



A REVIEW PAPER ON PARTIAL REPLACEMENT OF PORTLAND CEMENT BY ALCCOFINE

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Abstract –

Concrete is most widely used material for construction. Major component of concrete is cement. There is large amount of carbon dioxide emissions into the atmosphere, a major contributor for green house effect and global warming during manufacturing process of cement. Thus it becomes necessary to discover a substitute material for cement in concrete. There are many other Supplementary Cementitious Materials (SCM's) have been used as a partial replacement to cement in the production of concrete. Also the necessity of High Performance Concrete is increasing day by day. The production of high strength and durable eco-friendly concrete leads to the use of a new generation ultrafine supplementary cementitious material. Alccofine is a new generation micro fine concrete material which can be use in concrete by partially replacing the cement. Properties of concrete can be improved by partial replacement of cement by alccofine. Also Alccofine is easy to use and it can be added directly with cement. This paper involves the review of published literature of various authors which focused on effect of partial replacement of cement with alccofine in concrete. It is concluded that partial replacement of cement with alccofine can improve the strength and durability characteristics of concrete. The cost of concrete mix prepared with alccofine is less than the concrete without Alccofine for high strength concrete.

Keywords—Concrete, Cement, Alccofine, Supplementary Cementitious Materials (SCM's), strength and durability characteristics.

INTRODUCTION

Concrete is the most frequently and widely used construction material. Concrete is a homogenous mixture of cement, sand, coarse- aggregate, water and admixtures. . A major component of concrete is cement, which is one of the primary producers of carbon dioxide gas. Manufacturing of cement for concrete involves large amount of carbon dioxide emissions into the atmosphere, a major contributor for green house effect and global warming. Also necessity of high performance concrete is increasing because of the increasing demand of the construction materials in the construction industry. Thus it becomes necessary to discover a substitute material for cement in concrete. A lot of Supplementary Cementitious Materials (SCM's) like fly ash, silica fumes, slag powder etc. have been identified in the past and also have been effectively used as a partial replacement to cement in the production of concrete. The production of high strength and durable eco-friendly concrete leads to the use of a new generation ultrafine supplementary cementitious material Alccofine as a partial replacement of cement in concrete. This new ultrafine pozzolonic material has become popular in the construction industry and has brought a revolution in the field of civil engineering. A significant improvement in the properties of concrete at fresh and hardened stage has been observed by the partial replacement of cement with Alccofine in concrete. [15]

ALCCOFINE

Alccofine is a new generation, micro fine material of particle size much finer than other hydraulic materials like cement, fly ash etc. manufactured in India. It has unique characteristics to enhance 'performance of concrete' in fresh and hardened stages. It can be used as practical substitute for Silica Fume. This new ultrafine pozzolonic material has become popular in the construction industry and has brought a revolution in the field of civil engineering. A significant improvement in the properties of concrete at fresh and hardened stage has been observed by the partial replacement of cement with Alccofine in concrete.

Series of alccofine:

Alccofine series 1200: It is a range of micro fine mineral additives for concrete. It improves the performance parameters of concrete in wet and hardened stage.

Alccofine series 1100: It is a range of cementitious micro fine injection grouts for soil stabilisation, tunnel grouting, permeation grouting,etc

Alccofine series 1203: A supplementary cementitious material suitability replaces silica fume used in high performance concrete.

Alccofine series 1101: A micro fine cement based product used for injection grout in underground tunnels and soil stabilization etc. [2]

From above series of alccofine, alccofine 1203 can be used as supplementary cementitious material in concrete as partial replacement of cement. It can also be used as a high range water reducer to improve compressive strength or as a super workability aid to improve flow.

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 [4]

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 ingress becomes difficult
- Lowers permeability of the mix [4]

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 [15]

REVIEW OF LITERATURE

B.Kaviya, K.Rohith et.al [1] studied about partial replacement of cement using alccofine. The mechanical properties of Alccofine have been studied. Alccofine 1203 is a specially processed product based on high glass content with high reactivity obtained through the process of controlled granulation. Concrete attains high strength at a very early age, due to the presence of alccofine material. The mechanical properties studied here are compressive strength on concrete cubes at 7 & 28 days of curing and split tensile on cylinders at 7 & 28 days of water curing. It is observed from the result that the alccofine material increases the strength to a large extent at 15% replacement level of cement.

