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Method of Application of Common Admixtures on Concrete

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Abstract

Since the reform and opening up, the level of modern buildings in Our country is getting higher and higher, at the same time, the requirement of concrete performance is also getting higher and higher. The use of concrete admixture is the most common way to change concrete performance, but scientific and accurate use of admixture is of great significance to concrete performance. The use of concrete admixture is the most common way to change concrete performance, but scientific and accurate use of admixture is of great significance to concrete performance. Therefore, in the process of the use of the admixture, the principle of action of the admixture, the effect of concrete properties and the use of the admixture methods need to be thoroughly understood. Therefore, in the process of the use of the admixture, the principle of action of the admixture, the effect of concrete properties and the use of the admixture methods need to be thoroughly understood.

Keywords

Cement Hydration; Concrete; Additive; Concrete Performance.

1. Introduction

The use of admixtures makes the practical application of concrete more ideal. According to the present research, due to the complexity of concrete itself and the requirements of practical application, the use of various admixtures has higher and higher requirements.

2. Development of common admixtures

2.1 Retarders

2.1.1 Basic characteristics of retarders

Retarder is one of the common cement admixtures used in premix concrete. It aims to control the hydration speed and the peak temperature on the basis of having little influence on the durability of concrete, that is, the final setting time of concrete is extended. By adding retarder, the plastic time of concrete is prolonged, which is more beneficial to the casting of large structures[1]. And the decrease of the peak value of hydration heat of concrete can greatly ensure the construction quality of mass concrete.

2.1.2 Sub Study on the effect of retarder on concrete performance

The commonly used retarder is sodium gluconate retarder and cyclodextrin. The experiment shows that the hydration process of concrete can be slowed obviously by adding 4 of this type of additive. The effect of cyclodextrin is more obvious than that of sodium gluconate. At the same time, the temperature peak of the whole structure can be reduced moderately by adding retarder. It is particularly emphasized that the strength of concrete mixed with retarder has been improved after 7

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days and 28 days of hardening, indicating that retarder has promoted the uniform hydration of cementitious materials.

2.2 Air entraining agent

2.2.1 Basic characteristics of air entrainer

Air entrainer, also known as aerating agent, is a hydrophobic material, surfactant is the core component. Common air entrainment agents are soap, alkyl sodium sulfonate, etc. Before being added to concrete, the air entrant must be fully immersed in water. When added to concrete, it produces a large number of small air bubbles ranging in size from 50 μm to 125 μm[1]. The surface of the bubble is connected with the surfactant of the air entrainer, which makes the bubble stronger and not easy to break. The bubbles divide some of the gravel, thus reducing friction and collision between the gravel and improving the fluidity of the concrete. The uncured concrete belongs to solid liquid state, while the bubble belongs to gaseous state. The different state makes the bubble block the capillary channel of concrete, better ensures the stability of concrete water content, and improves the performance of frost resistance and impermeability of concrete.

2.2.2 Study on the influence of air entrainer on concrete performance

Air entrainment agents are generally used to improve the durability of concrete or, more specifically, are preferred only when frost resistance is needed. Its effect is especially obvious in concrete with low cement content. In particular, it should be noted that, other conditions being the same, the increase in the number of bubbles will reduce the strength of concrete, the more bubbles, the greater the decline in strength. Concrete strength decreases by 3-5% for every 1% increase in gas content. But sometimes adding air entrainment agent is the best way to improve the durability of concrete, without reducing the strength of concrete, it is necessary to add an appropriate amount of other admixtures, such as silicon powder, slag powder, fly ash, and its mixture. It is worth noting that in general, when admixtures are added, the amount of admixtures added will reduce the corresponding amount of cement, and the type of admixtures added will have little influence on the strength, but the addition of admixtures will also significantly improve the frost resistance of concrete.

2.3 Water reducer

2.3.1 Basic characteristics of water reducer

Water reducing agent is also one of the admixture is commonly used in concrete construction, not adding additive of concrete, because to attract each other between cement particles flocculate, through the water reducing agent is added in the concrete and mixing, can make between cement particles with the same charge, so the like charges repel each other, under the action of cement particles more dispersed, and release the floc between cement particles, can effectively improve the content of free water[1]. Therefore, on the premise of ensuring the fluidity of cement, adding water-reducing agent can reduce the water content of concrete in mixing and indirectly improve the strength of concrete. The addition of water-reducing agent is 1% of cement dosage generally, fluctuation does not exceed 0.5%. The water consumption of concrete can be reduced by 5-25%. What needs to be emphasized is that some water-reducing agents also have the role of retarder. In the process of use, if there is a high requirement for the hardening time of concrete, special attention should be paid not to work with the retarder that needs to be added at the same time, causing mistakes in construction.

2.3.2 Technical requirements for the use of water reducing agents

Superplasticizer is divided into liquid and solid two kinds of state, superplasticizer is generally in the concrete after the formal start of stirring 1-2 minutes after adding. When added, the additive error range is about 5%.If the liquid superplasticizer is added, the stirring time shall be longer than 1 minute since the addition. The difference between solid and liquid superplasticizers in use is only the need to increase the mixing time after adding superplasticizer. After mixing the concrete, it is required to finish the pouring within 1 hour. If the interval time is not ideal, it is combined with other types of additives to achieve the ideal interval time. At the same time, due to the addition of water-reducing

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agent, based on the theory that the cement flocculant is destroyed, the dosage of cement can be reduced appropriately, which not only saves cost, but also reduces the hydration heat[1].

