Performance of Concrete by Partial Replacement of Alccofine -1203

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Abstract- **Alccofine 1203 a mineral admixture in concrete when it is added in cement concrete for the green state and hardened state i.e..For workability and strength of concrete using ordinary Portland cement (43 grade). Partial replacement with ordinary Portland cement (43 grade) which varies from 1% to20% at interval of 1%, 2%, 3%, 4%, 5%, 10%, 15%, 20%, cubes for cement and 3 cubes forM20 mix cement partially replaced with Alccofine 1203,and 6 cement cubes ,3 for cement and sand , 3 for cement sand and alccofine. A total thirty three mixes were prepared for grade of concrete. All mix of concrete was examined for slump test of fresh concrete and by compressive strength for 3 days, 7days and 28 days. Total number of specimens for cubes was 33 which were casted for testing to study influence of alccofine1203 on concrete and cement. These Concrete specimens were deep cured in water under normal atmospheric temperature. Slump was found better in partial replacement at 10% as compared to that of addition of alccofine 1203 for M20 grade of concrete. M20 grade concrete, the compressive strength observed was 41.11N/mm2 which are greater than the target compressive strength of normal M30 grade concrete. On the basis of strength increment of variation mix of concrete gives better performance which indicates the consumption of waste material as mineral admixture for concrete could be promoted in a big way for environmental sustainability. Cement cubes has been test for 3,7&28 day strengths and partially replaced cement with 10% of alccofine and strength of 19.26 Mpa achieved in 28 day.**

Keywords: Alccofine 1203, Ordinary Portland cement (OPC).

I. INTRODUCTION

Concrete is a composite material composed of coarse aggregate bonded together with a 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. 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. Alccofine has unique characteristics to enhance 'performance of concrete' in fresh and hardened stages due to its optimized particle size distribution. Alccofine 1203 and Alccofine 1101 are two types of Alccofine with low calcium silicate and high calcium silicate respectively. Alccofine 1200 series is of 1201, 1202, 1203 which represents fine, micro fine, ultrafine particle size respectively. Alccofine 1203 is slag based SCM having ultra-fineness with optimized particle size distribution whereas Alccofine 1101 is a micro finer cementitious grouting material for soil stabilization and rock anchoring. The performance of Alccofine is superior to all the other admixtures used in India. Due to high Calcium oxide (Cao) content.

Applications of Alccofine 1203

- Bridges
- Roads and air ports
- High rise buildings

Benefits of Alccofine 1203 in Fresh State

- The workability of the mix retention is improved.
- Flow ability of the mix is increased
- Reduction in segregation can be observed in the mix
- Reduction in heat of hydration of the mix.

In Hardened state

- Improvement in durability of the mix
- Resistance to AAR is increased
- Strength at all ages is increased
- Resistance to chemical attack / corrosion is improved as ingression becomes difficult
- Lowers permeability of the mix

Often, additives (such aspozzolans or super plasticizers) are included in the mixture to improve the physical properties of the wet mix or the finished material. Most concrete is poured with reinforcing materials (such as rebar) embedded to provide tensile strength, yielding reinforced concrete. After the Roman Empire collapsed, use of concrete became rare until the technology was redeveloped in the mid-18th century. Today, concrete is the most widely used man-made material (measured by tonnage).

II. EASE OF USE

A. Concrete Mixing Procedure

- Trial Mix

For design of any type of concrete, we need to make many trial mixes to predict the lack and performance of

strength of concrete and slump of same. If we found any type lack in performance of concrete mix then we need to make another design for better concrete mix. We have trialled on a concrete mix of standard ratio given in IS 456:2000 [2] for M20 (1:1.5:3).

The control mixes was expected to achieve the target workability (slump) [7] for all types of concrete with minimum slump of 110-140mm in pumpable concrete. It accommodates the wide range of fine aggregate (well-shaped natural sand) and coarse aggregate (poorly shaped crushed stone) and OK-(grade-43) reach the appropriate strength for residential, commercial concrete and road pavement. The paste contents for the trial mixes were based on the void contents of the combination of coarse, intermediate and fine aggregates. The IS-2386 Part-3, 1963 [3] is Standard code which is used to determine the voids &Bulk, density of materials. Each mix needed enough jelly paste to fill the voids between aggregate and provide adequate lubrication of the aggregate particles with cement. Various trial mixes were tested in order to establish a suitable control mix. [1]

