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Influence of Mix Water Quality on Compressive Strength of Making Concrete

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A B S T R A C T

The influence of concrete mixing water quality on the compressive strength of concretes was investigated in this study. During the study, the compressive strength (CS) of the concretes was determined at 7, 14, and 28 days age. This study used 8 types of water of varying qualities as concrete mixing water (water with 71 UTN impurity level, water with 250 UTN impurity level, water with 1000 UTN impurity level, well-sourced water, acidified water, and alkaline water). Potable water was used as reference water. The results indicated that the lowest CS has been obtained by using alkaline water at a concrete age of 7 days while the usage of water with 250 UTN impurity level as a concrete mixing water yielded the highest CS. in addition, the lowest CS has been obtained when using a mixing water of alkaline at a concrete age of 14 days while the highest CS resulted from using water with 71 and 250 UTN impurities levels. Furthermore, the usage of water with 71 UTN impurities level and an acidic water as a concrete water mixing gave the lowest CS at twenty eight days concrete age, while using magnetic water and water with 250 UTN impurities as concrete mixing water resulted in the highest CS. The use of water with 250 UTN impurities as concrete mixing water favored CS development at all concrete ages. These obtained results have shown a various effects of different impurities which significantly indicate that only a few water impurities affect the concrete's CS seriously..

1. Introduction

Water is a major constituent of concrete that has a significant effect on its workability. Water is also important for efficient cement hydration. Therefore, the quality and quantity of water during concrete making must be carefully considered. Several researchers have investigated the influence of several types of water on concretes, including seawater, alkali water, mineral water, sewage water, industrial wastewater, water containing several chemical impurities, and black water from oil wells (**Mujahed F.S. (1989),(Olugbenga ATA (2014))**. The influence of the usage of microbes in concrete mixing water on the quality of the concretes has been studied by **Ghosh & Chattopadhyay (2006)**. The outcome of the study pointed towards increasing CS and tensile strength of concretes produced with such water (**Ghosh P. Mandal, et.al. (2006))**. Furthermore, **Babu et.al. (2009)** reported an increasing setting time of concretes (without losing CS) produced with treated wastewater from an electroplating plant. The study found marginal increases in the CS and flexural strengths of the concretes as the metal ions concentration increases in the wastewater (**Babu G. Reddy, et.al. (2009)**). Wastewater from car washing stations has been used by **Jabri et.al. (2011)** as mixing water and investigated its effect on the concretes compressive strength. Using the wastewater did not have a significant influence on the concrete's strength. (**AL-Jabri K. S., et.al. (2011))** . **Arunakanthi et.al. (2012)** examined the chemicals effect on high-performance concretes by using various hydrochloric acid (HCI) concentrations in mixing and curing. The investigation's results showed that higher chemical contents decreased the CS and splitting tensile strengths of the concretes as compared with those cured and mixed in normal water (**Arunakanthi E., et.al. (2012))**. The effect of sodium bicarbonate (NaHCO3)-containing water and sodium carbonate (Na2CO3) based on CS and the setting time of concrete were investigated by **Venkateswara & Vangala (2013)**. The

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study found the existence of Na_2CO_3 in mixing water substantially increase the concrete's initial and final setting time. In addition, the results showed that the CS and the concretes tensile strength were notably (**Venkateswara Reddy. and Vangala (2013)**) .A study investigation on the influence of the magnetic water use as a mixing water replacing the normal water, has shown a positive effect as reported by (**Reddy, et.al. (2014)**) and (**Ubale Pradnya, et.al (2016)**.

2. Experimental Work

This study used Type I Ordinary Portland Cement (OPC) which met the Iraqi specifications No.5/ 1984 (**Iraqi Specification No. 5 ,1984**). The fine aggregates used was a natural sand which met the necessities of an Iraqi Number 45/1984 specification. For the rough collective, there were crushed stones of 12.5 mm maximum size which met the Iraqi No. 45/1984 specification (**Iraqi Specification No. 45 ,1984**). For all the mixes, a mixing cement: a fine aggregates: the coarse aggregate ratio of 1:1.5:3 was used.

The water samples (8) for the mixing purpose were sought from different sources as follows:

i. Magnetic water: Normal tap water was passed through an electromagnetic field in the physics lab.
ii. Water with UTN impurity level of 71, 250 and 1000: different levels of water impurities were prepared to achieve the desired turbidity level by dissolving metakaolin into tap water.
iii. Well water: This water was drawn from a well from the Ramadi region and used as mixing water.
iv. Acidic water: This was prepared by introducing a certain amount of HCl into tap water.
v. Alkaline water: This was prepared by introducing a certain amount of NaCl into tap water.
vi. Potable water: This water served as the reference water. It is normal tap water sourced from the Ramadi region.

