EUROPEAN JOURNAL OF LIFE SAFETY AND STABILITY (EJLSS)
ISSN 2660-9630
www.ejlss.indexedresearch.org Volume 16, 2022 ||

Optimal Composition and Study of The Physical and Mechanical Properties of High-Strength Heavy Concrete

Botirov Bektosh Farhod o'g'li
Master student of Djizak Polytechnic Institute (Uzbekistan)

Berdiyev O. B.
PhD, professor of of Djizak Polytechnic Institute (Uzbekistan)

Abstract: *In this research the authors research optimal composition and study of the physical and mechanical properties of high-strength heavy concrete and improve the quality of concrete constructions. High-strength heavy concrete that have a water/binder ratio between 0.30 and 0.40 are usually more durable than ordinary concrete not only because their capillarity and pore networks. So, the concrete sample specimens were tested for physical and mechanical properties which are related to durability. And each consist has 300 kg/m3. After 28 days compressive strength increases to 40MPa and after 90 days 61MPa were achieved. Also tested flexural properties after 28 days got 4.7 and after 90 days 5.7MPa.*

Keywords: *high-strength heavy concrete, aggregate, durability, physical and mechanical properties.*

Date of Submission: 6-03-2022 ***Date of Acceptance: 7-4-2022***

Introduction

The concrete that was known as high-strength heavy concrete in the late 1980 s in Uzbekistan, is now referred to as HSC because it has been found to be much more than just stronger: it displays enhanced performances in such areas as durability and abrasion resistance. HSC can be made with cement alone or any combination of cement and mineral composition, such as, blast furnace slag, fly ash, silica fume, met kaolin, rice husk ash, and fillers, such as limestone powder. There is a picture which describes schematically the fundamental micro structural difference between cement pastes having a 0.65 and 0.25 water/cement ratio.

High strength concrete is made by lowering the water cement (W/C) ratio to 0.35 or lower. Often silica fume is added to prevent the formation of free calcium hydroxide crystals in the cement, which might reduce the strength at the cement aggregate bond. Low w/c ratios and the use of silica fume make concrete mixes significantly less workable, which is particularly likely to be a problem in high-strength concrete applications where dense rebar cages are likely to be used. To compensate for the reduced workability in the high strength concrete mix, super plasticizers are commonly added to high-strength mixtures. Aggregate must be selected carefully for high strength mixes, as weaker aggregates may not be strong enough to resist the loads imposed on the concrete and cause failure to start in the aggregate [1, 2, 3]. It can be noted, that weaker aggregates are not a suitable component for preparing concretes with designed compressive strength higher than 30 MPa. A variety of cements were used CEM I 42.5 and CEM I 52.5.

Materials and Methods

Portland cements CEM I 42.5 and CEM I 52.5 from Jizzakh Cement Plants as per PN-EN 197 were used. As NA, mountain sand and rock of 0,16-2,5 mm and 2,5-5 mm fractions wereSangzar river and Coarse aggregate 5-70 mm from Forish places. Aggregate fulfilled requirements of RCAC II (acc. to DIN 4226-100) and type A (acc. to PN-EN-206:2014). Coarse aggregates has been sieved into fractions of: 5-10, 10-20 and 20-40 mm. Natural aggregate fractions of 0,16-2 mm and of 2,5-5 mm were used together with 5-10 mm and 10-20 mm fractions of RCA. Natural aggregate was used at air-dry condition. It had been weighted and saturated with water, in an amount of 3.6 % of its air-dry weight. Water reducer Muralist FK 88 was used. Regular tap water was used as mixing water.

Table 1. Proportions of concrete mixtures [kg/m3]

Material denomination	Mix 1	Mix 2	Mix 3	Mix 4
CEM I 42.5	300	300		
CEM I 52.5			300	300
met kaolin	20	20	20	20
fly ash	40	40	40	40
natural sand 0,16-2,5	260	260	260	260
natural sand 2,5-5	280	280	280	280
Coarse aggregates10-40	600	400	600	400
Coarse aggregates40-70	600	800	600	800
water	140	145	150	155
W/C*	0.30	0.35	0.30	0.45

Four concrete mixtures were prepared. They contained 300 kg/m^3 of CEM I 42.5 and CEM I 52.5 cement were used, together with met kaolin and fly-ash in an amount of 4 and 8%. Mix proportions are presented in Table 1. The workability of concrete mixtures was measured by flow table test, in accordance with PN-EN 12350-5.

Compressive and Tensile Strength Test

Specimens were prepared and cured as per PN-EN 12390-2. They were cast in steel moulds and underwent double compaction on vibrating table. After 2 days the specimens were remolded and water-cured in the laboratory till the age of 28 days. The compressive strength tests were conducted in accordance with PN-EN 12390-3 on 100 mm cube specimens after 28 and 90 days of hardening. The tensile splitting strength tests were conducted on the same type of specimens in accordance with PN-EN 12390-6.

Results and discussion

Research results are presented in the Table 2 and 3. The results are mean values of four measurements. Only for fresh concrete mixtures, the result of flow is an average of three measured values.

