Volume: 2, Issue: 4
Page: 647-652
2018

ISSN 2520-4750 (Online) & ISSN 2521-3040 (Print)

International Journal of Science and Business

Evaluation of curing condition on the high Strength concrete durability: Bangladesh perspective

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Abstract:

This study measure the curing condition on the high Strength concrete durability in Bangladesh. In the industry of construction, HPC (High Performance Concrete) has important role for improving durability and improved strength over ordinary concrete. Appropriate concrete compaction is essential for ensuring durability and strength of concrete. Entrapped air expels can placed concrete freshly and set the combined particles collectively that can increase the concrete density. Alike, concrete cover should maintain properly from environmental effects that can protect reinforcement such as deterioration and affords thermal insulation. concrete Durability refers to the ability of concrete to oppose abrasion, chemical attack and weathering action whereas maintaining its preferred civil engineering properties. This study observed that concrete made by clean water and under normal curing condition showed low permeability and Concrete mode by clean water and used within 2 hours showed moderate permeability. This study also showed than Concrete mode with polluted water gave high permeability. The present study will assist civil engineers and supervisors to know the impact of curing condition on the performance concrete durability.

IJSB
Accepted 26 October 2018
Published 27 October 2018
DOI: 10.5281/zenodo.1472844

Keywords: Curing condition, High Strength concrete, Durability, compressive strength, tensile strength & shrinkage.

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Introduction:

A vast quantity of OPC (Ordinary Portland Cement) is produced in every year and utilized for the edifice of building, highways, roads and many other purposes but in constructional works and structural low quality cement may source of properties and lives loss So, quality guarantee of OPC is an critical and important concern. Chemical apparatus in Portland cement are made from diverse potential composites. The quantity of these potential composites are liable for diverse material properties of those cement. Four major composites of Portland cement are C_2S, C_3S, C_3A, and C_4AF but most important composites are the C_2S, silicates, C_3S that are responsible for the potency of hydrated cement adhesive. in cement the existence of C3A is unwanted. C4AF is also in cement in little amount but compared with other three composites it does not change the behaviour of the cement radically (Neville, 1996; Taylor, 1964). Worldwide technological Improvement of the HPC is developing the scale of application and testing of the HPC in the field trials and laboratory has been conducted at the point of civil engineering and nationalized standardization. In the United States, The concept of HPC was developed on SHRP (the Strategic Highway Research Program). That program recognized the preliminary parameters that are essential for HPC mix up proportions and renowned the recital of HPC arranged in the laboratory context and in the field context. concrete Durability refers to the ability of concrete to oppose abrasion, chemical attack and weathering action whereas maintaining its preferred civil engineering properties.

Cement is an essential industrial product for constructions . That includes huge amount of carbon footprint. For achieving sustainability of constructions lessen amount of concrete should be used. Also high quality of concrete can ensure strength and durability of structure. In Bangladesh principal construction material is concrete and the construction sector is growing rapidly with the economic growth. ACI mentioned that with equal to 41 MPa (6000 psi) or more can be considered as strength concrete. Many studies have been accomplished on high strength concrete in other countries (ACI Committee, 2005; Andrew et al., 2009; Mary et al., 2004). In Bangladesh 6,600 psi concrete is made although it is not adequate for high-rise constructions (Mohammad et al., 2009). In Bangladesh the foremost causes of early failure of constructions are high temperature and humidity and stretched rainy season. sustainability -based design of structure must deal with those factors. Most crucial for durability of a structure is well-planned. A construction plan should be well-designed and needed regular maintenance during and after developing structure. Water quality is also another crucial for upholding the quality of concrete. Polluted water badly distress the strength and durability of concrete. Idyllically, potable water should be used in all stages of construction including curation and casting. For upholding durability, concrete Compaction is crucial for structure and need some technical knowledge. In Bangladesh, Basically laborers with very slight idea about the construction job. So their works should be monitored by civil engineers and professionals. Ready mixed concrete quality decreases with time duration. International standards mentioned that within two hours ready mix after making should be used. But for traffic jam and poor communication system, usually it takes longer time to reach a construction site and ultimately ready mix quality falters drastically. So this issue should seriously judge to ensure the quality of ready mix.

