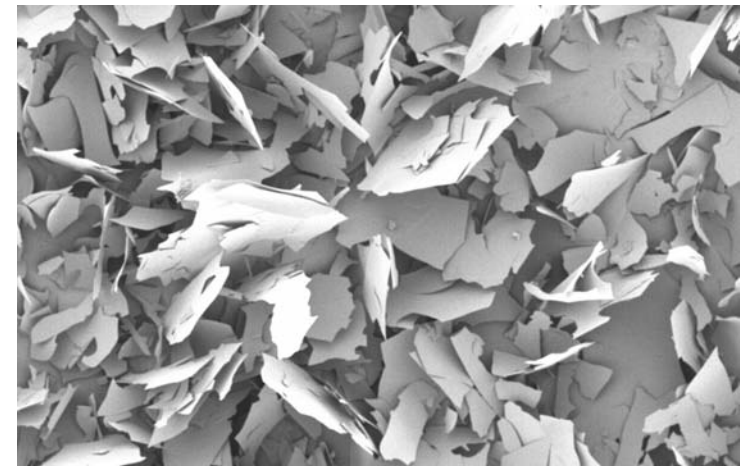
GLASSFLAKE

Innovation in Action

High specification glass flake products manufactured by Glassflake Ltd have their origins in an R&D project pioneered in 1981, striving to produce a superior material with improved performance characteristics, focused on the creation of a thinner flake.

Working with a diverse team of engineers and materials scientists, Glassflake has patented an innovative manufacturing process which consistently produces thinner flakes, achieving a higher aspect ratio (nominal flake thickness to average nominal flake diameter) and therefore advanced levels of planar reinforcement and rigidity.

These developments have resulted in the establishment of Glassflake as an innovator in flake glass technology. Today, investment continues with the company operating an ongoing product development programme in response to industry requirements and identified customer needs, meeting the challenges of applications as diverse as anti-corrosion coatings through to barrier reinforcement in engineering thermoplastics.



GLASSFLAKE

The Potential is Endless

Glass flake is already used extensively in the formulation of thermopolymers and coatings to achieve both performance and operational enhancements. Products manufactured by Glassflake are infinitely versatile materials, with inherent stabilising properties that are now making a significant contribution to a diverse range of products, processes and industries worldwide.

The application potential for these unique materials extends to almost any product seeking to enhance strength, stability and durability. Due to uniform lateral alignment within a resin, Glassflake products provide an excellent barrier to fluid and gas permeation, together with good resistance to mechanical stresses and abrasion. High cohesive and adhesive strength can be achieved with the aid of performance-enhancing silane surface pre-treatment.

Glass flake products are characterised as lamella structures, unlike granular fillers, which are uniform in all dimensions. Glassflake materials display very high aspect ratios and are manufactured in a range of nominal thicknesses and particle size ranges.

Glassflake products impart unique properties:-

- In situ barrier to moisture vapour permeation
- Enhanced mechanical properties
- Enhanced fire resistance
- Excellent thermal properties
- High dimensional stability
- UV and colour stability

ECR glass flake

All Glassflake materials are manufactured using extra corrosion resistant (ECR) composition glass, conferring excellent chemical resistance and acting as a natural electrical and thermal insulator.



GLASSFLAKE MATERIALS IN USE

Performance Coatings



Glass flake materials developed and manufactured by Glassflake Ltd are used extensively in the performance coatings field as an in situ barrier additive. Glass flake coating systems work on the principle of presenting a tortuous path to corrosive ions migrating through the permeable binder.

The effectiveness of the glass flake depends on the flake thickness, which determines the number of layers that can be achieved in a given film thickness. The particle size diameter will determine the distance laterally that the corrosive ion needs to travel to the next layer.

Glassflake manufactures material to suit most applications. Our products display consistent nominal thickness, giving higher aspect ratio flakes and resulting in better packing and leafing of the flakes. This provides a more homogenous film and significantly increases the tortuous path presented, which in turn gives significant reduction in moisture vapour permeation.

In addition to barrier properties, glass flake coatings have a similar coefficient of thermal expansion to low carbon steel. This arises because

the expansion between the resin with a higher rate than steel, and the glass with a lower rate, when used at the correct loadings gives a similar compound expansion rate.

Glass flakes also achieve a low lateral shrinkage rate during cure. This is obtained by the flakes preventing movement of the resin during the curing process, and results in low stress at the coating to substrate interface. The end result is coating systems with high resistance to undercutting.

Glass flake coating systems are used to offer long term corrosion protection in a diverse range of applications including marine, oil and gas, pipe linings, tank and vessel linings, through to flue gas desulphurisation columns.

Key performance benefits include:-

- Reduced moisture vapour transmission rates
- Low lateral shrinkage during cure
- Coefficient of thermal expansion similar to low carbon steel
- Good resistance to undercutting
- Relatively high abrasion resistance
- Composite dimensional stability
- Good resistance to cathodic disbonding

GLASSFLAKE MATERIALS IN USE

Thermopolymers

Flake glass manufactured by Glassflake is proven to offer significant performance advantages in a wide range of thermopolymers and elastomeric compounds, from high performance engineering to commodity thermal plastics.

The incorporation of glass flakes offers substantial improvements. The flake's natural tendency to leaf and overlap in planar alignment imparts uniform reinforcement, increasing dimensional stability and enhancing mechanical properties.

