World Academy of Science, Engineering and Technology
International Journal of Civil and Environmental Engineering
Vol:8, No:9, 2014

The Effect of Urmia-Lake Water on Tensional Strength Concrete with Various Admixtures

Hadi Barghlame, M. A. Lotfollahi-Yaghin, Mehdi Mohammad Rezaei

***Abstract*—**In this paper, the effect of admixtures on the tensional strength of concrete in Urmia-lake water have been investigated. We made different types of concretes with the ratio of w/c and replaced different percentages of micro-silica, air-entraining, super plasticizer, corrosion-inhibiting, and caulk with two types of cement I and II as well as investigating in both ordinary water and Urmia-lake water. The tensional strength was investigated on these samples.

***Keywords*—**Urmia-lake water, Tensional strength, Concrete, Admixtures.

Open Science Index, Civil and Environmental Engineering Vol:8, No:9, 2014 publications.waset.org/9999866/pdf

I. Introduction

URMIA lake is the biggest and saltiest lake in Iran. It is the saltiest lake in the world after Bahrolmiyat Lake in Palestine. Effect of water on the concrete strength is important, such as bridges and other structures should be constructed on the lake. Thus, it seems essential to perform researches in order to find better solutions for building durable concrete in this environment which is full of various ions in general and chlorine ions in particular [1].

The corrosion phenomenon effects on the structures which are made adjacent this water are due to Sulphate ions' density, so we can use Sulphate resistant cement to protect reinforced concrete [2], [3]. Due to the high density of chlorine ions in Urmia-lake water makes us to use special admixtures. On the other hand, the effect of admixtures to improve the mechanical properties of concrete in Urmia-lake water is investigated.

II. Concrete Reinforced Mixture

General specifications of Urmia-lake water in all different seasons and under different geographical conditions are varied and these specifications in high and low tide time are also varied. According to experimental results, specific gravity of Urmia-lake water in 20'c in fall is about 1.59 g/mm and in spring is about 1.146 g/mm. And also, electricity control of Urmia-lake water is about 3*105 and 2.15*105 micromos/cm, PH of this water is between 7.72 and 7.74 and the remainder (dried) after applying temperature about 180'c is between 251 and 235 g/it [4], [5].

Hadi Barghlame is with the Department of Civil Engineering, Ilkhchi Branch, Islamic Azad University, Ilkhchi, Iran (phone: 0098-914-3153097; fax: 0098-412-3326063; e-mail: hadi.barghlame@gmail.com).

M. A. Lotfollahi-Yaghin is with the Civil Engineering Faculty, University of Tabriz, Tabriz 51664, Iran (e-mail: lotfollahi@tabrizu.ac.ir).

Mehdi Mohammadrezaei is with the Department of Civil Engineering, Islamic Azad University Tasouj Branch, Tasouj, Iran (e-mail: rezaei@iau-tasouj.ac.ir).

III. Experimental Method and Employment of Admixtures

To consider the effect of using admixtures material in order to protect concrete adjacent Urmia-lake water as well as the effect of this material on mechanical strength of concrete. We tried to make 15 different types of mixture with 482 concrete cubic and core.

To make these samples, we used Portland cement I and II with different ratio of w/c 0.38, 0.4, 0.44 and also replaced Micro-silica with amount of: 0%, 10%, 15%, used weight of cement, and made concrete being investigated in Urmia-lake water and ordinary water. Also, the effect of each admixture of waterproof (W.P), corrosion inhibitor (F.g), and super plasticizer (S.P) on pressure, tension, abrasion and freezing and melting on 7, 14, 28 days concrete samples were investigated.

IV. Micro-Silica (M.S)

In most cases there is a direct relation between the amount of damage and penetrability. Generally the penetrability of concrete is the function of porosity and allotment of apertures measure; here the size of the apertures is more than 0.1m which affects the amount of penetrability.

Approximately most of the researchers believe in that Micro-silica concrete compared with other ordinary concretes is less penetrability. In the other hand, ordinary concrete penetrability versus Chlorine ions is about 20 times more than the concrete which has Micro-silica [6]. Researchers have shown that adding micro-silica into concrete in all the ages will cause compressive strength of concrete [7]. From the investigations, it has been revealed that slag concrete of cement slag mix ratio 70:30 has better resistance against strength deterioration for all curing conditions and curing ages. It is primarily due to high fineness of slag, which after hydration markedly reduce the permeability of concrete that restrict the penetration of sea salt. [8].

