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Research Article

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Experiment about improvement of physical and chemical properties of magnetized water on cement hydration reaction

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ABSTRACT

Substantial research results show that the magnetized water can make the cement hydration reaction more completely, so the physical and chemical properties of magnetized water in different degrees are studied in the thesis. The research starts with the physical and chemical properties of magnetized water such as the conductivity, viscosity, PH value and surface tension so on. On the basis of the study of magnetized water by the predecessors, a test about the physical and chemical properties of magnetized water has been taken based on two selected magnetized parameters, the corresponding magnetized field intensity and water flow rate. The improvement of physical and chemical properties of magnetized water on cement hydration reaction was analyzed in this issue.

Key words: magnetized water; cement hydration reaction; viscosity; PH value; surface tension

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INTRODUCTION

Up to now, by most accepted hypothesis was that under the action of Lorentz force, chain molecules group of ordinary water, which had been linked together with hydrogen bonds, would be cut or damaged. Consequently, it would crack into group of small molecules or individual water molecules.

Changes in the connection between molecules of magnetized water could lead to physical and chemical properties change of magnetized water, such as surface tension, PH value, density and volatile changes and the ability to change of oxygen or other substances dissolved and so on which can be inferred that magnetized water can make the cement hydration reaction more completely [1-3].

EXPERIMENTAL SECTION

Changes of magnetized water conductivity

Minor changes in the structure of molecules of magnetized water have indeed occurred after a certain conditions of magnetization process. Conductivity of water decreased after it was magnetized which can be shown as Tab.1.

Tab.1 Magnetized water conductivity

Sample	1	2	3	4	5	6	7	8	9
Double distilled water	1.676	1.692	7.555	2.110	1.975	1.596	3.063	2.961	2.529
Magnetize	1.564	1.521	3.150	1.963	1.805	1.478	2.508	2.386	1.852

PH value changes of magnetized water

Experimental of PH value instrument equipment is PHS-3B PH measuring apparatus as shown in Fig.1.

Fig. 1 PHS-3B PH measuring apparatus

Reason of measurement of the PH value of the difference between magnetized water and ordinary water at the same condition was shown in Tab. 2.

Tab. 2 Reason of measurement of the PH value

Magnetized field intensity (mT) Water flow rate (m/s)	Ordinary Water	230mT 2.0m/s	280mT 2.0m/s	330mT 2.0m/s	230mT 1.0m/s	280mT 1.0m/s	330mT 1.0m/s
PH value	7.52	7.52	7.53	7.54	7.52	7.55	7.61

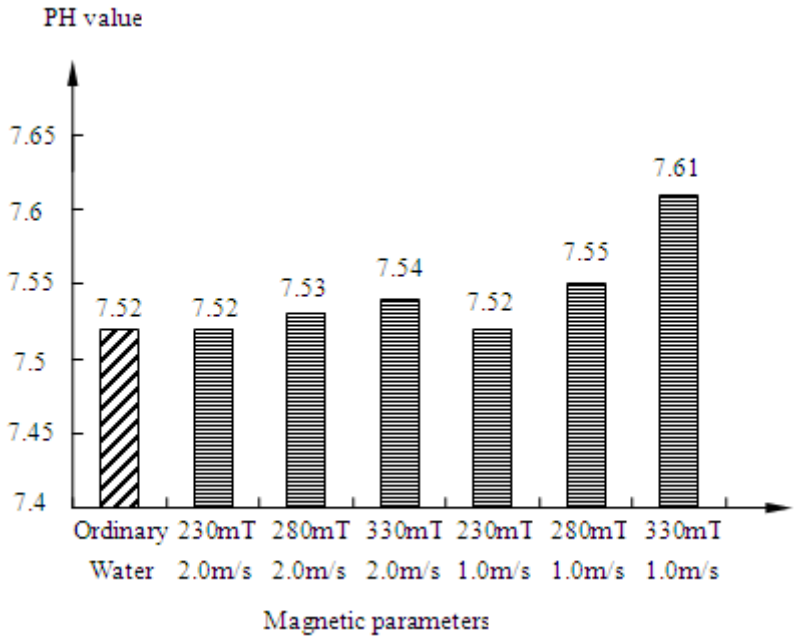

Fig. 2 Reason of measurement of PH value

From Tab.1 and Fig.2 it is indicated that, among the range of test parameters, when water is magnetized, PH value was indeed increased. Especially PH value of the magnetized water with the magnetized parameters (magnetized field intensity is 330mT, water flow rate is 1m/s) increased the most significant.

