EXPERIMENTAL INVESTIGATION ON PROPERTIES OF CONCRETE WITH ALCCOFINE1203 AS PARTIAL REPLACEMENT OF CEMENT SUBJECTED TO DIFFERENT CURING REGIMES

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ABSTRACT

In this paper, an experimental investigation is conducted to study the changes in the physical properties of concrete when alccofine 1203 is used in the concrete mix as a partial substitute for cement. This paper also aims at studying the effect in the properties of concrete mix that are caused when it is subjected to different types of curing regime. For this study, concrete mix of M35 grade is prepared and the proportion of alccofine in the concrete mix as a substitute material for cement is gradually increased at a rate of 5% i.e, concrete mix with 0%,5%,10%,15% & 20% alccofine measured by weight of cement. For the purpose of studying the early strength gain development, the cube samples were tested at ages of 3days, 7 days and 28 day for compressive strength while for the flexural strength the beam samples were tested at the age of 28 days. All the concrete samples made with different replacement proportions were then subjected to three different curing regimes separately. According to data obtained from this experiment, it indicates that there is overall increase in the strength of the concrete mix. Also water immersion curing gave the best results.

KEYWORDS: Alccofine 1203, Partial Replacement, Alccofine Concrete, Curing Regime

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INTRODUCTION

In cement plants, the magnitude of CO₂ released during its manufacturing process is very high effectuating to a substantial need for lowering down the quantity of cement consumption in the construction industries and thus, catalyse for the search of alternate materials as cement substitute. With the advancement of time, there is high demand for concrete with enhanced properties and high performance fostering to the incorporation of additives in concrete. Curing plays an important factor in concrete strength development and durability of concrete.

Alccofine 1203

Alccofine is an ultrafine sized material with blaine value of 12000cm²/gm. The raw material of alccofine is slag of high glass content with high reactivity obtained through the process of controlled granulation in addition to that controlled conditions are maintained with special equipments during its manufacturing process to produce optimized particle size distribution which is its distinctive attribute. According to previous studies, alccofine owing to its ultrafine particle size distribution and chemical constitution can be possibly utilized as a workability aid. Previous results also show that the incorporation of alccofine in the concrete mix enhances its properties.

So in this paper, it puts forward an attempt to study the changes in physical properties of concrete when alccofine 1203 is used in the concrete mix as a partial substitute for cement and is subjected to different regimes.

METHODOLOGY

Properties of Material Used

Table 1: Cement Properties

Serial No.	Properties	Values
1	Cement	OPC
2	OPC Grade	43
3	Normal Consistency	30.5%
4	Specific Gravity	3.3
5	Setting Time of Cement I. Initial Setting Time II. Final Setting Time	29 min 549 min

Table 2: Aggregate Properties

Serial No.	Properties	Values
1	Specific Gravity of Fine Aggregates	2.6
2	Specific Gravity of Coarse Aggregates	2.67
3	Fineness Modulus of Fine Aggregate	3.12
4	Fineness Modulus of Coarse Aggregate	8.09

Table 3: Alccofine1203 Physical Properties

Serial No.	Properties	Magnitude
1	Bulk Density	600-700 kg/m ³
2	Fineness	>12000 cm ² /gm
3	Particle Shape	Irregular
4	Particle Size, d ₁₀	<2μ
5	Particle Size, d ₅₀	<5μ
6	Particle Size, d ₉₀	<9μ

Table 4: Chemical Properties of Alccofine 1203

Serial No.	Compound	Range
1	CaO	32%-34%
2	SiO ₂	33%-35%
3	SO ₃	0.3%-0.7%
4	MgO	8%-10%
5	Fe ₂ O ₃	1.8%-2%
6	Al ₂ O ₃	18%-20%

Experimental Work

- **Mix Design and Proportion:** For this experiment, mix design was prepared as per IS 10262: 2019 for M35 grade concrete. And the concrete mix proportion used was 1:1.6:2.92 with water cement ratio taken as 0.38.
- **Preparation of Concrete Mix Specimens:** The dimensions of cube and beam specimens used are 150×150×150mm and 100×100×500mm respectively. For compressive strength test, cubed were casted for 7 & 28 day test, in addition to which 3 day test was also added to check for early strength and in case of flexural strength test casting was done for 28 day test. Three different sets of specimens were prepared for the three different curing regimes i.e. water immersion curing, polythene sheet curing and burlap curing. A total of 180 specimens were made with 60 specimens for each curing regime. Each set contain 60 specimens (45 cubes and 15 beams) where alccofine is used as partial substitute material for cement in 0%-20% i.e. (0,5,10,15&20%) respectively by weight of cement.

- Curing of Specimen:** After removing the cast the specimens were cured separately in the different arrangements made as per the curing regime it is subjected to. The first sets of specimens were immersed in curing tanks filled with water. Second set of specimens were covered with hessian bags (gunny bags) after which the hessian bags were wetted with water throughout the curing period. The third set of specimens were wrapped with polythene sheet and sealed completely until testing. The specimens were left undisturbed for the whole curing period.

TESTING AND RESULT

Compression Test Results

The test samples with different proportions of alccofine, subjected to various curing regime gave the following results for compression strength test.

Table 5: Compression Test Results for Cube Specimens

Sl. No.	Alccofine (%) by Weight of Cement	Compression Strength Results (in N/mm ²)								
		Water Immersion Curing			Polythene Sheet Curing			Burlap Curing		
		3 Day	7 Day	28 Day	3 Day	7 Day	28 Day	3 Day	7 Day	28 Day
1	0%	17.8	26.49	35.9	17.2	25.77	35.2	17.4	24.8	35.5
2	5%	20.3	27.12	37.3	20.9	28.35	36.2	20.1	26.6	36.32
3	10%	24.4	34.02	39	23.8	30.9	37.3	22.9	29.67	37.2
4	15%	22.7	32.81	41	21.6	29.70	38.1	21.8	31.88	39.6
5	0%	19.8	28.34	38.8	20.9	27.32	36.6	19.3	26.37	38.3

Figure 1: Variation in Compressive Strength (3 Day Test Result).

Figure 2: Variation in Compressive Strength (7 Day Test).

Figure 3: Variation in Compressive Strength (28 Day Test).

Flexural Test Results

Table 6: Results for Flexural Test in Beam Specimens

Serial No.	Alccofine (%) by Weight of Cement	Flexural Strength (in) for 28 Days		
		Water Immersion Curing	Polythene Sheet Curing	Burlap Curing
1	0%	7.1	6.9	7
2	5%	8.8	7.9	8.3
3	10%	9.2	8.6	9.02
4	15%	9	8.4	8.7
5	20%	8.3	8.09	8.4

Figure 4: Variation in Flexural Strength (28 Day Test).

Figure 5: Comparison between the Three Different Curing Regimens on the Basis of Compressive Strength (15% Alccofine).

CONCLUSIONS

- From the results obtained, 15% partial substitution of cement with alccofine gave the highest value of compression test results whereas for flexural strength test, it was found to be 10%. Therefore, the optimum partial replacement percentage were found to be 15% (Compressive strength) and 10% (Flexural strength).
- The incorporation of alccofine 1203 in the concrete mix induces early strength gaining properties in all mix proportions
- From this study it was observed that water immersion curing gives the best results followed by burlap curing.
- The water immersion curing gave overall maximum results at all ages.
- Therefore, by partially substituting 15% of cement with alccofine gives an increment of 17.14% in compressive strength while for flexural strength, 10% of alccofine gives an increment of 29.57%.

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