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Durability Properties of High Performance Fabric Fiber Reinforced Concrete with ALCCOFINE

HARINI.N, M.E
Structural Engineering (Student)Arulmigu Meenakshi Amman College of Engineering Vadamavandal -604 410,Thiruvannamalai Dt.

Dr.P.RAGUNATHAPANDIAN, M.E., Ph.D
Professor and Head of the DepartmentArulmigu Meenakshi Amman College of Engineering, Vadamavandal - 604 410,Thiruvannamalai Dt.

ABSTRACT
This project focuses on the durability properties of high performance concrete with fabric fiber. The HPC produced by addition of alccofine as a partial replacement of cement. fabric fibres are used in 0.1%, 0.2%, 0.3% selecting proportion for the mixof M60 grade concrete High Performance concrete is prepared with help of the guideline given by ACI-211-4R and in accordance with IS10262-2009. The specimen like cubes, cylinders and prism of standard size were casted for durability analysis. Alccofine is a new generation micro fine concrete material and which is important in respect of workability as well as strength. Also alccofine is easy to use and it can be added directly with cement. The ultrafine particle of alccofine provides better and smooth surface finish.It has the special attributes to enhance the performance of concrete in the fresh stage because of its optimized partical size distribution.In order to test durability test,compression strength,flextural strength of concrete at the interval of 7 days,14 days,28days of curing.

KEY WORDS – *Alccofine , Fabric fiber, partial replacement*

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I. INTRODUCTION

Concrete is a versatile building material made by mixing cement, fine aggregate, coarse aggregate and water. It is the cement and water that forms a paste, which glues the aggregate together and enables the concrete to set intoa hard, durable product. High Performance Concrete (HPC) is a composite materialconsisting of hydraulic cement, sand,alccofine, coarse aggregate, and water. In this composite material, fibres are randomly distributed throughout the concrete mass.

The usefulness of fabri fiber reinforced concrete (FFRC) in various civil engineering applications is indisputable. Fiber reinforced concrete has so far been successfully used in slabs on grade, architectural panels, precast products, offshore structures, structures in seismic regions, thin and thick repairs, crash barriers, footings, hydraulic structures and many other applications. Fabric Fiber Reinforced Concrete (FFRC) is gaining attention as an effective way to improve the performance of concrete.

Alccofine is a new generation, micro fine material of particle size much finer than other hydraulic materials like cement, fly ash, silica etc. It is manufactured in the controlled conditions with special equipments to produce optimized particle size distribution which is its unique property.

Alccofine 1203 is a proprietary patented product (IP Patent No. 297735) with low calcium silicate basedmineral additive.Controlled granulation process results in unique particle size distribution.

Its latent hydraulic property and pozzolanic reactivity results in enhanced hydration process. Addition of Alccofine 1203 improves the packing density of paste component.

II. LITERATURE REVIEW

1. BLN Saisrinath et al.,(2022)

Studied on Concrete is an indispensable construction material used worldwide. It primarily consists of the binder phase and aggregate phase. In the binder phase, cement replacement with silica fumes, fly-ash and ground granulated blast furnace slag (GGBS) is recommended in design mix guidelines (IS 10262- 2019). However, ultra-fine material like Alccofine was not recommended as supplementary cementitious material. This paper addresses the suitability of this admixture for concrete of various grades i.e. M20, M30 and M40 grade mixes. The relevant hardened concrete strength for 5%, 10%, 15%, and 20% cement replacement with

Alccofine was tested. All the design mixes established the acceptance criteria of test results. However, the highest test results were obtained for 15% replacement of Alccofine for all the mixes. Surprisingly the 28 days strength of M20 grade concrete was achieved even at seven days curing test results. In summary, the Alccofine material can reduce the consumption of cement and C02 emissions in the atmosphere.

2. K Ashwini, P Srinivasa Rao (2020)

Studied After water the most widely used substance on Earth is concrete. Manufacturing of cement for concrete consumes vast quantities of energy and releases CO2 in the process, which can be conserved by using supplementary cementitious materials. These materials enable to use hundreds of millions of tons of byproduct materials thereby reducing waste disposal problem and replacing part of cement withoutdeduction of equivalent engineering properties in binary blended or even ternary blended concrete. India is growing at an unprecedented pace and roads, bridges, dams, skyscrapers etc. are the need of an hour of the city. The Skyline is changing and with it demand for a sustainable, durable, eco- friendly and high performance concrete is increasing, to address this challenge a new generation micro fine pozzolanic material Alccofine can be used in concrete which opened the path for innovative research in the field of civil engineering. In this paper review on effect of recently developed Alccofine for sustainable development of concrete industry is studied.

