The influence of ambient temperature on the loses through time performance of concrete and the control measures of slump protection agent

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Abstract. This paper studies the effect of ambient temperature on the loses through performance of concrete, and discusses the effect of the control measures on improving the loses through performance of concrete. Through experimental observation and analysis, it is found that the higher the environmental temperature, the greater the loses through of concrete, and by changing the amount of slump protection agent, can effectively regulate the loses through of concrete, ensure the construction performance of concrete. The results of this paper can help to better control the construction performance of concrete and provide guidance for the preparation of concrete in practical engineering.

Keywords: Temperature, Slump protection agent, Loses through of concrete passage.

1 Introduction

Concrete is one of the most important materials in modern construction engineering, and its performance directly affects the safety and durability of buildings.[1]The Loses through of concrete refers to the loss of mixture liquidity due to the passage of time during the use process. The loss performance will affect the construction performance of concrete pump pipe blockage, concrete pouring uneven and other phenomena, at the same time if the second water to adjust the concrete to the construction state, will also affect the compressive strength and durability performance of concrete, causing great harm to the safety of concrete engineering structure. Therefore, it is of great significance to study the influence of environmental temperature on the loss performance of concrete, and to explore the effect of slump protection control measures to improve the loss performance of concrete.

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2 Test the raw materials and the mix ratio

2.1 Test raw materials

- Cement: Chunchi brand PO 42.5 ordinary Portland cement, the standard consistency water demand is 25%, and other properties meet GB175-2020;
- Fine aggregate: mechanical sand, fineness modulus 2.9, other indicators are to meet the GB / T 14684-2011 "construction sand" standard requirements;
- Coarse aggregate: using 5~25mm, 16.5~31.5mm continuously graded gravel, crushed value of 15%, other indicators all meet the GB / T 14685-2011 "construction pebble, gravel" standard requirements;
- Fly ash: grade ash, fineness sieve remaining 20%, water demand ratio 98%, other properties are in line with GB / T 1596-2017 "fly ash in cement and concrete" standard requirements;
- SLAG: S95 grade, 28d activity index 98%, flow ratio 105%, other properties are in line with GB / T 18046-2017 "for cement, mortar and concrete in the granular blast furnace slag powder" standard requirements;
- Mixing water: meet the requirements of JGJ 63-2006, Concrete Water Standard;
- PCE:KZJ Point-420HS high efficiency water reducing agent retartype, 2.0 water reduction rate 20%, other properties meet the requirements of GB 8076-2008 "Concrete admixture" standard;
- Slump protection agent: KZJ 10H slump protector, a polycarboxylic acid polymer synthesized at room temperature, has many advantages such as long slump time, moderate release rate and wide adaptability [2]. The molecular structure is shown in Figure 1 For example, the solid content of slump protector is diluted to 5% in order to improve the test accuracy.

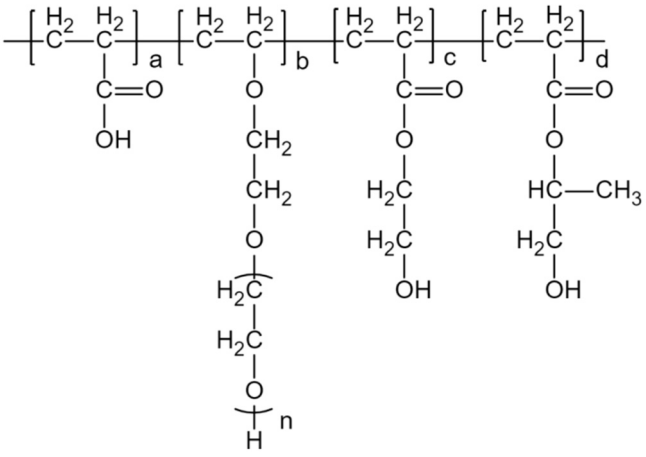

Fig. 1. Molecular structure diagram of the slump-preserve agent

2.2 The mix ratio

Mix ratio: C30 mix ratio is used, the aggregate used in the test is saturated surface dry state, see Table 1, PCE incorporation was 2.0% of the total mass of the cemented material[3].

Table 1. C30 test mix ratio.

Cement	Fly ash	SL	Mechanism sand	Gallet 5~20mm	Gallet 16.5~31.5mm	water
240	90	30	805	650	300	170

3 Effect of temperature on loss performance of mixture and analysis

According to the mix ratio described in Table 1, other factors are fixed unchanged, change the ambient temperature 5℃, 10℃, 15℃, 20℃, 30℃, 35℃, 40℃, 45℃, and test the loss performance [3] of the concrete mixture for 2h [4]. The measured results are shown in Figure 2.

