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ORIGINAL RESEARCH

Effect of superabsorbent polymer on the shrinkage and crack resistance of concrete at early age

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Abstract

The superabsorbent polymer (SAP) with different volumes and modes of entrained water is incorporated into concrete to study the effect of SAP on the compressive strength, flexural strength, shrinkage, plastic cracking and electrical resistivity of concrete at early age. The result indicated that the influence of SAP with different modes of entrained water on the early strength of concrete is relatively obvious. It is beneficial for the early strength of concrete to add pre-absorbed SAP whose internal curing (IC) is detracted from mixing water and unabsorbed SAP. But the early strength of concrete is decreased by adding pre-absorbed SAP. The effect of pre-absorbed SAP is limited on shrinkage of concrete when IC water is detracted from mixing water. The unabsorbed SAP gradually decreases the concrete shrinkage with its volume increase. The moderate volume of pre-absorbed SAP can decrease the early concrete shrinkage. In addition, SAP can effectively alleviate the early appearance and development of concrete cracks. Furthermore, the pre-absorbed SAP can efficiently enhance the crack resistance of concrete. When the unabsorbed SAP is added, the cracking of concrete is reduced with the increase of volume. The longer the curing age, the more obvious would be the influence of SAP on the internal humidity of concrete, which effectively delays the increase of concrete resistivity.

Keywords Crack resistance · Early performance · Internal curing · Shrinkage · Superabsorbent polymer

Introduction

Concrete is a kind of brittle material with heterogeneous complex system whose tensile strength is clearly lower than compressive strength [1]. With the development of concrete technology, high performance concrete and high strength concrete have wider applications [2]. However, when water cement ratio is relatively low, it will deform shrinkage in concrete and reduces its crack resistance, which means that there would be more shrinkage and cracking problems than ordinary concrete. The shrinkage deformation is an important factor that causes the early cracking of the structure. Autogenous shrinkage and drying shrinkage are the main causes of early cracking of concrete [3, 4]. The generation and development of cracks provide an effective path for the transmission of corrosive media, which will inevitably reduce the strength and durability of concrete matrix. The test results [5, 6] have shown that the microstructure of concrete is dense when the water cement ratio is low. External moisture is not easily penetrated into the interior of concrete for effective curing. Therefore, the cement paste with capillarity pressure is generated and the autogenous shrinkage of concrete occurs. In addition, the hydration reaction of cement and mineral admixtures leading to the internal relative humidity gradually decreases and gives rise to the drying shrinkage of concrete. Accordingly, it is necessary to control shrinkage deformation and crack development of modern concrete.

To adapt to the development of modern concrete curing demand and meet the effective curing mechanism of concrete, it is necessary to study a kind of efficient green curing technology. Effective curing technology not only can ensure the moisture environment needed for reducing the early crack and drying shrinkage outside the concrete, but also can ensure the humidity environment needed for the

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