Ankit Nainwal, et.al [2] presented Comparison Between Simple Concrete Cubes And Alccofine Mixed Concrete Cubes (M20 Grade). The paper deals with the comparison of normal concrete cubes and alccofine mixed concrete cubes. The compressive strength of hardened concrete is considered to be an index of other properties for e.g quality and quantity of cement, water and aggregates; batching and mixing; placing, compaction and curing. The aim of study was to evaluate the performance of concrete containing supplementary cementitious materials such as alccofine and the effect of alccofine on the properties of concrete.

Surendra Kumar, Mr. Rohit Kumar[3] presented review on Behaviour of High Performance Concrete Using Alccofine and Flyash. The aim of study was to evaluate the high performance of concrete containing supplementary cementations material such as alccofine & fly ash. In the paper literature of various researchers were studied on durability of high performance concrete with alccofine & fly ash. The necessity of HPC is increasing because of demands in the construction industry. Efforts for improving the performance of concrete over the past few years suggest that cement replacement materials along with mineral & chemical admixtures can improve the strength and durability characteristics of concrete. Alccofine is a new generation micro fine

concrete material for high strength concrete which is important in respect of workability as well as strength. For high strength concrete the cost of the concrete mix prepared with alccofine is lesser than the concrete without alccofine.

Saurabh Gupta, Dr. Sanjay Sharma et.al [4] presented Review on Alccofine : A supplementary cementitious material. Supplementary cementitious materials (SCM) are becoming popular in the construction industry as these materials are bringing technical revolution in the field of civil engineering. The aim of paper is to highlight the importance of Alccofine as Supplementary cementitious materials in construction industries. 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 where as Alccofine 1101 can be used as a grouting purpose.

Ansari U.S., Chaudhri I.M. et.al [5] presented research on High Performance Concrete with Partial Replacement of Cement by ALCCOFINE & Fly Ash. In this study cement is partially replaced by ALCCOFINE and fly ash for M70 grade of concrete. The compressive strength of concrete of OPC concrete and with ALCCOFINE and fly ash is compared and it has been found that the strength of concrete got increased by 20% with partial replacement of cement by ALCCOFINE.

K. Gayathri, Dr. K. Ravichandran et.al [7] studied about Durability and Cementing Efficiency of Alccofine in Concretes. A new ultrafine material called Alccofine is tried out for replacing partially in this study. M20 grade of concrete is intended to study the Durability And Cementing Efficiency of Alccofine in concretes by replacing the cement with Alccofine of various percentages such as 5%, 10%, 15%, 20%. Design mix is made for M20 grade and cubes were cast with various percentage of alccofine as said above. The results are presented and discussed. It is observed that 15% of alccofine replacement with the cement is yielding good strength as compared to other mix percentages. Also it is determined that the cementing efficiency of alccofine is good in earlier ages of concrete.

Ishan Tank, Sanjay Sharma et.al [8] presented Study on Rheological and Hardened Properties of Alccofine and Fly Ash based High Strength Self- Compacting Fibrous Concrete. This study presents the effect of incorporating Alccofine and crimped steel fibres on the rheological and mechanical properties of HSSCC. Slump flow, V-funnel, L-box and U-box was carried out for rheological properties and compression, splitting tensile and flexure tests were carried out to know the mechanical properties. Fibres were added in the proportion of 0.5%, 1.0% and 1.5% and were compared with the controlled mix. There was significant increase in the splitting tensile strength and flexural strength of the concrete mix designed.

Jigar N.Saiya, Ankit A.Tiwari[9] presented paper on experimental investigation on effect of alccofine with fly ash and GGBS on high performance concrete. This paper is an attempt to study the behaviour of Alccofine 1203 (5%, 6%,7%,8% and 10% replacement by weight of cement) along with Fly Ash (15%) and GGBS (15%) replacement on fresh & hard property of concrete. As well as optimizing the percentage dosage of chemical admixture to achieve required retention period (upto 3hrs) and workability (Slump and Flow) to increase the productivity of concrete design. This paper also studies the effectiveness of applying value engineering to actual concrete mixtures. The application of value engineering to such concrete mixtures results in increase in performance, optimizing the mix by adding appropriate dosage of admixtures so as to work in different situation and increase its value, increase in durability of structure in which concrete will be used, reduction in cost of concrete and overall cost of construction projects, increasing the market share and competitiveness of concrete producers. This research shows that applying the methodology of value engineering to ready-mixed concrete is an effective way to save around 5% of the total cost of concrete mixtures supplied to construction projects

Malvika Gautam, Dr. Hemant Sood[14] presented review on Effect of Alccofine on strength characteristics of Concrete of different grades. In this paper literatures of various researchers who have researched on durability of high performance concrete with Alccofine are reviewed. Because of the demands in the construction industry, the necessity of high performance concrete is also increased. Over the past few years, the efforts which are made for improving the performance of concrete suggest that cement replacement materials along with the minerals and chemical admixtures can improve the strength and durability characteristics of concrete.