Table 2. Concrete Cubic Strength Results

Mixes	Concrete Cubic Strength, MPa					
	7 day	14day	28 day	60 day	90 day	180 day
Control	19	24	39	45.5	56	67.1
Mix 1	22.1	25.1	40	49.9	61	67.2
Mix 2	20.5	26	48.1	49.8	64	69.87
Mix 3	20.6	28	48.9	60	65.2	69
Mix 4	25	28.9	50	58.8	65.5	72.1

Table 3. Results of flexural strength of concrete

Составы бетонов	Flexural strength of concrete, MPa					
	7 day	14 day	28 day	60 day	90 day	180 day
Control	3.5	3.8	4.0	4.9	5.21	6.76
Mix 1	3.78	4.03	4.7	5.7	5.89	6.77
Mix 2	3.98	4.34	4.76	5.78	6.03	6.54
Mix 3	3.99	4.56	5.12	6.09	6.45	6.78
Mix 4	3.67	4.9	5.02	6.96	7.05	7.13

Compressive Strength of Concrete

The highest value of mean compressive strength 40 MPa was obtained for MIX1 series containing CEM I-42.5 cement. This mixture reached also the highest compressive strength of 61MPa after 90 days, which means a strength gain of 23% due to post hardening. A significant gain in compressive strength from 39MPa after 28 days to 56MPa after 90 days. Mixtures MIX 1 andMIX 4did not obtain surprising gain in strength between 28 and 90 days, they were 15%, and 16% respectively. The difference was mainly the result of using 2,5-5 mm fraction of natural aggregate in MIX 3 concrete series instead of the same fraction in MIX3 concrete. This explains the requirement in EN-206 standard which exclude 0, 16-5 mm fractions of aggregate from the usage in concrete production. MIX 2 and MIX 3 show good results in a 64 and 65.7 MPa. At the same time if this strength decrease due to the fine aggregate is compensated, than the authors would not exclude [4, 5].

Tensile Strength of Concrete

In accordance with the compressive strength values, the highest splitting tensile strength after 28 days could be measured on the concrete out of MIX 1 mixture, which was 4.7 MPa. After 90 days the highest measured splitting tensile strength obtained was for concrete out of MIX1 mixture, which was 5.89 MPa. The mean splitting tensile strength of the concretes is 5,89 MPa. The average value for all concrete is 5.41. These are typical values for concrete of that level of average strength.

Summary and Conclusions

In the paper it has been shown that it is possible to produce a high-strength heavy concrete with a targeted 61MPa mean compressive strength at the age of 28 days and of more than 65 MPa after 90 days. Good durability influencing properties could be measured at the same time by the usage of coarse aggregate of an average quality. The increase in strength between 28 and 90 day of laboratory ambient conditions curing shows that test after more than 28 days period reflects better the actual properties of the tested concretes. This applies to both the mechanical properties and to those which are associated with durability. The limit of 5 % of water absorption is practically impossible to meet [6]. Replacing 2.5-5 mm fraction of natural aggregate caused slight worsening of most of the concrete durability properties.

References

1. Turdimurod o'g, J. Q. L., Shahriyor, A., & Aziza, K. (2021). Concrete Products from Waste Materials. European Journal of Life Safety and Stability (2660-9630), 12, 99-102.

   EUROPEAN JOURNAL OF LIFE SAFETY AND STABILITY (EJLSS) ISSN 2660-9630. www.ejlss.indexedresearch.org Volume 12, 2021. http://ejlss.indexedresearch.org/index.php/ejlss/article/view/274.

2. Aziza, K., & Kh, K. (2021). DURABILITY CHARACTERISTICS OF CONCRETE ADMIXED WITH WOLLASTONITE MINERAL. European Journal of Life Safety and Stability (2660-9630), 5, 9-13.

   EUROPEAN JOURNAL OF LIFE SAFETY AND STABILITY (EJLSS)

   ISSN 2660-9630. www.ejlss.indexedresearch.org Volume 5, 2021

   http://ejlss.indexedresearch.org/index.php/ejlss/issue/view/5.

3. Kuldashev, H., & Kuldasheva, A. Improvement Of Vertical Butting Seismic-stability Large-panel Buildings. JournalNX, 210-215.

   JournalNX - a Multidisciplinary Peer Reviewed Journalю ISSN No.(E):2581-4230 https://journalnx.com/journal-article/20151680.

4. Ibragim, U., Erkin, E., & Aziza, K. (2021). Physical Properties of High Performance Concrete on Base Wollastonite. European Journal of Life Safety and Stability (2660-9630), 11, 101-105.

   EUROPEAN JOURNAL OF LIFE SAFETY AND STABILITY (EJLSS) ISSN 2660-9630 www.ejlss.indexedresearch.org Volume 11, 2021 || http://ejlss.indexedresearch.org/index.php/ejlss/issue/view/11.

5. Mamatqosim, B., & Aziza, K. (2021). Reinforcing in the Production of Gypsum Materials on Base Wollastonite Fibers. European Journal of Life Safety and Stability (2660-9630), 12, 20-23.

   EUROPEAN JOURNAL OF LIFE SAFETY AND STABILITY (EJLSS) ISSN 2660-9630 www.ejlss.indexedresearch.org Volume 11, 2021 || http://ejlss.indexedresearch.org/index.php/ejlss/issue/view/11.

6. Kuldasheva, A., Saidmuratov, B., & Kuldashev, H. (2020). The Use of Wollastonite Fiber to Enhance the Mechanical Properties of Cement Compositions. International Journal of Progressive Sciences and Technologies, 22(2), 37-45. International Journal of Progressive Sciences and Technologies (IJPSAT) ISSN: 2509-0119.https://ijpsat.ijsht-journals.org/index.php/ijpsat/article/view/2175.