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STRENGTH STUDY ON CONCRETE WITH GRAPHENE OXIDE AND SAWDUST

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ABSTRACT
Concrete is one of the most widely used construction materials globally, but its production contributes significantly to carbon emissions and resource depletion. In recent years, researchers have explored alternative materials and additives to improve concrete's sustainability while maintaining its structural integrity. This study investigates the incorporation of graphene oxide (GO) as a cement replacement and sawdust as a fine aggregate replacement in concrete mixtures. Graphene oxide, derived from graphene, possesses remarkable mechanical, thermal, and electrical properties. By substituting a portion of cement with GO, concrete can potentially exhibit enhanced strength, durability, and resistance to environmental degradation. Furthermore, the utilization of sawdust, a readily available waste product, as a partial replacement for fine aggregate offers environmental benefits by reducing the demand for natural resources and minimizing waste disposal. Testing methodologies such as compressive strength and Split tensile strength, will be employed to assess the performance of the developed concrete mixtures for 7 and 28 days.

Keywords:
Graphene Oxide, Sawdust, Sustainability, Compressive Strength and Split tensile Strength.

1. INTRODUCTION

Concrete is the most widely used construction material globally, owing to its versatility, durability, and cost-effectiveness. However, conventional concrete production processes are associated with significant environmental impacts, including high energy consumption, CO2 emissions, and depletion of natural resources. To address these sustainability challenges, there is a growing interest in exploring alternative materials and technologies that can reduce the environmental footprint of concrete while maintaining or enhancing its performance.

One promising avenue for improving the sustainability of concrete is the incorporation of novel additives and replacements, such as graphene oxide (GO) and sawdust. Graphene oxide, a derivative of graphene, exhibits exceptional mechanical, thermal, and electrical properties. By utilizing GO as a partial replacement for cement, it is possible to enhance the mechanical strength, durability, and other performance characteristics of concrete. Additionally, sawdust, a byproduct of various industries, presents an opportunity to reduce the demand for natural aggregates while simultaneously diverting waste from landfills.

The combination of graphene oxide as a cement replacement and sawdust as a fine aggregate replacement offers a synergistic approach to sustainable concrete production. By integrating these materials into concrete mixtures, it is possible to achieve a balance between performance, environmental impact, and resource efficiency. However, thorough investigation and understanding of the effects of these additives on concrete properties are essential to ensure their successful implementation in practice.

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2. OBJECTIVES

1. Analyze the potential cost savings and economic benefits associated with the use of graphene oxide and sawdust replacements in concrete production.
2. Evaluate the compressive strength and tensile strength of concrete specimens containing graphene oxide (GO) as a partial replacement for cement and sawdust as a replacement for fine aggregate to assess their impact on the overall strength and structural integrity of the concrete.

3. MATERIALS

3.1 Cement: Cement is a key component in the production of concrete, mortar, and grout, providing strength and stability to structures.

3.2 Fine Aggregate: Fine aggregate is sourced from natural deposits, such as riverbeds or quarries, or manufactured from crushed rock or gravel. It is essential for achieving desired properties in construction materials and is used in various applications, including concrete production, plastering, and paving.

3.3 Coarse Aggregate: Coarse aggregate is defined as material that has been preserved over IS Sieve 4.75 mm. The typical maximum size for self-compacting concrete is gradually 10–20 mm, while it has been seen to employ particle sizes of up to 40 mm or higher.

3.4 Graphene Oxide:- Graphene oxide exhibits unique properties such as high surface area, mechanical strength, electrical conductivity, and thermal conductivity, which are distinct from those of pristine graphene. These properties make GO suitable for various applications, including energy storage devices, composite materials, sensors, membranes, and biomedical applications.

3.5 Sawdust:- Sawdust in fine aggregate replacement in concrete presents opportunities to reduce the environmental impact associated with traditional concrete production, as it utilizes a waste material that would otherwise be disposed of. Additionally, it may offer benefits such as improved thermal insulation, reduced density, and enhanced sustainability credentials for construction projects.

3.6 Water:- Adding water to the dry ingredients of a concrete mixture to initiate hydration and facilitate the formation of a workable and cohesive paste. Concrete typically consists of several components, including cement, aggregates (such as sand and gravel), water, and optional admixtures.

4. EXPERIMENTAL INVESTIGATIONS

4.1 **Compressive Strength Results:** Compressive strength is a fundamental mechanical property of materials, including concrete, which measures the ability of a material to withstand axial compressive forces without failure.

Table 1: Compressive strength of concrete with sawdust as partial replacement of fine aggregate.

S.No	% of SAW DUST	Compressive strength (N/mm^2)	
		7 days	28 days
1	0%	27.73	39.57
2	5%	19.91	28.44
3	10%	17.65	25.19
4	15%	12.72	18.31

Table 2: : Compressive strength of concrete with Graphene Oxide replacement of cement.

S.No	% of Graphene Oxide	Compressive strength (N/mm^2)	
		7 days	28 days
1	0%	27.73	39.57
2	0.05%	37.47	53.61
3	0.10%	41.52	58.97

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4	0.15%	38.16	55.32

Table 3: Combined Compressive Strength of 5 % of saw dust With Partial Replacement of fine aggregate +0.10 % of Graphene oxide replacement of cement.

S.No	% of SD+% of GO	Compressive strength (N/mm^2)	
		7 days	28 days
1	0%	27.73	39.57
2	5% SD+ 0.10% GO	37.29	53.36

4.2 Split Tensile Strength Test:-Split tensile strength, also known as indirect tensile strength or diametral tensile strength, is a mechanical property of materials, including concrete, which measures the ability of a cylindrical specimen to resist tensile stresses.

