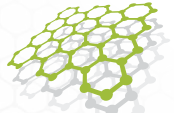


Graphene Enhanced Concrete

Case Study - PureGRAPH™ performance in cement composites



first graphene

The world's leading graphene company

PureGRAPH™ graphene additives give stronger, lighter concrete structures enabling novel and potentially greener approaches in building and infrastructure project design. Testing at the University of Adelaide show a 34% increase in the compressive strength and a 27% increase in the tensile strength of concrete, when tested to international standard methods.

Background:

Population growth and rapid urbanisation continue to boost the growth of concrete products; the precast concrete market size alone is expected to reach US\$130.11 billion by 2025. The concrete admixtures market is estimated to be worth US\$18.10bn by 2020. The industry faces major challenges notably the pressure to reduce the carbon footprint (CO₂ contribution) of cement-based products. The use of graphene admixtures can increase strength, reduce materials usage (reducing carbon footprint) and potentially increase longevity of products.

The technology has the potential to deliver stronger, lighter concrete structures enabling a new generation of concrete designs.

The Collaboration:

Working within the Australian Research Council (ARC) Graphene Hub at the University of Adelaide significant improvements in the strength of concrete products has been demonstrated in a systematic study. Full scientific results have been submitted to *Cement and Concrete Composites Journal*.



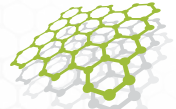
Building technology evolution demands high performing materials

ASX:FGR

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Results:

It has been confirmed that addition levels of 0.02% w/w of PureGRAPH™ additive, produces increases in compressive strength of 34% and increases in tensile strength of 27% in concrete mortars.

The PureGRAPH™ concrete additive was introduced as a concrete admixture directly in the water used for preparing the concrete mortar. No additional mixing equipment or processing steps were required. Strengthening was dependent upon the type of graphene additive used, with higher aspect ratio graphenes providing the best improvement. The increase in strength opens up the possibility of stronger or lighter concrete structures with an associated reduction in carbon footprint for major infrastructure projects.

Typical cement mortar mixing steps:



Dry ingredients



Mixer



Solid added
and mixed



Graphene/
water/plasticiser
added



Concrete
mixed

Outcomes:

These results are currently being reviewed with cement manufacturers and consultants in the construction sector to initiate industry evaluation in 2019.

In a further development, the programme is being extended to evaluate the reduction in water permeability and ion transport which would reduce issues with concrete corrosion around reinforcement bars (rebars). First Graphene is supporting a 2019, UK government funding proposal with the School of Mechanical, Aerospace and Civil Engineering at the University of Manchester to develop graphene additives for reduced water permeability.

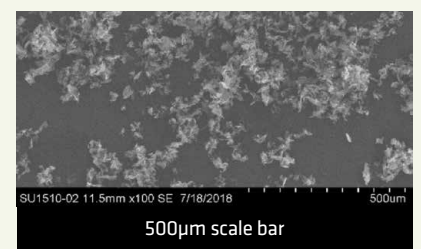
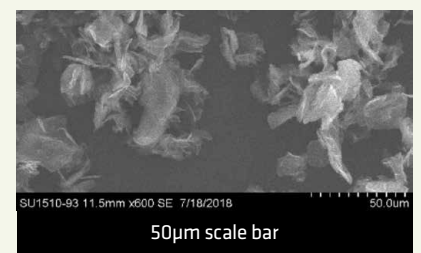
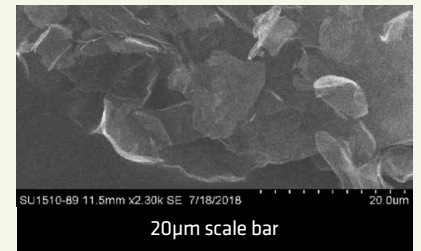
For more information on PureGRAPH™ products please contact us at info@firstgraphene.com.au

LIMITED WARRANTY INFORMATION:

The information contained herein is offered in good faith and is believed to be accurate at the time of printing. This information should not be used as a substitute for your own quality control and/or testing procedures to ensure that our products are safe, effective and fully satisfactory for the intended end use. Suggestions of use shall not be taken as inducements to infringe any patent.

PureGRAPH™ Graphene powders are low defect, high aspect ratio graphene platelets available in three product sizes

- PureGRAPH™ products have well controlled particle sizes at 5µm, 10µm and 20µm for consistent and repeatable performance.
- PureGRAPH™ products disperse readily and easily in solvents, polymer resins, rubber and water-based formulations.
- PureGRAPH™ products are high purity with very low metal and silicon contaminant levels.



Typical SEM analysis of PureGRAPH™ 20