**AN EXPREMENTAL INVESTIGATION ON POLYPROPYLENE FIBER CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT WITH HYPO SLUDGE**

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**ABSTRACT:** A troubling reality that has contributed to environmental sustainability concerns is the rising volume of waste. A hypo plant in the paper business produces a lot of slurry-based waste, the disposal of which might cause environmental pollution.Cement manufacture emits carbon dioxide into the atmosphere, contributing to global warming. Therefore, using industrial waste in the composition of concrete can aid in reducing environmental issues.In this investigation, septic sludge was utilised in place of cement in the construction of a building using hyposludge. A synthetic hydrocarbon polymer called polypropylene fibre (PPF) was added to the concrete to increase its strength. In the current investigation, 450 specimens were created using varied amounts of polypropylene fibre and hypo sludge (0%, 5%, 10%, and 15%).The compressive strength and splitting tensile strength of concrete were tested after 7 and 28 days of curing.

**Keywords:** Cement, hypo sludge , poly propylene fibre and aggregate, compressive strength, split tensile.

# INTRODUCTION

# More than six billion tonnes of cement are produced annually, making concrete the second most widely used material after water. For many applications, including new inventions, corrections, recoveries, and retrofitting, concrete is explicit. The development of mechanical, commercial, and residential floor pieces typically uses post-tensioned chunks. Because cement is produced in different places and uses and has different needs and features, it makes sense to categorise how it is used based on these factors. With the advancement of innovation and enlarged field of cement and concrete use, the demand for concrete is second only to that of water.

Waste from the paper industry is known as hypo sludge. Its chemical and physical qualities have been studied and it is used to substitute cement in the production of concrete. Natural resources for building materials have grown scarce, and they also contribute to air pollution issues with the environment.

# Due to the chemical inertness of polypropylene, any substance that won't harm the components of concrete won't affect the fibre either. Concrete always deteriorates first when more corrosive chemicals are present, followed by fibres. The hydrophobic surface of fibres, which cement paste does not contaminate, aids in preventing the balling up of chopped fibres. When polypropylene fibres are utilised in concrete, there is no water demand and no requirement for a minimum amount of concrete cover. Fibres in concrete help to prevent settling and bleeding. The resistance to impact, abrasion, and freeze and thaw.2. OBJECTIVES

# This study's goals are to:

# To assess the Hyposludge in cement.

#  To enhance the polypropylene concrete by using compressive and split tensile strengths.

# 3. MATERIALS

## Cement: A material called cement is used in construction as a binding agent to keep the other building elements together. Fine aggregate fills the spaces left by the coarse particles in concrete, which mostly consists of coarse aggregate. Plain cement combined with fine aggregate and water is known as mortar, and concrete made with mortar and coarse aggregate is known as concrete. Occasionally, different types of admixtures are added to cement to give concrete the necessary properties. Concrete's strength and quality will be shown by the water-to-cement ratio. Water and cement react to form cement, which then solidifies. The process of "hydration" is an exothermic reaction that generates heat. Concrete must come into touch with water in order to build strength through this process.

**Fine Aggregate**: Fine aggregate is the substance that can be filtered through a 4.75 mm sieve. The granular substance known as sand is made up of tiny pieces of rock and mineral. Sand's composition varies, but its identity is determined by the size of its grains. While silt and gravel have larger grains, sand has smaller granules. A soil with more than 85% of its mass made up of sand-sized particles can also be referred to as sand. To create excellent concrete that has the strength and other attributes that are desired, several grades of zones are used in the fine aggregate. The coarsest sand is found in zone I, followed by moderately fine sand in zones II and III, and fine sand in zone IV. For fine aggregate, zone II sand is often used in accordance with IS 383:1970.

**Coarse Aggregate:** The phrase "coarse aggregate" refers to the material that passes through the IS Sieve at a size of 4.75 mm. According to IS 383:1970, the typical maximum size increases by 10 to 20 mm with time. The term "aggregate" refers to a large class of coarse- to medium-grained particle materials used in building. The majority of mining occurs for aggregates. In composite materials like asphalt concrete and concrete, aggregates are a key component

Numerous drainage systems, including septic drain fields, retaining wall drains, foundation and French drains, and roadside edge drains, employ aggregates. Additionally, aggregates are used as the base material for roads, railroads, and foundations. In other words, aggregates are employed as a predictable, consistent base for roads and railroads (e.g., to help avoid differential settling under the road or building) or as a cheap extender that fuses with more expensive cement or asphalt to produce concrete. To add bulk and alter the mix's physical and chemical qualities, aggregates are combined with cement and water. Aggregates might be clean, hard or powerful, long-lasting, and in good shape, among other desirable qualities.

**Hypo Sludge:**

A waste product gathered from the paper industry is called hypo sludge. Its chemical and physical characteristics have been studied and it is utilised as a cement substitute in the production of concrete. Natural resource-based building materials are currently scarce and contribute to air pollution and other environmental issues. It develops into a brand-new innovation that can be employed as a support material for green technologies. Due of the silica and magnesium characteristics, it acts as cement. The silica and magnesium in this material help the concrete set more quickly. the hypo sludge gathered from the Orient Paper Mill in the Amlai District of Shahdol. The purpose of this project is to compare the acquired results in order to identify the ideal percentage (0%, 5%, 10%, and 15%) of Hypo sludge as a replacement for cement for hardened concrete qualities.

