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STRENGTHENING OF POLYPROPYLENE FIBER CONCRETE WITH PARTIALLY REPLACED OF CEMENT WITH HYPO SLUDGE

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ABSTRACT

The growing amount of waste is a worrisome reality that has added to worries about environmental sustainability. A hypo plant in the paper industry generates a lot of slurry-based waste, and its disposal could harm the environment. The production of cement releases carbon dioxide into the atmosphere, causing global warming. As a result, including industrial waste into concrete can help to mitigate environmental problems. In this experiment, sewage sludge was used to create a building instead of cement. In order to strengthen the concrete, polypropylene fibre (PPF), a synthetic hydrocarbon polymer, was used. 450 specimens were made for the current experiment utilising different percentages of polypropylene fibre and hypo sludge (0%, 5%, 10%, and 15%).The compressive strength and split tensile strength and ultra sonic pulse velocity of concrete were tested after 28 days,56 days and 90 days of curing whereas the workability of concrete was tested immediately after preparation. The results show that when the content of hypo sludge and polypropylene fibre increases, the workability of concrete declines from medium to low. For all curing ages up to a particular point, adding hypo sludge and polypropylene fibre makes concrete stronger.

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

1. INTRODUCTION

Concrete is utilised more than any other substance after water, and each year more than six billion tonnes of cement are produced. Concrete is explicit for numerous purposes, including new inventions, corrections, recoveries, and retrofitting. Post-tensioned chunks are frequently used in the construction of industrial, commercial, and residential floor components. It makes sense to group cement's uses based on these characteristics because it is manufactured for various purposes, in various locations, and with various needs and features. Concrete is now more in demand than water because to technological advancements and an expanded range of applications for cement and concrete.

Hypo sludge is the name for waste produced by the paper industry. Its chemical and physical characteristics have been investigated, and it is utilised to make concrete instead of cement. The availability of natural resources for building materials has decreased, and they also contribute to environmental problems with air pollution.

Any substance that won't harm the components of concrete won't hurt the fibre either because polypropylene is chemically inert. When more corrosive chemicals are present, concrete always deteriorates first, followed by fibres. Chopped fibres are less likely to ball up because of their hydrophobic surfaces, which cement paste does not contaminate. There is no water demand and no need for a minimum amount of concrete cover when polypropylene fibres are used in concrete. Concrete fibres aid in preventing settling and bleeding. the ability to withstand impact, abrasion, freezing, and thawing.

2. OBJECTIVES

The objectives of this study are to:

a) evaluate the hyposludge content of cement; and

b) improve polypropylene concrete using compressive and split tensile strengths.

3. MATERIALS

Cement: in order to hold the other building components together, cement is a substance that is utilised in construction. Concrete, which mostly comprises of coarse aggregate, fills the voids left by the coarse aggregate. Mortar is simply plain cement mixed with fine aggregate and water, and concrete is simply concrete formed using mortar and coarse aggregate. On occasion, various admixtures are added to cement to give concrete the desired characteristics. The water-to-cement ratio can reveal the strength and calibre of the concrete. Cement is created when water and cement

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react, and it subsequently solidifies. A heat-producing exothermic reaction is the "hydration" process. In order for concrete to be strengthened through this process, it must come into contact with water.

Fine Aggregate: The material that can pass through a 4.75 mm screen is fine aggregate. Small fragments of rock and mineral make up the granular material known as sand. Despite the fact that sand's composition changes, its identity is based on the size of its grains. Sand has smaller granules than silt and gravel, which have larger ones. Sand can also be used to describe soils that include sand-sized particles in excess of 85% of their bulk. Several degrees of zones are employed in the fine aggregate to produce great concrete with the desired strength and other qualities. Zone I contains the coarsest sand, whereas zones II and III include medium fine sand and zone IV contains fine sand.

Coarse Aggregate: The material that can pass through a 4.75 mm screen is fine aggregate. Small fragments of rock and mineral make up the granular material known as sand. Despite the fact that sand's composition changes, its identity is based on the size of its grains. Sand has smaller granules than silt and gravel, which have larger ones. Sand can also be used to describe soils that include sand-sized particles in excess of 85% of their bulk. Several degrees of zones are employed in the fine aggregate to produce great concrete with the desired strength and other qualities. Zone I contains the coarsest sand, whereas zones II and III include medium fine sand and zone IV contains fine sand.

Aggregates are used in many drainage systems, such as roadside edge drains, foundation and French drains, retaining wall drains, septic drain fields, and retaining wall drains. As a base material for roads, trains, and foundations, aggregates are also employed. In other words, aggregates are used as a predictable, uniform base for roads and railroads (for example, to prevent differential settling under the road or building) or as a cheap extender that fuses with more expensive cement or asphalt to produce concrete. Aggregates are mixed with cement and water to give the mix bulk and to change the physical and chemical properties. A few desirable characteristics of aggregates include cleanliness, strength, durability, and good condition.

Hypo Sludge: Hypo sludge is a byproduct gathered from the paper manufacturing. It is used as a cement substitute in the creation of concrete and its chemical and physical features have been examined. Current shortages of natural resource-based building materials also contribute to air pollution and other environmental problems. It evolves into a novel invention that can be used to promote green technology. It functions as cement because of the silica and magnesium properties. The silica and magnesium in this substance hasten the concrete's setting time. the hypo sludge recovered at Shahdol's Amlai District from the Orient Paper Mill. Comparing the obtained data is the project's goal in order to determine the appropriate proportion For hardened concrete, hypo sludge can be used in place of cement in amounts of (0%, 5%, 10%, and 15%).