Table 4: Split tensile strength of concrete with Sewdust as partial replacement of fine aggregate.

S.No	% of sewdust	Split tensile strength (N/mm^2)	
		7 Days	28 Days
1	0%	2.76	3.95
2	5%	1.93	2.81
3	10%	1.72	2.46
4	15%	1.27	1.82

Table 5: Split tensile strength of concrete with Graphene oxide replacement of cement.

S.No	% of Graphene oxide	Split tensile strength (N/mm^2)	
		7 Days	28 Days
1	0%	2.76	3.95
2	0.05%	3.48	5.35
3	0.10%	4.02	5.83
4	0.15%	3.89	5.47

Table 6: Combined Split tensile strength of 5 % of Sewdust With Partial Replacement of fine aggregate +0.10 % of Graphene oxide replacement of cement.

S.No	% of SD+% of GO	Split tensile strength (N/mm^2)	
		7 Days	28 Days
1	0%	2.76	3.95
2	5% SD+ 0.10% GO	3.98	5.61

5. CONCLUSIONS

1. At 5% Sawdust, the compressive strength of concrete decreases the strength result is 19.91, and 28.44 N/mm^2 at 7 and 28 days.

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2. For 0.10% Graphene Oxide the compressive strength increases the strength result is 41.52 and 58.97 N/mm^2 at 7 and 28 days
3. With 5% Sawdust + 0.10% Graphene Oxide the maximum compressive strength is 37.29 and 53.36 N/mm^2 at 7 and 28 days.
4. At 5% Sawdust, the split tensile strength of concrete decreases the strength result is 1.93, and 2.81 N/mm^2 at 7 and 28 days.
5. For 0.10% Graphene Oxide the split tensile strength increases the strength result is 4.02 and 5.83 N/mm^2 at 7 and 28 days
6. With 5% Sawdust + 0.10% Graphene Oxide the maximum split tensile strength is 3.98 and 5.61 N/mm^2 at 7 and 28 days.

REFERENCES

1. V.Tamilselvan1 , M.Shyamkumar2 , B.Kondababu3 and V.Bharathi4. Experimental Study on Microbial Fibre Concrete, International Journal of Engineering and Management Research,8(6), (2018), 161-170.
2. Dr.K.Chandramouli,J..Sree Naga Chaitanya, Dr.N.Pannirselvam, A. Murali Krishna. Ultra-High Strength Concrete by Using Alccofine (1203), International Journal of Creative Research Thoughts, 9(8), b41-b44.
3. Das, S., Krishnaraj, C., & Mukherjee, A. (2019). Sawdust as a Partial Replacement of Fine Aggregate in Concrete Mix Design: A Review. International Journal of Advanced Research in Engineering and Technology, 10(3), 293-303.
4. Chandra Sekhar I, Gopinathan P and Ramamohana B. INFLUENCE OF GRAPHENE OXIDE ON MECHANICAL PROPERTIES OF QC-LFS AND GGBFS BASED HARDENED CEMENTITIOUS COMPOSITES, 5(4), 2018, 387-392.
5. Dr.K. Chandramouli, J. Sree Naga Chaitanya, K. Divya Dr.D. Vijayakumar, Mechanical Properties On Graphene Oxide And Metakaolin Aspartial Replacement of Cement And Quarry Dust As Partial Repalcement of Fineaggregate In Concrete, North Asian International Research Journal of Sciences, Engineering & I.T.,Vol. 9, Issue-5 May-2023,32-39
6. Cheng, Huaigang, et al. “Morphological Investigation of Calcium Carbonate during Ammonification-Carbonization Process of Low Concentration Calcium Solution.” Journal of Nanomaterials, vol. 2014.
7. J.Sree Naga Chaitanya, Dr.K.Chandramouli,N.Pannirselvam, M.Priyanka Experimental Investigation on Jute Fibre Concrete with Partial Replacement of Cement with Alccofine and Metakaolin Using M30 Grade of Concrete 8(4)(2021),591-594.
8. DR. KOTA SRINIVASU, DR.K. CHANDRAMOULI, J. SREE NAGA CHAITANYA, SK.SAHERA, EXPERIMENTAL INVESTIGATION ON CRIMPED STEEL FIBER CONCRETE AS PARTIAL REPLACEMENT OF ZEOLITE POWDER WITH CEMENT,North Asian International Research Journal of Sciences, Engineering & I.T.,Vol. 9, Issue-5 May-2023,24-31
9. Patel .G.K, Deo.S.V. Parametric Study of Natural Organic Materials as Admixture in Concrete, International Journal of Applied Engineering Research,11(9),(2016), 6271-6277.
10. J. SREE NAGA CHAITANYA, DR.K. CHANDRAMOULI, SK.SAHERA, K. DIVYA, EXPERIMENTAL INVESTIGATION ON BAMBOO FIBER REINFORCED CONCRETE BY USING ZEOLITE POWDER AS FINE AGGREGATE AND GGBS AS CEMENT PARTIAL REPLACEMENT IN CONCRETE, North Asian International Research Journal of Sciences, Engineering & I.T.,Vol. 9, Issue-5 May-2023,40-47
11. Li, D., & Kaner, R. B. (2008). Materials Science: Graphene Oxide Paper. Nature, 453(7194), 271-272. Https://doi.org/10.1038/453271a