- Control mix

Concrete should be mixed on water tight that no segregation would occur and mix platform need to be non-absorvent. mixing implement can be taken by shovel and trovel and mixing was done by hand mixing method as per IS516:1959 [5]. The cement and fine aggregate was being mixed dry until the mixture was thoroughly blended and was uniform in color. The coarse aggregate was then be added and mixed with the cement and fine aggregate until the coarse aggregate was uniformly distributed throughout the batch. The water was then be added and the entire mixed until the concrete appears to be homogeneous and has the desired consistency [6]. The quantity of water was not added completely at once, it was added to mix at three step of mixing for uniform mixing of water. If repeated mixing was necessary, then it was done for homogeneous and uniformity of concrete. Slump was also conducted for fresh concrete after immediate mixing of concrete.

Table I. Control Mix Proportion for M20 with w/c ratio of 0.55

S.No	Materials	Weight(Kg)
1	Cement(OPC-43)	50
2	Coarse Aggregate(20mm)	100
3	Coarse Aggregate(l0mm)	50
4	Fine Aggregate	75
5	Water	27.5
6	W/C Ratio	0.55

Control Mix with Alccofine 1203

In this blend of control mix, we have made two variations with cement. First one is to add few percentage of alccofine to cement which varies from 0% to 20% at interval of 5% and second one is to replace few percentage of cement with alccofine which varies from 0% to 20% at interval of 5% for concrete mixes of M20.

Table II.Control Mix with Alccofine 1203

S.No	Mix Name %	cement (Kg)	Alccofine (Kg)	Coarse Aggregate (Kg)		Fine Aggregate (Kg)	Water (kg)
				20 mm	10 mm		
1	OPC+AL (100+0)	50	0	100	50	75	27.5
2	OPC+AL (99+1)	49.5	.5	100	50	75	27.5
3	OPC+AL (98+2)	49	1	100	50	75	27.5
4	OPC+AL (97+3)	48.5	1.5	100	50	75	27.5
5	OPC+AL (96+4)	48	2	100	50	75	27.5
6	OPC+AL(95+5)	47.5	2.5	100	50	75	27.5
7	OPC+AL(90+10)	45	5	100	50	75	27.5
8	OPC+AL(85+15)	42.5	7.5	100	50	75	27.5
9	OPC+AL(80+20)	40	10	100	50	75	27.5

Concrete should be mixed on water tight that no segregation would occur and mix platform need to be non-absorbent mixing implement can be taken by shovel and trowel and mixing was done by hand mixing method as per IS516:1959.

a) The cement and fine aggregate was being mixed dry until the mixture was thoroughly blended and was uniform in color.

b) The coarse aggregate was then be added and mixed with the cement and fine aggregate until the coarse aggregate was uniformly distributed throughout the batch.

c) The water was then be added and the entire mixed until the concrete appears to be homogeneous and has the desired consistency. The quantity of water was not added completely at once, it was added to mix at three step of mixing for uniform mixing of water. If repeated mixing was necessary, then it was done for homogeneous and uniformity of concrete.

B. Fresh concrete Testing Procedure

- *Workability*

Workability testing procedure was conducted as per IS 1191:1959 [4] and procedure is given below:

The internal surface of the mould was thoroughly cleaned and freed from superfluous moisture and any set concrete before commencing the test. The mould was being placed on a smooth, horizontal, rigid and non-absorbent surface, such as a carefully leveled metal plate, the mould being firmly held in place while it is being filled. The mould was being filled in four layers, each approximately one-quarter of the height of the mould. Each layer was being tamped with twenty-five strokes of the rounded end of the tamping rod.

The strokes were being distributed in a uniform manner over the cross-section of the mould and for the second and subsequent layers shall penetrate into the underlying layer. The bottom layer was being tamped throughout its depth. After the top layer has been rodded, the concrete was being struck off level.
The mould was being removed from the concrete immediately by raising and rotating it slowly and carefully in a vertical direction. This allowed the concrete to subside and the slump was being measure immediately by determining the difference between the height of the mould and that of the highest point of the specimen being tested. The above operations were being carried out at a place free from vibration or shock, and within a period of two minutes after sampling.