Micro-silica is a type of soft material having dimensions about 0.1~0.2 micron (Approximately about centigram dimension of cement). Due to being so fine (soft), Micro-silica granular can fill the apertures of the concrete, it increases the strength and decreases the penetrability as well as increasing the viscosity between the granular of cement and also between cement and grains [9]. Specific mass of this material which contains about 85%~98% silica equals 2.2 gr/cm^3 and has area about 14m^2/gr [10].

Open Science Index, Civil and Environmental Engineering Vol:8, No:9, 2014 publications.waset.org/9999866/pdf

V. Waterproof

At the beginning of this research, 18 samples of spiral beams used with transverse spiral bars in positive and negative direction and links. As it is clear in Fig. 4, it is considerable that all the beams in this series have the dimension about 250 mm. [10 in] x 250 mm. [10 in] and 450 mm. [18 in] in length. All of these reinforced beams include 6 longitudinal of grade 10 on a circle with about 200 mm. [8 in] of diameter. It is clear that in all the beams mentioned we used transverse bars with grade 6 and circle with 200 mm. [8 in] of diameter at every 60 mm. [2.4 in] steps. In order to prevent the beams of locally cracking where there is a concentration stress which occurs at 80 mm. [3.2 in] of beginning of these models restrained at every 3 directions X, Y, Z (boundary condition of cantilever beams). And the loading on models located at 80 mm. [3.2 in] from the end of model with 45 force segments in every sides of reinforced concrete beam where all the forces have the same direction of torsion. The distance between bars in spiral condition is according to ACI code. Also, in positive and negative spiral beams transverse bars are used with continual spiral with the same characteristics for transverse bars used in beams with tie. The difference between these kinds of beams and the beams with tie is that continual of transverse bars are on the length of the beam.

VI. Super Plasticizer

Super plasticizer is a type of an improved water-reducing admixture. According to code in ASTM-C1017-85, it is a kind of material which causes to make plasticize concrete with a slump more than 19 mm if used in the concrete on protecting its viscosity not separating the grains. This material in code ASTM-C494-85 is called F type and also admixtures which causes to decrease the amount of water and leads to slow-setting cement, is called G type [11].

In using super plasticizer, surface ions active are absorbed by cement grains which cause negative charge in cement grains and make repellent force between them and finally it causes diffuseness in cement grains [12]. By using super plasticizer material, we can decrease the use of water about 25%~35%. As a conclusion, we can make a concrete with a low ratio of w/c and with a high strength [13].

VII. Air-Entraining

By using the cement which has air entraining admixtures in concrete, small air bubbles with the diameter smaller than 20 micrometer is produced. Bubbles are not related to each other and the size of the concrete paste uniformly spread. Concrete containing air resistance against freezing and thawing cycles should be sufficient. Air bubbles in hardened concrete properties in the standards and regulations of most countries, such as ASTM-C457 are available. The shape and the thickness of bubbles in stability, especially in its first formation of bubbles in cement are useful.

For example, if we compare two materials called Cocamid-Etanol-Amid and Wood-Resin which is called Rozivenizul, it is clear that Cocamid (D.E.A) according to the standards of ASTM-C260, ASTM-C233 produce bubbles in concrete which are hard and stable in their shape and structure and distribute steadily and in this case, the concrete got enough strong versus freezing and melting. The air bubbles of Rezinvenizul standpoint of an irregular shape and thin wall in whole concrete doesn't have the same characteristics with the material which is called Cocamid [14]. Concrete with air bubbles has the feature of being stuck and as a conclusion the separation of granular and water loss decrease [15].

VIII. Effect of the Ratio between Water and Cement (W/C) on Tensional Strength

Decreasing the ratio between water and cement for making concrete leads to the decrease of void and porosity and increases its durability and strength, as we considered before the same result in last part for compressive strength. Here too is expected by decreasing the ratio between water and cement increases the tensile strength of concrete. In all concrete samples without paying attention to conditions and type of cement, increasing the life time of concrete tensile strengthen its tensile.

If we pay attention to figures, it is clear in two important points that, first: decreasing the ratio between water and cement in samples will decrease the tensile strength for the samples which are made in Urmia-lake water. Because when the water-cement ratio decreases, the porosity and prevents the penetration of aggressive agents is Chlorine, Sulfate and etc decrease.

Second: as time passes and the time of embedment of the samples in Urmia-lake water makes more difference in tensile strength like the ounces made in ordinary water and this is due to continuous attack of diffusion.

The most important point that we pay to attention more in Figs. 1 and 2 is that tensile strength of samples made by cement I and the same type made by cement II makes no difference. Whereas compressive strength of the samples which are made of cement I have more compressive strength than the samples which are made of cement II.

