

## Review on Alccofine:Supplementary cementitious material in concrete

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### ABSTRACT

The aim of this paper is to highlight the importance of Alccofine as Supplementary cementitious materials in construction industries. Manufacturing of cement for concrete involves large amount of carbon dioxide emissions into the atmosphere, a major contributor for greenhouse effect and global warming. Thus it becomes necessary to discover a substitute material for cement in concrete. Supplementary cementitious materials (SCM) are becoming popular in the construction industry as these materials are bringing technical revolution in the field of civil engineering. Alccofine is a new generation micro fine concrete material for high Strength Concrete which is important in respect of workability as well as strength. This can be used as a SCM due to its ultrafine size and high content of calcium oxide (Cao), Alccofine1203 is essential in terms of reducing heat of hydration and strength at all stages. The ultrafine particle of Alccofine provides better and smooth surface finish.

**Keywords:** Concrete, Cement, Alccofine, Supplementary Cementitious Materials (SCM's), High Performance Concrete (HPC).

### 1. INTRODUCTION

In the past several years, improvements have been occurring in Concrete Technology. Revolutionary developments in super-plasticizing admixtures and sustainable use of supplementary materials have facilitated improvements in the mechanical properties and durability of concrete. The production and use of concrete had led to a wide range of environmental and social consequences. A major component of concrete is cement, which is one of the primary producers of carbon dioxide gas. The production of Portland cement contributed 7% to global anthropogenic CO<sub>2</sub> emissions, largely due to the sintering of limestone and clay at 1,500 °C. Growth in the infrastructure development and advancement in the concrete technology has further led to the evolution of High Strength Concrete (HSC). HSC is becoming more popular now-a-days and is highly accepted in the construction industry. High cement/binder factors and very low water/cement ratios are the two main characteristics of High Strength Concrete. A concrete with high cement/binder content and very low W/C ratios results in the poor workability and workability retention. 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. ALCCOFINE 1203 is a specially processed product based on slag of high glass content with high reactivity obtained through the process of controlled granulation. The raw materials are composed primary of low calcium silicates. Alccofine has unique characteristics to enhance, performance of concrete in fresh and hardened stages due to its optimized particle size distribution. The computed blain value based on PSD is around 12000 cm<sup>2</sup>/gm and is truly ultra-fine. ALCCOFINE 1203 can also be used as a high range water reducer to improve compressive strength or as a super workability aid to improve flow. Alccofine 1203 results in to formation of dense pore structure and inbuilt CaO provides increased secondary hydrated product because of which improved strength gain at early as well as later ages observed. Alccofine 1203 has the lime contain 34% which provides more quantum of secondary hydrated product. This results in prolonged chemical reaction and responsible for reduced heat liberated by the hydration process. Alccofine 1203 has batter particle packing which results in to increased rheology resulting in to improved flow ability. ALCCOFINE 1203 have utilized complying with ASTM C989-99.

**Table 1: Chemical Composition of Alccofine**

Chemical Analysis	Mass %
SiO <sub>2</sub>	33-35
Al <sub>2</sub> O <sub>3</sub>	18-20
Fe <sub>2</sub> O <sub>3</sub>	1.8-2
CaO	32-34
MgO	8-10
SO <sub>3</sub>	0.3-0.7

**Table 2: Physical parameters of Alccofine 1203 (ASTM C 989-99)**

Specific gravity	Bulk density (kg/m <sup>3</sup> )	Particle size distribution (μ)		
		d10	d50	d90
2.9	600-700	1-2	4-5	8-9

### Advantags of use of alccofine

- Use of alccofine as partial replacement of cement is Eco-friendly drive.
- Alccofine is acts as filler material as well as bonding agent as it show bonding property also.

- Use of fly ash in concrete can save the thermal industry disposal costs and produced a 'greener' concrete for construction.
- Alccofine and pond ash can be use to form various higher concrete grades.
- The cement content can be reduced a lot by increasing te Fly ash and Alccofine content to make it more economical and also we can achive designed strength.
- Partially replacement of cement is does not change original strength of concrete.