C. Hardened Concrete Testing Procedure

- Density

The density of specimen was determined before testing the specimen of cube, beam & cylinder and before determination of density of specimen, surface of specimen was cleaned and sweeped with clean cotton cloths.

- Compressive Strength

The compressive strength of all mixes was measured with cube specimen of size 150mm (length) x 150mm (width) x 150mm (depth).The specimens were tested after curing for 7 days and 28 days fully immersed in water tank as per IS 516:1959[5] for method of tests for strength of concrete. Few cubes were also tested within 28-29 hours which gave the strength for 28days and curing was done by accelerated curing method as per IS 9013-1978.

IV. FINDINGS

We have analyzed the result of work and all blends /mixes in which there have been many variations in result of different mixes. Results have been tabulated graphically and presented.There has been various mixes of different type i.e. we have made two variations with cement. We have partially replaced cement with few percentages of alccofine which varies from 0% to 20% at interval of 1%, 2%, 3%, 4%, 5%, 10%, 15% and 20% for concrete mixes of M20. We have tested for density, slump, compressive strength and flexure strength [2].

Table III. Test Findings when Addition of Alccofine to OPC 43 Grade Cement.

PERCEN-TAGES	3 DAY TEST	7 DAY TEST	28 DAY TEST
1	10N/mm^2	14.66 N/mm^2	36.44 N/mm^2
2	10.44 N/mm^2	18 N/mm^2	35.77 N/mm^2
3	11.55 N/mm^2	15.11 N/mm^2	34.88 N/mm^2
4	12.77 N/mm^2	17.77 N/mm^2	37.77 N/mm^2
5	17.33 N/mm^2	22.48 N/mm^2	35.11 N/mm^2
10	10.22 N/mm^2	27.11 N/mm^2	41.11 N/mm^2
15	13.55 N/mm^2	27.55 N/mm^2	40.44 N/mm^2
20	17.11 N/mm^2	29.11 N/mm^2	32 N/mm^2
M20	11 N/mm^2	17 N/mm^2	27 N/mm^2

Table IV. Slump for Partial Replacement of Alccofine with Cement of M20 Grade

S.No	Mix (Cement + Alccofine 1203)	Slump(mm)
1	OPC+ AL (100+0)	118
2	OPC+ AL (99+1)	122
3	OPC+ AL (98+2)	127
4	OPC+ AL (97+3)	125
5	OPC+ AL (96+4)	128
6	OPC+AL (95+5)	120
7	OPC+AL (90+10)	127
8	OPC+AL (85+15)	132
9	OPC+AL (80+20)	136

Table V. 3 Days compressive strength of cube for addition of alccofine to cement for M20 grade

S.No	Mix Name%	LOAD (N)	STRENGTH (N/MM^2)
1	OPC+ AL(99+1)	225000	10
2	OPC+ AL(98+2)	234900	10.44
3	OPC+ AL(97+3)	259875	11.55
4	OPC+ AL(96+4)	287325	12.77
5	OPC+AL(95+5)	389925	17.33
6	OPC+AL(90+10)	229950	10.22
7	OPC+AL(85+15)	304875	13.55
8	OPC+AL(80+20)	384975	17.11
9	M20	247500	11

Table VI. 7 days compressive strength of cube for addition of alccofine to cement for M20 grade

S.No	Mix Name%	LOAD (N)	STRENGTH (N/MM^2)
1	OPC+ AL(99+1)	329850	14.66
2	OPC+ AL(98+2)	405000	18.00
3	OPC+ AL(97+3)	339975	15.11
4	OPC+ AL(96+4)	399825	17.77
5	OPC+AL(95+5)	505800	22.48
6	OPC+AL(90+10)	609975	27.11
7	OPC+AL(85+15)	619875	27.55
8	OPC+AL(80+20)	654975	29.11
9	M20	382500	17.00

Table VII. 8 days compressive strength of cube for addition of alccofine to cement for M20 grade

S.No.	Mix Name%	LOAD (N)	STRENGTH (N/MM^2)
1	OPC+ AL(99+1)	819900	36.44
2	OPC+ AL(98+2)	804825	35.77
3	OPC+ AL(97+3)	784800	34.88
4	OPC+ AL(96+4)	849825	37.77
5	OPC+AL(95+5)	789975	35.11
6	OPC+AL(90+10)	92475	41.11
7	OPC+AL(85+15)	909900	40.44
8	OPC+AL(80+20)	720000	32
9	M20	607500	27

