

An Comparative Study of OPC and PSC with Partial Replacement of Different Pozzolanic , Materials

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ABSTRACT: In the present investigation an attempt is made to compare various compressive strengths of cement mortar cubes. Mathematical models were elaborated to predict the strength of mortar cubes with 10% partial replacement of cement by various types of mineral admixtures with and without super plasticizers. The strength of cubes with different types of cement (OPC, PSC) after 3,7,28 and 90 days with 28 days curing and also durability tests after 60 days, have been analysed to evaluate the effect of addition content, the time of curing and the type of cement on the changes in compressive strength. The test results of selected properties of binders and hardened mortar cubes with admixtures are also included. The analysis showed that mortar cubes with admixtures is characterized by advantageous applicable qualities.

The investigation revealed that use of waste materials like fly ash, micro silica, rice husk ash and ground granulated blast furnace slag, which are otherwise hazardous to the environment may be used as a partial replacement of cement, leading to economy and in addition by utilizing the industrial wastes in a useful manner the environmental pollution is also reduced to a great extent.

I. INTRODUCTION

The greatest challenge before the construction industry is to serve the two pressing needs of human society namely the protection of the environment and meeting the infrastructure requirement of our growing population and consequentially needs of industrialization and urbanization in the past. The concrete industry has met these needs very well. However for a variety of reasons, the situation has been changed now.

The cement and concrete industries due to their large size are unquestionably feasible scope for economic and safe disposal of millions of tonnes of industrial by products such as fly ash, microsilica, slag, rice husk ash. Due to their properties, byproducts can be used in certain amount such as cement replacement material than in the practice today. In fact, these mixes replaced by 15% of by-products have shown high strength and durability at relatively early ages. This development has removed one of the strong objections to the use of high volume of by products in mortar cubes.

Therefore, it should be obvious that certain scale cement replacement with industrial by products is highly advantageous from the stand point of cost, economy, energy efficiency, durability and overall ecological and environmental benefits.

The advantageous in concrete technology method of construction and type of construction have paved the way to make the best use of locally available materials by judicious mix proportioning and proper workmanship so as to result in a construction industry satisfying the performance requirements. Proper design of mixes is intended to obtain such proportioning of ingredients that will produce of high durability during the designed life of a structure.

High performance does not necessarily require high strength, it is proportioning of mixes, which has low permeability, as possible for particular use that determines the long-term high strength performance behaviour of a structure.

ADMIXTURES:

This publication provides information on the types and functions of admixtures that have been, or are being, standardized in Europe for implementation in national standards in CEN member countries. It also provides guidance on the circumstances when it may be necessary to specify an admixture to a concrete producer.

Admixtures are materials other than cement, aggregate and water that are added to concrete either before or during its mixing to alter its properties, such as workability, curing temperature range, set time or color. Some admixtures have been in use for a very long time, such as calcium chloride to provide a cold-weather setting concrete. Others are more recent and represent an area of expanding possibilities for increased performance. Not all admixtures are economical to employ on a particular project. Also, some characteristics of concrete, such as low absorption, can be achieved simply by consistently adhering to high quality concreting practices.

Admixtures are now widely accepted as materials that contribute to the production of durable and cost-effective concrete structures. The contributions include improving the handling properties of fresh concrete making placing and compaction easier, reducing the permeability of hardened concrete, and providing freeze/thaw resistance.

II. TYPES OF ADMIXTURES

Admixtures vary widely in chemical composition, and many perform more than one function. Two basic types of admixtures are available:

- 1) Mineral admixtures.
- 2) Chemical admixtures.

All admixtures to be used in concrete construction should meet specifications; tests should be made to evaluate how the admixture will affect the properties of the concrete to be made with the specified job materials, under the anticipated ambient conditions, and by the anticipated construction procedures.

1) MINERAL ADMIXTURES

Mineral admixtures (fly ash, silica fume [SF], and slag) are usually added to concrete in larger amounts to enhance the workability of fresh concrete; to improve resistance of concrete to thermal cracking, alkali-aggregate expansion, and sulfate attack; and to enable a reduction in cement content.