Siddharth Upadhyay, Prof. M.a. Jammu [6] studied effect on compressive strength of high performance concrete incorporating alccofine and fly ash. In this study two different shapes of cubes were casted (cylindrical and cubical) and their strength was compared. The author partially replaced cement with ultra-fine slag Alccofine. Compressive strength between cylindrical and cubical concrete was compared and from the comparison following conclusion were drawn:

- With Alccofine hardened properties of concrete are increased or are improved.
- There were very nominal changes after 10% replacement of Alccofine.
- Cylindrical strength of concrete increases after addition of Alccofine but always less than its cubical counterpart.

Abhijitsinhparmar, Dhaval M Patel [10] presented Experimental Study on High Performance Concrete by Using Alccofine and Fly Ash - Hard Concrete Properties. A concrete can be made high performance by using SCM's. In this research work author replaced cement with Alccofine, GGBS and fly ash. The test's which were taken into consideration were compressive strength test, chlorides attack tests, sea eater test and accelerated corrosion test at the age of 28 and 56 days. The author concluded that the results shows that concrete incorporating with alccofine and fly ash have higher strength and also alccofine has increased the durability of concrete have reduced the chloride diffusion. The compressive strength achieved by using Alccofine (8%) + fly ash (20%) is 54.89 Mpa at 28 days and 72.97 Mpa at 56 days.

Yatin H Patel, P.J. Patel, Prof. Jignesh M Patel, Dr. H S Patel[11] presented Study on Durability of High Performance Concrete With Alccofine And Fly Ash. In this study author used fly ash, volcanic ash, volcanic pumice, pulverized fuel ash, blast slag and silica fume as cement replacement material. The main of this study was to have ecofriendly and economical high strength concrete. After curing, compressive strength test was carried out at 7, 28, 56 days and results shows that the compressive strength test at 7 days is excellent, between 7 to 28 days the strength gained was comparatively less and between 28 to 56 days strength gain is high because of fly ash in m³ proportion. and according to IS 456-2000 table 7 clause 6.2.1 fly ash in m³ proportion get acceptable strength. It is found that initial compressive strength achieved by using fly ash (22%) and Alccofine (8%) is 42.33 Mpa and 66.64 Mpa at 7 and 28 days respectively, but after 28 days strength gain is comparatively less.

M.S. Pawar, A.C. Saoji. Et.al [12] studied Effect of Alccofine on Self Compacting Concrete. In this study properties of SCC and fly ash are evaluated and compared with the properties of SCC with fly ash and alccofine. From the experimental investigations following conclusions were drawn.

- Filling ability, passing ability and resistance to segregation are the self compatibility characteristic are increased by adding alccofine in SCC mixes.
- The properties such as fresh properties and harden properties of SCCs are superior with 10% alccofine as compared to the 5% and 15% of alccofine.

Rajesh Kumar S, Amiya K Samanta, Dilip K. Singha Roy [13] presented An Experimental Study on The Mechanical Properties Of Alccofine Based High Grade Concrete . In this paper author concluded that alccofine increases compressive as well as flexural strength to a large extent at 10% replacement. 7 days of compressive strength when compared and cement replaced by 10 % alccofine, strength is increased by 25.5% and when 28 days curing has been done it is found that the flexural strength is increased by 27.6%. it acts as a filler material if the percentage of alccofine is increased beyond that level and also it yields good workability to the concrete.

