International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2020): 7.803

An Experimental Study on High Early Strength of Concreta

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Abstract: ***High early strength concrete is a type of concrete mix in high - performance concrete. A high early strength concrete is the one which is capable of having a compressive strength of at one day after concreting in site which will achieve structural concrete quality. To produce high early strength concrete there are four main factors to be considered they are cement type, cement content, water/ cement ratio and admixture. The present research manages the examination on the advancement of high early strength concrete by adding of chemical admixture and mineral admixture in a definite proportion to get the best mix for the concreting, utilizing 53 grade cement. The properties for example compressive quality and workability are concentrated***

Keywords: High Early strength workability, water cement ration

1. Introduction

Fast cars, fast travel schedules, fast track construction has become the order of the day. In many ways, these technological advancements have been an economic boon for the mankind but at what cost? Speeding cars are thrill on the race tracks but the risks are also a part of the system. The concept of 'time saved is money saved' induced the fast - track work in construction industry, since then engineers and administrators are making a holistic approach by making every part of construction to contribute into the system in making the construction faster. High Strength concrete is also one of them. The history of high strength concrete is about 35 years old, in late 1960s the invention of water reducing admixtures lead to the high strength precast products and structural elements in beam were cast in situ using high strength concrete. Since then, the technology has come of age and concrete of the order of M60 to M120 are commonly used. Concrete of the order of M200 and above are a possibility in the laboratory conditions.

With this as a confidence level the industry today has some very challenging demands for the cement manufacturers, admixture manufacturers. The demand for high strength in a very short duration has come up. There have been demands like,

- 40 MPa of M60 concrete in 3 days,
- 50% of target strength in 24 hours,
- 12 MPa in 12 hours
- 12 MPa in 10 hours.

2. Aim of the Research

The vital task work is to obtain a mix design of cement opc 53 grade by conducting trail mixes by utilizing the chemical admixture like polycarboxylate ether super plasticizer, cacl2 accelerator, and Ground granulated blast furnace slag powder in the concreting work and accordingly achieve the concrete quality and workability. The concrete which is accordingly evolved is then assed with the traditional M53 concrete regarding solid properties for example compressive quality. Like wise cube specimens are projected and their compressive quality boundary is considered.

3. Objectives

- To conduct tests and understand the basic properties of the ingredients to be used in HIGH EARLY STRENGTH CONCRETE (HESC)
- To develop mix design for HESC by adding chemical admixture such as Poly Carboxylate Ether Super Plasticizer, Accelerator of Calcium Chloride and mineral admixture such as Ground Granulated Blast Furnace Slag Powder (GGBS).
- To develop a mix design for High Early Strength Concrete having high strength and rapid final setting time.
- To conduct tests for 2nalysing the mechanical properties.
- To study the compressive strength of cubes.

4. Materials and Methodology

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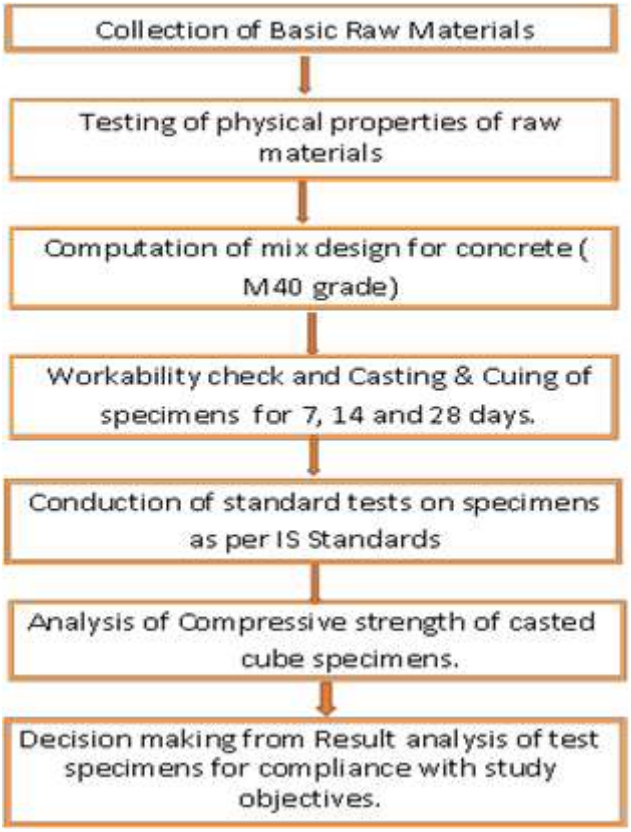