Viscosity

Viscosity can be indicated by dynamic viscosity and motorial viscosity, and the relationship between them can be shown as Eq.1.

$$\nu = \eta / \rho \tag{1}$$

Where ν is the motorial viscosity, η is the dynamic viscosity, and ρ is the density of liquid. Motorial viscosities of ordinary water and magnetized water can be tested by viscometer. The result was shown in Tab. 3.

Tab.3 The relation of viscosity and the magnetized field strength

Magnetized field intensity (A/m)	0	250	300	350	400	450
Motorial viscosity (m^2/s)	1.114	1.109	1.103	1.096	1.081	1.083
Dynamic viscosity (Pa·s)	1.113	1.108	1.102	1.096	1.089	1.082

It is indicated from Tab. 3 that the viscosity reduces when water is magnetized, and they show a negative linear correlation. Touch surface of cement particles and magnetized water is increased because of reduced viscosity. It increases the level of hydration reaction of cement.

Surface tension

Some research showed that surface tension of water would change when it was magnetized. In order to find the relationship between surface tension of water and magnetization, pullout method is adopted to test the surface tension of water in different magnetized field intensity. The principle of pullout method is shown in Fig. 3.

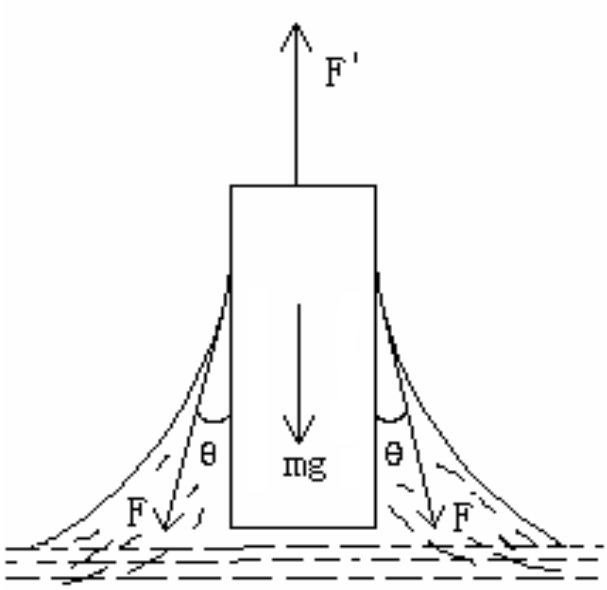

Fig.3 The principle of pullout method

When the metal ring is pulled out of the water, the θ becomes zero. The surface tension can be shown as Eq.2.

$$F' = mg + F \tag{2}$$

Where F' is the tension when the metal is pulled out of water, mg is the gravity of metal ring and the water attaching ring, F is the surface tension. The results of test are shown in Tab. 4 and Fig. 4.

Tab. 4 Reason of measurement of surface tension

Magnetized field intensity (mT)	0	230	280	330	230	280	330
Water flow rate (m/s)	0	2.0	2.0	2.0	1.0	1.0	1.0
Surface tension (mN/m)	74.14	74.08	73.79	73.59	73.66	72.45	71.44

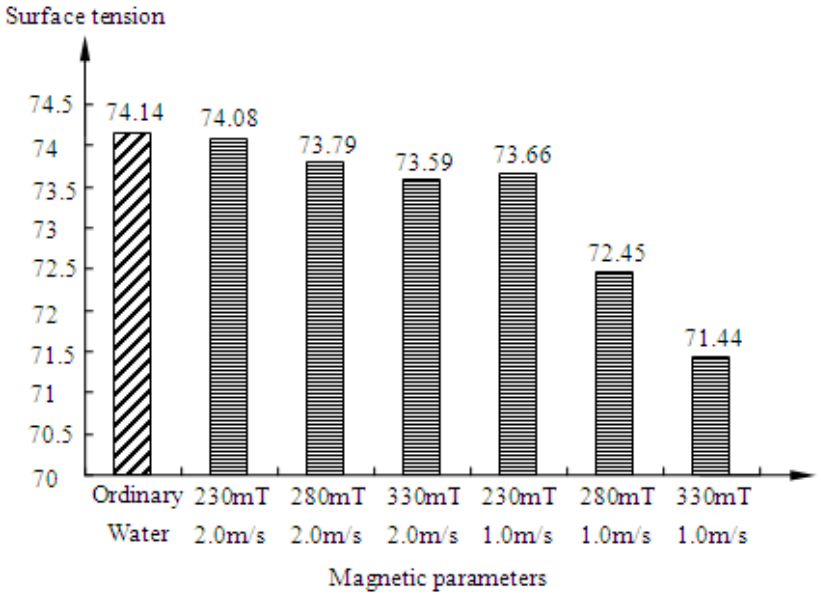

Fig. 4 Reason of measurement of the surface tension

From Tab.4 and Fig.4 it was indicated that, among the range of test parameters, when water was magnetized, the surface tension was indeed decreased. Especially surface tension of the magnetized water with the magnetized parameters (magnetized field intensity is 330mT, water flow rate is 1m/s) declined the most significant.