When used as a performance filler or reinforcer in polymer systems, Glassflake benefits include:-

Improved Mechanical Properties

- Increased tensile strength/modulus
- Improved flexural strength/modulus
- High weld strength
- Reduced shrinkage
- Reduced warpage
- High impact strength
- Reduced anisotropy
- Improved dimensional stability

Improved Barrier Properties

- Increased chemical resistance
- Reduced liquid and vapour permeation
- In situ barrier to oxygen

Improved Fire Retardancy

- Physical barrier impeding the passage of oxygen
- Aids formation of stable char structure
- Reduces burn mass
- Reduction of surface spread of flame and smoke emissions

Tribological Properties

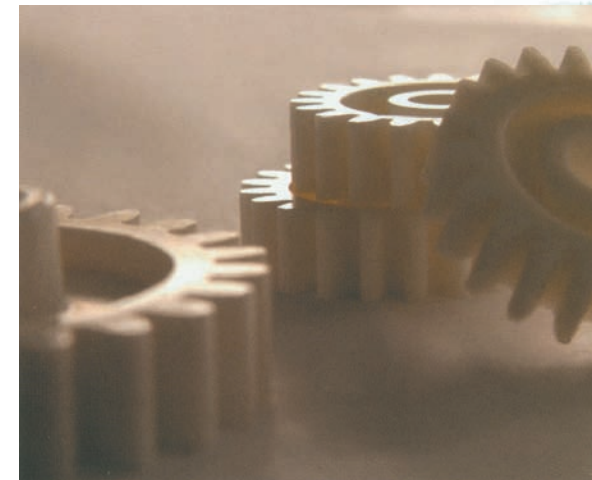
- Improved wear and abrasion resistance

Improved Thermal Properties

- Increased vicat temperature
- Increased heat distortion temperature

Glassflake's complete range offers products to suit most applications. In addition, our silane pre-treated products further enhance flake to polymer adhesion and enhance material properties.

Glassflake materials may be used in conjunction with other fillers and additives.



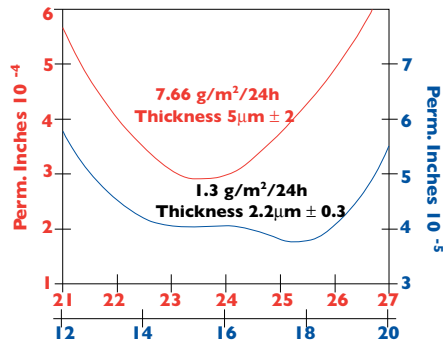
GLASSFLAKE

Performance Details

Product Consistency

Due to the patented manufacturing process, Glassflake consistently produces thinner flake to meet our tight nominal thickness specification, in addition to producing consistency in terms of particle size range.

Thinner flakes can substantially improve the perform of your materials, and represent a cost saving too.



Test Method: ASTM D1653
Test Temperature: 25° C
Film Thickness: +/- 1mm

Nano Flake

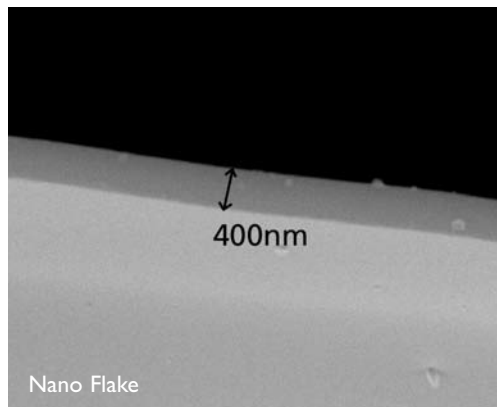
Innovation and unique manufacturing processes have facilitated the development of Glassflake's one-dimensional nano glass flake products, available on request with nominal thicknesses ranging from 750nm down to 200nm.

Organo-functional silanes

Glassflake materials are also offered with the option of surface pre-treatment with a range of silane coupling agents displaying functionality to suit most resin systems. Silanes further enhance flake to resin adhesion and cohesion resulting in improvements in mechanical properties.

Surface Treatment	Resin
Amino Silane	Polyamides, Phenolics, PET
Vinyl Silane *	Polyester, polyethers, polyolefins
Epoxy Silane	Epoxy, PU, Styrene Butadiene
Acryl Silane *	PP, Polyolefins

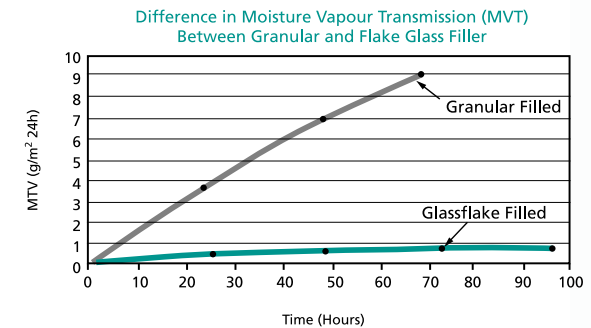
* Produced to order



One Micron Flake

Glassflake's advanced production process facilitates the manufacture of flake at a consistent nominal thickness of 1 micron. These products are available on request.

Moisture Vapour Transmission



Agglomerated Flake

Glassflake materials are also available as an agglomerate, held together by a universal binder. Eliminating dusting issues, this material offers improvements in areas including handling, processing and feedability.



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