



Analysis on microstructure of impermeability of magnetized water concrete

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ABSTRACT

Substantial research results show that the magnetized water can make the cement hydration reaction more completely, which can increase the cohesion of concrete mixture and enhance the strength of concrete. Therefore, the compactness and water impermeability of the concrete mixed with magnetized water in different degrees are studied in the paper. On the basis of the study of the concrete of magnetized water by the predecessors, a test of magnetized water concrete has been taken based on two selected magnetic parameters, the corresponding magnetic field intensity and water flow rate. According to the principle of cross-test, 21 samples with the intensity levels C20, C25 and C30 are chosen. The tests indicate the different properties between the magnetized water concrete and ordinary water concrete at the condition of same strength to study the special law influenced by the flow speed of water and the magnetic field strength. Based on the test above, the typical samples of the magnetized water concrete and ordinary water concrete have been scanned by the electron microscope. The pictures scanned by electron microscope can help to analyze the microstructure of magnetized water concrete and the ordinary one. The magnetized water can improve the properties of concrete. On the basis of the study of magnetic water concrete by the predecessors, the effects such as hypothesis of the mechanism, action of the cement hydration, concrete workability, water ratio of the concrete, setting time and hardening process of magnetized water concrete was studied in this issue. The mechanism of improvement of magnetized water concrete is also analyzed from the perspective of microanalysis.

Key words: magnetized water concrete; electron microscopy; magnetic field intensity; water flow rate; microstructure

INTRODUCTION

The difference between magnetized water concrete and ordinary water concrete with different intensity levels C20, C25 and C30 are contrasted by this test. Under the same mix proportion of concrete, each strength class of concrete will make a group of ordinary water concrete and 6 groups of magnetized water concrete. According to the principle of cross-test, 6 groups of magnetized water concrete adopt different magnetic field intensity (230mT, 280mT, 330mT) and different water flow rate (1m/s, 2m/s) in the comparison test under the same condition of agitation, material, curing (28 days standard curing periods). Firstly, samples of C25 ordinary water concrete and magnetized water concrete with the same condition were selected, which can be scanned by JSM-6390LV electron microscopy. Secondly, the selected 7 samples of C25 concrete (1 group of ordinary water concrete and 6 groups of magnetized water concrete) were respectively enlarged 50 times, 200 times, 500 times, 1000 times, 2000 times, 4000 times, and then their differences in the microstructure were compared. Finally, by comparing the difference between 7 groups of C25 concrete samples at the microstructure. Which can help to find most ideal microstructure of concrete samples. And as the basis of its magnetic parameters, select the same magnetic parameters of C20, C30 magnetized water concrete and ordinary water concrete with the same condition, then scanned by electron microscopy, which can

compare the differences in microstructure, and further confirms improvement of magnetized water concrete. Microstructures of ordinary water concrete and magnetized water concrete with different intensity were scanned by electron microscopy. Improvement mechanism of magnetized water concrete was analyzed by comparing the differences in microstructure between ordinary water concrete and magnetized water concrete.

EXPERIMENTAL SECTION

Experimental instrument equipment

The special magnetizer made by Chinese Academy of Science engineering research institute as shown in Fig.1.



Fig.1 Magnetizer's appearance

SG-4L Tesla terms as shown in Fig.2 is adopted in this test.



Fig.2 SG-4L Tesla terms

Test materials

Cement: 32.5MPa ordinary Portland cement.

Sand: medium sand of 2.6 fineness modulus.

Aggregate: diameter: 0.5~2.5cm, fine grading.

Water: ordinary water and, magnetic water with different magnetic parameters.

Under the same condition of agitation, material, curing (28 days standard curing periods). The difference between magnetized water concrete which adopted different magnetic field intensity (230mT, 280mT, 330mT) and different water flow rate (1m/s, 2m/s), and ordinary water concrete with different intensity levels C20, C25 and C30 are contrasted by this test.

(1) Mix proportion of concrete with strength class of C20:

Cement: sand: aggregate: water cement ratio =1:1.50:3.50:0.47;

(2) Mix proportion of concrete with strength class of C25:

Cement: sand: aggregate: water cement ratio =1:0.76:3.04:0.38;

(3) Mix proportion of concrete with strength class of C30:

Cement: sand: aggregate: water cement ratio =1:0.79:2.81:0.36;

Mechanical agitation and vibration are adopted in the course of the experiment.