- (a) Fly Ash
- (b) Silica Fume
- (c) Ground Granulated Blast Furnace Slag
- (d) Rice husk ash

2) CHEMICAL ADMIXTURES

Chemical admixtures are added to concrete in very small amounts mainly for the entrainment of air, reduction of water or cement content, plasticization of fresh concrete mixtures, or control of setting time.

Seven types of chemical admixtures are specified in ASTM C 494, and AASHTO M 194 [06], depending on their purpose or purposes in PCC. Air entraining admixtures are specified in ASTM C 260 and AASHTO M 154[05]. General and physical requirements for each type of admixture are included in the specifications.

- (a) Air-Entrainment agents.
- (b) Water-Reducers.
- (c) Set-Retarders.
- (d) Accelerators.
- (e) Superplasticizers.

FUNCTIONS

In ACI 212-3R [01], the reasons for the use of admixtures are outlined by the following functions that they perform:

I. Increase workability without increasing water content or decrease the water content at the same workability

- II. Retard or accelerate time of initial setting.
- III. Reduce or prevent shrinkage or create slight expansion
- IV. Modify the rate or capacity for bleeding
- V. Reduce segregation
- VI. Improve pumpability
- VII. Reduce rate of slump loss
- VIII. Retard or reduce heat evolution during early hardening
- IX. Accelerate the rate of strength development at early ages
- X. Increase strength (compressive, tensile, or flexural)
- XI. Increase durability or resistance to severe conditions of exposure, including application of deicing salts and other chemicals
- XII. Decrease permeability of concrete
- XIII. Control expansion caused by the reaction of alkalis with potentially reactive aggregate constituents
- XIV. Increase bond of concrete to steel reinforcement
- XV. Increase bond between existing and new concrete
- XVI. Improve impact and abrasion resistance
- XVII. Inhibit corrosion of embedded metal and Produce colored concrete or mortar

The construction industry is now slowly becoming aware of the environmental issues and other sustainable development issues for cement and concrete industries. It is looking for the ways and means to develop building products, which will increase the life span and quality, it is in this regard that merit of using silica fume, ground granulated blast furnace slag, fly ash and rice husk ash have been well recognized by the construction industry.

Addition of these materials was found to have enhanced the basic properties including strength and durability both in fresh and hardened state.

There have been subtle changes in the way aggregates are used. Proportioning between different sizes is now much more flexible is designed for specific purpose in response to intended specific performance criteria. There has also been development in the optimum use of locally available materials with the consideration of economy. Finally, addition of admixtures with PSC is more than that of the OPC in the similar manner.

