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INVESTIGATION ON GRAPHENE OXIDE CONCRETE WITH QUARTZ POWDER AS PARTIAL REPLACEMENT OF CEMENT

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ABSTRACT

It has been discovered that the hydration characteristics of GO-cement composites lead to a higher hydration rate, which impacts the composites' workability and water demand. The functions and impacts of GO in cement-based composites, as well as how it affects hydration, workability, transport characteristics, the development of mechanical properties, and durability. Cement partially replaces graphene oxide in several percentages, including 0%, 0.05%, 0.10%, and 0.15%. In order to increase the durability of concrete, quartz powder is a building additive. Crushed quartz rock that has been ground into a powder and combined with water makes up the substance. These qualities also make quartz the perfect material for construction projects, where it may be utilised as insulation or as cement's raw material. The quartz powder increases the durability of concrete when added. When mixed with wet cement, one pound of this chemical produces around one cubic foot of expanded material and, on average, strengthens concrete by 10%. For instance, it can withstand wear and tear significantly better than conventional concrete when used on roads and pavements. Then concrete determines compressive, and split tensile strength properties were improved at ages 28, 56 and 90 days.

Key words: Graphene oxide, Quartz Powder, Compressive strength, Split tensile strength and Ultrasonic pulse velocity.

1. INTRODUCTION

Concrete is a composite material made of coarse aggregate joined by fluid cement that gradually becomes harder. The most common types of concrete are those created with hydraulic cements or lime-based concretes like Portland cement concrete. Cement-based materials are currently the most significant construction materials, and it is quite likely that they will maintain this status in the future.

Stronger, longer-lasting concrete constructions are made possible by graphene concrete and cement additives, allowing for innovative and maybe more environmentally friendly design methods for infrastructure and building projects. When evaluated using worldwide standard standards, external testing reveals an improvement in the tensile and compressive strength of cement mortar. One of the materials that have entered our lives to change the course of human history is graphene. Graphene is a solid chemical compound made entirely of carbon atoms, and it has a honeycomb-like arrangement of its molecules. It has only been synthesised for the first time in the last 15 years, but we are confident that it will revolutionise a number of industries, including design and building. Graphene's application in the building industry is the sole focus of this essay. A type of graphite called Graphene Oxide (GO) has been developed.

Although the degree of crystallisation can vary, quartz is primarily crystalline in its arrangement. The macro-crystalline kind is the one in which a single crystal can be seen with the unassisted eye. The other type is micro-crystalline or cryptocrystalline, in which crystal aggregates are only visible when viewed under close-up light. The cryptocrystalline variations are either translucent or primarily opaque, with the macrocrystalline type of transparency being more common. Quartz sand has distinct qualities that make it particularly useful in the concrete, paint, and glue industries. Quartz sand makes paint and other goods more resistant to chemicals. Silicon-oxygen tetrahedra (SiO_4), a continuous structure made up of silicon and oxygen atoms, make up the igneous rock known as quartz. Two tetrahedra share each oxygen atom individually.

2. OBJECTIVES:

1. To optimize the usage of Quarry powder in cement.
2. To optimize the usage of Graphene oxide in cement.

3. MATERIALS

3.1 Cement:

The materials are ground, mixed in specific ratios based on their purity and composition, and then burned in clinker at temperatures between 1300 and 1500 °C. At this temperature, the materials partially fuse and sinter to form clinker that has a nodular shape. With the addition of between 3 and 5% gypsum, the clinker is cooled and pulverised to a fine powder. Cement is the byproduct created utilising the aforementioned technique.

3.2 Fine aggregate:

Fine aggregates are any broken stone fragments that are 14" or smaller, such as natural sand. This product is frequently referred to as 1/4''' minus because it describes the size, or grading, of this specific aggregate. River sand in zone II.

3.3 Coarse aggregate:

Any particles larger than 0.19 inches are considered coarse aggregates, but they typically have a diameter between 3/8 and 1.5 inches. Crushed stone makes up the majority of the remaining coarse aggregate, which is primarily made up of gravel.

3.3 Water:

Water is one of the most important building resources since it is necessary for various processes, such as the creation of mortar, the mixing of cement, the curing of work, and more. Durability of mortar and cement concrete in building is directly impacted by the quality of water used.

3.4 Quarry Powder:

When used as aggregate in concrete rather than as a fine powder to replace cement, quartz is almost always inert. It means that it cannot react under typical circumstances. less response and a real issue that is easier to regulate. That is what causes concrete desirable, along with its hardness.

3.5 Graphene oxide:

A single layer of atoms organised in a two-dimensional honeycomb lattice nanostructure make up the carbon allotrope known as graphene oxide. Graphene is a material made entirely of carbon atoms, and it has a solid molecular structure structured like a honeycomb.

4. EXPERIMENTAL RESULTS

4.1 Compressive strength

The 150mm x 150mm x 150mm cube specimens were cast, tested in a compression testing equipment for seven and twenty-eight days while curing the concrete, and then shown inTable.

Table 1 Compressive Strength result on concrete with quartz powder as partial replacement of cement

S.No.	% Quartz powder	Compressive Strength, N/mm^2		
		28 Days	56 Days	90 Days
1	0	39.21	42.69	45.86
2	5	42.44	46.21	49.58
3	10	44.27	48.17	51.69
4	15	48.01	52.32	56.17
5	20	46.40	50.54	54.21

Table 2: Compressive Strength on concrete with graphene oxide as partial replacement of cement.