RESULTS AND DISCUSSION**Microstructure of concrete**

Different strength of concrete, which enlarged 50 times by electrical microscopy observations as shown in Fig.3.

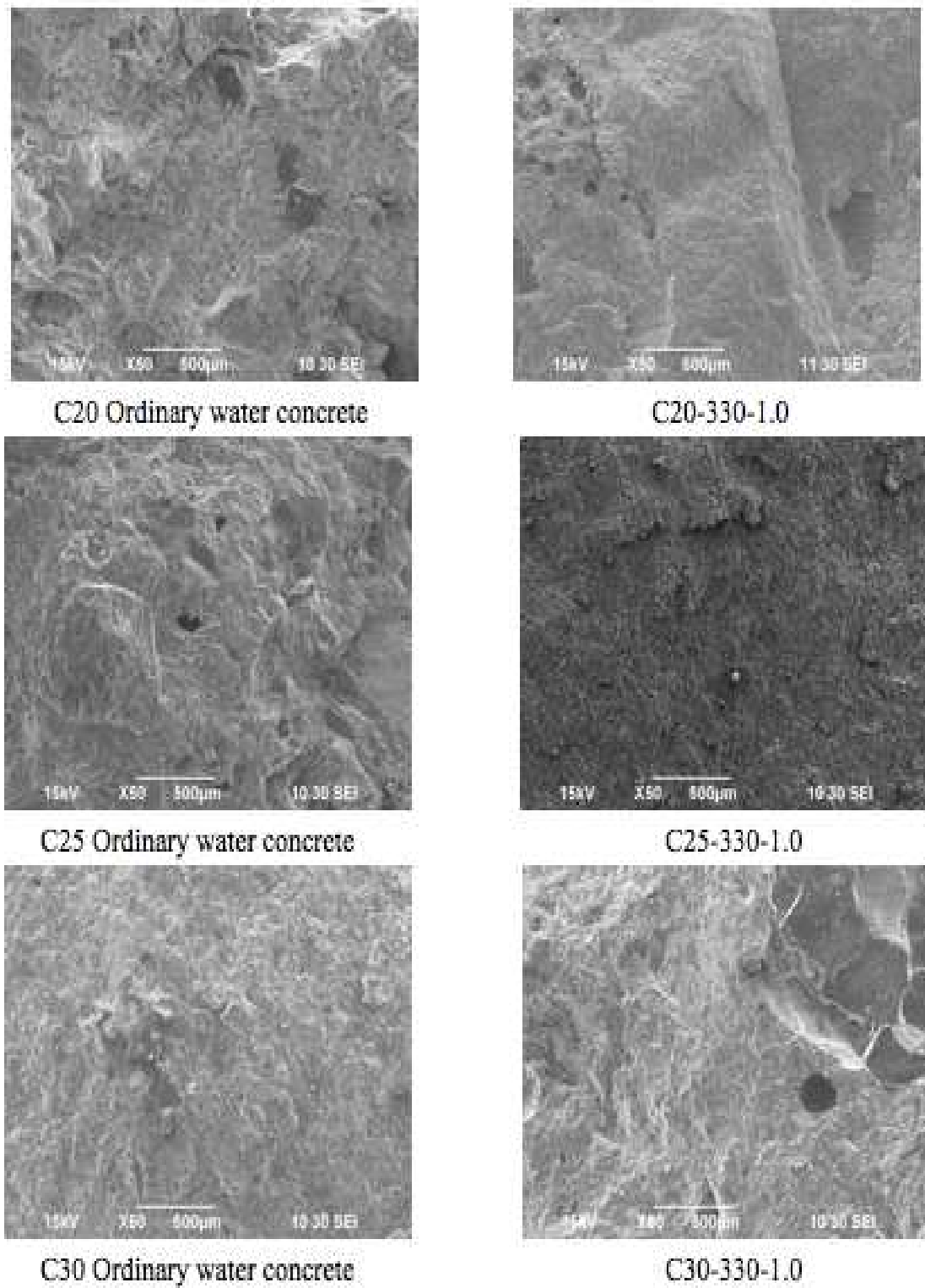


Fig.3 50× observation

Different strength of concrete, which enlarged 200 times by electrical microscopy observations as shown in Fig.4.