3. P.R.Kalyana et al.(2017)

Studied the presence of Alccofine in theconventional concrete in optimum dosage can be expected to improve the compressive strength and provide resistance against chloride attack, sea water attack and accelerated corrosion attack. The main objective of this workfocuses on the compressive strength of concrete with partial replacement of cement with Alccofine. The project focuses on the experimental investigation on concrete by replacing cement with Alccofine on varying percentage. 0%, 4%, 8%, 16%, 17%, 20%, 25%, 50%, 75% and 100% for 7 and 28 days. The design mix carried out throughout the experiment was M25. The increase in percentage of compressive strength for 7 days and 28 days curing was found to be maximum at 16% replacement exhibiting the value of 50.95 % and 60.95% when compared with conventional. Alcoffine in various percentages improves the strength of concrete initial period. Alccofine acts as filler materials such that reduces permeability improving workability of fresh concrete. Overall it is a comparative study governing compressive strength as main point of contradiction.

4. M.V.Sekhar Reddy, et al. (2016) [15]

In this study investigated the done experimental work on partial replacement of cement with fly ash and alccofine for M40 Grade concrete. The fly ash and alccofine are replaced at 5%, 10%, 15%,20% with cement. The conclusion summarizes that the addition of alccofine indicates an early strength gaining capacity and is ecofriendly to nature. Alccofine showed greater results then compared with fly ash in long term Strength Properties.

5. S. Kavitha and T. Felix Kala (2016)

Evaluated the alccofine and GGBS combination can be used in the SCC as the strength enhancer. SCC being a high performance concrete after the addition of alccofine, produces a high performance and high strength concrete. Methods/Statistical Analysis: Mix design for SCC can be carried out by Nan-Su method which is considered as a simple mix design and the dosage of super plasticizer will be determined by trial and error as substantial result of characteristics of fresh and hardened concrete and effect of alccofine (5%, 10%, 15% and 20% by volume) by keeping the GGBS percentage constant (30%) on rheological properties and strength properties were investigated. Findings Applications/Improvements: The improvement in behaviour of SCC is because of enhancement in union strength and pore refinement by GGBS. In contrast, the improvement in properties of concrete like compressive strength from 36.6 to 42.9 N/mm2, splitting tensile strength from 3.8 to 7.9 N/mm2 and flexural strength from 4.9 to 8.3 N/mm2 at 28 days was observed with increase in alccofine dosage. Finally the conclusion has been drawn that alccofine and GGBS combination can be used in the SCC as the strength enhancer.

6. Nikhil G Raval, Nilesh Hapaliya (2016)

Studied about the India, road network is the world's second largest. It is 3.5 million km including both paved and unpaved surfaces. The major types of materials are used to construct the roads in the country are, bitumen and concrete. Concrete is a superior material in many counts, a very small share is used for road construction. Due to increase of utility of cement, many environmental problems are faced at the National level. It is necessary to think about the materials which can be used as alternative in the concrete. The use of specific amount of Alccofine in replacement of cement provides better strength. It is very much essential to develop

profitable building materials from Alccofine. The innovative use of Alccofine in concrete making formula as a cement replacement material was tested as an alternative to traditional concrete in the present study. To find optimum dosage of Alccofine, Cement is replaced by Alccofine in the range of 0%, 5%, 10%, 15%, 20%, 25% & 30% by weight for M-40 grade concrete. Concrete mixtures were produced, tested and compared in terms of compressive strength with the conventional concrete. These tests were carried out to evaluate the mechanical properties for 7, 14 and 28 days. The present study is focused on investigating the behaviour of concrete.

II. MATERIALS USED.

1. CEMENT

Ordinary Portland cement (53 Grade) was used for casting all the specimens. To produce fibre reinforced high performance concrete, the utilization of high strength cements is necessary. Different types of cement have different water requirements to produce pastes of standard consistence. Different types of cement also will produce concrete having a different rates of strength development. The choice of brand and type of cement is the most important to produce a good quality of concrete. The type of cement affects the rate of hydration, so that the strengths at early ages can be considerably influenced by the particular cement used. table 3.2.1 properties of cement will be shown. It is also important to ensure compatibility of the chemical and mineral admixtures with cement.
Properties of cement physical properties of the cement in the present experimental work are given below.