Figure 1: Flow Diagram

5. Raw Materials

The raw materials, along with their specifications and properties which are used for the experiment are discussed below:

- Cement - Ordinary Portland Cement of 53 grade.
- Fine aggregates –Aggregates of size between 4.75mm and 2.36mm are taken.
- Coarse aggregates – Normal coarse aggregates of size between 12 mm and 10 mm are taken.
- PCE type Superplacticizer
- GGBS
- CaCl2 Accelerator
- Water

Figure 2: Procurement of Raw Materials

Figure 3: Accelerator

Figure 4: GGBS

6. Tests on Raw Materials

Table 1: Experiment results which were done in laboratory

Experiments	*Values Observed*
Specific Gravity Test	2.53
Water Absorption Test	20.12%
Fineness Modulus Test	4.59

Table 2: Results of tests on course Aggregate

Properties	Values
Type	crushed
Water Absorption	0.35%
Specific Gravity	2.70
Fineness Modulus	7.36
Aggregate Impact Value	24.93%
Aggregate Crushing Value	40%
Abrasion Value	33%

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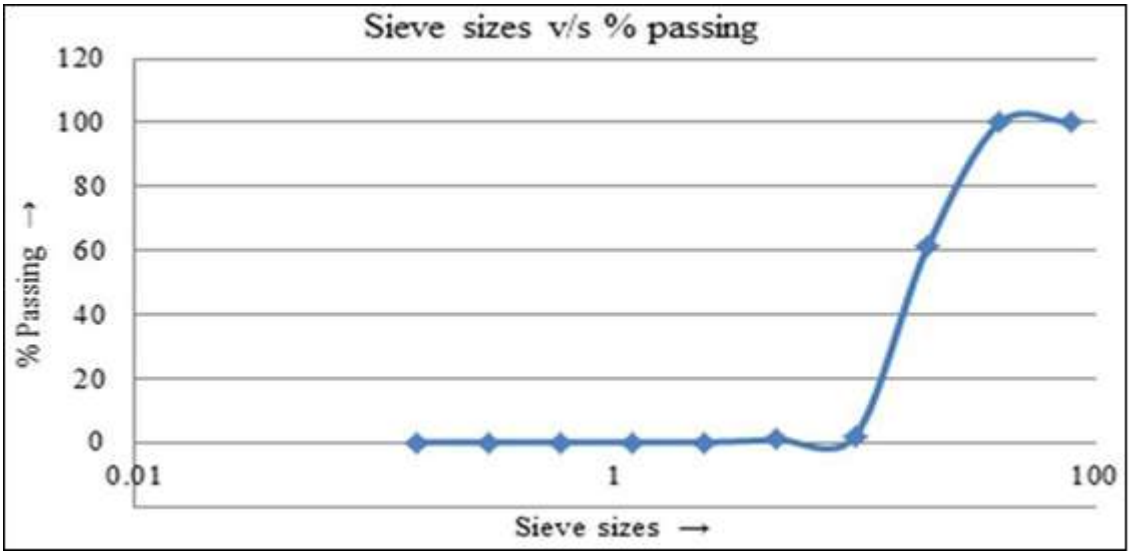

Graph 1: Sieve Analysis of Coarse Aggregates

Figure 5: Manual Concrete Mixer

Figure 6: Preparation of fresh concrete

Figure 7: Accelerator

Figure 8: Accelerator

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Figure 9: Accelerator

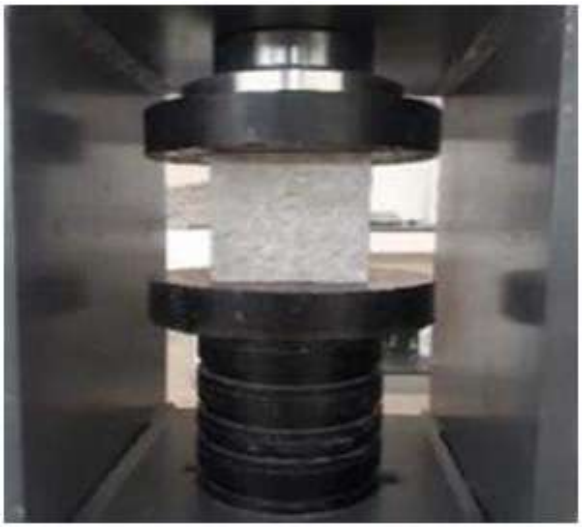

Figure 10: Accelerator

Results on Testing of Water

Table 3: Results of testing of water

Properties	*Values Observed*
Ph Value	7.5
Dissolved Solids	280
Suspended Solids	NIL
Chloride Content	22