These water samples served as the concrete mixing water in different experimental setups. The effect of impurities on the concrete mixtures after using these water sources as mixing water was investigated. The parameters measured include , total dissolved solids (TDS), pH, conductivity, turbidity and salinity, and as illustrated in Table 1. Testing the CS test has been conducted according to BS 1881: Part 116 on the concretes at the 7th, 14th, and 28 days post-curing.

Table 1.:Analyzed of water Type

Type of water	PH	TDS	Conductivity	Sal.	Turbidity
Magnetic water	8.34	606	1299	0.6	1.26
Turbidity71	8.42	677	1460	0.7	71
Turbidity 250	8.18	692	1506	0.7	250
Turbidity 1000	8.28	792	1727	0.7	1000
Well water	7.9	2560	5820	2.6	0.91
Acidic water	5.39	608	1462	0.5	3.93
Alkaline water	9.97	568	1360	0.5	267
Potable water	8.78	645	1552	0.6	2.16

3. Results of Test

1. **Setting time**: the results indicate the effectiveness of the magnetic water which remarkably increased both the initial and final concrete setting times. The observed differences in the initial concrete setting time compared to tap water were approximately +8 min in the case of water at a turbidity level of 71 UTN, +15 min for water with turbidity of 250 UTN, +18 min for water with turbidity of 1000 UTN, magnetic water at-32 min, -5 min for well water, +40 min for acidic water, and -10 min alkaline water. The use of acidic water as mixing water produced the utmost initial concrete time set. The observed change in the final concrete time setting , compared to tap water, was about -38 min magnetic water, +14 min for water with turbidity 71 UTN, +20 min for water with turbidity 250 UTN, +18 min for water with turbidity 1000 UTN, -8 min for well water, +36 min for acidic water, and -10 min for alkaline water. Furthermore, it can be seen that the acidic water usage provided the utmost initial concrete setting time as shown in Figure 1 and Figure 2 .

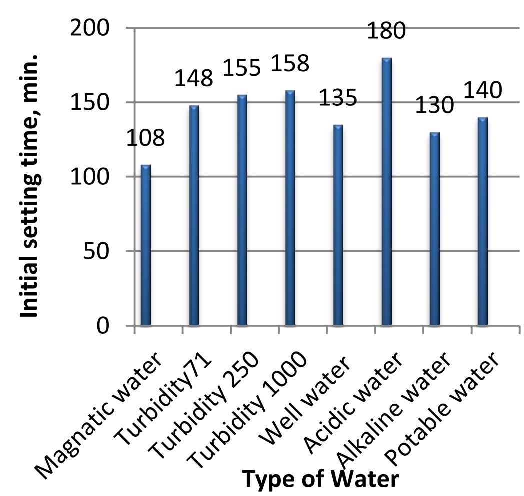

Fig. 1: Varation of initial setting time with type of water

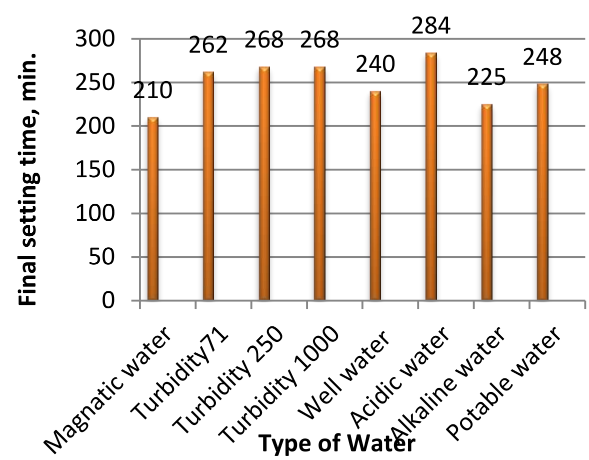

Fig. 2: Varation of final setting time with type of water

2- Compressive strength: The differences in the CS of the concretes produced with different types of mixing water after 7 days curing are shown in Figure 3 .