1.1 Physical Properties of Cement

S. No	Property of Cement	Values
1	Grade Of Cement	53
2	Fineness Of Cement	10%
3	Specific Gravity	3.15
4	Initial Setting time	30min
5	Final Setting Time	600min

2. FINE AGGREGATE: -

Clean and dry river sand available locally will be used. Sand passing through IS 4.75mm Sieve will be used for casting all the specimens. Free moisture forms a film around each particle. This film of moisture exerts what is known as surface tension which keeps the neigh bouring particles away from it. Similarly, the force exerted by surface tension keeps every particle away from each other. Therefore, no point contact is possible between the particles. This causes bulking of the volume. It is interesting to note that the bulking increases with the increase in moisture content upto a certain limit andbeyond that the further increase in the moisture content results in the decrease in the volume and at a moisture content representing saturation point, the fine aggregate shows no bulking. Sand conforming to Zone-II (White Sand) was used as the fine aggregate, as per I.S 383-1970. The sand was air dried
Properties of Fine Aggregate Physical properties of the fine aggregate used in the present work are given below.

1.1 Physical Properties of Fine Aggregate

S .No	Properties	Values
1	Specific Gravity	2.65
2	Fineness Modulus	2.20

3. WATER: -

Casting and curing of specimens were done with the potable water available in the college premises.
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4. COARSE AGGREGATE : -

Crushed granite aggregate with specific gravity of 2.7 and passing through 20 mm sieve and retained on 10 mm was used for casting all specimens. Several investigations concluded that maximum size of coarse aggregate should be restricted in strength of the composite. In addition to cement paste – aggregate ratio, aggregate type has a great influence on concrete dimensional stability. Concrete mixtures containing coarse aggregates derived from limestone or basalt are generally known to perform very well in FRHPC.

1.1 Physical Properties of Coarse Aggregate

S .No	Properties	Values
1	Specific Gravity	2.74
2	Size Of Aggregates	Passing through 20 mm and 10 mm Sieve
3	Fineness Modulus	5.90

5. ALCCOFINE (Mineral Admixture)

The mineral admixture (Alccofine-1203) enhances strength of concrete, modulus of elasticity along with workability, durability and reduction in segregation. HPC is required as a construction material in special structures like tunnels in sea beds, off-shore piers and platforms, jetties and ports, and tall structures .It can be used as an alternative material for cement. To reduce the usage of cement to certain limit.

The reason being, alccofine triggers the initial reaction during hydration of cement. Also, the latter age strength of concrete increases as the alccofine 1203 consumes the by- product calcium hydroxide that is released from the hydration of cement. Thus it forms extra amount of C-S-H gel which is similar to other pozzolans. The computed particle size distribution of alccofine (PSD) is approximately 12000cm²/g. It can be replacedwith cement even up to 70% for replacement level as per requirement.

5 .1 Physical Properties of Alccofine

S .No	Propertsies	Values
1	Colour	White
2	Specific gravity	2.8
3	Bulk density	650kg/m3
4	Partical size	Irregular

6. TEXTAIL WASTE POLYMIDES FABRIC FIBRES

Textile waste fabric fibers from "The Textile Deportment" has been used in this project. fiber such as polymides or natural fiber may be chemically more inertthan either steel or glass fibers. They are also cheaper, especially if natural. A large volume of vegetable fiber may be used to obtain a multiple cracking composite

ADVANTAGES OF TEXTILE FIBRES:

- Corrosion resistant reinforcement.
- They are light and thin.
- High quality fine grained concrete surfaces withgreat freedom ofdesign in terms ofsurface structure and colour.
- Can be freely positioned in alignment with the direction of force andclose to the surfaceof the component.
- Easy processing and high degree of freedom in form.
- Control cracking due to plastic shrinkage and drying shrinkage.

Figure :1 Fabric Fibers

IV. MIX DESIGN

Cement = 450 Kg/m³ Water = 141 Kg/m³ Fine aggregate = 652 Kg/m³Coarse aggregate = 1252 Kg/m³ Chemical admixture = 3.48Kg/m³
CEMENT : FINE AGGREGATE : COARSE AGGREGATE : WATER:ADMIXTURE1 :1.44 : 2.78 : 0.40 : 0.008

Mix Proportioning

Mix	Cementkg/m3	Alccofinekg/m3	FibreKg	FA kg/m3	CA kg/m3	WaterL/m3	SP L/m3
CM	620	-	-	546	1167	185	4.5
FFRHPC0.0	494	126	-	490.20	1167	185	4.5
FFRHPC0.1	494	126	0.9	487.42	1167	185	4.5
FFRHPC0.2	494	126	1.8	482.90	1167	185	4.5
FRHSC0.3	494	126	2.7	470.18	1167	185	4.5