Materials and methods

Holcim Cement was used in the present study. In Portland cement amounts of SiO2 should be within the range 21% to 22%, Amount of CaO within the range 63% to 67%, amounts of MgO in OPC should be equal or less than 2.0%, mentioned by British standards. in Holcim cement, SiO_2 was 21.45%, CaO was 64.32%, Al_2O_3 was 4.3%, Fe_2O_3 was 3.28%, Free line was 1.274, SO3 was 3.56%, IR was 0.35% and LoI was 2.055% (Ali et al, 2008). This study also used coarse aggregate (stone chips) and fine aggregate (sand) with cement. The mixture was prepared by flowing ASTM C128 & C136 method. In the mixture capacity of absorption of stone and sand was 1.2% and 0.89% weight of them was 1520 kg/m3 and 1603 kg/m3. All samples mortar are prepared with that mixture according to ASTM C109. Half of the observed mixture was made by using clean water and other half was made by mixing industrial polluted water. Half of the mixture from clean water was used within 2 hours (C2) and other half was used after 4 hours (c4). Similarly half of the mixer from polluted water was used within 2 hours(P2) and other half was used after 4 hours (P4). one sample from clean water (Cw) and one from polluted water (Pw) were kept under external normal curing condition for comparing with other samples. All other samples bars from clean water mixture were submerged under clean water and samples bars made for polluted water were submerged under polluted water for 7 days but For measuring shrinkage result, one sample form every mixture was kept under lime saturated water for 30 after preparing sample and initial length of sample reading were taken and continue taken the reading up to 60 days.

Concrete performance under diverse simulated curing condition was measured at 7 day, 30 day and 60 day in terms of compressive strength (performed according to ASTM C39), split tensile strength (performed according to ASTM C39), chloride permeability (performed by RCPT test, ASTM C1202) and drying shrinkage (performed according to ASTM C157). Length changes of concrete bars were evaluated to measure liner shrinkage of the sample bars.

Result and discussion

Compressive strength is the ability of a concrete structure or material to resist loads tending to diminish size and opposed to strength tensile , which resists loads tending to stretch. Basically, compressive strength opposes firmness (being pressed together), while tensile strength opposes pressure (being pulled separately) and tensile strength, strength of materials, shear strength and compressive strength can be measured independently.

Impact of various curing condition at 7, 30 and 60 days on concrete's compressive strength presented in figure-1. Evaluated external normal curing condition from clean water (Cw) achieved highest strength was 18, 25 and 35 MPa at 7, 30 and 60 days respectively and P4 achieved lowest strength that was 9, 13, 15 MPa at 7, 30 and 60 days respectively. strength for C2 was 16, 21,30 MPa, for C4 was 14, 19,20 MPa, for Pw was 11, 17,17 MPa and for P2 was 10,15,16 MPa at 7, 30 and 60 days respectively.

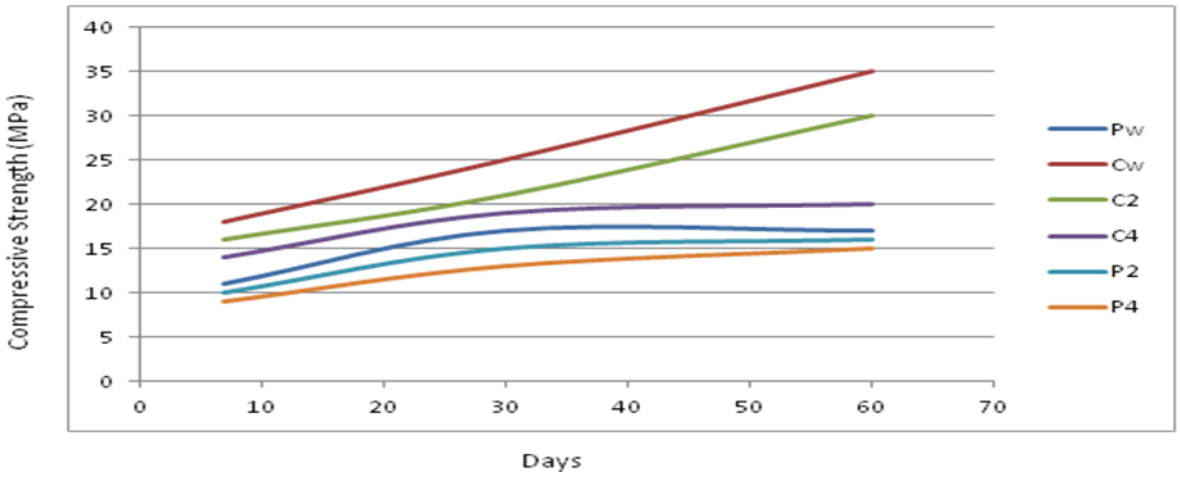

Figure-1: Compressive strength of Samples under various curing options

The method of evaluating the tensile strength of the concrete by a cylinder concrete which splits transversely the vertical thickness that is the indirect technique of testing concrete's tensile strength.