RESULTS AND DISCUSSION

Cement hydration reaction of magnetized water

Action of cement hydration firstly took place on the surface of cement particles, and the layer of gel film can be formed on the surface of the cement, which can reduce surface tension of the magnetized water and increase the activity of the cement [4-8]. Therefore, magnetized water can make the cement hydration more completely and the structure more compactly. The process of cement hydration reaction of magnetized water can be shown as follows.

$$\begin{cases} 2(3CaO\cdot SiO_2)+6H_2O=3CaO\cdot 2SiO_2\cdot 3H_2O+3Ca(OH)_2\cdot \\ 2(2CaO\cdot SiO_2)+4H_2O=3CaO\cdot 2SiO_2\cdot 3H_2O+Ca(OH)_2 \\ 3CaO\cdot Al_2O_3+6H_2O=3CaO\cdot Al_2O_3\cdot 6H_2O \\ 4CaO\cdot Al_2O_3\cdot Fe_3O_4+7H_2O=3CaO\cdot Al_2O_3\cdot 6H_2O+CaO\cdot Fe_2O_3\cdot H_2O \\ 3CaO\cdot Al_2O_3\cdot 6H_2O+3(CaSO_4\cdot 2H_2O)+19H_2O=3CaO\cdot Al_2O_3\cdot 3CaSO_4\cdot 31H_2O \end{cases} \quad (3)$$

Workability of magnetized water concrete

As we all know, there is not much strong physical and chemical activity single water molecule in ordinary water and the activity of water is not enough, which can affect the cement hydration. Through the magnetized field, the water flow may be affected by Lorentz force, resulting changes in the orbital motion of electrons around the nucleus in water molecules and the spin motion, thereby the state of charge of water was changed.

Single polar water molecules ($O^{2-}$and H^{+}) will be partly separate from water molecules. The number of this strong activity single water molecules will be increased which can greatly enhance the activity of the magnetized water. Therefore, magnetized water molecules can easily enter the cement grains and make the cement hydration more completely.

Water ratio of the magnetized water concrete

Fig.5 show that when the cement mixing with water, due to the action of molecular cohesion between cement particles, the cement could be formed of flocculation structure. From Fig.6 it is indicated that, under the action of the electric repulsive, the cement particles can be separated. And it can make the flow ability of the concrete mixture increased without increasing the water consumption [9-11].