### Fields of Applications

- RCC residential, commercial structures
- High rise structures with challenging situations to pump the concrete with ease
- Temperature controlled mass concrete for raft and pile foundations
- Aluminum / tunnel form work with high flow or self-compacting concrete
- High performance concrete with extremely low water to binder ratio
- Shotcrete with improved cohesion and faster initial strength gain
- Precast concrete elements for tunnels, bridge, segmental construction, hollow core slabs, commercial precast units
- Post tension / pre stressed concrete slab
- Construction grouts, plasters, repair mortars

## 2. LITERATURE REVIEW

VimalArokiaraj G, Elangovan G experimented the effects of alccofine in concrete by optimum replacement of cement and variation of steel fibers to determine the workability and compressive strength. From the workability test results, slump value slightly decreases with optimum replacement 10% alccofine with varying percentage of steel fibers in concrete. The compressive strength for reference mix is 27.38 N/mm<sup>2</sup>. The compressive strength of 10% of alccofine concrete is 43.97 N/mm<sup>2</sup>.

T. Jaya Krishna, S. Venkatesh, K. Murali studied the Influence on Strength and Durability Analysis of Concrete Incorporating Optimum dose of alccofine by 12%. As compared with controlled concrete there is 39.5% increase in compressive strength. Flexural strength of plain concrete beams at 12% replacement of cement with alccofine shows 45% increase in flexural strength when compared with controlled concrete. Flexural strength of reinforced concrete beams at 12% replacement of cement with alccofine shows 62% increase in flexural strength when compared with controlled concrete. There is increase in 38% of split tensile strength of concrete cylinders with 12% alccofine and 1.5% by volume of steel fibers. There is also significant increase in flexural strength of steel fiber reinforced concrete beams with same amount of alccofine and steel fibers.

Suganya R, Lathamaheswari R focuses on the experimental investigation on concrete by replacing cement with alccofine on varying percentage such as 0%, 5%, 10%, 15%, 20% and 25% for 7, 14 and 28 days. The compressive strength of the concrete get increased when the cement is partially replaced with alccofine up to 15% and gradually decreases by increasing the percentage of alccofine. Optimum level of replacement of cement by alccofine is found to be 15%. Highest compressive strength is achieved at 15% replacement of alccofine and 100% replacement of manufactured sand in concrete.

MahimMathur, AshishMathur conducted experiment on Partial replacement with ordinary Portland cement (43 grade) which varies from 1% to 20% at interval of 1%, 2%, 3%, 4%, 5%, 10%, 15%, 20% by alccofine 1203. Addition of alccofine 1203 in Ordinary Portland Cement, Slump of the concrete mix increased initially 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. On 10% partially replacement of Ordinary Portland Cement with alccofine for M20 grade concrete, they found the compressive strength of 41.11N/mm<sup>2</sup> which are greater than the target compressive strength of normal M30 grade concrete.

A. ParvathyKarthika, V. Gayathri analyses the performance of various combinations of concrete in which cement is partially replaced with 30% fly ash with different proportions of alccofine of grade 1203, micro fine silica includes 0%, 4%, 8%, 12% respectively. Specimens are casted for M 60 grade as per mix design using manufactured sand (M sand) as fine aggregate. From RCPT results, the charge passed in Coulombs get reduced that is permeability class changed from low to very low. The durability aspects of concrete for a mix proportion consisting of 30 % fly ash and 12 % alccofine replaced with cement was best among all other combinations.

Keyur S Jasani, S. Manivel and G. Senthil Kumar examines the influence of recycled aggregate on the compressive strength, split tensile strength and flexural behavior properties of an R.C beam. Addition of Alccofine 1203 in recycled aggregate concrete decreases porosity and gives better bonding behavior, due to which a better load-deflection curve is obtained compared to conventional concrete. As a result, Alccofine 1203 shows less crack spacing and crack width compared to that of conventional concrete.

KomalaPriya, P. Eswanth studied the strength characteristics of concrete are observed by partially replacing the cement in concrete with 8%, 10% and 12% Alccofine and compared with normal concrete. There is more strength increment between 8% and 10% replacement compared to 10% and 12% replacements. There is slight increment from 10% to 12% replacement levels and therefore it can be concluded that 10% replacement is the optimum percentage of replacement of cement.