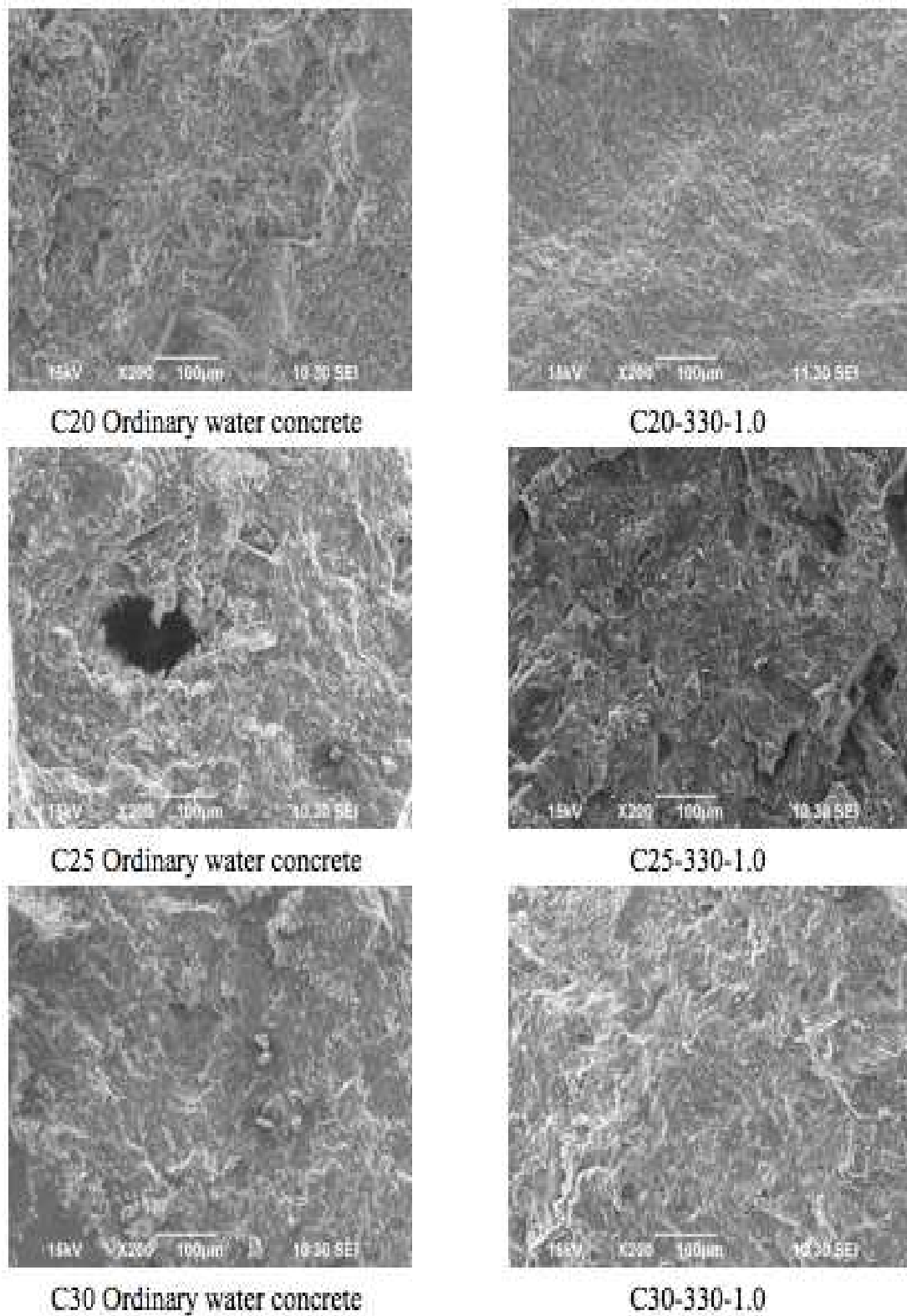


Fig.4 200× observation

Different strength of concrete, which enlarged 500 times by electrical microscopy observations as shown in Fig.5.