Table VIII.Results for testing of cement cube without alccofine

3 DAYS	7 DAYS	28 DAYS
5.41N/mm^2	7.63 N/mm^2	11.03 N/mm^2

Table IX.Results for testing of cement cube with 10% partial replacement of alccofine 1203

3 DAYS	7 DAYS	28 DAYS
9.22 N/mm^2	18.45 N/mm^2	19.26 N/mm^2

Table X.Mixing Qantity of 1 concrete mould (150X150)

PERCENTAGE OF ALCCOFINE	CEMENT (kg)	ALCCO (kg)	SAND (kg)	AGGREGATE (kg)		W/C RATIO= 0.55
				10mm	20mm	
1%	1.458	0.014	2.20	1.45	2.915	0.809 kg
2%	1.443	0.029	2.20	1.45	2.915	0.809 kg
3%	1.428	0.044	2.20	1.45	2.915	0.809 kg
4%	1.414	0.058	2.20	1.45	2.915	0.809 kg
5%	1.398	0.074	2.20	1.45	2.915	0.809 kg
10%	1.323	0.147	2.20	1.45	2.915	0.809 kg
15%	1.249	0.220	2.20	1.45	2.915	0.809 kg
20%	1.176	0.294	2.20	1.45	2.915	0.809 kg
M20	1.472	0.000	2.20	1.45	2.915	0.809 kg

Table XI. Mixing Qantity of 1 cement mould

CEMENT	SAND	WATER
200 gm	400 gm	0.84 gm

Table XII. Mixing Qantity of 1 cement mould (cement partially replaced with 10% alccofine 1203)

CEMENT	ALCCOFINE	SAND	WATER
160 gm	40gm	400gm	.84 gm

Table XIII. Cost comparision of alccofine with cement material at 10 % partial replacement.

	CEMENT (kg)	ALCCOFINE (kg)	SAND (kg)	AGGREGATE(kg)	
				10mm	20mm
Cost	5.60/-	12*/-	1/-	0.60/-	1/-
Concrete 1 Mould Cost	8.232/-	0/-	2.20/-	0.87/-	3/-
Partially Replacement At 10% With Alccofine	7.408/-	1.764/-	2.20/-	0.87/-	3/-

Table XIV.Rate comparision of alccofine with cement material at 10 % partial replacement.

M20- COSTING OF 1 MOULD	=14.30/-
M20 PARTIALLY REPLCED WITH 10% ALCCOFINE COST OF 1 MOULD MATERIAL	=15.25/-

In this by expanding of rupee 0.95/- I have achived the strength of 41.11Mpa strength which is almost equal to the Targated mean strength of M30. By this test of cement 10% partially replaced with alccofine 1203 we have achived almost ultimate strength in 7 days.

V. CONCLUSION

1. By addition of alccofine 1203 in Ordinary Portland Cement, Slump of the concrete mix increased initally by 5% on comparision the slump of control mix concrete ,but slump was gradually decreased and comes closely equal to the slump of control mix at 10% addition for mixes M20.

2. By partially replacement cement by alccofine the slump of the concrete mix was initally increased by 10% on comparision to the slump of control mix concrete and slump was gradually increased up to 10% replacement for mixes M20.

3. Slump was found higher in partial replacement at 10% as compare to that of addition of alccofine 1203 for M20.
4. Higher slump was found is 140 mm but on 10% addition of alccofine with M20 grade and 127mmslump was found for partially replacement of alccofine 1203.
5. Compressive strength of concrete was increased in mixe M20, when alccofine 1203 was partially replaced with Ordinary Portland Cement but higher strength was found on 10% addition of alccofine 1203 with M20 mix.
6. On 10% partially replacement of Ordinary Portland Cement with alccofine and M20 grade concrete, we found the compressive strength of 41.11N/mm^{2}which are greater than the target compressive strength of normal M30 grade concrete.
7. We have also made cement cube for testing for 3,7,28 days and again it was partially replaced with alccofine at 10% amount of cement.
8. In this by expanding of rupee 0.95/- I have achived the strength of 41.11Mpa strength which is almost equal to the Targated mean strength of M30.
9. By this test of cement 10% partially replaced with alccofine 1203 we have achived almost ultimate strength in 7 days.

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