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# MECHANICAL PROPERTIES OF GRAPHENE OXIDE CONCRETE WITH SAWDUST

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**ABSTRACT**
Despite being one of the most extensively utilised building materials in the world, the manufacture of concrete greatly increases carbon emissions and depletes natural resources. Researchers have been looking on substitute materials and additives to increase the sustainability of concrete without sacrificing its structural integrity. In this work, sawdust is substituted for fine aggregate in concrete mixes and graphene oxide (GO) is used in lieu of cement. Derived from graphene, graphene oxide has exceptional electrical, mechanical, and thermal characteristics. It is possible for concrete to show improved strength, durability, and resistance to environmental deterioration by adding GO in place of some of the cement. Additionally, by lowering the demand for natural resources and minimising waste disposal, the partial replacement of fine aggregate with sawdust—a commonly available waste product—offers environmental benefits. Test techniques including split tensile strength and compressive strength will be used to evaluate the performance of the created concrete mixes for 28,56 and 90 days.

**Keywords:**
**Sawdust, Graphene Oxide, Waste disposal, Compressive and Split tensile Strength.**

## 1. INTRODUCTION

The most popular building material in the world is concrete because of its affordability, toughness, and adaptability. Conventional concrete production methods, however, have a number of negative environmental effects, such as excessive energy use, CO2 emissions, and resource depletion. There is a rising interest in investigating substitute materials and technologies that might lessen concrete's environmental impact while preserving or improving its performance in order to meet these sustainability issues.

Graphene oxide (GO) and sawdust are two innovative additions and substitutes that show promise for enhancing the sustainability of concrete. One of graphene's derivatives, graphene oxide, has remarkable mechanical, thermal, and electrical characteristics. Concrete can have its mechanical strength, durability, and other performance attributes improved by using GO in part lieu of cement. Furthermore, sawdust—a byproduct of a number of industries—offers a chance to divert trash from landfills and lessen the need for natural aggregates.

A synergistic approach to sustainable concrete manufacturing is provided by the substitution of fine aggregate with sawdust and cement with graphene oxide. Performance, environmental effect, and resource efficiency may all be balanced by including these components into concrete compositions. To ensure their effective use in practice, however, extensive research and comprehension of the impacts of these additions on the characteristics of concrete are necessary.

## 2. OBJECTIVES

1. Examine the possible financial gains and cost reductions related to replacing sawdust and graphene oxide in the manufacturing of concrete.
2. To determine how graphene oxide (GO) and sawdust substitutes for fine aggregate and cement, respectively,

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affect the overall strength and structural integrity of the concrete, evaluate the specimens' compressive and tensile strengths.

## 3. MATERIALS

**3.1 Cement:** In order to produce concrete, mortar, and grout—which provide buildings strength and stability—cement is an essential ingredient.

**3.2 Fine Aggregate:** Fine aggregate is produced from crushed rock or gravel, or it can be obtained from natural deposits like riverbeds or quarries. It is utilised in several processes, including as the creation of concrete, plastering, and paving, and is crucial for obtaining desired qualities in building materials.

**3.3 Coarse Aggregate:** Material maintained over IS Sieve 4.75 mm is referred to as coarse aggregate. Self-compacting concrete normally uses particles that are no larger than 10–20 mm, however it has been known to use particles as large as 40 mm or more.

**3.4 Graphene Oxide:-** Compared to pure graphene, graphene oxide has special characteristics such a large surface area, mechanical strength, electrical conductivity, and thermal conductivity. Because of these characteristics, GO may be used in a wide range of applications, including as biomedical applications, composite materials, sensors, energy storage devices, and membranes.

**3.5 Sawdust:-** Because sawdust is a waste item that would otherwise be disposed of, replacing fine aggregate in concrete with sawdust offers chances to lessen the environmental impact associated with typical concrete manufacturing. It could also provide advantages for building projects, such better thermal insulation, lower density, and higher environmental credentials.

**3.6 Water:-** Adding water to a concrete mixture's dry ingredients to start the hydration process and make it easier for a cohesive, workable paste to develop. The usual components of concrete are cement, aggregates (such sand and gravel), water, and optional admixtures.