Figure-2 showed the tensile strength of sample under various curing conditions where highest strength was 4 Mpa for Cw sample and lowest was 2.75 Mpa for P4 sample. Other samples strength was 3.25 Mpa for Pw sample, 3.75 Mpa for C2 sample, 3.5 Mpa for C4 sample and 3 Mpa for P2 sample.

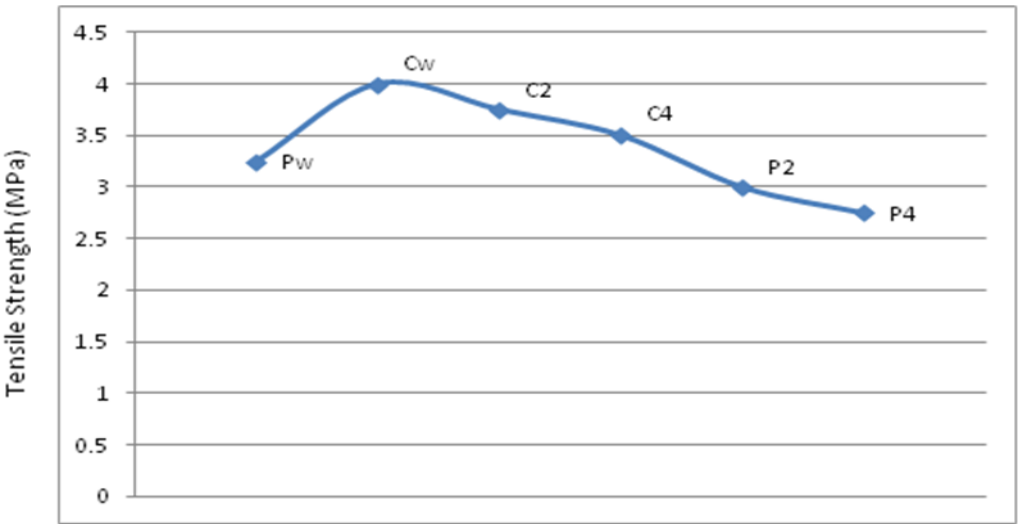

Figure-2 Split tensile strength of sample under various curing options

At lofty humidity, Drying shrinkage is reasoned principally by compressive stresses in the frozen microstructure that poise the amplify in surface tension and capillary tension on the aperture walls. The low aperture humidities (less than 75%), shrinkage is caused by a reduce of the disjoining stress transversely nano-pores fewer than about 3 nm wide, full-filled by adsorbed water. The compound processes of the Portland cement hydration cause to another form of shrinkage, that is called the autogeneous shrinkage, that is observed in conserved specimens. That is caused partially by the volume changes of chemical, however largely by self-desiccation owing to loss the water immersed by the hydration reaction. Figure-3 showed shrinkage result of samples under different curing options. For measuring shrinkage

result, sample was kept under lime saturated water for 30 after preparing sample and initial length of sample reading were taken and continue taken the reading up to 60 days. All samples showed shrinkage from day 1. Among all sample P4 showed maximum shrinkage at all observed days. Cw showed minimum maximum shrinkage and shrinkage changing behavior was very high than other sample. At 30 days the shrinkage of Cw was 67% lower than Pw, Shrinkage of C2 was 44% lower than P2 and 33% lower than C4, Shrinkage of P2 lower than P4. At 60 days shrinkage of Cw was 41% lower than Pw. Shrinkage of C2 was 40% lower than C4 and 50% lower than P2.