REFERENCES

1. ACI 212-3R: "Use of admixtures are outlined by the functions that they perform".
2. ACI 363 and ASTM E329: "Detail specifications for specimen size, shape, type of mould, testing the apparatus, specimens preparations etc.",
3. Alireza Naji Givi, Suraya Abdul Rashid, Farah Nora A. Aziz and Mohamad Amran Mohd Salleh : "The use of supplementary cementing materials has become an integral part of high strength and high performance concrete mix design".
4. ASTM C 150-78a (1955): "Specification for Portland Cement, Philadelphia".
5. ASTM C 260 and AASHTO M 154: "General and physical requirements for each type of admixture and Air entraining admixtures".
6. ASTM C 494 and AASHTO M 194: "Types of chemical admixtures are specified depending on their purpose or purposes in PCC".
7. Bentur et.al: "The strength of silica fume concrete is greater than that of silica fume paste which they attributed to the change in the role of the aggregate in concrete".
8. Bogue, R.H. (1995): "Chemistry of Portland Cement, Reinhold Publishers, NewYork".
9. BS 12:1978: "Ordinary and Rapid-Hardening Portland cement British, Standards Institution, London".
10. Cong et.al: "The replacements of cement by silica fume (up to 18%) and the addition of superplasticizer increased the strength of cement paste".
11. Czernin and Wolfgang (1962): "Cement Chemistry and Physics for Civil Engineers, Crosby Lockwood and Son Ltd".
12. Duggal, S.K. (1997): "Text Book on Building Materials, Oxford and IBM Publishing Co. Pvt. Ltd., New Delhi".
13. Dunstan, M.R.H: "Indicated that structural concrete with adequate strength and air entraining admixtures in concrete".
14. Gengying Li and Xiaohua Zhao: "Investigated a laboratory study on the influence of combination of fly ash (FA) and ground granulated blast-furnace slag (GGBS) on the properties of high-strength concrete".
15. Gleize et.al: "determined compressive strength of silica fume mortar having proportion 1:1:6(Cement + silica fume: lime: sand)".
16. Harunur Rashid, Md., Keramat Ali Molla, Md. and Tarif Uddin Ahmed: "Using Rice Husk Ash (RHA) as a partial cement replacement material in mortar mixes to investigated the compressive strength and the porosity of mortar".
17. Hogan, F.J. and Meusel, J.W: "Evaluation of a ground granulated blast furnace slag as a partial replacement for portland cement in mortars and concrete".
18. Hooton, R.D. (1993): Influence of Silica Fume Replacement of Cement on Physical Properties and Resistance to Sulphate Attack, Freezing, and Thawing, and Alkali Silica Reactivity, American Concrete Institute Materials Journal, Vol. 90, No. 2, pp. 143-151.
19. Huang and Feldman: "Mortar without silica fume has lower strength than cement paste with the same water-cement ratio, while mortar with 30% of cement replaced with silica fume has a higher strength than cement-silica fume paste with the same water-cementitious ratio".
20. IS 269:1976: "Specifies the limit for soundness as per the Le-Chatelier's test result for Ordinary Portland Cements".
21. IS 383:1970: "The specification for particle size composition of the sand".
22. IS 456:2000: "Code of Practice for Plain and Reinforced Concrete, Indian Standards Institution, New Delhi".
23. IS 516:1959: "Methods of Test for Strength of Concrete".

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24. IS 650:1966: "The specifications for sand used in cement mortar".
25. IS 4031 (Part 6) 1968: "Specifications for a combination of cement and sand in the proportion 1:3 by weight, was carried out using a mechanical mixer".
26. IS 4031:1988: "Ordinary Portland Cement is graded according to strength, the other cements too have to gain a particular strength. 33, 43 and 53 grade in OPC indicates the compressive strength of cement".
27. IS 5513:1976: "Vicat's Apparatus (First Revision), Indian Standards Institution, New Delhi".
28. IS 5514:1969: "Apparatus Used in Le-Chatelier Test, Indian Standards Institution, New Delhi".
29. IS 8112:1989: "Specifications for 43-Grade Ordinary Portland Cement, Indian Standards Institution, New Delhi".
30. IS 9103:1999: Concrete Admixtures-Specifications., Bureau of Indian Standards, New Delhi, India.
31. Joshi, R. C: "reported that with fly ash replacement level up to 50% by cement weight, concrete with adequate strength and with adequate durability can be produced".
32. Kaushik, S.K., Kukreja, C.B., Gupta, V.K., Kishore, K. (1988): Standard Publishers and Distributors, Delhi, pp. 7-10, 15-16.
33. Komar, A. (1987): "Building Materials and Composites, Mir Publisher, Moscow".
34. Kraiwood Kiattikomol et.al: "The influence of chemical and physical properties of ground coarse fly ashes from different sources on compressive strength of mortar".* •
35. Krishnamurthy, G.S. (1991): "Material Testing Laboratory Manual, S.V.U. College of Engineering, Tirupati, Vol. 2".
36. Kuhl, (1929): "Most of the standard specifications specified the percentage of constituents with the various ratios".
37. Langly, W.S. and G.H.Leaman: "Higher replacement of cement with fly ash, highly •kf durable concrete can be obtained and resistance to freezing and thawing".
38. Madan D. S. et.al: "The effect of replacement of cement by fly ash by weight".