Polypropylene Fibers: Polypropylene fibres are a type of chemical fibre of a more recent generation. They rank fourth in production volume behind polyesters, polyamides, and acrylics and are produced in enormous quantities. Over 4 million tonnes of polypropylene fibres are produced worldwide each year. Polypropylene fibres are non-magnetic, non-rusting, alkali-resistant, safe, and easy to use. Twine made of polypropylene is affordable, readily available, and of dependably high quality. All chemical admixtures used in concrete are compatible with polypropylene fibres, making handling and storage simple. Due to its high molecular weight, polypropylene offers many advantageous characteristics. Any substance that won't harm the components of concrete won't hurt the fibre either because polypropylene is chemically inert. When more powerful chemicals come into contact with concrete, damage results.

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/mm^2		
		28 Days	56 days	90 Days
1	0	39.25	42.71	45.83
2	5	45.40	49.83	53.12
3	10	51.43	56.05	60.17
4	15	44.70	48.67	52.24

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

S.No.	% Of polypropylene fibers	Compressive strength of concrete, N/mm^2		
		28 Days	56 days	90 Days
1	0	39.25	42.73	45.83
2	0.5	43.60	47.45	50.96
3	1	44.39	48.38	51.93
4	1.5	44.08	47.99	50.57

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/mm^2		
		28 days	56 Days	90 Days
1	0	39.25	42.78	45.88
2	10%HS+1%PF	54.01	59.34	63.19

4.2 Split tensile strength results

The split tensile strength conducted in compression testing machine for the cast and cured specimens and the results are furnished in table 4 to 6.

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/mm^2		
		28 days	56 Days	90 Days
1	0	3.8	4.13	4.43
2	5	4.4	4.69	5.09
3	10	5.1	5.55	5.96
4	15	4.4	4.73	5.14

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

S.No.	% Of polypropylene fibers	Split tensile strength of concrete, N/mm^2		
		28 days	56 Days	90 Days
1	0	3.8	4.14	4.43
2	0.5	4.3	4.53	5.01
3	1	4.4	4.79	5.14
4	1.5	4.3	4.68	5.03

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

S.No.	Hypo sludge and polypropylene fibers	Split tensile strength of concrete, N/mm^2		
		28 days	56 Days	90 Days
1	0	3.8	4.14	4.49
2	10%HS+1%PF	5.39	5.87	6.31

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4.3 Ultrasonic Pulse Velocity Test

Table 7: Ultrasonic pulse velocity(upv) test of concrete with hypo sludge as partial replacement of cement in concrete.

S.No.	% Of hypo sludge	Pulse Velocity (M/S)	Concrerte Quality
1	0	4496	Good
2	5	4561	Excellent
3	10	4582	Excellent
4	15	4419	Good

Table 8: Ultrasonic pulse velocity(upv) test of concrete with polypropylene fibers in concrete.

S.No.	% Of Polypropylene fibers	Pulse Velocity (M/S)	Concrerte Quality
1	0	4496	Good
2	0.5	4638	Excellent
3	1	4928	Excellent
4	1.5	4469	Good

Table 9: Ultrasonic pulse velocity (upv) of Concrete with combine replacement of 10%hypo sludge and 1% polypropylene fibers.

S.No.	Hypo sludge and polypropylene fibers	28 Days	Concrerte Quality
1	0	4496	Good
2	10%HS+1%PF	4989	Excellent

5. CONCLUSION

1. At 10% hypo sludge, the compressive strength of concrete is 51.43 N/mm^2 , 56.05 N/mm^2 and 60.17 N/mm^2 for 28 days, 56 days and 90 days.
2. For 1% polypropylene fibers the compressive strength of concrete is 44.39 N/mm^2 ,48.38 N/mm^2 and 51.93 N/mm^2 for 28 days,56 days and 90 days.
3. With 1% polypropylene fibers + 10% hypo sludge the maximum compressive strength is 54.01 N/mm^2 , 59.34 N/mm^2 and 63.19 N/mm^2 for 28 days, 56 days and 90 days.
4. At 10% hypo sludge,the split tensile strength of concrete is 5.1 N/mm^2 , 5.55 N/mm^2 and 5.96 N/mm^2 for 28 days,56 days and 90 days.
5. For 1% polypropylene fibers the split tensile strength is 4.4 N/mm^2 , 4.79 N/mm^2 and 5.14 N/mm^2 for 28 days,56 days and 90 days.
6. With 1% polypropylene fibers + 10% hypo sludge the maximum split tensile strength is 5.39 N/mm^2 ,5.87 N/mm^2 and 6.31 N/mm^2 for 28 days,56 days and 90 days.
7. For 10% hypo sludge, the Ultrasonic pulse velocity (upv) of concrete is 4585 m/s for 28 Days.
8. For 1% polypropylene fibers the Ultrasonic pulse velocity (upv) of concrete is 4928 m/s for 28 Days.
9. With 1% polypropylene fibers + 10% hypo sludge the maximum Ultrasonic pulse velocity (upv) of concrete is 4989 m/s for 28 Days.

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