

# A CRITICAL REVIEW ON THE ALCCOFINE BASED CONCRETE

## Abstract

This critical review provides insights into the application of Alccofine 1203 in the construction industry. Presently, numerous researchers are actively working towards making concrete more environmentally friendly and reducing carbon dioxide emissions during the manufacturing and construction processes. Alccofine 1203, as a micro-finer additive for mortars and concrete, offers unique and significant properties, including low calcium silicate, hydraulic and pozzolanic activity, and enhancement of cement past packing density. This review thoroughly examines decades of research on Alccofine 1203 and concluded that the optimal dosage of this additive should range from 8% to 12% by volume of the total binder content, depending on the concrete grades. However, adjustments to this proportion might be necessary to achieve specific properties in the concrete.

**Keywords:** Alccofine; High Performance Concrete; High Strength Concrete; Micro Fine Particles

## Authors

### S. C. Boobalan

Assistant Professor  
Civil Engineering  
Sri Krishna College of Engineering and Technology  
Coimbatore, India.  
boobalansc@skcet.ac.in

### V. Gayathri

Associate Professor  
Civil Engineering  
Kumaraguru College of Technology  
Coimbatore, India.  
gayathri.v.ce@kct.ac.in

## I. INTRODUCTION

Currently, researchers are actively exploring alternatives to traditional cement ingredients in concrete to mitigate greenhouse emissions in the atmosphere. They are using cement replacement materials (CRMs) and new micro-fine generation materials like ground granulated blast furnace slag (GGBS) as partial substitutes. The main purpose of CRMs is to enhance the refinement and production of concrete while densifying its microstructure, resulting in reduced permeability. Alccofine is one such material, that serves the purpose of cement replacement material.

Alccofine is a new micro-fine material of particle size much lower than other hydraulic materials like fly ash, cement, GGBS, silica fume, etc., manufactured in India. It has significant attributes, such as optimized particle size distribution, which will improve concrete performance in the fresh and hardened stages. It will be improving the packing density of the cement paste components, reducing water demand and admixture dosage. Meanwhile, it will improve any concrete's durability and strength parameters at all ages. The calculated amount of Alccofine 1203 will be extra to the concrete mix proportion along with cement and other pozzolanic materials. The recommended dosage is 8% to 12% by volume of the total binder content based on the grades of concrete.

High performance concrete was studied with high-quality ingredients of Alccofine 1203. M50 grade concrete was prepared with partial replacement of conventional cement with Alccofine 1203 by 5%, 10%, 15%, and 20%, respectively. They determined the mechanical properties of HPC, modulus of elasticity, and durability property of rapid chloride permeability values. He concluded that the 10% optimum replacement of Alccofine showed improved strength and durability properties compared to the controlled concrete mix proportion (Srinivasan, 2020). Concrete was manufacturing with full replacement of natural sand and partial replacement of Alccofine 1203 in the ranges of 0 to 25% in the increment of 5%. The experimental results showed that 15% of Alccofine in the concrete mix showed better results and after that gradually decreasing manner was achieved (Suganya, 2019). M80 grade of high strength concrete was prepared with Alccofine and industrial waste products. Strength properties showed that 5% of Alccofine showed high compressive strength results when compared to the other proportions (Varinder Singh, 2018). M60 grade of high performance concrete was developed based on the ACI method blended with flyash of 20% and alccofine of 0 – 15% in the increment of 3% along with water-cement ratio of 0.25. The mechanical properties values showed that 12% addition of alccofine in M60 grade concrete attained higher strength than the remaining proportions (Surendra Kumar, 2018).

The cement mortar cube strength was depended on the partial replacement of alccofine in the mortar mix proportion. Due to its higher pozzolanic nature, hydration process yields denser CSH gel and it exhibits addition of Alccofine 1203 yielded higher strength for the cement mortar cubes (Balamuralikrishnan, 2021). The self compacting concrete was developed with the effective addition of 25% flyash and alccofine of various percentages (5, 10, 15%). The results indicated that the mechanical properties obtained better for the mix proportions of 10% alccofine (Bode Venkata Kavyateja, 2020).