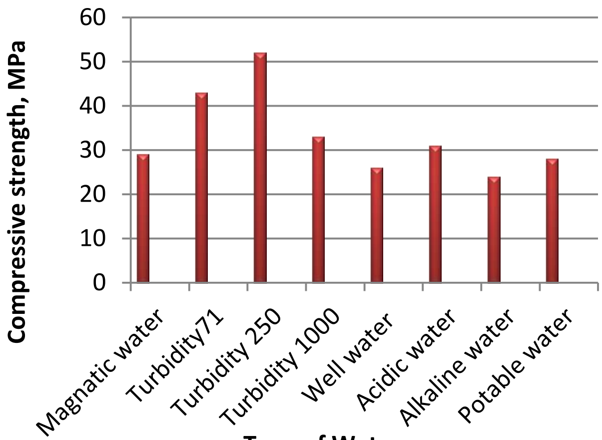

Figure 3: Varation of compressive strength with type of water at 7 days age

Based on various mixing water types, alkaline water achieved the highest CS while concrete with the least CS has been achieved using water with 250 UTN turbidity. Besides, alkaline water produced as well concretes with the least CS at concrete age of 14 days, while the concrete with the highest CS has been obtained using water with 71 and 250 UTN turbidity as depicted in Figure 4. While using water with a turbidity of 71 and 250 UTN as concrete mixing water produced concretes with the highest CS as depicted in Figure 5.

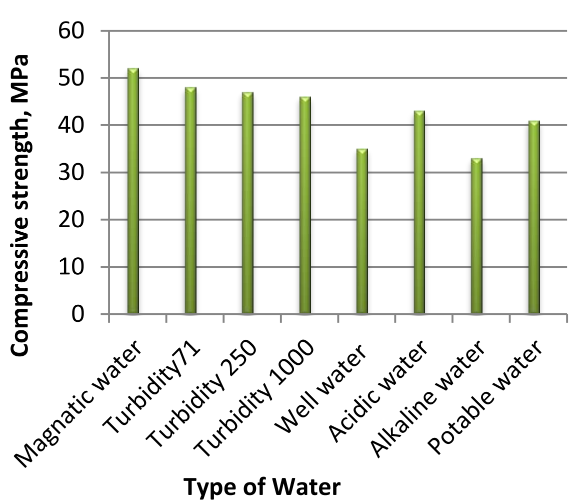

Figure 4: Varation of compressive strength with type of water at 14 days age

The concretes with the lowest CS at 28 days concrete age have been obtained using magnetic water as concrete mixing water. Acidic water and water with a turbidity of 71 UTN produced concretes with the lowest CS as well at 28-days concrete age .

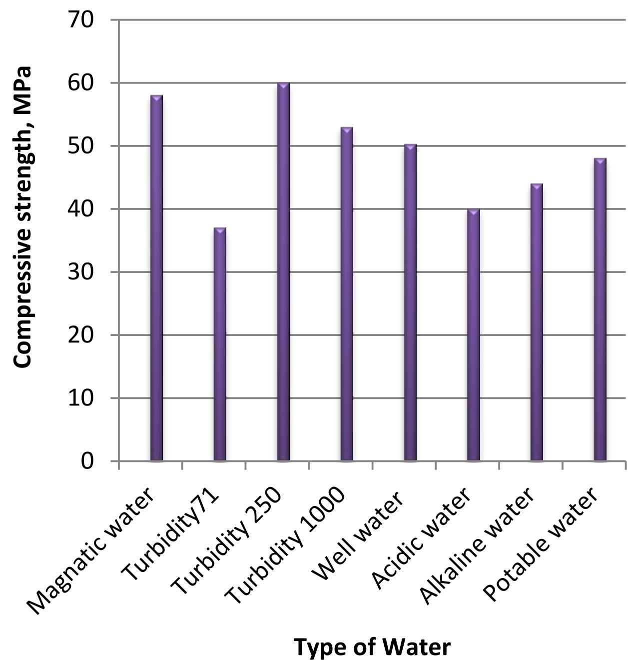

Figure 5: Varation of compressive strength with type of water at 28 days age

the using of magnetic water as mixing water gave the highest compressive strength compared with using of normal tap water. This may be due to form of a stronger hydrogen bonds due to the broken hydrogen bonds after magnetization**.** The smaller size of magnetized water molecules led to thinner water layer surrounding the cement than normal water molecules, therefore less water demand has a positive effect of hardened concrete properties **((Reddy, et.al. (2014))** , **(Ubale Pradnya, et.al (2016)**.

