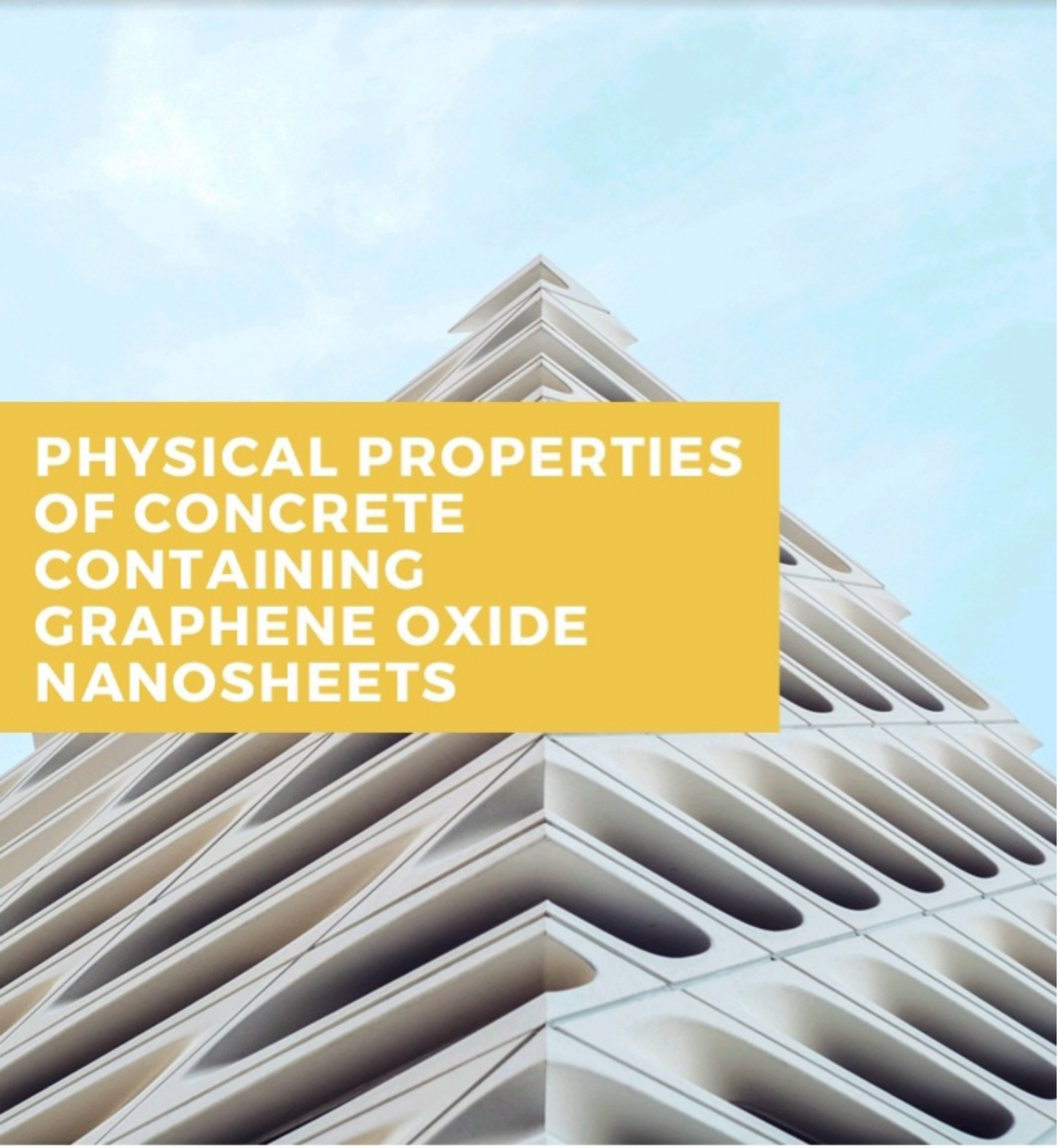