2.3.3 Study on the influence of water-reducing agent on concrete performance

The use of water-reducing agent, because of the existence of ionic water-reducing agent, will produce tiny bubbles in concrete, and the formation mechanism and characteristics of these bubbles are very different[3]. When mixing concrete, the superplasticizer added is mostly adsorbed on the surface of cement particles and does not diffuse for a long time. In the concrete with water reducing agent, 2% bubbles of uneven size and uneven distribution were eliminated. Meanwhile, the concrete parameters were evenly distributed, which greatly improved the tensile properties of concrete. In addition, the small bubbles formed by the addition of water-reducing agent can effectively fill the micro-pores generated during the shrinkage of concrete, thus improving the impermeability of concrete. The existence of small bubble buoyancy alleviates the hydrostatic pressure in concrete and improves the ability of repeated freezing and thawing of concrete. In the middle and late stage of concrete hardening, water-reducing agent can slow down hydration and improve concrete strength.

2.4 Early strength agent

2.4.1 Sub The basic characteristics of early strength agent

At present, the early strength agents used in China are divided into organic, inorganic and compound types[3]. At present, calcium formate, triethanolamine and sodium sulfate as examples, analysis of concrete hardening principle. After adding calcium formate admixture, compared with Ca^{2+}, the diffusion rate of formate ions is faster, and can well penetrate into the hydration layer of cement components C_2S and C_3S, thus accelerating the precipitation of calcium hydroxide and the hydration of calcium silicate to achieve the purpose of early strength. After adding sodium sulfate admixture, sodium sulfate, as a strong electrolyte, greatly increases the concentration of ions in cement slurry and reacts with $Ca(OH)_2$ to form $CaSO_4$ and NaOH, which increases the alkalinity of concrete slurry and further speeds up the dissolution rate of C_3A and $Ca(OH)_2$, thus improving the concentration of calcium sulphoaluminate and playing a role of early strength. After adding triethanolamine additive, triethanolamine and Fe^{3+}, the interaction of Al^{3+} complexing ions to form soluble in water, can promote the dissolution of C_4AF and C_3A, to generate calcium sulphoaluminate provides a better condition, at the same time can reduce the concentration of calcium and aluminum ions, promoting in the concrete of C_3S hydration, so as to improve the early strength of concrete.

2.4.2 Study on the Effect of early strength agent on concrete performance

Admixtures that can improve the early strength of concrete are collectively called early strength agents, which are generally used in emergency repair or winter construction, and have little effect on the late strength of concrete[3]. For concrete with early strength agent, 1d strength, as for the three early strength agents mentioned in this paper, all increased by about 35%, and 3D strength increased by about 30%. The early strength increased significantly, while the strength of 28d showed a trend of shrinkage.

2.5 Composition and hydration of cement

In order to better understand the action principle of the admixture, as well as the human requirements for concrete hydration, a comprehensive understanding of the cement composition and hydration process, for the concrete performance research to lay a solid foundation, the basic properties of cement are simply described below.

Cement is the most core component of concrete, which contains four kinds of minerals that hydrate after being exposed to water[4]. The cementitious materials generated bond the other components of concrete together, so cement is the key to concrete performance.The different proportions of these four minerals in cement directly determine the strength difference of concrete at each age. The hydration speed of C_3A is the fastest, and the initial and final setting time is basically determined by the content of C_3A.C_4AF is the second, but the general content is very small, because of good wear resistance, hydration is reduced, when used on the road, the benefit is greater;The reaction speed of

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C_3S is fast and the content is relatively high, and the strength of 28d is generally determined by it.The hydration rate of C_2S is the slowest and is the main factor for the strength improvement of concrete from 28d to 90d.

3. Summary

The use of admixture, very good to realize the human's subjective desire of concrete performance, this paper on the commonly used concrete admixture of action principle, use methods and concrete performance changes do a brief analysis.

In the process of using concrete admixtures, it is generally necessary to add a variety of admixtures at the same time. However, the comprehensive influence of adding at the same time on the performance of concrete is seldom studied in the past, but this kind of influence cannot be ignored.For example, the mixed use of the three early strength agents mentioned in this paper, calcium formate, triethanolamine and sodium sulfate, is taken as an example. When the three admixtures are added in the optimal amount at the same time, the early strength is obviously higher than that of only one additive, but the effect of all three additives is not the best.We also have to consider that when all kinds of admixtures are involved at the same time, the strength of concrete gel material will not fail.It is suggested to design a more reasonable admixture combination application scheme and the most reasonable adding order under the situation of various admixtures nowadays.

As far as precast concrete is concerned, the optimal amount of retarder is added during concrete mixing to facilitate long time transportation. However, after pouring, the hardening rate will be slowed down. However, if the early strength agent is added before concrete is put into mold, what will be the effect? Moreover, if the concrete in the pouring, beyond the allowed time, and inconvenient to transport back to the mixing station, at this time we should reduce its strength for use, or do other treatment, did not give normative advice.

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