Use of alccofine 1206 to achieve high performance durable concrete

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Abstract

This dissertation work is to study the influence of Alccofine 1206 a mineral admixture in concrete when it is mixed in cement concrete for the green state and hardened state i.e. for workability and strength of concrete using OPC (43 grade). Alccofine 1206 has been added to OPC which varies from 5% to 15% at interval of 5% by total weight of OPC and partial replacement of OPC (43 grade) by Alccofine 1206 which varies from 5% to 15% at interval of 5% by total weight of OPC. A total eighteen mixes (trial mix, control mix and variation mix) were prepared for grade M25 of concrete. This study investigates the performance of concrete mixture in terms of Compressive strength for 7days and 28 days, Flexural strength of beam 28 days and Splitting tensile strength of Cylinder for 28 days respectively of M-25 grade concrete. The addition levels of OPC by Alccofine 1206 were 5%, 10% and 15% where addition levels of 1% super-plasticizer was used in all the test specimens for better workability at lower water-binder ratio and to identify the sharp effects of Alccofine1206 on the properties of concrete. Water-binder ratio was kept 0.43 for all cases. Total number of specimens for cubes 24, cylinders 12 and beams 12 which were casted for testing to study influence of Alccofine 1206 on concrete. These Concrete specimens were deep cured in water under normal atmospheric temperature. On the basis of result that addition of concrete from Alccofine 1206 was found to increase in all strength (Compressive, Flexural & Splitting Tensile strength) and durability of variation mix of concrete on all age when compared to normal concrete its use should be promoted for better performance as well as for environmental sustainability.

***Key Words*:-** *Alccofine 1206, Compressive strength, Durability, High Performance Concrete Workability, Compressive Strength, Flexural Strength, Splitting Tensile Strength.*

I .Introduction

The demand of better concrete is increasing day by day. Improved quality of concrete will only perform better if concrete improves workability, durability, flow ability & resistance to chemical attack/corrosion and reduce w/c ratio, heat of hydration & segregation mainly. For the fulfilment of above properties waste produced from the steel & other industries are used for effective & efficient strength & durability of concrete.

Alccofine 1206 has been added into OPC which varies from 5% to 15% at interval of 5% by total weight of OPC and partial replacement of OPC by Alccofine1206 which varies from 5% to 15% at interval of 5% by total weight of OPC for M25 grade of concrete.

There are many waste products which are generated from industries and factories, dumped openly which cause environmental problems and also spread diseases. These waste products can be recycled in useful way to save the environment. These waste material or so called by-products are fly ash, silica fume, ground granulated blast furnace slag and Alccofine which are being reused now a days in construction industries mainly by making few stabilized changes in these waste materials.

In present days some waste material are used to produce efficient & effective concrete as blending material or mineral admixture. Most common and known blending materials or mineral admixture used in concrete production industries are marble powder, silica fume, fly ash, ground granulated blast furnace slag and new by product admixture is Alccofine which is glass based and take from iron factories. This is due to the fact that recycling of industrial wastes as blending materials has technical, economical and environmental benefits.

Containing mineral admixtures within pozzolanic concretes are used extensively throughout the world for their good performance and for ecological and economic reason and the applications of such concretes are increasing day by day due to their superior structural performance, environmental friendliness and energy conserving implications. Mineral admixture, super plasticizer and retarders etc are playing effective role for high performance of concrete industries, a mineral admixture which performs in superior manner than all admixture used in India is Alccofine 1206 will be better composite material with cement to mix with natural fine aggregate and coarse aggregate for measurement of conventional concrete performance.

II. Objective of study

- The main objective of this study is to use of Alccofine 1206 as mineral admixture which is mixed (on addition of Alccofine 1206 into OPC & partial replacement

of OPC by Alccofine 1206) with OPC to investigate the influence of Alccofine 1206 in concrete and to see the suitability of Alccofine 1206 for use in concrete.

- To analyze the results of density, workability, compressive strength, flexural strength and splitting tensile strength for M25 grade of concrete by using waste material of iron factories.
- To compare the engineering properties of improved concrete for M25 (mix with Alccofine 1206 by addition & partial replacement) samples with conventional concrete (M25 as per mix design).

III. Methodology

A.Binder selection

Mostly used OPC (Ordinary Portland Cement) and then only few have used PPC (Portland pozzolana cement) for their research because of its durability, high strength (more than 80-85 % strength is achieved within 28 days as compare to that of PPC which only achieves 70-75 % maximum within 28 days).