The first reason is that the samples made by cement I are brittle and this is due to high percentage of C3A and C3S in this cement and this leads to the flash setting of concrete. The second reason is decreasing the ratio of the tensile strength to compressive strength in hard concretes.

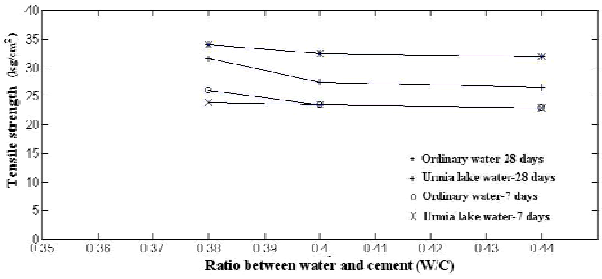


Fig. 1 Tensional strength for area condition mindfully different ratio between water and cement and cement I

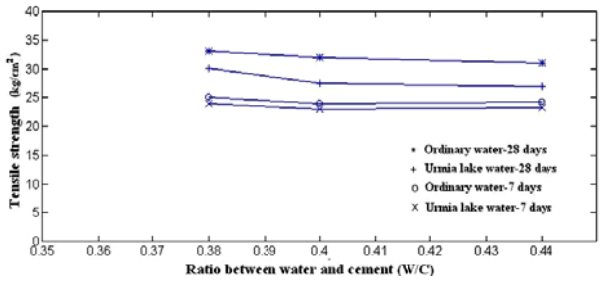


Fig. 2 Tensional strength for area condition mindfully different ratio between water and cement and cement II

IX. The Effect of Substitution Percentage of Micro-Silica on Tensile Strength

Tensional strength (Brazilian experiment) of concretes having Micro-silica increases with different percentages of substitution without paying attention to the type of the cement used. Whereas, substituting 15% of Micro-silica increases tensile strength of in ordinary condition about 22% to the witness sample (without micro-silica). This quantity for the samples made of cement I or II which are made by Urmia-lake water is about 20%. Increasing the tensile strength on concretes which have Micro-silica similar to their compressive strength is because of two important micro-silica mechanisms, namely, the property of its Pozzolanic and so fine grains. In this paper, it is considerable that study on the effect of Urmia-lake water on tensile strength of concretes shows in all cases Urmia-lake water cause to decrease the tensile strength of concrete (Fig. 3).

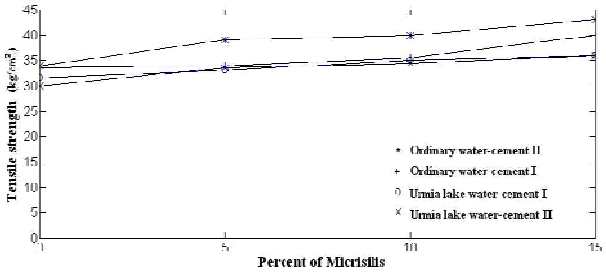


Fig. 3 Tensional strength of 28 days of samples with different percentage of micro-silica for different condition of areas and different cement

The most important point of the tensile breaking samples which have Micro-silica is their brittle and sudden break. We can increase the brittle and sudden break of the samples by increasing the percentage of Micro-silica. In tensile breaking samples without micro-silica is mostly accompanied with crack and sometimes like rift. Whereas in the samples with Micro-silica cause the samples to be open and made half. This action for the samples with more micro-silica, make in faster and sudden and with an explosion noise.

X. The Effect of Admixture Studied on Tensile Strength

The results of investigation and the effect of each admixture waterproof, anticorrosion and entraining agent are shown in Fig. 4.

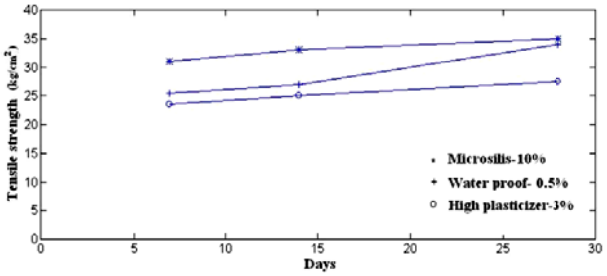


Fig. 4 The effect of waterproof and anticorrosion admixture on tensile strength of concrete in Urmia-lake water condition

Fig. 4 shows that if we added more waterproof than needed and anticorrosion to the samples which have about 10% of Micro-silica cause to decrease tensile strength but this decreases about 18% for the samples which are made by ordinary condition with waterproof. Also this quantity for the samples made in Urmia-lake water is about 1.3% and 20% and as shown in samples with waterproof decrease the tensile strength versus aggressing (chlorine, sulfate, ...) in Urmia-lake water. The first mechanism of micro-silica in these two combinations (combination like waterproof and anticorrosion) are the main reasons which decrease the tensile strength.