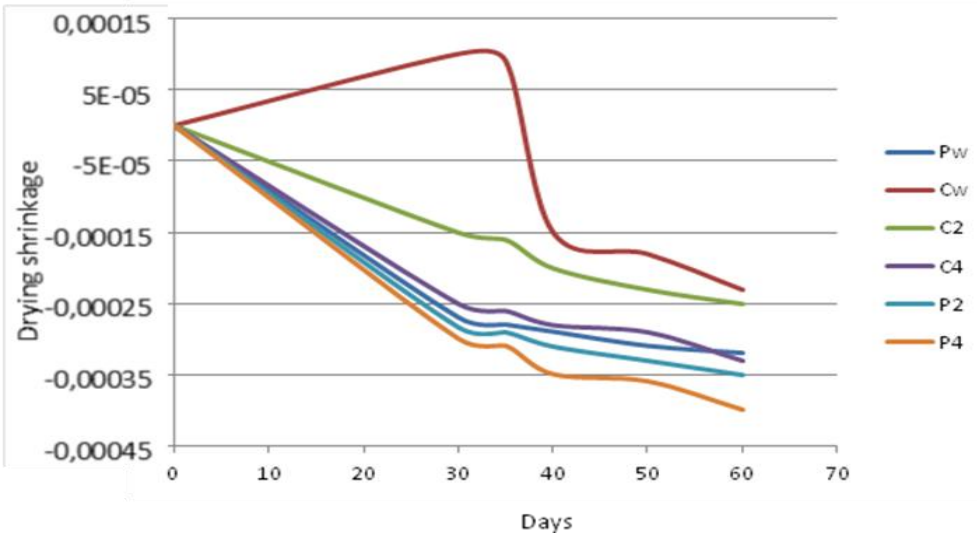

Figure-3: Shrinkage result of evaluated samples under various curing options

Conclusion:

Curing has an significant role on the durability and strength development of concrete. Curing should takes set instantaneously after concrete insertion and finishing, and engrosses upholding of temperature conditions and preferred moisture both at near and depth of the surface for completed periods of time. accurately cured concrete has an enough quantity of moisture for development of strength and continued hydration, resistance to freezing and thawing, volume stability, and scaling and abrasion resistance. This study observed that concrete made by clean water and under normal curing condition showed low permeability and Concrete mode by clean water and used within 2 hours showed moderate permeability. This study also showed than Concrete mode with polluted water gave high permeability. So this study suggest that mixture of concrete should be made with clean water and clean water should be used in the every stage during building structure and concrete mixture should be used within 2 hours for getting high durability. This study will help civil engineers and supervisors to know the impact of curing condition on the performance concrete durability. If mixture of concrete made with polluted water and used after 2 hours the permeability of concrete will be increase more than 3 times.

References:

Austin G. T., *Shreve's Chemical Process Industries*, 5th ed. 1985, Singapore: McGraw Hill Book Company.
Bogue R.H., *The Chemistry of Portland Cement*, 2nd Ed. 1955, Reinhold Publishing Corporation.

Bumanis G, Bajare D, and Korjakins A 2016 Durability of High Strength Self Compacting Concrete with Metakaolin Containing Waste *Key Eng. Mater.* **674** 65–70 concrete in various curing conditions *Materials (Basel)* **8** 5537–5553
Duda W. H., *Cement Data Book*. Vol. 2. Berlin: Bauverlag GmbH.
https://en.wikipedia.org/wiki/Compressive_strength
https://en.wikipedia.org/wiki/Ultimate_tensile_strength
Neville A.M., *Concrete Technology*, 4th ed. 1996, Singapore: Long man Singapore Publishers Ltd.
Nowak-Michta A 2013 Water-binder ratio influence on de-icing salt scaling of fly ash concretes *Procedia Engineering* **57** 823–829
Pandey G. N. and S. D. Shukla, *A Text Book of Chemical Technology*. Vol. 1. 1980, New Delhi: Vikas Publishing House.
Park J S, Kim Y J, Cho J R and Jeon S J 2015 Early-age strength of ultra-high performance
Taylor H. F. W., *The Chemistry of Cements*. Vol. 1. 1964, New York: Academic Press.
Van Den Heede P, Furniere J, and De Belie N 2013 Influence of air entraining agents on deicing salt scaling resistance and transport properties of high-volume fly ash concrete *Cem. Concr. Compos.* **37** 293–303
Zhang X and Han J 2000 The effect of ultra-fine admixture on the rheological property of cement paste *Cem. Concr. Res.* **30** 827–830
ASTM C136-06, *Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate,* ASTM International, West Conshohocken, PA, 2006
ASTM C128-12, *Standard Text Method for Density, Relative Density (Specific Gravity), and Absorption of fine Aggregate,* ASTM International, West Conshohocken, PA, 2012
ASTM C109/C109M-13, *Standard Test Method for Compressive Strength of Hydraulic Cement Mortar (Using 2 in or 50 mm) Cube Speciment.* ASTM International, West Conshohocken, PA, 2013
ASTM C39-14a, *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.* ASTM International, West Conshohocken, PA, 2005
ASTM C 1202-12, *Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration.* ASTM International, West Conshohocken, PA, 2012

Cite this article:

Md Nasir Uddin (2018). Evaluation of curing condition on the high Strength concrete durability: Bangladesh perspective. *International Journal of Science and Business*, *2*(4), 647-652. doi: https://doi.org/10.5281/zenodo.1472844

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