CONCLUSION

This paper presents a review on effects of partial replacement of cement by using Alccofine on properties of concrete. It was found that the addition of Alccofine show early strength gaining prop term strength. It is recommended to utilize the Alccofine material with cement after checking its durability studies. The following conclusions are drawn:

1. Alccofine being use as mineral admixture in a concrete mix increase the initial strength of the concrete than the ordinary concrete.
2. The concrete posses high workability and retain the workability for sufficient time.
3. Alccofine is easy to use and can be added directly with cement, ultrafine particle of Alccofine provide better and smooth surface finish.
4. 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.
5. Alccofine is proved to be a superior Supplementary Cementitious Material as compared with other materials enhancing the workability, strength and durability of concrete. Optimum dosage of Alccofine may be considered as 15%.
6. The addition of Alccofine in SCC mixes increases the self compatability characteristic like filling ability, passing ability and .resistance to segregation.

7. As per cost concern ALCCOFINE is cheaper than cement so for better strength and durability of concrete it should be promoted in Indian construction industry.
8. The addition of Alccofine increases the self compatibility characteristics like filling ability, passing ability and resistance to segregation.
9. ALCCOFINE 1203 has less content of calcium oxide and silicon dioxide compare to silica fumes. Hence ALCCOFINE 1203 is ecofriendly material used in concrete preparation.

REFERENCES

- B.Kaviya, K.Rohith, Soniya Kindo,et.al, "Experimental Study On Partial Replacement Of Cement Using Alccofine," International Journal of Pure and Applied Mathematics Volume 116 No. 13 2017, 399-405.
- Ankit Nainwal, Akshay Chauhan , Jaibeer Bhandari, "Comparison Between Simple Concrete Cubes And Alccofine Mixed Concrete Cubes (M20 Grade)", *IJSRE Volume 05 Issue 09 September 2017*, pp.6857-6871.
- Surendra Kumar, Mr. Rohit Kumar, "A Review Paper On Behavior Of High Performance Concrete Using Alccofine And Flyash," in International Journal For Technological Research In Engineering Volume 5, Issue 10, June-2018, ISSN (Online): 2347 – 4718
- Saurabh Gupta, Dr. Sanjay Sharma, Er. Devinder Sharma, "A Review on Alccofine : A supplementary cementitious material", International Journal of Modern Trends in Engineering and Research (IJMTER), Volume 02, Issue 08, [August– 2015] ISSN (Online):2349–9745
- Ansari U.S., Chaudhri I.M., Ghuge N.P., et.al, "High Performance Concrete with Partial Replacement of Cement by ALCCOFINE & Fly Ash", Indian Research Transaction Vol. 5, No.2 , Apr-June 2015 EISSN: 2250-0804, pp. 19-23.
- Siddharth P Upadhyay Prof. M.A. Jamnu "Effect on compressive strength of high performance concrete incorporating alccofine and fly ash" ISSN, Volume 2 Issue 2
- K. Gayathri, Dr. K. Ravichandran and Dr. J. Saravanan, "Durability and Cementing Efficiency of Alccofine in Concretes", International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 5 Issue 05, May-2016
- Ishan Tank, Sanjay Sharma et.al, " Rheological and Hardened Properties of Alccofine and Fly Ash based High Strength Self- Compacting Fibrous Concrete", International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887 Volume 5 Issue VIII, August 2017.
- Jigar N.Saiya, Ankit A.Tiwari , "experimental investigation oneffect of alccofine with flyash and GGBS on high performance concrete", International Advanced Research Journal in Science, Engineering and Technology Conference on Advances in Civil Engineering 2018 (CACE-2018), Vol. 5, Special Issue 3, February 2018
- Abhijitsinh Parmar, Dhaval M Patel, "Experimental Study on High Performance Concrete by Using Alccofine and Fly Ash - Hard Concrete Properties" International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 12, December.
- Yatin Patel, Dr. B.K. Shah,et.al.,Study on durability of high performance Concrete with alccofine and fly ash, (1998). IJSRD Vol.1 Issue (2013)
- M.S. Pawar, A.C. Saoji, "Effect of Alccofine on Self Compacting Concrete" The International Journal of Engineering and Science (IJES), Volume 2 Issue 6,Pages05-092013,ISSN(e): 2319 – 1813 ISSN(p): 2319 – 1805
- Rajesh Kumar, Dilip k. Singha "An experimental study on the mechanical properties of alccofine based high grade concrete" International Journal of Multidisciplinary Research and Development
- Malvika Gautam, Dr. Hemant Sood, " A review on Effect of Alccofine on strength characteristics of Concrete of different grades", International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 04 Issue: 05, May -2017.
- Abhishek Sachdeva, V. Rajesh Kumar, " Replacement of Portland cement with Alccofine: A Review", International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653,Volume 6 Issue III, March 2018