A comprehensive review on the concrete with alccofine powder concluded that the fineness property doesn't increasing the water demand. Meanwhile the dosage of the

alccofine in the ranges of 5 – 15% of the volume of the ordinary Portland cement (Tejashree Chaudhari, 2021). Another comprehensive review on the alccofine based concrete was conducted, their review of literatures showed that low calcium silicate available alccofine (range of 0-20%) increases the strength of the concrete (Narender Reddy, 2017). Another review on the alccofine based high performance concrete suggested that 15% replacement showed better strength properties and enhances the durability and workability of the concrete (Boobalan, 2021).

The objective of this critical review gives an idea of utilization of Alccofine 1203 in the various applications and their optimum proportions in the cement concrete and also for the cement mortars. The addition of alccofine increases the hydration process resulted in the improved CSH gel which in turn increasing the strength of the specimens.

## II. MATERIAL PROPERTIES

Alccofine 1203 is used as an additive for the concrete and mortars. It has low calcium silicate content. Its hydraulic and pozzolanic properties resulted in superior hydration process. The optimum proportion of Alccofine 1203 varies from 8 – 12 % by the volume of the cement. The presence of calcium oxide and silica in Alccofine of higher amounts improves the pozzolanic reaction, which in turn additional amount of CSH gel is formed, resulted in the development of superior core concrete matrix (Bhanavath Sagar, 2021). The typical properties of Alccofine 1203 are shown in table 1.

**Table 1: Typical Properties of Alccofine 1203**

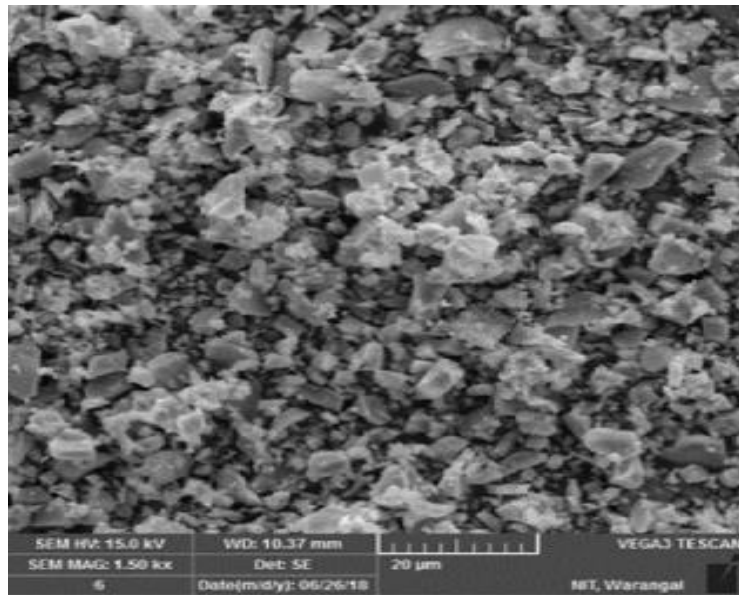
Property Description	Range of Values	Chemical Properties	% Mass
Specific Gravity	2.86	CaO	30 – 34
Fineness	12000 cm <sup>2</sup> /gm	Al <sub>2</sub> O	18 – 25
Average Particle Size	4 – 6 microns	Fe <sub>2</sub> O <sub>3</sub>	0.8 – 3.0
Bulk Density	600 – 700 kg/m <sup>3</sup>	SO <sub>3</sub>	0.1 – 0.4
		MgO	6 - 10
		SiO <sub>2</sub>	30 - 36

Alccofine 1203 mixed with concrete reduces the pores available due to its fineness. The shape, size and morphology of the Alccofine 1203 is presented in SEM image of figure 1. The more amount of calcium oxide in the Alccofine is making the concrete to perform superior with other ultra fine ingredients of concrete. The proportion of Alccofine is presented in figure 2 (Bhanavath Sagar, 2021). The chemical properties of Alccofine form EDAX shown in table 2.

