EFFECT OF LOCALLY MANUFACTURED GRAPHENE OXIDE ON CONCRETE STRENGTH

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The research investigates the impact of locally manufactured Graphene Oxide (GO) from Ceylon Graphene Technologies on the properties of concrete, focusing on compressive strength, sorptivity, early heat of hydration, and SEM analysis, to determine if GO can be a cost-effective method for concrete construction. Three concrete grades were tested withvarying GO concentrations (0.02%, 0.04%, 0.06%) and compared to control samples at 7- and28-day curing periods.

For grade 25 concrete, the compressive strength increased by 24.84% to 52.58% at 7 days and 13.82% to 46.74% at 28 days for GO concentrations of 0.02% to 0.06%, respectively. Grade 30 concrete exhibited even more substantial improvements, with compressive strength increases of 44.1% to 68.34% at 7 days and 11.9% to 27.45% at 28 days for the same GO concentrations. Grade 35 concrete showed modest gains, with 7-day increases of 10.5% to 10.534% and 28-day increases of 2.98% to 16.59%. These results demonstrate that higher GO concentrations lead to more significant enhancements in compressive strength, underscoring GO's potential to improve concrete strength and durability cost-effectively.

In addition to compressive strength, sorptivity tests on grade 30 concrete samples revealed that higher GO content results in lower water absorption rates. This reduction in sorptivity indicates enhanced durability and resistance to water ingress, crucial for the longevity of concrete structures. The early heat of hydration tests on grade 30 concrete indicated that GO increases heat production during the hydration process, with temperatures rising as GO percentages increased. This dose-dependent impact suggests that GO accelerates the hydration process, contributing to quicker strength gain. SEM analysis provided further insights into the microstructural changes induced by GO. The SEM images of GO-mixed concrete showcased a significant increase in hydrated products compared to conventional concrete.

These findings highlight the ability of GO to improve infrastructure durability by reducing sorptivity and enhancing structural resilience. The integration of GO into concrete formulations can lead to more durable and resilient structures, offering substantial benefits for the construction industry. GO's ability to enhance concrete properties suggests it could be a cost-effective, transformative material for future infrastructure projects. The study concludes that incorporating GO into concrete not only boosts its compressive strength but also reduces water absorption and accelerates the hydration process. These improvements, evident across different concrete grades and GO concentrations, indicate that GO is a promising additive for developing stronger, more durable concrete in a cost-effective manner. The research provides valuable insights for future studies and practical applications, suggesting that GO can significantly contribute to the advancement of construction materials and methods, ultimately leading to more robust and enduring infrastructure.

Keywords: Compressive strength, Concentration, Graphene oxide, Hydration, Sorptivity

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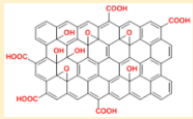
1. Background



Graphene oxide molecule

Material properties

Bonding

Physical form

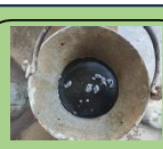
Concentration

- Ceylon Graphene Technologies
- Water dispersions
- 10 g/l
- Room temperature

Concrete grades 25, 30, 35 with varying concentrations of graphene oxide at 0%, 0.02%. 0.04% and 0.06%

2. Research Methodology

Sample casting



GO mixing with water

Cube Casting

Cylinder casting

Curing

Compressive strength

Three cubes from each sample – 7 & 28-days water curing

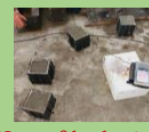
Sorptivity

~ 28 d water curing
~ 50 ^{0} C heat curing for 3 days
~ Air curing for 15 days

Testing

Cube testing

Sorptivity

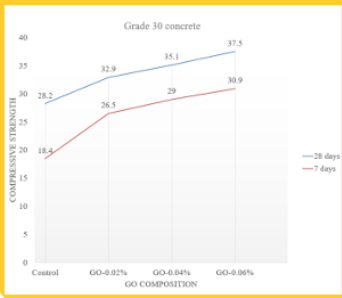


Heat of hydration

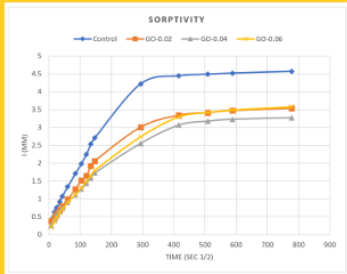
SEM

3. Results

Compressive strength (C30)



Sorptivity (C30)



Heat of hydration (C30)