



# First Graphene Making Progress Towards PureGRAPH™ Concrete Additives

## Highlights

- PureGRAPH™ additives give a 34% increase in the compressive strength of concrete and a 27% increase in the tensile strength of concrete, when tested to international standard methods.
- PureGRAPH™ concrete additive is easily dispersed into the mortar using standard methods and can be selected to optimise performance; high aspect ratio materials are most effective.
- Reduced permeability giving reduced re-bar corrosion is an expected additional benefit.

First Graphene (FGR) continues to make excellent progress in developing PureGRAPH™ graphene additives for concrete products. 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, 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. As with other composite developments at FGR, 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. 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 (re-bars). FGR 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.

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### *ASX Symbol*

FGR  
FGROC

**Concrete Market:** 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 (CO<sub>2</sub> contribution) of cement-based products. The use of graphene admixtures has the potential to increase strength, reduce materials usage (reducing carbon footprint) and increase longevity of products.

**Concrete Testing:** Testing was carried out within the School of Civil, Environmental and Mining Engineering at the University of Adelaide. All results were carried out on concrete mortar products (Ordinary Portland Cement/aggregate sand/water with PureGRAPH™). Note - tests carried out on cement pastes alone may not be representative. The additive level is expressed as %w/w PureGRAPH™ per total solids in the concrete mortar. The test specimens were stored in environmentally controlled conditions prior to testing. The reported results are after 28 days cure time. ASTM test methods were employed (ASTM C109 for compressive strength; and ASTM C307-03 for tensile strength).

### *About First Graphene Ltd (ASX: FGR)*

*First Graphene produces high quality graphene from high grade Sri Lankan vein graphite.*

*First Graphene seeks to develop graphene production methods and acquire graphene related intellectual property which can provide further revenue related opportunities.*

### *About Graphene*

*Graphene, the well-publicised and now famous two-dimensional carbon allotrope, is as versatile a material as any discovered on Earth. Its amazing properties as the lightest and strongest material, compared with its ability to conduct heat and electricity better than anything else, means it can be integrated into a huge number of applications. Initially this will mean graphene is used to help improve the performance and efficiency of current materials and substances, but in the future, it will also be developed in conjunction with other two-dimensional (2D) crystals to create some even more amazing compounds to suit an even wider range of applications.*

*One area of research which is being very highly studied is energy storage. Currently, scientists are working on enhancing the capabilities of lithium ion batteries (by incorporating graphene as an anode) to offer much higher storage capacities with much better longevity and charge rate. Also, graphene is being studied and developed to be used in the manufacture of supercapacitors which can be charged very quickly, yet also be able to store a large amount of electricity.*

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