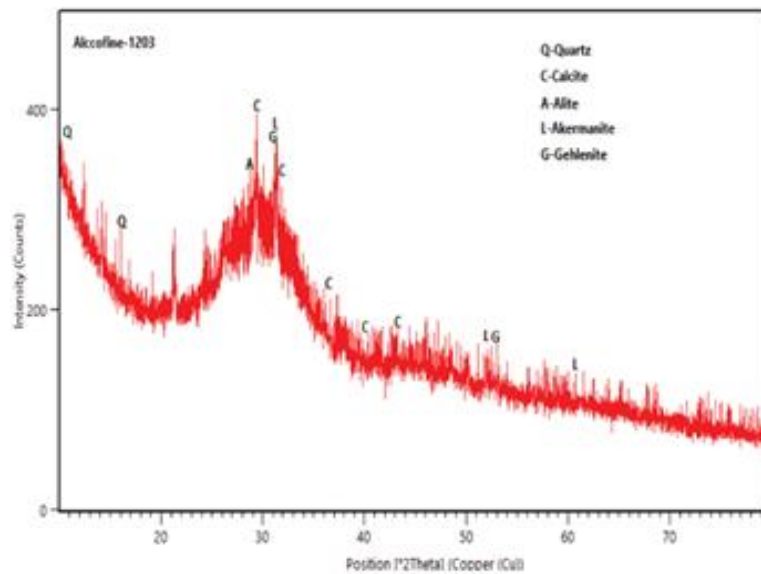
**Table 2: Chemical Properties of Alccofine 1203**  
(Panga Narasimha Reddy, 2020).

Property Description	Weight (%)	Atomic (%)
C K	45.69	57.64
Ca K	8.66	3.27
Al K	4.01	2.25

O K	35.26	33.39
Si K	6.38	3.44



**Figure 1:** SEM image of Alccofine 1203 (Bhanavath Sagar, 2021)



**Figure 2:** XRD Analysis of Alccofine 1203 (Bhanavath Sagar, 2021)

### III. EXPERIMENTAL INVESTIGATION

The experimental investigations carried out with the addition of Alccofine 1203 in the various types of concrete were studied. The physical and chemical properties of the materials used in the concrete are studied and then required materials are selected for the mixing of the concrete. The experimental investigation includes the fresh, hardened and durability properties. The testing of various types of concrete in addition of alccofine is shown in table 3.

**Table 3: Testing of Alccofine in the Various Grades and Application of Concrete**

Literatures	% of Alccofine	Grade of Concrete	Testing properties description	Optimum proportion of Alccofine
Srinivasan, 2020	5, 10, 15, 20	M50	Mechanical and durability properties	10%
Mahim Mathur, 2018	0, 5, 10, 15, 20	M20	Fresh and hardened properties	10%
Suganya, 2019	5, 10, 15, 20, 25	M20	Mechanical properties	15%
Kaviya, 2017	5, 10, 15	M30	Mechanical Properties	10%
Surendra Kumar, 2018	0, 3, 6, 9, 12, 15	M60	Mechanical Properties	12%
Mahim Mathur, 2018	0, 5, 10, 15, 20	M20	Mechanical Properties	10%
Balamuralikrishnan, 2021	0, 5, 10, 15, 20	Mortar	Strength Properties	10%
Panga Narasimha Reddy, 2020	0, 4, 8, 12, 16	Various Mixes	Durability Properties	8%
Bode Venkata Kavyateja, 2020	0, 5, 10, 15	SCC	Strength Properties	10%
Rajesh Kumar, 2015	0, 5, 10, 15, 20	M60	Mechanical Properties	10%
Kulkarni, 2011	0, 30%	Design mix	Strength and Durability	30%
Pavittar Singh, 2017	0, 3, 6, 9, 12	M80	Strength Properties	12%
Devinder Sharma, 2016	15%	M100	Durability Properties	15%
Mohd. Hamraj, 2014	0, 5, 10, 15, 20	M50	Strength and Durability	15%
Karthick, 2020	0, 5, 10, 15	M60	Strength Properties	10%
Sinha Deepa, 2016	0, 4, 6, 8, 10	M50	Strength Properties	8%
Ardra Mohan, 2017	0, 5, 10, 15	SCC	Mechanical Properties	10%

#### IV. RESULTS AND DISCUSSION

The development of self compacting concrete was mixed with alccofine in the ranges of 0 – 15% by the increment of 5% resulted in 10% partial replacement of alccofine based SCC concrete achieved high strength properties (Ardra Mohan, 2017), (Bode Venkata Kavyateja, 2020). A comprehensive review of the alccofine based concrete in the recent studies concluded that 8 – 12 % of the partial replacement of alccofine showed higher strength properties (Boobalan, 2021).

