

# PureGRAPH® ENHANCES PERFORMANCE OF CEMENT COMPOSITES

The addition of small amounts of PureGRAPH® graphene platelets gives significant performance enhancements in cement-based systems. First Graphene Ltd is actively working with world-leading academics and companies to capitalise on the unique properties of our graphene materials in widely used construction materials to deliver a range of benefits.

## Background

Population growth and rapid urbanisation are driving a global increase in the need for concrete-based construction materials. Today, the building industry faces major challenges which include:

- A need to reduce the carbon footprint of the cement production process.
- The lack of availability of cement-based products as demand exceeds supply.

PureGRAPH® graphene enhanced concrete technology has the potential to deliver stronger, thinner concrete structures which are more durable. This will enable a novel, greener approach to delivering civil engineering infrastructure projects.

First Graphene Ltd is actively developing admixtures that will allow its graphene products to be easily incorporated into concrete systems.

## The Collaboration

First Graphene Ltd and the Australian Research Council (ARC) Graphene Research Hub at the University of Adelaide have collaborated in a systematic study that

has demonstrated significant improvements in the strength of concrete mortars. Full scientific results have been published in multiple journals including Construction and Building Materials.



Building technology evolution demands high performing materials

## Results

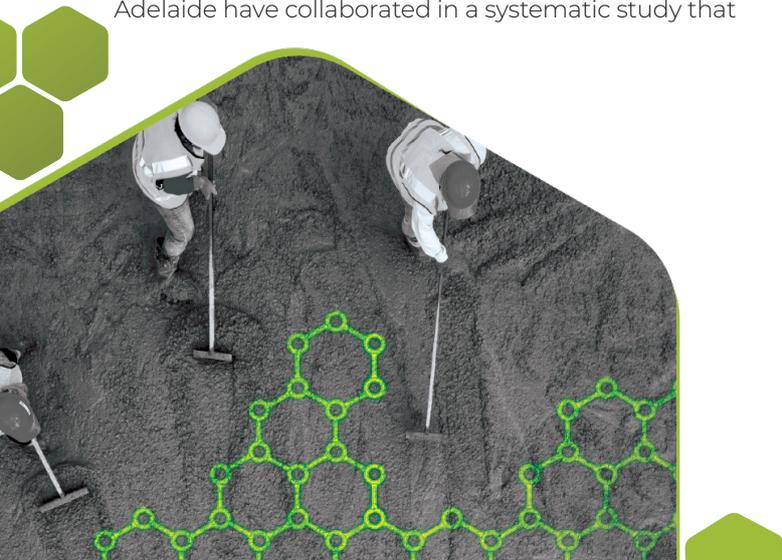
Professor Dusan Losic's team at the ARC's Graphene Research Hub have demonstrated that the addition of very small amounts of graphene platelets can significantly improve the mechanical properties of cement-based mortars used in concrete systems.

When used as an additive in a typical cement-based mortar, a loading level of less than 0.1% can give:

- A 34% increase in compressive strength
- A 27% increase in tensile strength

The PureGRAPH® additive was prepared as a simple water-based admixture using standard processing equipment. The research team found that First Graphene's high aspect ratio graphene platelets are unique in terms of having the optimum size range and surface functionality to deliver these impressive results.

The mechanism for enhancement is the improved hydration of calcium silicate hydrate gels and an increased level of adhesion between platelets and cement gels.



# Outcome

Professor Losic's work has been peer reviewed and published. It is now being used to inform a comprehensive evaluation program with downstream partners in the admixture, cement production and construction sectors.

**“We have had a successful collaboration with First Graphene Ltd, which has resulted in the publication of three peer-reviewed articles to date. Our work has shown that the incorporation of small amounts of First Graphene's unique product has a significant positive impact on the mechanical strength of cement mortar systems.”**

Professor Dusan Losic, Leader of the Nano Research Group at the University of Adelaide, August 2021

First Graphene Ltd is also actively collaborating with researchers at the School of Mechanical, Aerospace and Civil Engineering, University of Manchester. The research team, led by Dr Meini Su, has shown that **PureGRAPH®** graphene platelets is effective at reducing water permeability in cement-based systems. This has the potential to reduce ion transport in concrete mortars, reducing corrosion of the steel reinforcing bars (rebars), whilst also improving mechanical properties of the concrete matrix.

## Typical cement mortar mixing steps



Dry ingredients



Mixer



Solid added and mixed



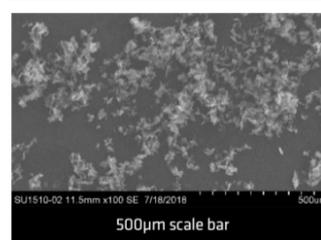
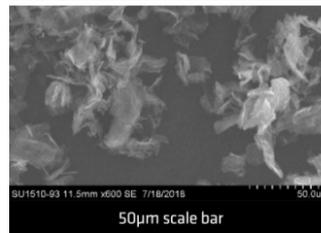
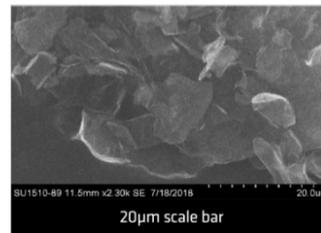
Graphene/water plasticiser added



Concrete mixed

**“Over the last few years, we have developed a good working relationship with First Graphene Ltd This has helped us to understand how graphene can be used as a multifunctional additive in cement systems.”** Dr Meini Su, Senior Lecturer in Structural Engineering in the Department of Mechanical, Aerospace and Civil Engineering at University of Manchester – August 2021

## Typical SEM analysis of PureGRAPH® 20



**PureGRAPH®** Graphene powders are low defect, high aspect ratio graphene platelets available in three product size.

- ✓ Well controlled particle sizes at 5µm, 10µm and 20µm for consistent and repeatable performance.
- ✓ Disperse readily and easily in solvents, polymer resins, rubber and waterbased formulations.
- ✓ High purity with very low metal and silicon contaminant levels.

For more information on **PureGRAPH®** products please contact us at [info@firstgraphene.net](mailto:info@firstgraphene.net)

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