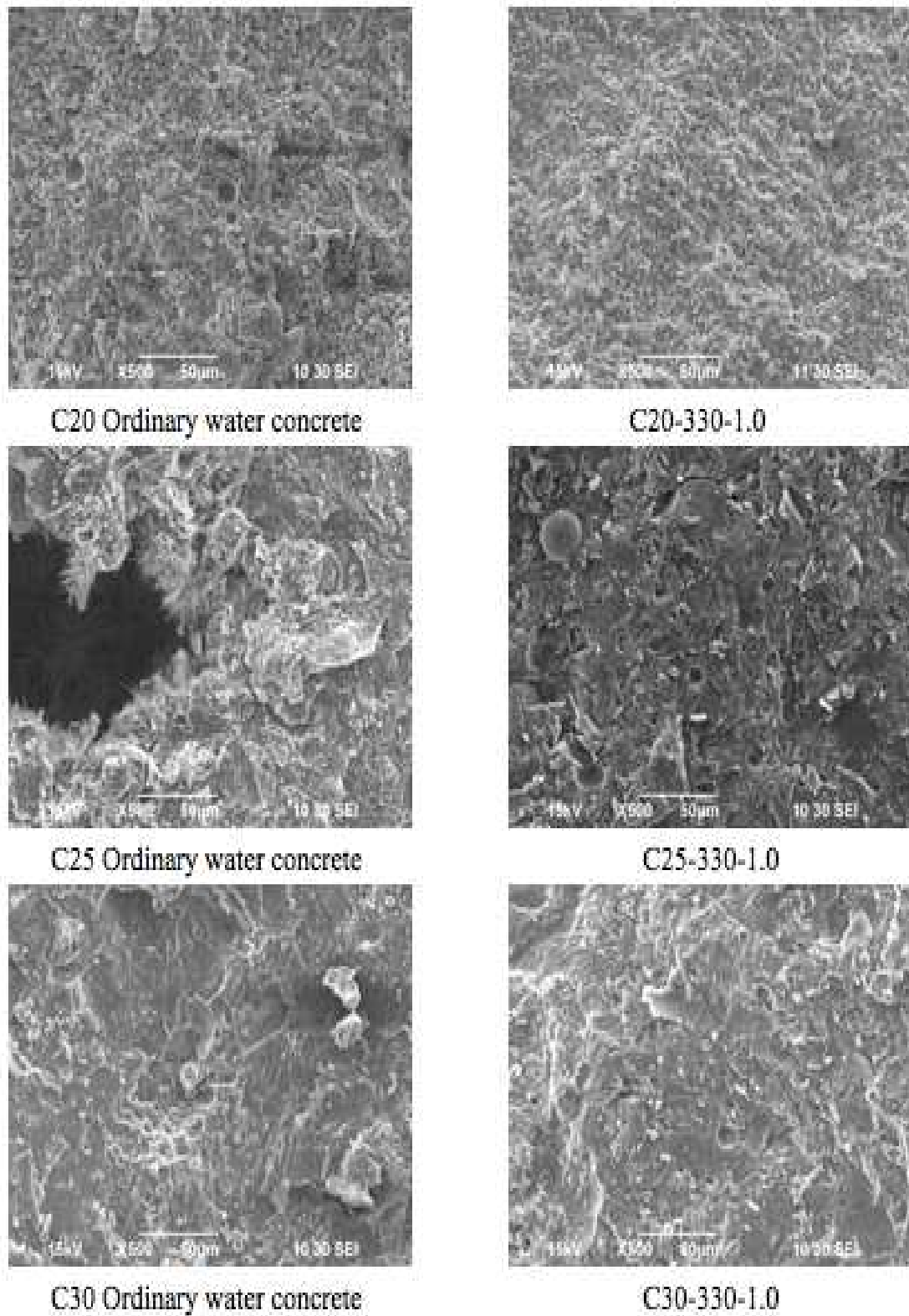


Fig.5 500× observation

Different strength of concrete, which enlarged 1000 times by electrical microscopy observations as shown in Fig.6.