B.Additive selection

Mostly there are two types of additive, these are mineral admixture and chemical admixture and research has been performed by different researcher over all additive for their properties of performance and influence when mix with Portland cement. As per demand of high strength, high performance, durability, workability and anti corrosive concrete. A mineral admixture which performs in superior manner than that of all other admixture found/use in India is Alccofine.

Table 1 Properties of Alccofine 1026

Analysis	Alccofine 1026
Bulk Density (kg/m3)	750-850
Surface Area (cm2/gm)	8000
Particle Shape	Irregular
Particle Size	N\A
d10	N\A
d50	<7 micron
d95	<20 micron
Specific Gravity	2.9
CaO (%)	30-34
Al_2O_3 (%)	18-25
Fe_2O_3 (%)	0.8-0.3
SO_3 (%)	0.1-0.4
MgO (%)	6-10
SiO_2 (%)	30-36

Aggregate selection

Aggregates for concrete consist of gravel and sand which represents the grain skeleton for the concrete. All cavities which are within this skeleton need to be filled with binder paste as much as possible. Concrete aggregates occupy approximately 80% of total concrete weight and 70 – 75% of total concrete volume. Optimum use of the aggregates quality and size improves the concrete quality, mainly coarse aggregate maintain better improvement for performance.

Table 1. Properties of coarse aggregates of 20mm

Tests	**Coarse Aggregate 20mm**
Density(OD)	1476 kg/m3
Density(SSD)	1560 kg/m3
Bulk Density(Dry)	1481 kg/m3
Sp. Gravity(OD)	2.62
Sp Gravity(SSD)	2.65
Water Absorption	0.44%

Fine Aggregate

There are four grading zone for fine aggregate as per IS-383:1970 and these are Grading Zones I, II, III & IV. These grading zone classified as per percentage passing material from various sieves and there are mainly four zones and they all have different passing percentage limit for different sieves but there is only one sieve(600 micron) which is almost common to all Zone specification .

Table 2. Properties of fine aggregate

Tests	**Natural Fine aggregate**
Density(OD)	1622 kg/m3
Density(SSD)	1670 kg/m3
Bulk Density (Dry)	1622 kg/m3
Bulk Density (SSD)	1670 kg/m3
Sp Gravity (OD)	2.61
Sp Gravity (SSD)	2.62
Water Absorption	1.25%

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 for method of tests for strength of concrete.

Compressive strength = P/A (Unit = N/mm2 or MPa) Where P = Load,,A = Area of Specimen

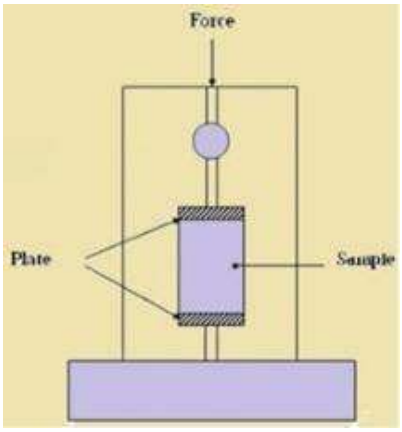


Fig 1. Compressive Testing machine

Flexural Strength

The Flexural strength of all mixes was measured with beam specimen of size 700mm(length) x 150mm(width) x 150mm(depth).The specimens were tested after curing for 28 days fully immersed in water tank as per IS 516:1959 for method of tests for strength of concrete. The central point loading method was used for this testing.

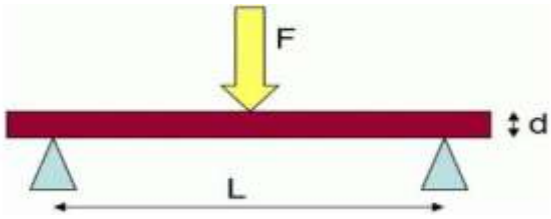


Fig2. Flexural strength Test (for single loading)

Flexural Strength = 3PL/2bd2 = 3PL/2d3 (b=d,due to size of b and d are equal) (Unit = N/mm2 or MPa) Where, P = Load ,L = Distance From Centre of Two Support ,b = Depth of Specimen ,d = Width of Specimen.

Splitting Tensile Strength

The split tensile strength of all mixes was measured with cylinder specimen of size 300mm(length) x 150mm(diameter).The specimens were tested after curing for 28 days fully immersed in water tank as per IS 5816:1999 for method of test splitting tensile strength of concrete.