In order to study the effect of air entraining on tensile strength we have presented Fig. 5. As it shows, adding admixture of air entraining decreases the tensile strength of concrete to witness concrete. It is justifiable that adding this type of admixture increases the air-entrained and porosity in concrete.

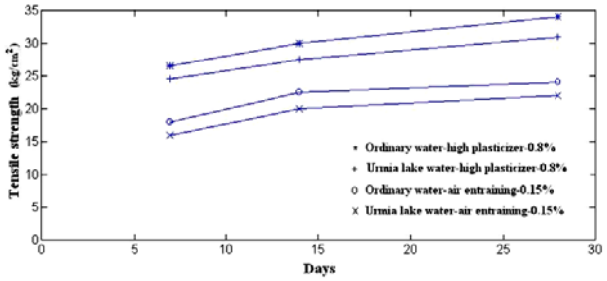


Fig. 5 Comparing the compressive strength of concrete which has air-entraining with the concrete has high plasticizer in different area water condition

XI. Conclusion

In this study, the optimum ratio of water to cement to increase the strength of concrete is about 0.38.

The results show that the concrete made by cement I is stronger than the one made by cement II.

Substituting 10% of Micro-silica in the samples made by cement I and II is known as an ideal percentage in this study.

Open Science Index, Civil and Environmental Engineering Vol:8, No:9, 2014 publications.waset.org/9999866/pdf

Waterproof admixture decreases the amount of diffusion of chlorine ion and increases electrical strength of samples.

Using anticorrosion admixture, with 10% of substituting Micro-silica causes to decrease the strength and increases the permeability.

REFERENCES

[1] Ameli M, Ronagh H.R., "Treatment of torsion of reinforced concrete beams in current structural standards", Asian Journal of Civil engineering (Building and Housing) 2007, V. 8, No. 5, pp. 507-519.
[2] Wang, W, Thomas H., " Limit Analysis of Reinforced Concrete Beams Subjected To Pure Torsion", Journal of Structural Engineering, January 1997, pp. 86-94.
[3] Collins M.P, Mitchell D., " Shear and torsion design of pre-stressed and non-pre-stressed concrete beams", PCI Journal 1980, No. 4 ,pp. 32-100.
[4] Hsu TTC, Mo YL.,"Softening of concrete in torsion members -Theory and tests", ACI Journal Proceedings 1985 ,82(3) ,pp. 290–300.
[5] Hsu TTC.,"Unified theory of reinforced concrete", Boca Raton (Fl): CRC, 1993.
[6] Csikos A., Hegedus I., "Torsion of Reinforced Concrete Beams", Technical University of Budapest, Department of Reinforced Concrete Structures H-1521 Budapest, 1998.
[7] Chansawat, K., "Nonlinear Finite Element Analysis of Reinforced Concrete Structures Strengthened with FRP Laminates", personal communication, Oregon State University, Corvallis, OR ,2000.
[8] Kaushal P., Chetan M., "Analytical Model of Reinforced Cement Concrete Beam Using Glass Fiber Reinforced Polymer", International Journal of Advanced Engineering Technology, V. 1, Issue 1, April-June 2010, pp. 46-58.
[9] Wafa W., et al, "Pre-stressed High-Strength Concrete Beams Under Torsion", Journal of Structural Engineering, September, 1995, V.121, No.9.
[10] Chalioris CE., "Experimental study of the torsion of reinforced concrete members", Structural Engineering & Mechanics 2006, 23(6):713–37.
[11] American Concrete Institute, Building Code Requirements for Reinforced Concrete, ACI 318-99, 1999.
[12] Karayannis CG., "Smeared crack analysis for plain concrete in torsion", Journal of Structural Engineering ASCE 2000;126(6):638–45.
[13] Hsu T.T.C., " Torsion of Reinforced Concrete", Van Nostrand Reinhold, Inc., New York, N.Y. 1984; 516 pages.
[14] Mitchell D, Collins M.P., " Diagonal Compression Field Theory – A Rational Model for Structural Concrete in Pure Torsion", Structural Journal of the American Concrete Institute, 1974; V. 71, No.8, pp. 396-408.
[15] Panchacharam S, Belarbi A., "Torsion Behavior of Reinforced Concrete Beams Strengthened with FRP Composites", First FIB Congress, Osaka, Japan, October 13-19,2002.

Open Science Index, Civil and Environmental Engineering Vol:8, No:9, 2014 publications.waset.org/9999866/pdf