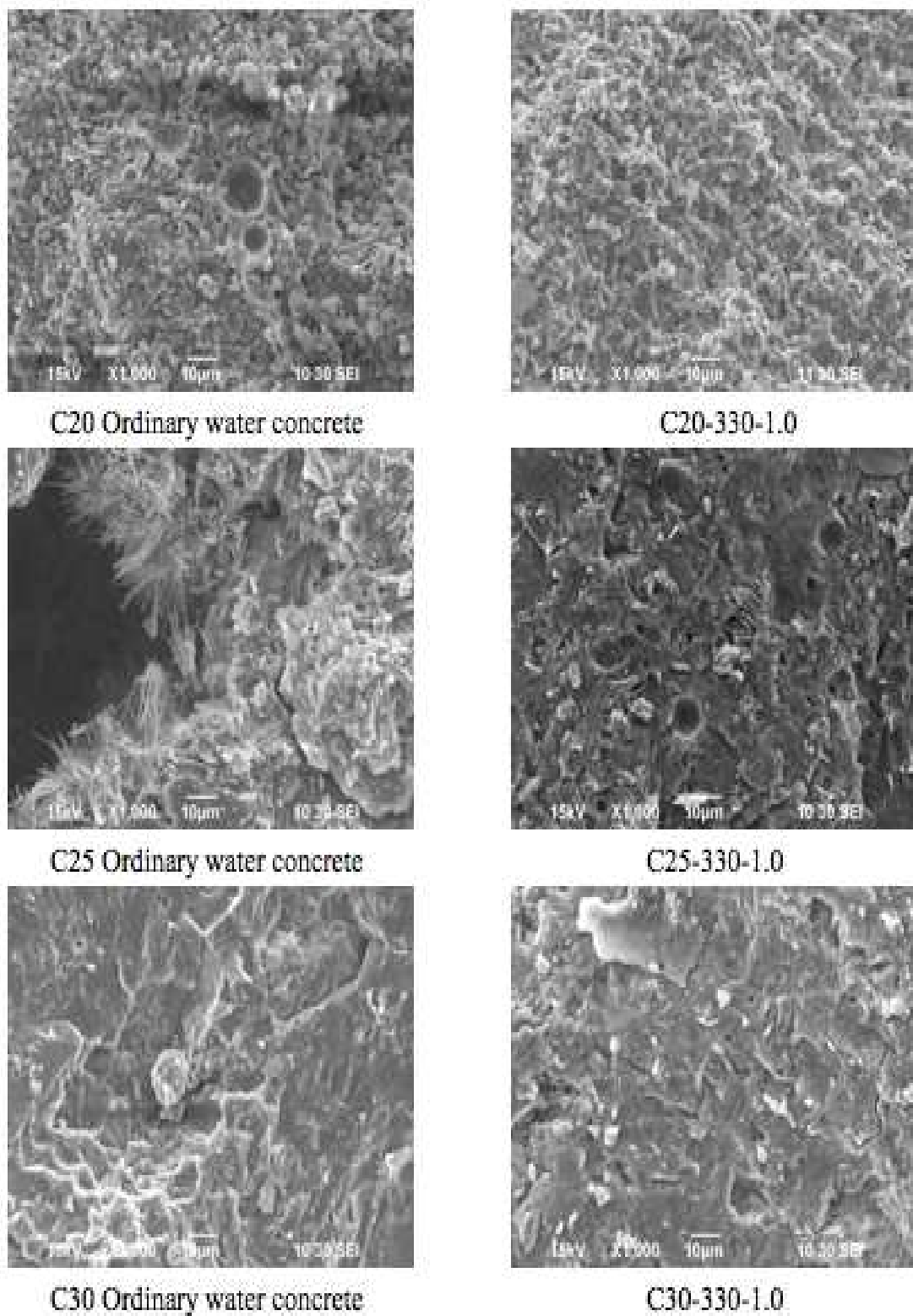


Fig.6 1000× observation

Different strength of concrete, which enlarged 2000 times by electrical microscopy observations as shown in Fig.7.