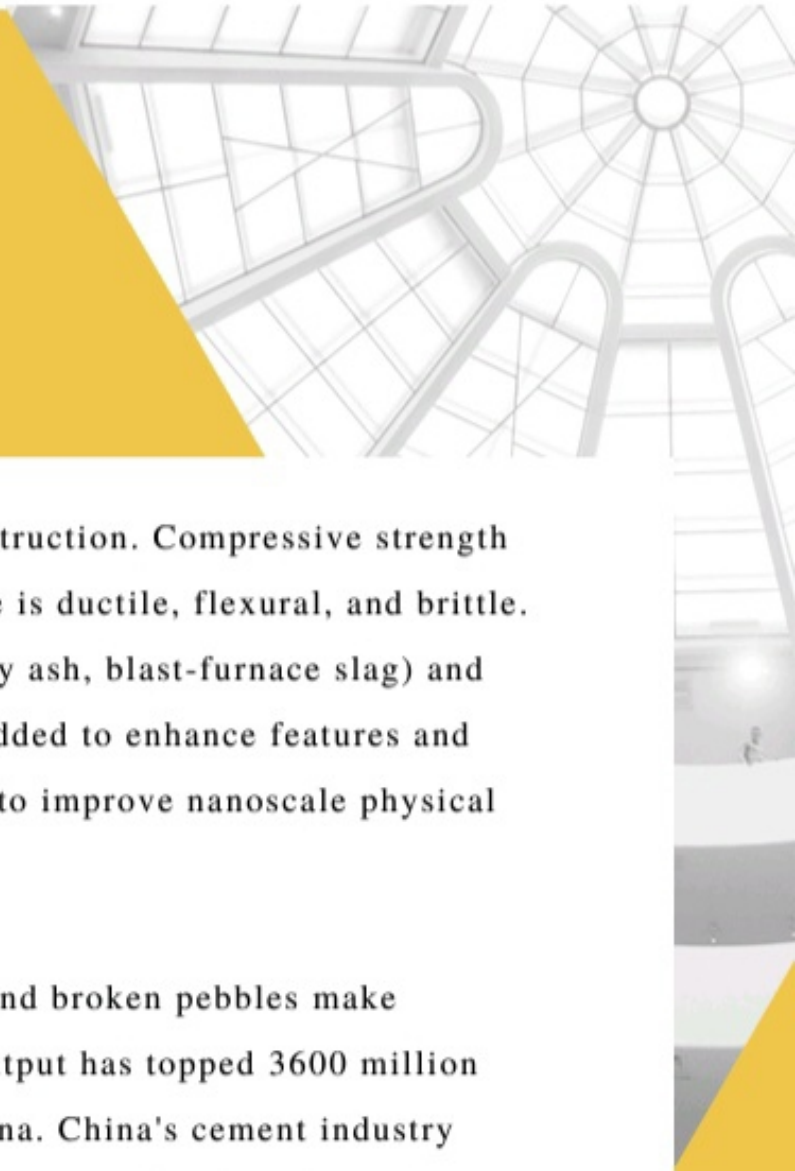