The workability properties of the high strength and high performance concretes with addition of alccofine in the ranges of 0 – 15% by the increment of 5% resulted in higher compressive strength, splitting tensile and flexural strength values (Mohd. Hamraj, 2014). In the past two decades, various researchers were going on for utilizing the alccofine in the

effective manner for achieving the higher strength properties due to the calcium silicate content. The durability properties such as water permeability, rapid chloride permeability tester, carbonation, acid resistance values of the concrete was enhanced due to the adding together of alccofine in some percentage to the concrete mix proportions (Devinder Sharma, 2016).

The strength properties of 10% alccofine based high grade concrete resulted in compressive strength of 64.45 MPa (7 days) and 74.48 MPa (28 days). The alccofine proportion increased in the concrete which would be acting as filler materials for the other ingredients and yielding the better workability of the concrete (Rajesh Kumar, 2015). M80 grade of concrete was developed with 3 – 12% of alccofine in the increment of 3%. The strength property values concluded that 12% of alccofine proportion in concrete yield better compressive, splitting and flexural strength (Pavittar Singh, 2017). The experimental investigation of high performance concrete with 100% ordinary portland cement and another proportion of 70% ordinary Portland cement and 30% micro cement were studied. They conducted the physical properties test such as sorptivity tests and colour analysis test, and non destructive tests such as ultrasonic pulse velocity. From the ultrasonic pulse velocity values, compressive strength, splitting tensile strength values were identified and compared with the control specimens. From the concluded values, performance of the all the mix proportions were similar at elevated temperatures (Kulkarni, 2011).

High performance concrete was developed by adding the quart dust and alccofine of 5 to 15% in the increment of 5%. Properties such as compressive, splitting, flexural strength, bending and breaking strength were determined. The test results showed that 15% of alccofine, 5% of quartz dust and 10% of silica fume high performance concrete would be better than other mix proportions (Karthick, 2020). The comprehensive review on the alccofine based high performance concrete concluded that utilization of alccofine materials as an partial replacement upto 20% by the volume of the cement content and it would be acting as an filler material, yields superior workability (Narender Reddy, 2017).

## V. CONCLUSION

The following are the conclusions obtained from the studies of various literatures related to alccofine based concrete are as follows: The optimum proportion of alccofine in the cement based concrete is from the ranges of 8 – 12% based on the applications and their other ingredients of the concrete. The addition of alccofine in the concrete improves the durability parameters by refining the pore structure and reduces the permeability. It also maintains the concrete pH and resisting the reinforcement from corrosion. Alccofine based concrete will be having the enhanced slump without increasing the dosages of the chemical admixtures. Especially alccofine is used as an strength enhancer in the high performance concrete with low water-binder ratio. The field of application is commonly for all the types of structures and particularly for the green complaint structures also.

## REFERENCES

- [1] G. Srinivasan, "Study on Alccofine Based High-Performance Concrete", IOP Conference Series: Materials Science and Engineering, Vol 993, (2020), 012040.
- [2] Mahim Mathur and Ashish Mathur., "Performance of Concrete by Partial Replacement of Alccofine – 1203", International Journal of Engineering Research & Technology, Vol 6, No 11, ( 2018), 1-5.