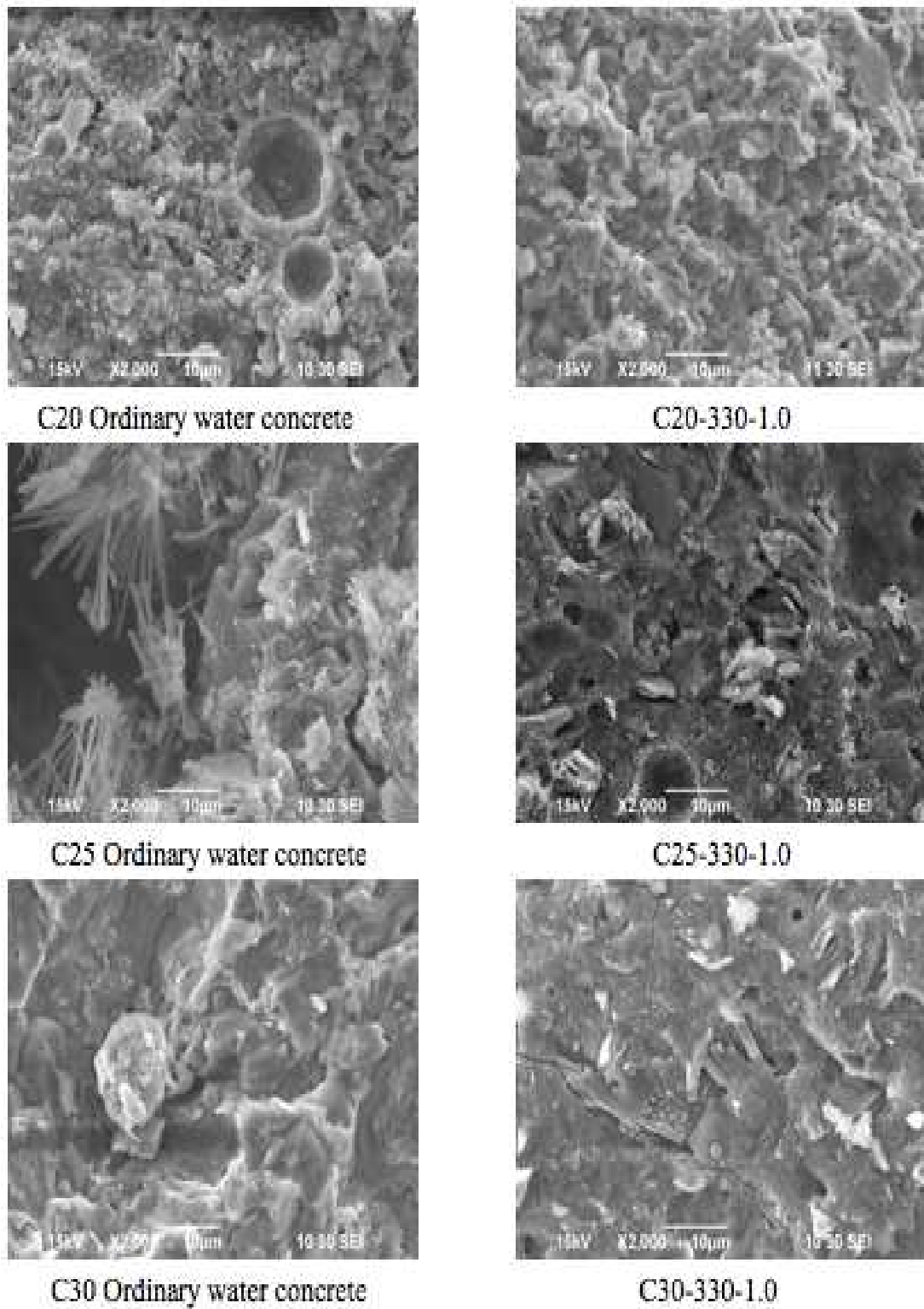


Fig.7 2000× observation

Different strength of concrete, which enlarged 4000 times by electrical microscopy observations as shown in Fig.8.