PHYSICAL PROPERTIES OF CONCRETE CONTAINING GRAPHENE OXIDE NANOSHEETS

GREEN GRAPHENE LLC



a year's overview

WHERE WE ARE NOW

Portland cement dominates construction. Compressive strength makes concrete strong. Concrete is ductile, flexural, and brittle. Many cementitious materials (fly ash, blast-furnace slag) and fibers (glass, steel) have been added to enhance features and performance, however they fail to improve nanoscale physical qualities and durability.

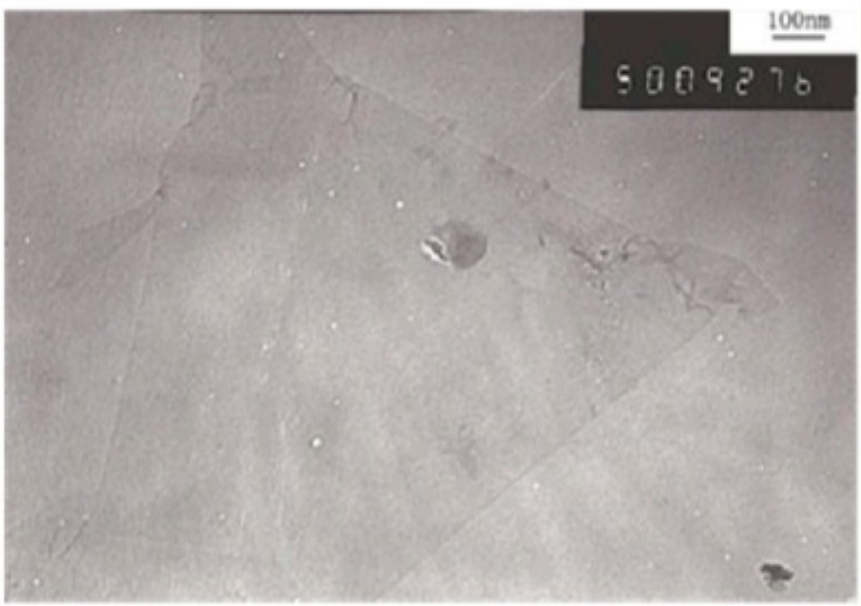
Portland cement, sand, gravel, and broken pebbles make concrete. Since 2011, cement output has topped 3600 million tonnes, with over 55% from China. China's cement industry released 15%–20% PM2. 5, 3% to 4% sulfur dioxide, and 8% to 10% nitrogen oxides.

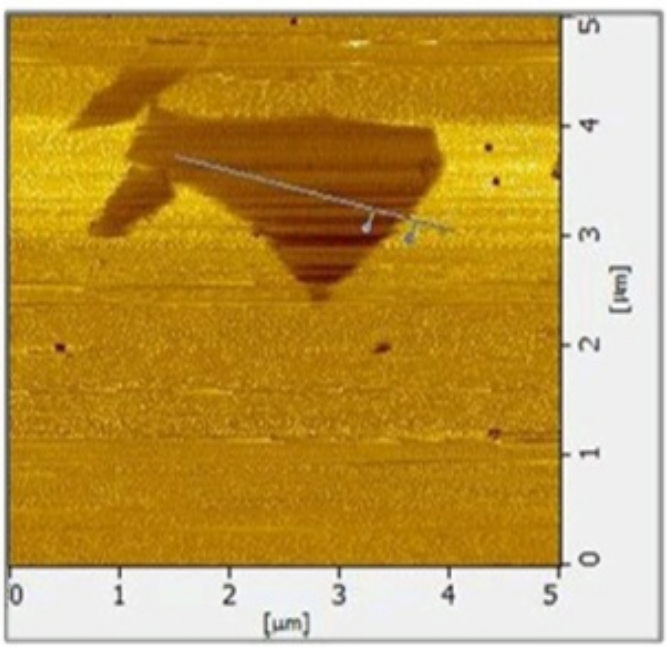
Component CaO SiO2 Al2O3 Fe2O3 MgO K2O Na2O SO3
Content (%) 65.16 21.25 4.21 3.35 2.90 0.97 0.50 0.72

Table 2. The composition and dimensions of graphene oxide nanosheet.

Items Carbon (%) Oxygen (%) The Length/Width (μm) Thickness (nm)
Value range 45–60 40–55 2–10 1–1.5

Nanoparticles may enhance cement. Studies show that adding 0.05% graphene oxide (GO) nanosheets (by weight of cement) boosts the compressive and flexural strengths of ordinary Portland cement paste by 15% to 33% and 41% to 58%, respectively. Forceful int, mechanical interlocking, microcrack-nanosheet contact, and hydration promotion may induce this. These findings imply GO nanosheet-reinforced cement-based composites. Most investigations have examined cement paste and mortar's physical characteristics, durability, and rheology.





