

An Experimental Investigation on Polypropylene Fiber Reinforced Concrete with Alccofine-1203

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Abstract- In this research, cement with Alccofine-1203 which is finer than cement which provides higher strength and durability to the concrete structure. Polypropylene fibers are used to enhance strength properties of concrete. Polypropylene fibers are added at 0.5, 1.5 and 2.0%. Cement with Alccofine-1203 added in different percentages of 5, 10, 7.5 and 12.5%. Strength tests are conducted at 7 and 28 days for hardened concrete. Destructive tests are conducted on the cured specimens to evaluate the mechanical properties of concrete.

Keywords: Alccofine-1203, Compressive strength, Destructive test, polypropylene fibers.

I. INTRODUCTION

Concrete is a composite material composed of coarse aggregate bonded together with fluid cement which hardens over time. Most concretes used are lime-based concretes such as Portland cement concrete or concretes made with other hydraulic cements.

However, road surfaces are also a type of concrete, asphalt concrete, where the cement material is bitumen, and polymer concretes are sometimes used where the cementing material is a polymer. In Portland cement concrete (and other hydraulic cement concretes), when the aggregate is mixed together with the dry cement and water, they form a fluid mass that is easily molded into shape.

Cement based materials are the essential production materials and they will have maximum possibly to continue the same significance within the future.

While dealing with problems like production, economic conditions, quality and environmental issues, they need to compete with different construction materials along with plastic, metallic and timber.

Long lasting concrete will retain its quality and serviceability while exposed to environment.

Cement based materials for concrete should be fine mineral powders such as fly ash, ground granulated blast furnace slag, limestone, silica fume and alccofine. These cement based materials are mixed with cement or at the mixer when the concrete is being produced.

This paper gives information about the behaviour of alccofine in concrete. Alccofine is the micro fine material of particles finer than that of cement, fly ash, silica and many other cement-based materials which are producing in India. This material had a unique character to enhance the performance of concrete in all the stages because of its optimized particle size distribution.

The cement reacts chemically with the water and other ingredients to form a hard matrix which binds all the materials together into a durable stone-like material that has many uses.

Alccofine is a new generation, micro fine material of particle size much finer than other hydraulic materials like cement, fly ash, silica etc. being manufactured in India.

II. OBJECTIVES

The objectives of this study are as follows

- To optimize the percentage of partial replacement of Alccofine-1203 to cement.
- To investigate the mechanical properties of the cast specimens by both destructive and non-destructive tests.

III. MATERIALS

The properties of cement, fine and coarse aggregate are presented in Table 1.

Table 1. properties of cement

S. No.	Property	Cement (53 grade)
1	Specific gravity	3.17
2	Fineness	9.19
3	Consistency	33%
4	Initial setting time	33 min
5	Final setting time	510min

1. Alccofine -1203:

Alccofine 1203 is a new generation micro fine material with a particle size significantly smaller than cement, fly ash, and other similar materials. The mineral additive Alccofine, produced by Ambuja Cements Ltd., was utilized in this experiment. Alccofine 1203 is a supplemental cementitious ingredient that can be used in high-performance concrete to replace silica fume. It's made from materials used in the iron ore business.

Alccofine has a higher percentage of alumina and silica content in its chemical composition. It has specific properties that help concrete operate better in both fresh and hardened stages. It can be utilised as a viable alternative to silica fume. The use of Alccofine 1203 as a cement substitute improves the strength and durability of concrete of all ages.

2. Polypropylene Fibers:

Polypropylene fiber, also known as polypropylene or PP, is a synthetic fiber, transformed from 85% propylene, and used in a variety of applications. It is used in many different industries, but one of the most popular is the manufacturing of carpet yarns. For example, most of the economical carpets for light domestic use are made from this fiber.

The fiber is thermoplastic, resilient, light weight and resistant to mildew and many different chemicals.

3. Concrete Mix Design

The mix design conducted in the laboratory conditions by trial and error and confirming to IS: 10262- 2009 for M40 grade of concrete. The weight ratio of mix proportion is 1:1.28:2.41 with water cement ratio 0.4.

IV. EXPERIMENTAL INVESTIGATIONS

1. Compressive strength results:

The compressive strength conducted in compression testing machine for the cast and cured specimens and the results are furnished in Table 2 to 4.

Table 2. Compressive strength of concrete with alccofine-1203.

S.No.	% of alccofine-1203	Compressive strength	
		7 days	28 days
1	0%	36.34	52.3
2	5%	39.37	56.58
3	7.5%	41.80	60.32
4	12.5%	38.37	55.54

Table 3. Compressive strength of concrete with polypropylene fibers.

S.No.	% of polypropylene fibers	Compressive strength	
		7 days	28 days
1	0%	36.34	52.3
2	0.5%	40.08	57.59
3	1.5%	43.43	62.68
4	2%	39.35	56.95

Table 4. Combined compressive strength of concrete with alccofine-1203 and polypropylene fibers.

S.No.	% of AL + PF	Compressive strength	
		7 days	28 days
1	7.5%AL+1.5%PF	41.86	58.96

2. Split tensile strength results:

The split tensile strength conducted in flexural testing machine for the cast and cured specimens and the results are furnished in Table 5 to 7.

Table 5. Split tensile strength of concrete with alccofine-1203.

S.No.	% of Alccofine	Split Tensile Strength, N/mm^2	
		7 days	28 days
1	0%	3.52	5.07
2	5%	3.87	5.47
3	7.5%	3.91	5.76
4	12.5%	3.72	5.42

Table 6. Split tensile strength of concrete with polypropylene fibers.

S.No.	Polypropylene fibers	Split Tensile Strength, N/mm^2	
		7 days	28 days
1	0%	3.52	5.07
2	0.5%	3.84	5.57
3	1.5%	4.12	5.98
4	2%	3.81	5.56

Table 7. Combined split tensile strength of concrete with alccofine-1203 and polypropylene fibers.

S.No.	% of AL + PF	Split tensile strength, N/mm^2	
		7 days	28 days
1	7.5%AL+1.5%PF	4.05	5.70

V. CONCLUSIONS

At 7.5% of replacement of cement with alccofine the compressive strength is increased by 15.02% for 7 days. At 7.5% of replacement of cement with alccofine the compressive strength is increased by 15.33% for 28 days.

The compressive strength of concrete with combined 7.5% of alccofine and 1.5% of polypropylene will be 12.71% for 7 days. The compressive strength of concrete with combined 7.5% of alccofine and 1.5% of polypropylene fibers is increased by 27.52 % for 28 days

At 1.5% of addition of polypropylene fibers to concrete the compressive strength is increased by

19.84% for 28 days. At 7.5% of replacement of cement with alccofine the split tensile strength is increased by 11.07% for 7 days.

At 7.5% of replacement of cement with alccofine the split tensile strength is increased by 13.6% for 28 days. At 1.5% of addition of polypropylene fibers to concrete the split tensile strength is increased by 17.04% for 7 days.

At 1.5% of replacement of cement with polypropylene fibers the split tensile strength is increased by 17.9% for 28 days. The split tensile strength of both 7.5% of alccofine and 1.5% of polypropylene will be 27.5% for 7 days. The split tensile strength of both 7.5% of alccofine and 1.5% of polypropylene is increased by 24.7% for 28 days.

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