- [3] R. Suganya and R. Lathamaheswari, "Experimental Investigation on Alccofine Concrete", *International Journal of Engineering Research & Technology*, Vol 8, No 4, (2019), 548-550.
- [4] B. Kaviya, K. Rohith, Soniya Kindo., J. Manoj Kumar, and P. Divya, "Experimental Study on Partial Replacement of Cement using Alccofine", *International Journal of Pure and Applied Mathematics*, Vol 116, No13, (2017), 399-405.
- [5] Varinder Singh and Sanjeev Naval., "Strength Evaluation of High Strength Cement Concrete using Alccofine 1203", *Global Journal for Research Analysis*, Vol 7, No 5, (2018), 4-6.
- [6] Bhanavath Sagar and Sivakumar M V N., "Use of Alccofine 1203 in Concrete: Review on Mechanical and Durability Properties", *International Journal of Sustainable Engineering*, Vol 14, No 6, (2021), 2060-2073.
- [7] Surendra Kumar and Rohit Kumar., "Behaviour of High-Performance Concrete using Alccofine and Flyash", *International Journal for Technological Research in Engineering*, Vol 5, No 10, (2018), 3985-3990.
- [8] Tejashree Chaudhari, Surekha Patil, Mayuri Dighe, Pranita Shind, and Sumit Jogdand., "A Review on Experimental Analysis of Concrete with use Alccofine Powder", *International Journal of Advances in Engineering Research*, Vol 22, No 1, (2021), 39-44.
- [9] Mahim Mathur and Ashish Mathur., "Performance of Concrete by Partial Replacement of Alccofine 1203", *International Journal of Engineering Research & Technology*, Vol 6, No 11, (2018), 1-5.
- [10] Balamuralikrishnan R., and Saravanan J., "Effect of Addition of Alccofine on the Compressive Strength of Cement Mortar Cubes", *Emerging Science Journal*, Vol 5, No 2, (2021), 155-170.
- [11] Panga Narasimha Reddy and Bode Venkata Kavyateja., "Durability Performance of High Strength Concrete incorporating Supplementary Cementitious Materials", *Materials Today: Proceedings*, Vol 33, No 1, (2020), 66-72.
- [12] Bode Venkata Kavyateja, Guru Jawahar J., and Sashidhar C., "Effectiveness of Alccofine and Fly ash on Mechanical Properties of Ternary Blended Self Compacting Concrete", *Materials Today: Proceedings*, Vol 33, No 3, (2020), 73-79.
- [13] Parveen, Dharendra Singhal, Talha Junaid M., Bharat Bhushan Jindal, Ankur Mehta., "Mechanical and Micro structural properties of fly ash based Geopolymer concrete incorporating Alccofine at ambient curing", *Construction and Building Materials*, Vol 180, (2018), 298-307.
- [14] Ardra Mohan and Mini K M., "Strength Studies of SCC Incorporating Silica Fume and Ultra Fine GGBS", *Materials Today: Proceedings*, Vol 5, (2018), 23752-23758.
- [15] Boobalan S C., Aswin Srivatsav V., Mohamed Thanseer Nisath A., Pratheesh Babu A., and Gayathri V., "A Comprehensive Review on Strength Properties for making Alccofine based High Performance Concrete", *Materials Today: Proceedings*, Vol 45, (2021), 4810-4812.
- [16] A. Sinha Deepa, and K. Sabuwala Hasan, "Study of Mechanical and Durability Properties of High-Performance Self Compacting Concrete with Varying Proportion of Alccofine and Fly ash", *International Journal of New Innovations in Engineering and Technology*, Vol 5, No 1, (2016), 72-81.
- [17] A. Narender Reddy and T. Meena, "A Comprehensive Overview on Performance of Alccofine Concrete", *International Journal of Pharmacy & Technology*, Vol 9, No 1, (2017), 5500-5506.
- [18] M. S. Karthick, P. Chandrasekaran, K. Nirmalkumar and M. Raghunanathan, "Effects of Mineral Admixtures in Mechanical Behaviour of High-Performance Concrete", *International Journal of Advanced Science and Technology*, Vol 29, No 3, (2020), 8031-8038.
- [19] Mohd. Hamraj., "Experimental Study on Binary Blended High Strength Steel Fibre Reinforced Concrete using Alccofine as Mineral Admixture", *International Journal of Science, Engineering and Technology*, Vol 2, No 8, (2014), 56-62.
- [20] Devinder Sharma, Sanjay Sharma, and Ajay Goyal., "Utilization of Waste Foundry Slag and Alccofine for developing High Strength Concrete", *International Journal of Electrochemical Science*, Vol 1, (2016), 3190-3205.
- [21] Pavittar Singh., "Study the effect of Alccofine on Development of High Strength Concrete", *International Journal of Advance Research in Science and Engineering*, Vol 6, No 11, (2017), 1985-1992.
- [22] K. S. Kulkarni, S. C. Yaragal and K. S. Babu Narayan, "Effect of Elevated Temperatures on Mechanical Properties of Microcement based High-Performance Concrete", *International Journal of Applied Engineering and Technology*, Vol 1, No 1, (2011), 24-31.
- [23] S. Rajesh Kumar, Amiya K Samantha, Dilip K Singha Roy., "An Experimental Study on the Mechanical Properties of Alccofine based High Grade Concrete", *International Journal of Multidisciplinary Research and Development*, Vol 2, No 10, (2015), 218-224.