Introduction

GNP-based UHSC and UHPC have limited physical characteristics. Lu and Ouyang found that GO nanosheets from 0.00% to 0.03% cement weight lowered UHSC fluidity and increased flexural and compressive strengths. 28-day UHSC with 0.01% GO nanosheets exhibited 7.82% greater compressive strength. Meng and Khayat found that GNPs below 0.05% lowered high-range water reducer (HRWR) demand, improving flowability, whereas GNPs over 0.05% did the opposite. Depending on size and specific surface area, 0.3% GNPs enhanced UHPC compressive strength by 5.2% to 5.7%, flexural strength by 39% to 59%, and tensile strength by 40% to 45%. Dimov and Craciun et al. found 146% and 79.5% UHPC compressive and flexural strength improvements. Rarely explored GO nanosheet-containing concrete. Thus, further investigation is needed.

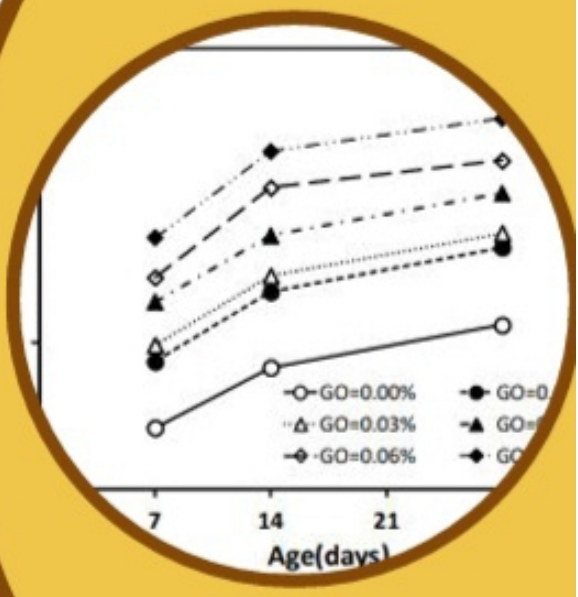
GO nanosheets are used to analyze concrete slump and characteristics. At 0.5 water–cement ratio, GO nanosheet weight is 0.00%, 0.02%, 0.03%, 0.04%, 0.06%, 0.08%. Concrete compressive, flexural, and split tensile strengths. Determine GO nanosheet dose for concrete split tensile strength.

Fine aggregate (FA) and coarse aggregate (CA) were air dried in the laboratory environment before being mixed with potable mix water and mechanically stirred for one and a half minutes using a hand-mixer. Pre-mixed solution was added to the dry mixed cement and aggregates and then mixed for two minutes at moderate speed. The freshly mixed concrete was poured into pre-oiled molds and compacted on an electric concrete vibration table after which the specimens were covered with a polyethylene sheet and cured for twenty-four hours. Compressive strength, flexural strength, and split tensile strength of specimens were measured.

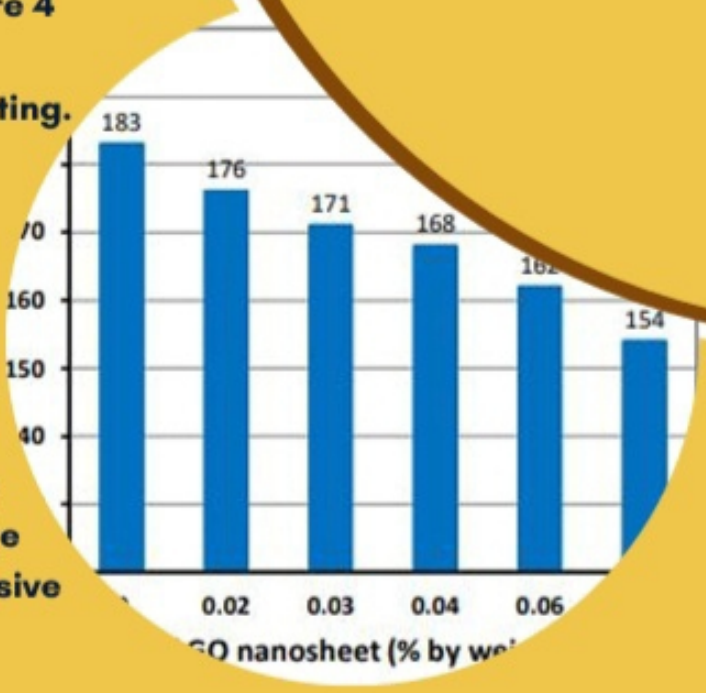
Mix ID	Total Water (kg/m^3)	Cement (kg/m^3)	FA (kg/m^3)	CA (kg/m^3)	PCs (kg/m^3)	GO (%)	GO (kg/m^3)
GCO0	168	336	626	1270	6.72	0.00	0.0000
GCO2	168	336	626	1270	6.72	0.02	0.0672
GCO3	168	336	626	1270	6.72	0.03	0.1008
GCO4	168	336	626	1270	6.72	0.04	0.1344
GCO6	168	336	626	1270	6.72	0.06	0.2016
GCO8	168	336	626	1270	6.72	0.08	0.2688