## 4. EXPERIMENTAL INVESTIGATIONS

4.1 **Compressive Strength Results:** One essential mechanical characteristic of materials, such as concrete, is its compressive strength, which expresses how well a material can bear axial compression stresses without failing.

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

| S.No | % of sawdust | Compressive strength (N/mm$^2$) | | |
|---|---|---|---|---|
| | | 28 Days | 56 Days | 90 Days |
| 1 | 0% | 39.57 | 43.12 | 46.29 |
| 2 | 5% | 28.44 | 30.98 | 33.27 |
| 3 | 10% | 25.19 | 27.46 | 29.51 |
| 4 | 15% | 18.31 | 19.93 | 21.48 |

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

| S.No | % of Graphene Oxide | Compressive strength (N/mm$^2$) | | |
|---|---|---|---|---|
| | | 28 Days | 56 Days | 90 Days |
| 1 | 0% | 39.57 | 43.12 | 46.29 |
| 2 | 0.05% | 53.61 | 58.43 | 62.76 |
| 3 | 0.10% | 58.97 | 64.27 | 68.98 |
| 4 | 0.15% | 55.32 | 60.31 | 64.71 |

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**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$^2$) | | |
|---|---|---|---|---|
| | | 28 Days | 56 Days | 90 Days |
| 1 | 0% | 39.57 | 43.12 | 46.29 |
| 2 | 5% SD+ 0.10% GO | 53.36 | 58.16 | 62.43 |

**4.2 Split Tensile Strength Test:-**A mechanical characteristic of materials, including concrete, called split tensile strength, sometimes called indirect tensile strength or diametral tensile strength, gauges a cylindrical specimen's capacity to withstand tensile pressures.

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

| S.No | % of sewdust | Split tensile strength (N/mm$^2$) | | |
|---|---|---|---|---|
| | | 28 Days | 56 Days | 90 Days |
| 1 | 0% | 3.95 | 4.32 | 4.68 |
| 2 | 5% | 2.81 | 3.06 | 3.24 |
| 3 | 10% | 2.46 | 2.68 | 2.87 |
| 4 | 15% | 1.82 | 1.95 | 2.13 |

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

| S.No | % of Graphene oxide | Split tensile strength (N/mm$^2$) | | |
|---|---|---|---|---|
| | | 28 Days | 56 Days | 90 Days |
| 1 | 0% | 3.95 | 4.32 | 4.68 |
| 2 | 0.05% | 5.35 | 5.83 | 6.27 |
| 3 | 0.10% | 5.83 | 6.38 | 6.82 |
| 4 | 0.15% | 5.47 | 5.96 | 6.39 |

**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$^2$) | | |
|---|---|---|---|---|
| | | 28 Days | 56 Days | 90 Days |
| 1 | 0% | 3.95 | 4.32 | 4.68 |
| 2 | 5% SD+ 0.10% GO | 5.61 | 6.18 | 6.54 |

## 5. CONCLUSIONS

1. At 5% Sawdust, the compressive strength of concrete decreases the strength result is 28.44, 30.98 and 33.27 N/mm$^2$ at 28,56 and 90 days.
2. For 0.10% Graphene Oxide the compressive strength increases the strength result is 58.97, 64.27 and 68.98 N/mm$^2$ at 28,56 and 90 days.
3. With 5% Sawdust + 0.10% Graphene Oxide the maximum compressive strength is 53.36, 58.16 and 62.43

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$N/mm^2$ at 28,56 and 90 days.

4. At 5% Sawdust, the split tensile strength of concrete decreases the strength result is 2.81, 2.68 and 2.87$N/mm^2$ at 28,56 and 90 days.
5. For 0.10% Graphene Oxide the split tensile strength increases the strength result is 5.83, 6.38 and 6.82 $N/mm^2$ at 28,56 and 90 days.
6. With 5% Sawdust + 0.10% Graphene Oxide the maximum split tensile strength is 5.61,6.18 and 6.54 $N/mm^2$ at 28,56 and 90 days.

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