V. RESULT AND ANALYSIS

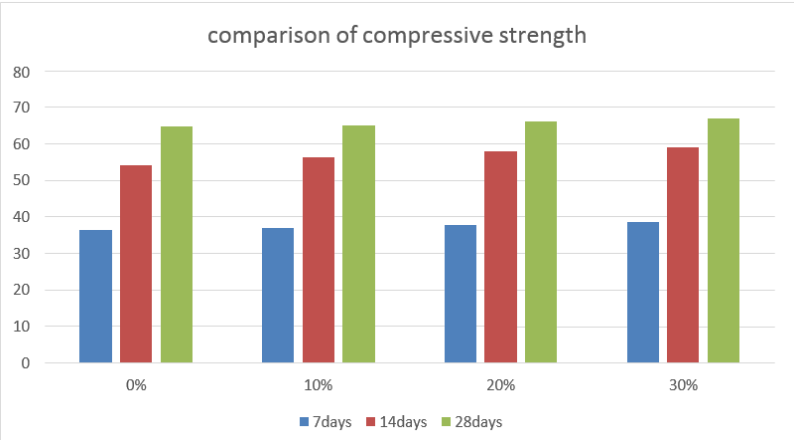
To study and compare the behaviour of concrete usingt, quarry dust as 100% replacement to sand and with addition of Alccofine & fabricfiber of various experimental investigations as mentioned above werecarried out on concrete samples to find their strength properties. To compare the test results of conventional concrete and self-cured concrete were tested with all its replacements. The concrete samples were casted with mix proportion of M60 grade concrete. The tests were carried out of 7days, 14 days, 28 days.

1. Compressive strength test

This test is considered as one of the most important properties ofconcrete and it is often used as an index of the overall qualityof concrete. For this, the cubes were casted cured and tested for its compressive strength at the age of 7, 14 and 28 day.

Comparison of compressive strength between standard, 10%, 20%and 30% for Alccofine of concrete cubes

% of Alccofine	7days (N/mm²)	14days (N/mm²)	28days (N/mm²)
0	36.41	54.08	64.80
10	37.00	56.43	65.03
20	37.84	58.05	66.16
30	38.57	59.18	67.00

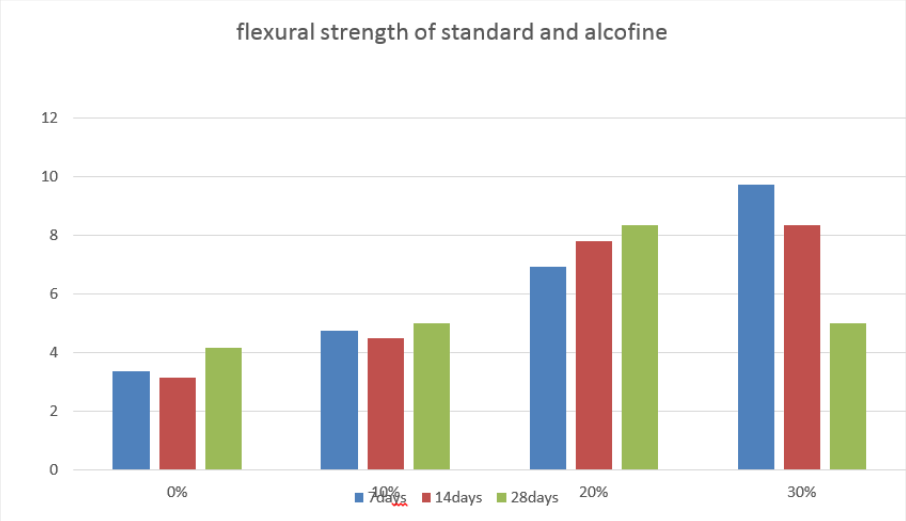


2. Flexural Strength Test

The concrete prisms were tested for its flexural strength at the age of 7, 14 and 28 days. The test result shown in table 8.7 revealed that flexural strength of Alccofine added concrete prism is considerably higher than that of standard concrete. Chart
8.7 shows the relation between no. of days and its mean flexural strength of concrete prisms.

Table - Flexural Strength of standard and Alccofine added concrete prisms

% of Alccofine	7days (N/mm²)	14days (N/mm²)	28days (N/mm²)
0	3.37	3.15	4.17
10	4.76	4.48	5.01
20	6.93	7.81	8.36
30	9.73	8.36	11.33



VI. CONCLUSION

In this phase study was conducted to evaluate the effect of using alccofine as the partial replacement of cement in concrete composites and also to give an idea to use these materials within specific range. By adding Alcoffine content there is minimum increase of compressive strength. The addition of fabric fiber does not have effect on compressive strength. By adding the fibers it increase creep resisiting of the concrete.Flexural strength increased with the Alccofine content and amount of fabric fiber content. Concurrent addition of alcofine and fiber was more effective at improving the flexural strength than the addition of either material individually. This is because the addition of Alccofine improved the bonding between materials through the formation of a dense mix.The impact energy increases with increase in Alcofine content and fiber content.Fabric Fiber Concrete with Alccofine content of 30% and fiber content of 0.3% showed improved impact resistance combined with adequate compressive strength, split tensile strength and flexural strength .

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