4. Conclusions

The results of this study showed various effects of different impurities levels in which some have a notable positive influence on the concrete's CS while other impurities have a negative impact. This study has proved the efficiency of using a magnetic water as a concrete mixing water which could produce concretes having the highest CS rather than using tap water. However, using acidic and alkaline water as concrete mixing water has detrimental effects on the strength of concrete.

5. References

AL-Jabri K. S., A. AL-Saidy A.H., Taha R. and AL-Kemyani A. J. (2011) " Effect of using Wastewater on the Properties of High Strength Concrete" Procedia Engineering Vol. 14, pp.370–376. doi:10.1016/j.proeng.2011.07.046

Al-Jabri K.S., Taha R. and Al-Saidy A.H. (2010). "Effect of using non-fresh water on the mechanical properties of cement mortars and concrete". Proceedings The Third International fib Congress and PCI Annual Convention & Exhibition, May 29 –June 2, Washington D. C., USA.

Arunakanthi E., Rao H. Sudarsana and Reddy I.V. Ramana (2012) " Effects of Hydrochloric Acid in Mixing And Curing Water on Strength of High-Performance Metakaolin Concrete" International Journal of Applied Engineering and Technology Vol. 2 (2) April-June, pp.68-76. ISSN: 2277-212X (Online)

Babu G. Reddy, Rao H. Sudarsana, Reddy I.V. Ramana, (2009) "Effect of metal ions in industrial wastewater on cement setting, strength development and hardening", Indian Concrete Journal.

BS 1881-116, 1983. Method for determination of compressive strength of concrete cubes. British Standards Institution.

Cebeci O.Z., and Saatci A.M. (1989). "Domestic sewage as mixing water in concrete", ACI Materials Journal. 86(5), pp. 503-506.

Chini A.R., Muszyasti L.C., and Ellis P.S. (1999). "Recycling process water in ready-mixed concrete operations". Final Report Submitted to the Florida Department of Transportation, University of Florida, Gainesville, FL.

El-Nawawy O.A., and Ahmad S. (1991). "Use of treated effluent in concrete mixing in an arid climate". Cement and Concrete Composites. 13(2), pp. 137-141.

Ghosh P. Mandal, S. and Chattopadhyay, B. D. (2006) "Effect of micro-organism on the strength of concrete", Indian Concrete Journal (Online)

Iraqi Specification No. 45, "The Ruins of The Natural Resources Used in Concrete Construction", the Central Agency for Standardization and Quality Control, Baghdad 1984.

Iraqi Specification No. 5, "Portland Cement", the Cement Agency for Standardization and Quality Control, Baghdad 1984, 8 p.

More Rakesh A. and Dubey S.K. (2014) " Effect of Different Types of Water on Compressive Strength of Concrete" International Journal on Emerging Technologies Vol. 5(2), pp.40-50.

Mujahed F.S. (1989). "Properties of concrete mixed with red sea water and its effects on steel corrosion". Unpublished M.S. Thesis, Jordan University of Science and Technology, Jordan.

Olugbenga ATA (2014) " Effects of Different Sources of Water on Concrete Strength: A Case Study of Ile-Ife" Civil and Environmental Research, Vol.6, No.3, pp. 39-43. ISSN 2224-5790 (Paper) ISSN 2225-0514 (Online)

Reddy, B. S. K., Ghorpade, D. V. G., & Rao, D. H. S. (2014). Use of magnetic water for mixing and curing of concrete. International Journal of Advanced Engineering Research and Studies E-ISSN2249–8974.

Taha R., Al-Harthy A.S., and Al-Jabri K.S. (2010). "Use of production and brackish water in concrete". Proceedings International Engineering Conference on Hot Arid Regions (IECHAR 2010). March 1-2, Al-Ahsa, Kingdom of Saudi Arabia, pp. 127-132.

Taha R., Al-Rawas A., Al-Oraimi ., Hassan H., and Al-Aghbari M. (2005). "The use of brackish and oil-contaminated water in road construction", Environmental and Engineering Geoscience. XI(2), pp. 74-150.

Ubale Pradnya, Pandit Rahul D., Wadekar Abhijeet P. (2016)" Performance Evaluation of Magnetic Field Treated Water on Convectional Concrete Containing Fly Ash" International Journal of Science Technology and Management, Vol. 5(2). pp. 68-77.

Venkateswara Reddy. and Vangala (2013) " Effects of Strong Alkaline Substances in Mixing Water on Strength and Setting Properties of Concrete" International Journal of Mining, Metallurgy & Mechanical Engineering (IJMMME) Volume 1(2), pp. 133-136. ISSN 2320–4060 (Online)