B. Kaviya et al carried out the experimental work for effects of Alccofine as a supplementary cementing material and filling material on the strength of concrete was investigated. It is observed from the result that the alccofine material increases the strength to a large extent at 15% replacement level of cement. The addition of Alccofine increases the self compatibility characteristics like filling ability, passing ability and resistance to segregation. It increases the durability and resistance to chemical attack and also reduces the heat of hydration. The relative cost of Alccofine is cheaper than cement hence it is economic with higher strength. By use of super plasticizer reduces the water demand and increase the workability of concrete

Faisal. K. M., AnishaAsafali evaluated the performance of concrete containing supplementary materials such as alccofine and glass fiber. Alccofine increases the workability till 10 % of replacement of cement. Alccofine is an early strength gaining material. Replacement of cement till 10 % of alccofine will help in attaining high strength concrete. Glass fibers reduce the workability but it can be counteracted by the addition of super plasticizers. Addition of glass fiber increases the fracture toughness of concrete.

Pooja S. Naringrekar, Dr.Sumedh Y. Mhaske Study on New Supplementary Cementitious Material in Construction of Green Building, cement is partially replaced by ALCCOFINE 1203 and Silica Fumes for M80 grade of concrete. ALCCOFINE 1203 has less content of calcium oxide and silicon dioxide compare to silica fumes. The maximum compressive strength of M80 grade concrete for 28 days curing period is 83.9 MPa by partial replacement of cement by 15% ALCCOFINE and fine fly ash. ALCCOFINE 1203 is more economical cementitious material than silica fumes hence its is also known as green building material.

Manisha M. Magdum, Dr. V. V. Karjinni presents the influence of Alccofine-1203 on mechanical properties of hybrid fiber reinforced concrete. Fiber volume fraction (VF) 1.5% by volume of concrete was added with Alccofine-1203 contribution of 5%, 7.5% and 10% by weight of cement. Experiments with M60 grade of concrete suggest that 7.5% replacement of cement with Alccofine-1203 and 1.5% hybrid fibers(80% steel fiber and 20% polypropylene fiber) resulted in best concrete compressive strength. The flexural strength of concrete with 7.5% replacement of cement with Alccofine-1203 and 1.5% hybrid fibers (80% steel fiber and 20% polypropylene fiber) resulted in maximum. The results indicated that the use of hybrid fibers with Alccofine-1203 enhance the mechanical properties of concrete.

Yatin H Patel et al investigated the performance of concrete (HPC) containing supplementary cementitious materials such as Fly ash & Alccofine. compressive strength achieved by using Alccofine (8%) + Fly Ash (20%) is 54.89Mpa and 72.97 Mpa at 28 and 56 days

respectively. The minimum loss of weight and loss of compressive strength of concrete in Chloride Resistance test and Sea water test due to addition of Alccofine. Due to its more compactness and less permeability of concrete effect of Chloride Attack is reducing.

### 3. CONCLUSION

Alccofine being use as mineral admixture in a concrete mix increase the initial strength of the concrete than the ordinary concrete. The concrete posses high workability and retain the workability for sufficient time. Alccofine is easy to use and can be added directly with cement, ultrafine particle of Alccofine provide better and smooth surface finish. Alccofine improves workability of concrete. For Alccofine, the water demand is reduced to achieve the specific slump value. This decrease in water demand is due to the presence of the high glass content which has water repelling properties. Due to the presence of inbuilt CaO content, Alccofine triggers both the primary and the pozzolonic reactions resulting in the formation of additional C-S-H gel. This results in the formation of dense pore structure and ultimately higher strength gain. Hydration and pozzolonic reactions of the Alccofine mixtures improved the pore structure of concrete. Because of its finer pore structure and chemical stability, Alccofine in concrete is substantially more resistant to chloride diffusion. Thus, it reduces the penetration of chlorides in concrete and protects embedded steel from corrosion resulting in the improved durability of concrete. For high strength concrete the cost of the concrete mix prepared with Alccofine is lesser than the concrete without Alccofine. It also lower the water/binder ratio.

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