Results on Tests on Fresh Concrete

Table 4: Results on Tests on Fresh Concrete

Concrete Type	Slump Cone Value (mm)	Compaction factor
Normal concrete	10	0.86
High early strength concrete	10	0.56

Table 5: Results of compressive test

Compressive Strength	1 day (MPa / N/mm2)	7 days (MPa / N/mm2)
Mix Design 1	1.53	22.33
Mix Design 2	1.81	22.64
Mix Design 3	2.74	23.98
Mix Design 4	2.10	26.10
Mix Design 5	2.76	26.32

7. Conclusion

The conclusion which can be drawn from the project from the use of following admixtures are:

1) The test data shows that cement added with the use of admixtures such as Super plasticizers and accelerators have a substantial increase of early age strength compared to the conventional concrete without any additional use of any chemical admixtures, so therefore concrete mixes with super - plasticizers and accelerators can be used in confidence to produce high early strength concrete.
2) As the amount of super - plasticizers increase in the mix proportion until the optimum dosage it reduces the water content but its workability decreases.
3) Using of super - plasticizers mix design can be reduce to water cement ration to lowest as possible in this case 0.35.
4) Accelerator cacl2 can be used only in plain concrete because chlorine will corrode the reinforcement.

References

[1] Marchon, D., & Flatt, R. J. (2016). Mechanisms of cement hydration. In Science and Technology of Concrete Admixtures. Elsevier Ltd.
[2] Nkinamubanzi, P. C., Mantellato, S., & Flatt, R. J. (2016). Superplasticizers in practice. In Science and Technology of Concrete Admixtures. Elsevier Ltd.
[3] Xiao, L. zhen, Li, Z. jin, & Wei, X. sheng. (2007). Selection of superplasticizer in concrete mix design by measuring the early electrical resistivities of pastes. Cement and Concrete Composites, 29 (5), 350–356.
[4] Aïtcin, P. C. (2016). Accelerators. Science and Technology of Concrete Admixtures, 405–413.
[5] Ibragimov, R., & Fediuk, R. (2019). Improving the early strength of concrete: Effect of mechanochemical activation of the cementitious suspension and using of various superplasticizers. Construction and Building Materials, 226, 839–848.
[6] Marchon, D., & Flatt, R. J. (2016). Impact of chemical admixtures on cement hydration. In Science and Technology of Concrete Admixtures. Elsevier Ltd.
[7] Neville, A., & Aïtcin, P. C. (1998). High performance concrete - An overview. Materials and Structures/Materiaux et Constructions, 31 (2), 111–117
[8] Superplasticizer effects on setting and structuration mechanisms of ultrahigh - performance concrete. (2001). Cement and Concrete Research, 31 (2), 63–71.
[9] Zhang, M. H., Sisomphon, K., Ng, T. S., & Sun, D. J. (2010). Effect of superplasticizers on workability retention and initial setting time of cement pastes. Construction and Building Materials, 24 (9), 1700–1707
[10] Li, P. P., Yu, Q. L., & Brouwers, H. J. H. (2017). Effect of PCE - type superplasticizer on early - age behaviour of ultra - high performance concrete (UHPC). Construction and Building Materials, 153, 740–750.
[11] Aïtcin, P. C. (2016). Curing compounds. In Science and Technology of Concrete Admixtures. Elsevier Ltd.
[12] Flatt, R. J. (2016). Conclusions and outlook on the future of concrete admixtures. In Science and

Licensed Under Creative Commons Attribution CC BY

Technology of Concrete Admixtures. Elsevier Ltd.
[13] Day, K. W. (2021). Properties of concrete. In Concrete Mix Design, Quality Control and Specification. Trans - Atlantic Publications
[14] Aïtcin, P. C. (2016). Phenomenology of cement hydration. In Science and Technology of Concrete Admixtures: Vol. d. Elsevier Ltd
[15] Nkinamubanzi, P. C., Mantellato, S., & Flatt, R. J. (2016). Superplasticizers in practice. In Science and Technology of Concrete Admixtures. Elsevier Ltd

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