The values of slump obtained for concrete with GO nanosheets are lower than that of concrete without them. It is possible to improve the slump of conventional mixes by using fly ash [15] and PCs [26]. However, Meng and Khayat [17] verified that when the GNPs content is less than 0.05%, the high-range water reducer (HRWR) demand decreased. This suggests that the workability of the ultra-high strength concrete (UHPC) is affected by both additive and GNPs. Further studies are necessary to better understand the influence of GO on ordinary concrete.

Compressive Strength

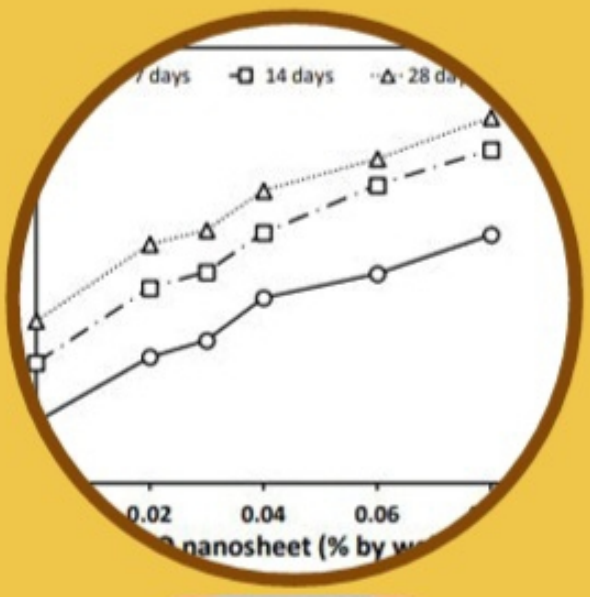


1. GO nanosheets in concrete increase compressive strength (GCO0). Figure 4 depicts 7, 14, and 28-day concrete specimen compressive strength testing. Age enhances concrete specimen compressive strength.



2. All concrete specimens gain flexural strength from GO nanosheets. Experimental and anticipated values diverge, especially in EC-02. Concrete strength grows slower than compressive strength.

3. GO nanosheet inclusion boosts concrete split tensile strength with a water-cement ratio of 0.5. Compared to 0.02% and 0.06%, 0.03% GO nanosheet dosage enhances concrete specimens the most.



GRAPHENE OXIDE

The properties given to concrete by GO at 0.08% by weight of cement are shown below

Compressive strength 55.22 MPa at 0.08% GO

Flexural strength 7.24 at 0.08% GO

Sorptivity

GO (graphene oxide) at 0.08% by weight of cement reduces the sorptivity of water by 24.8%

Tensile strength

GO at 0.08% by weight of cement gives a tensile strength of 3.01 MPa

Weight reduction~ 22%

Fire Rating properties

At 0.08% GO by weight of cement gives a 70% retention of residual strength from 800°C