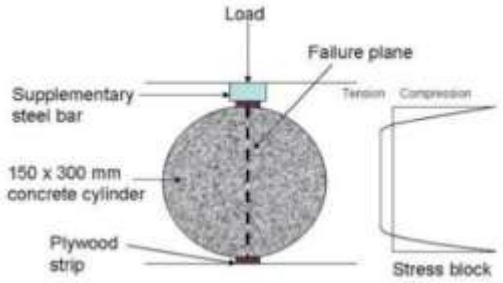


Fig3. Splitting Tensile strength Test

Splitting Tensile Strength = 2P/πld (Unit = N/mm2 or MPa)Where,P = Load,l = Length of Specimen,d = Diameter of specimen

Table 3. Compressive Strength of Cube on Replacement of OPC by Alccofine for M25 Grade for 7 Days

S.no	Mix(Cement+ Alccofine)	Average for compressive	
		Load(N)	Strength(N/mm^2)
1	OPC+AL(100+0)	493333	21.93
2	OPC+AL(95+5)	433333	22.1
3	OPC+AL(90+10)	485000	22.95
4	OPC+AL(85+15)	513333	24.2

Graph 1. Compressive Strength For 7 Days

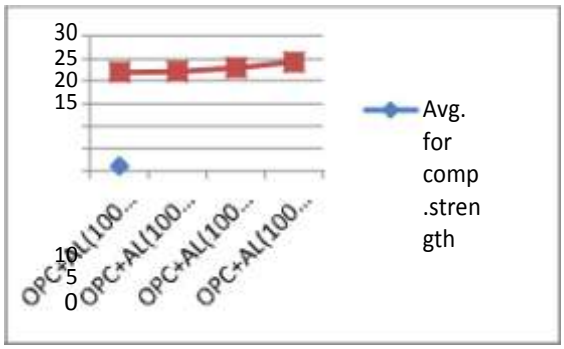


Table 4. Average Compressive Strength of cube on replacement of OPC for M25 for 28 Days

S.no	Mix(Cement+ Alccofine)	Average for compressive	
		Load(N)	Strength(N/mm^2)
1	OPC+AL(100+0)	681666	30.30
2	OPC+AL(95+5)	750000	33.33
3	OPC+AL(90+10)	790000	35.11
4	OPC+AL(85+15)	838333	37.26

Graph 2. Compressive strength for 28 Days

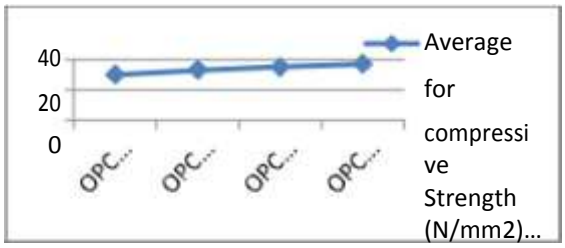


Table 5. Comparison of Average Compressive Strength of cube on replacement of OPC for M25 for 7 Days & 28 Days

S.no.	Mix(Cement+ Alccofine)	Average for compressive Strength (N/mm^2)	
		7 Days	28 Days
1	OPC+AL(100+0)	21.93	30.3
2	OPC+AL(95+5)	22.1	33.33
3	OPC+AL(90+10)	22.95	35.11
4	OPC+AL(85+15)	24.2	37.26

Graph 3. Comparison of Average compressive strength of M25 at 7 Days & 28 Days

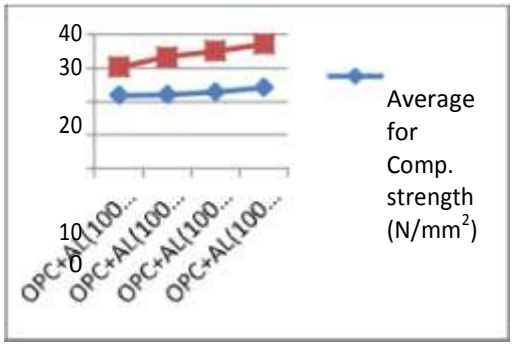


Table 6. Flexural Strength on replacement of OPC by Alccofine for M25 Grade for 28 Days

S.no	Mix(Cement+ Alccofine)	Average for Flexural	
		Load(N)	Strength(N/mm^2)
1	OPC+AL(100+0)	17700	4.72
2	OPC+AL(95+5)	19050	5.08
3	OPC+AL(90+10)	19333	5.16
4	OPC+AL(85+15)	20000	5.33