S.No.	% Graphene Oxide	Compressive Strength, N/mm^2		
		28 Days	56 Days	90 Days
1	0	39.21	42.69	45.86
2	0.05	52.94	57.63	61.55
3	0.10	58.28	63.51	67.81
4	0.15	54.62	59.47	63.61

Table3 :Compressive strength of concrete for combined replacement of cement by 0.12% Graphene oxide and fine aggregate by 30% of Quarz powder

S.No	Combined replacements (%)	Compressive strength, N/mm^2		
		28 days	56 Days	90 Days
1	0	39.21	42.69	45.86
2	30%QP+0.12%GO	62.68	68.31	73.29

4.2 Split tensile strength results

The cylindrical specimens (150 mm in diameter x 300 mm in height) were examined for assessing the split tensile strength at 7 and 28 days. A cylindrical samples is placed horizontally between the loading surface of a compression testing machine, and a load is applied until the cylinder fails along the vertical diameter.

*Table 4:Split tensile strength of concrete **Partial replacement of Cement with Quartz powder***

S.No.	% Quartz powder	Split tensile Strength, N/mm^2		
		28 Days	56 Days	90 Days
1	0	3.84	4.15	4.48
2	5	4.17	4.52	4.86
3	10	4.37	4.75	5.10
4	15	4.79	5.23	5.58
5	20	4.57	4.96	5.29

Table 5: Split tensile strength on concrete Partial replacement of Cement with graphene oxide.

S.No.	% graphene oxide.	Split tensile Strength, N/mm^2		
		28 Days	56 Days	90 Days
1	0	3.84	4.15	4.48
2	0.05	5.19	5.62	6.08
3	0.10	6.11	6.64	7.15
4	0.15	5.45	5.93	6.37

Table6: Split tensile strength of concrete for combined partial replacement of cement by 0.10% Graphene oxide and fine aggregate by 15% of Quartz powder

S.No	Combined replacements (%)	Split tensile strength, N/mm^2		
		28 days	56 days	90 Days
1	0	3.84	4.15	4.48
2	15%QD+0.10%GO	6.58	7.16	7.68

Table 7: **Ultra sonic pulse velocity result on concrete with quartz powder as partial replacement of cement.**

Sl.no	% Of Quartz powder	Pulse velocity (m/sec)	Concrete quality
1	0	4601	Excellent
2	5	4722	Excellent
3	10	4836	Excellent
4	15	4921	Excellent
5	20	4752	Excellent

Table 8: Ultra sonic pulse velocity result on concrete with graphene oxide as partial replacement of cement.

Sl.no	% Of Graphene Oxide	Pulse velocity (m/sec) for 28days	Concrete quality
1	0	4601	Excellent
2	0.05	4863	Excellent
3	0.10	4978	Excellent
4	0.15	5010	Excellent

Table 9: Ultra sonic pulse velocity result on concrete for combined partial replacement of cement by 0.10% Graphene oxide and fine aggregate by 15% of Quartz powder

Sl.no	Combined replacements(%)	Pulse velocity (m/sec) for 28days	Concrete quality
1	0	4601	Excellent
2	15%QD+0.10%GO	5109	Excellent

5. CONCLUSION:

1. The normal concrete of compressive strength result of concrete for 28,56 and 90 days is 39.21, 42.69 and 45.86N/mm^2.
2. At 15% replacement of cement by quartz powder is achieved compressive strength of concrete for 28,56 and 90 days is 48.01, 52.32 and 56.17N/mm^2.
3. At 0.10% replacement of cement by Graphene oxide is achieved compressive strength of concrete for 28,56 and 90 days is 58.28, 63.51 and 67.81N/mm^2.
4. The combined replacements 30%Quartz powder + 0.12% Grapheneoxide the compressive strength result of concrete for 28,56 and 90 days is 62.68, 68.31 and 73.29N/mm^2
5. The normal concrete of Split temsile strength result of concrete for 28,56 and 90 days is 3.84, 4.15 and 4.48N/mm^2.
6. At 15% replacement of cement by quartz powder is achieved Split temsile strength of concrete for 28,56 and 90 days is 4.79, 5.23 and 5.58N/mm^2.
7. At 0.10% replacement of cement by Graphene oxide is achieved Split temsile strength of concrete for 28,56 and 90 days is 6.11, 6.64 and 7.15N/mm^2.
8. The combined replacements 30%Quartz powder + 0.12% Grapheneoxide the Split temsile strength result of concrete for 28,56 and 90 days is 6.58, 7.16 and 7.68 N/mm$^{2.}$
9. The normal concrete of ultra sonic pulse velocity result of concrete for 28days is 4601m/s.
10. At 15% replacement of cement by quartz powder is achieved ultra sonic pulse velocity of concrete for 28 days is 4921 m/s.
11. At 0.10% replacement of cement by Grapheneoxide is achieved ultra sonic pulse velocity of concrete for 28 days is 4978 m/s.
12. The combined replacements 30%Quartz powder + 0.12% Grapheneoxide the ultra sonic pulse velocity of concrete for 28 days is 5109m/s.

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