**Polypropylene Fibers:**Chemical fibres of a newer generation include polypropylene fibres. They are produced in vast quantities and rank fourth in production volume behind polyesters, polyamides, and acrylics. The annual global production of polypropylene fibres is over 4 million tonnes. Fibres made of polypropylene are non-magnetic, rust-free, alkali-resistant, secure, and simple to use. Polypropylene twine is inexpensive, widely accessible, and of consistently high quality. Polypropylene fibres may be handled easily and are compatible with all chemical admixtures used in concrete. Polypropylene has a lot of helpful qualities thanks to its large molecular weight. Due to the chemical inertness of polypropylene, any substance that won't harm the components of concrete won't affect the fibre either. Concrete is harmed when more potent chemicals come into touch with it.

# 4. EXPERIMENTAL INVESTIGATIONS

## 4.1 Compressive strength results

The cube specimens of 150mm150mmx150mm were cast and tested in compression testing machine for 7 and 28days of curing period for different proportions of concrete mix and presented in table 1 to 3.

**Table 1: Compressive strength of concrete with hypo sludge as partial replacement of cement in concrete.**

|  |  |  |
| --- | --- | --- |
| **S.No** | **% Of hypo sludge** | **Compressive strength of concrete, N/mm2** |
| **7 Days** | **28 Days** |
| 1 | 0 | 26.65 | 39.25 |
| 2 | 5 | 30.46 | 45.40 |
| 3 | 10 | 34.86 | 51.43 |
| 4 | 15 | 30.57 | 44.70 |

**Graph-1: compressive strength of concrete with hypo sludge as partial replacement of cement in concrete.**

**Table 2: Compressive strength of concrete with polypropylene fibers in concrete.**

|  |  |  |
| --- | --- | --- |
| **S.No** | **% Of polypropylene fibers** | **Compressive strength of concrete, N/mm2** |
| **7 Days** | **28 Days** |
| 1 | 0 | 26.65 | 39.25 |
| 2 | 0.5 | 29.69 | 43.60 |
| 3 | 1 | 30.54 | 44.39 |
| 4 | 1.5 | 29.75 | 44.08 |

**Graph-2: Compressive strength of concrete with polypropylene fibers in concrete.**

**Table 3: Compressive strength of Concrete with combine replacement of 10%hypo sludge and 1% polypropylene fibers.**

|  |  |  |
| --- | --- | --- |
| **S.No** | **Hypo sludge and polypropylene fibers** | **Compressive strength of concrete, N/mm2** |
| **7 Days** | **28 Days** |
| 1 | 0 | 26.65 | 39.25 |
| 2 | 10%HS+1%PF | 37.15 | 54.01 |

**Graph.3: Compressive strength of Concrete with combine replacement of 10%hypo sludge and 1% polypropylene fibers.**

## 4.2 Split tensile strength results

At the age of 7 and 28days, the cylindrical specimens (150mm diameter x 300mm height) were tested for evaluating the split tensile strength. The experiment is performed by putting a cylindrical sample horizontally between a compression testing machine loading surface and the load is applied until the cylinder fails along the vertical diameter.

**Table 4: Split tensile strength of concrete with hypo sludge as partial replacement of cement in concrete.**

|  |  |  |
| --- | --- | --- |
| **S.No** | **% Of hypo sludge** | **Split tensile strength of concrete, N/mm2** |
| **7 Days** | **28 Days** |
| 1 | 0 | 2.5 | 3.8 |
| 2 | 5 | 2.9 | 4.4 |
| 3 | 10 | 3.4 | 5.1 |
| 4 | 15 | 3.0 | 4.4 |

**Graph-4: Split tensile strength of concrete with hypo sludge as partial replacement of cement in concrete.**

**Table 5: Split tensile strength of concrete with polypropylene fibers in concrete.**

|  |  |  |
| --- | --- | --- |
| **S.No** | **% Of polypropylene fibers** | **Split tensile strength of concrete, N/mm2** |
| **7 Days** | **28 Days** |
| 1 | 0 | 2.5 | 3.8 |
| 2 | 0.5 | 2.9 | 4.3 |
| 3 | 1 | 3.0 | 4.4 |
| 4 | 1.5 | 2.9 | 4.3 |

**Graph-5: split tensile strength of concrete with polypropylene fibers in concrete.**

**Table 6: Split tensile strength of Concrete with combine replacement of 10%hypo sludge and 1% polypropylene fibers.**

|  |  |  |
| --- | --- | --- |
| **S.No** | **Hypo sludge and polypropylene fibers** | **Split tensile strength of concrete, N/mm2** |
| **7 Days** | **28 Days** |
| 1 | 0 | 2.5 | 3.8 |
| 2 | 10%HS+1%PF | 3.67 | 5.39 |

**Graph.6: Split tensile strength of Concrete with combine replacement of 10%hypo sludge and 1% polypropylene fibers.**

**5. CONCLUSION**

In this study, the concrete has a partial replacement of cement with hypo sludge of 0%,5%.10%,15% and polypropylene fibers is added to concrete at a percentage of 0%,0.5%,1%,1.5% and we got the optimum values of strength at the particular percentages given below:

1.At 10% partial replacement of hypo sludge with cement the compressive strength of concrete at 7 and 28 days are 34.86 and 51.43 N/mm2 .

2. At 10% partial replacement of hypo sludge with cement the split tensile strength of concrete at 7 and 28 days are 3.4 and 5.1 N/mm2 .

3.At 1% addition of polypropylene fibers the compressive strength of concrete at 7and 28 days are 30.54 and 44.39 N/mm2 .

4.At 1% addition of polypropylene fibers the split tensile strength of concrete at 7 and 28 days are3.0 and 4.4 N/mm2 .

5.By the combination of 10% hypo sludge +1% polypropylene fibers with cement the compressive strength of concrete at 7 and 28 days are 37.15and 54.01 N/mm2 .

6.By the combination of 10% hypo sludge +1% polypropylene fibers with cement the split tensile strength of concrete at 7 and 28 days are 3.67 and 5.39N/mm2 .

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