Graph 3. Flexural strength For 28 Days

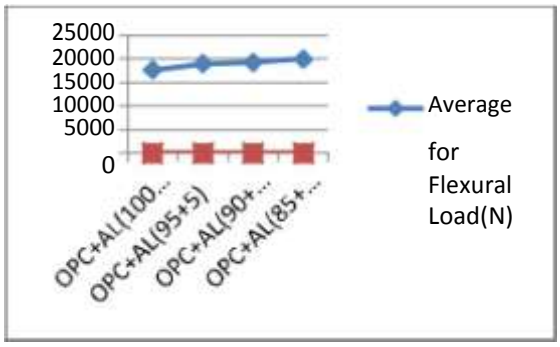
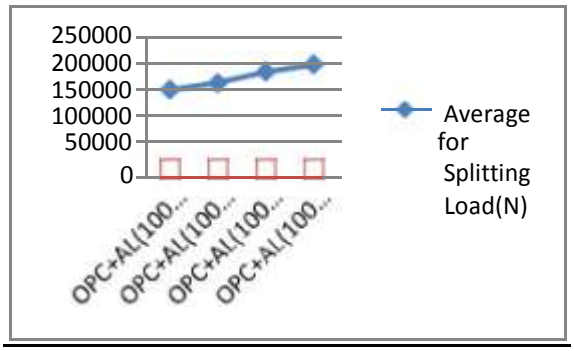


Table 7. Splitting Tensile strength of cylinder on Replacement of OPPC by Alccofine for M25 Grade for 28 days.

S.no	Mix(Cement+ Alccofine)	Average for Splitting	
		Load(N)	Strength(N/mm^2)
1	OPC+AL(100+0)	150333	2.13
2	OPC+AL(100+5)	162666	2.30
3	OPC+AL(100+10)	184333	2.61
4	OPC+AL(100+15)	197666	2.80

Graph 4. Splitting Strength for 28 Days



RESULTS AND ANALYSIS

There had been various mixes of different type i.e. two variations with cement had been made. First one was to add few percentage of Alccofine to cement which varies from 0% to 15% at interval of 5% and second one was to replace few percentage of cement with Alccofine which varies from 0% to 15% at interval of 5% for both concrete mix of M25. Tests had been conducted for result of compressive strength, flexure strength & splitting tensile 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 for method of tests for strength of concrete.

The Flexural strength of all mixes was measured with beam specimen of size 700mm (length) x 150mm(width) x 150mm(depth) .The specimens were tested after curing for 28 days fully immersed in water tank as per IS 516:1959 for method of tests for strength of concrete. The central point loading method was used for this testing.

The split tensile strength of all mixes was measured with cylinder specimen of size 300mm(length) x 150mm(diameter).The specimens were tested after curing for 28 days fully immersed in water tank as per IS 5816:1999 for method of test splitting tensile strength of concrete.

CONCLUSIONS

By analyzing the results of Compressive Strength test, Flexural Strength test and Splitting Tensile Strength test. Following conclusions have been drawn:

1. Compressive strength of concrete was increased in mix M25, when Alccofine 1206 was added to OPC or partial replacement of OPC by Alccofine 1206 but higher strength (21.61% for M25) was found on 15% addition of Alccofine 1206 with M25.
2. On 15% addition of Alccofine 1206 into OPC and partial replacement of OPC by Alccofine 1206 of M25 grade concrete, the compressive strength was observed 26.67 N/mm2 and 24.20 N/mm2 respectively.
3. Compressive strength of concrete was increased in mix M25, when Alccofine 1206 was added to OPC or partial replacement of OPC by Alccofine 1206 but higher strength (by 26.43% for M25) was found on 15% addition of Alccofine 1206 with both M20 & M25.
4. Flexural strength of concrete was increased in mix M25, when Alccofine 1206 was added to OPC or partial replacement of OPC by Alccofine 1206 but higher strength (by 19.49 % for M25) was found on 15% addition of Alccofine 1206 with M25.
5. Splitting tensile strength was increased in mix M25, when Alccofine was added to OPC partial replacement of OPC by Alccofine but higher strength (by 35.45% for M25) was found on 15% addition of Alccofine 1206 with M25.

Future Scope of the Work

1. The durability study of M25 grade concrete with addition of Alccofine 1206 into OPC and partial replacement of OPC by Alccofine 1206 is required to be done.
2. The study on addition of natural fibres to improve upon the toughness and crack resistance of M25 grade concrete with addition of Alccofine 1206 into OPC and partial replacement of OPC by Alccofine 1206 is required to be done.
3. The study on use of crusher dust as partial replacement with natural sand and addition of Alccofine 1206 into OPC & replacement of OPC by Alccofine 1206 for M25 grade of cement is required to be done.
4. The comparative study on addition of Silica fume & Alccofine 1206 with OPC and partial replacement of OPC by Silica fume & Alccofine 1206 for M25 grade concrete is required to be studied.

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