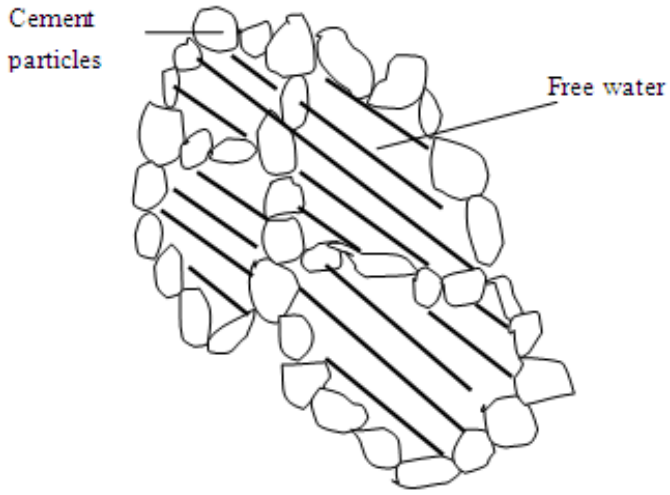

Fig. 5 Cement mortar flocculated structure

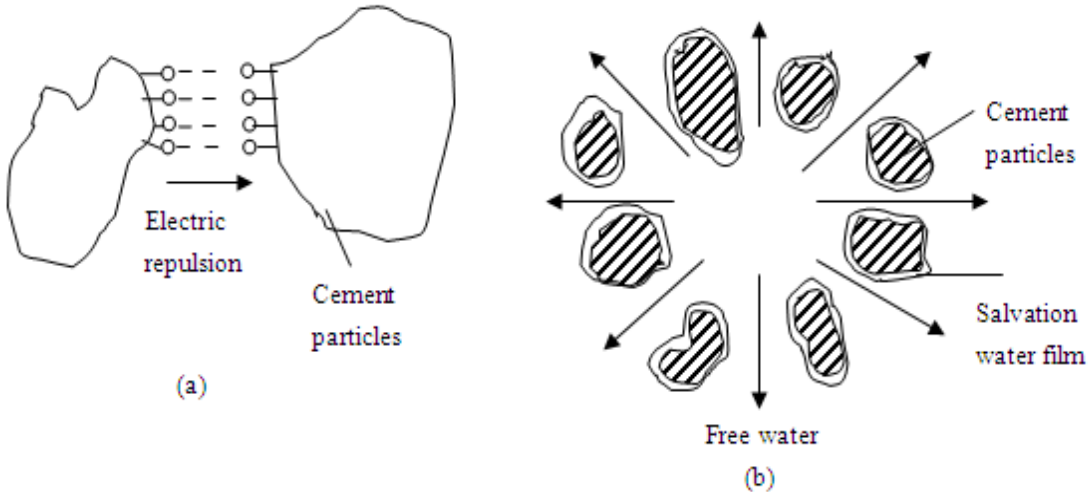

Fig. 6 Affection of magnetized water

CONCLUSION

By analysis, the water system is a complex object, which is difficult to study. Minor changes in structure of molecules of magnetized water have indeed occurred. So the magnetized water can make the cement hydration reaction more completely.

(1) After a certain conditions of magnetization process, physical and chemical properties of water were improved in the following areas: conductivity, viscosity and surface tension were decreased; PH value was increased and so on.

(2) Among the range of test parameters, when water is magnetized, PH value was indeed increased. Especially PH value of the magnetized water with the magnetized parameters (magnetized field intensity is 330mT, water flow rate is 1m/s) increased the most significant. And the surface tension was indeed decreased. Especially surface tension of the magnetized water with the magnetized parameters (magnetized field intensity is 330mT, water flow rate is 1m/s) decline the most significant.

(3) The magnetized water has lower surface tension, which can increase the activity of the cement. Therefore, magnetized water can make the cement hydration more completely and the structure more compactly.

(4) Magnetized water molecules can easily enter into the cement grains. Therefore, magnetized water can increase the workability of concrete mixture, which can reduce the in homogeneity degree of mixture.

(5) As the magnetized field changes the morphology and water impurities in the water molecules, so that the physical and chemical properties of magnetized water, some changes have taken place.

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REFERENCES

[1] Charlotte Porteneuve; Hélène Zanni; Jean-Pierre Korb; Dominique Petit. *Comptes Rendus de l'Académie des Sciences-Series IIC- Chemistry*, **2001**, 4(11), 809-814.
[2] Shanyu Zhao. *Journal of Concrete*, **2006**,201 (7), 1-4.
[3] Joanna Boguszynska; Marc C.A.Brown; Peter J.McDonald; Jonathan Mitchell; Mike Mulheron; Jadwiga Tritt-Goc; Dimitris A.Verganelakis. *Cement and Concrete Research*, **2005**, 35(10), 2033-2040.
[4] S.D.Beyea; B.J.Balcom; T.W.Bremner; P.J.Prado; D.P.Green; R.L.Armstrong; P.E.Grattan-Bellew. *Cement and Concrete Research*, **1998**, 28(3), 453-463.
[5] Lijiu Wang; Huizhi Li. *Journal of Research & Application of Building Materials*, **2007, (01)**, 13-16.
[6] Nan Su; Yeong-Hwa Wu; Chung-Yo Mar. *Cement and Concrete Research*, **2000**, 30(4), 599-605.
[7] Baomin Wang; Lijiu Wang. *Journal of Concrete*, **2002**, (11), 9-12.
[8] Patil; Jagadish H.; Sanil, Prajwal H.; Malini, B.M.; Manoj, V.; Deepika, D.; Chaitra, D. *Journal of Chemical and Pharmaceutical Research*, **2012**, 4(5), 2585-2589.
[9] Liu Ying; Cao Jiaji; Zhang Haowei; He Yajin; Xu Xinxin, *Journal of Chemical and Pharmaceutical Research*, **2014**, 6(1), 254-258.
[10] Zhang Yuanxiang; Ji Yingyu, *Journal of Chemical and Pharmaceutical Research*, **2014**, 6(2), 77-82.
[11] Tong Zhengong; Li Yani; Haidong Shangguan, *Journal of Chemical and Pharmaceutical Research*, **2013**, 5(12), 467-471.