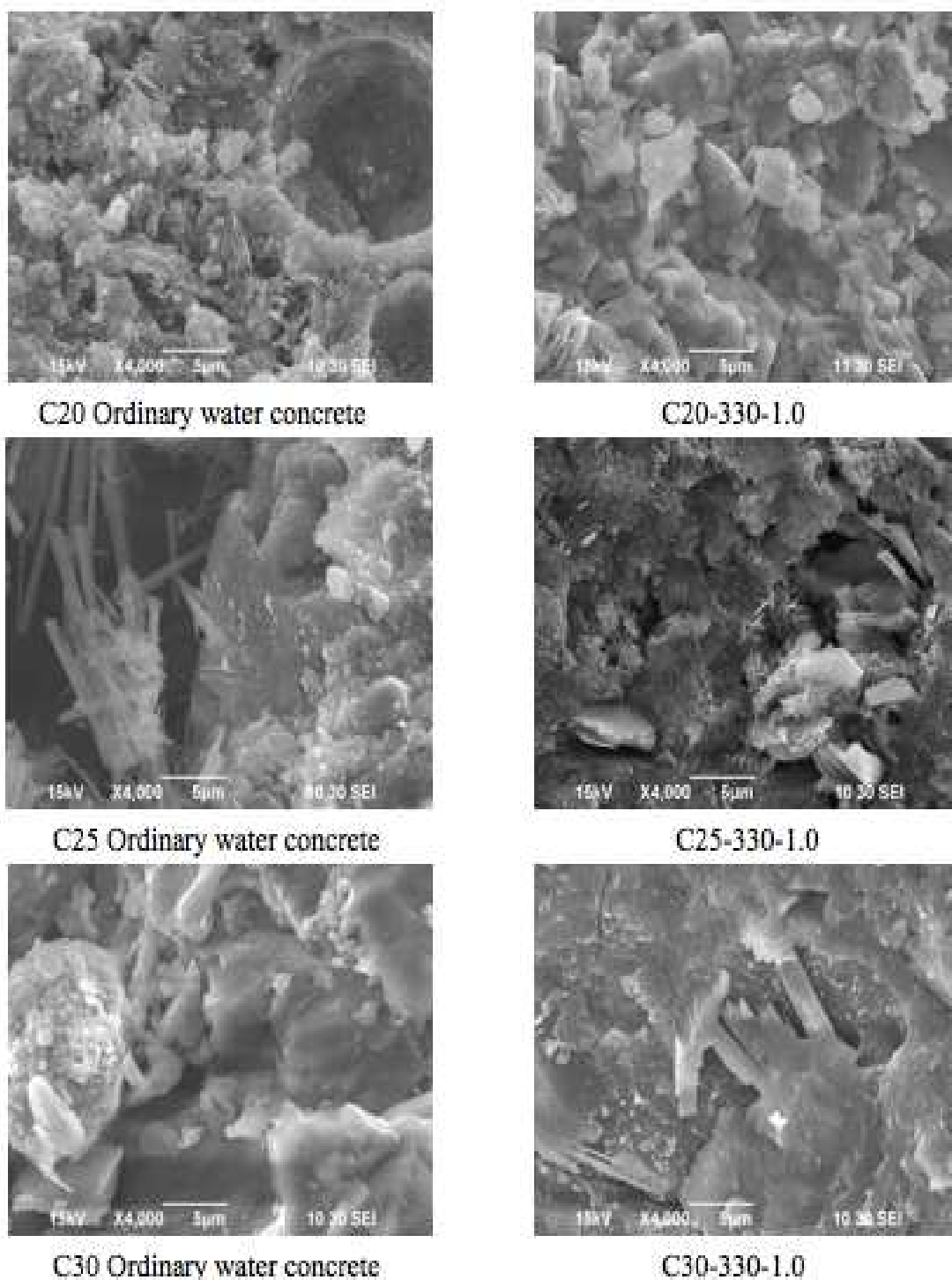


Fig.8 4000× observation

Impermeability Mechanism of Magnetized Water Concrete

Hypothesis of the mechanism of magnetization of water

Up to now, by most accepted hypothesis is that under the action of Lorentz force, chain molecules group of ordinary water, which has been linked together with hydrogen bonds, will be cut or damaged. Consequently, it will crack into group of small molecules or individual water molecules [1-5].

Changes in the connection between molecules of magnetic water can lead to physical and chemical properties change of magnetic 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.

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

Action of cement hydration of magnetic water concrete

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 magnetic water and increase the activity of the cement. Therefore, magnetic water can make the cement hydration more completely and the structure more compactly [6-9].

Workability of magnetic 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 magnetic 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 magnetic water. Therefore, magnetic water molecules can easily enter the cement grains and make the cement hydration more completely [8-11].

Water ratio of the magnetic water concrete

When the cement mixing with water, due to the action of molecular cohesion between cement particles, the cement could be formed of flocculation structure. 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 [6, 11].

CONCLUSION

The structure of molecules of magnetic water has indeed occurred the minor changes, resulting in increased activity of the water. The magnetized water can make the cement hydration reaction more completely, which can increase the cohesion of concrete mixture.

- (1) It is discovered by test that, among the range of test parameters, the best magnetic field intensity is 330mT and the best water flow rate is 1m/s, which have been obtained among the range of test parameters.
- (2) Magnetic water molecules can easily enter into the cement grains. Therefore, magnetic water can increase the workability of concrete mixture, which can reduce the inhomogeneity degree of mixture.
- (3) Under the action of the electric repulsive, the cement particles can be separated. This can make the flowability of the concrete mixture increased without increasing the water consumption.
- (4) As the magnetic 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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