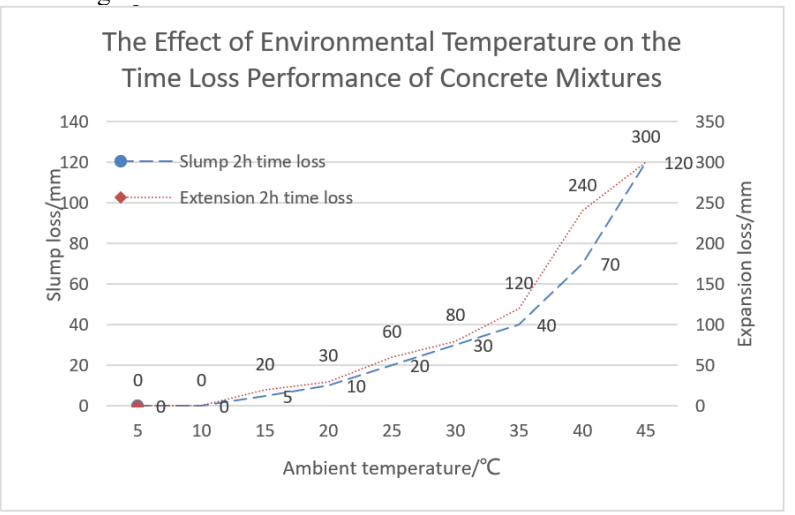

Fig. 2. The Effect of Environmental Temperature on the Time Loss Performance of Concrete Mixtures.

According to the analysis in Figure 2, the conclusion is as follows:

- When other conditions are the same, the environmental temperature has a great impact on the loss of concrete, with the increase of concrete slump loss, expansion loss shows a trend of increasing;

- At the ambient temperature of 5℃ ~10℃, the 2h concrete loss is 0mm, indicating that the concrete slump, expansion maintenance ability is good, conducive to construction;
- At the ambient temperature of 15℃ ~30℃, the concrete 2h slump loss 5mm~30mm, 2h expansion loss loss 20mm~80mm, in this temperature range although the concrete mix construction performance has a certain loss, but still can meet the normal construction requirements[5];
- When the ambient temperature is 35℃ ~45℃, the loss of 2h slump is 40mm~120mm, 2h expansion and the loss is 120mm~300mm. The construction performance loss of concrete mixture in this temperature range is large, which can not meet the normal construction needs.

4 Regulation regulation of slump retention at different ambient temperatures

From Figure 2 concrete mixture with the ambient temperature rise, after excessive loss, affect the construction performance, the author by adjusting the dosage of slump (and quality ratio of the cementitious material), control the other conditions unchanged, make the slump under the temperature condition 2h loss control in 5mm, 2h extension loss of 10mm, in order to achieve the best construction performance, the test results are shown in Figure 3.

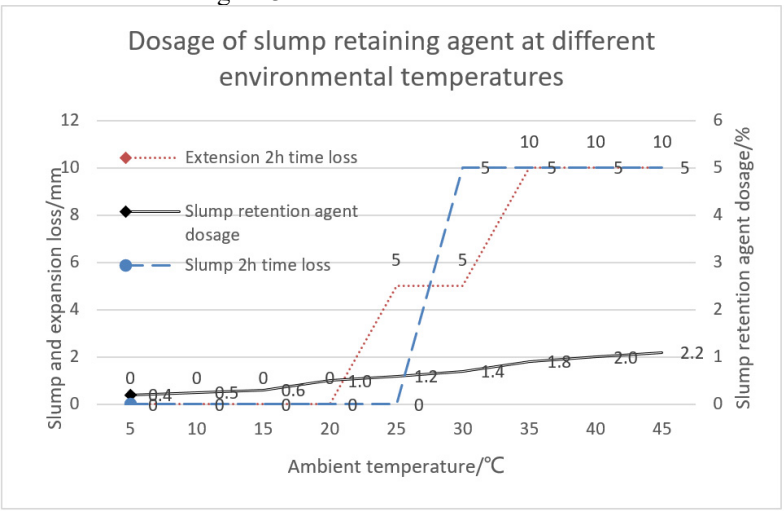

Fig. 3. Dosage of slump retaining agent at different environmental temperatures.

According to Figure 3. The analysis, the conclusion is as follows:

- At the ambient temperature between 5℃ and 45℃, the menstrual loss performance of the concrete mix is improved by adjusting the amount of slump inclusion, so that the slump loss of 2h is controlled at 0mm~5mm, and the extension loss of 2h is

controlled at 0mm~10mm, indicating that the concrete mix in each temperature range can achieve excellent construction performance[6] ;

- In the 5℃ ~15℃ ambient temperature range, the slump agent mixing range is 0.4%~0.6%, the ambient temperature increases every 5℃, the slump agent mixing content is increased by 0.1%, can make the slump and expansion of concrete mixture 2h time loss is 0mm;
- In the ambient temperature range of 20℃ ~30℃, the dosage range of slump is 1.0%~1.4%, the ambient temperature increases every 5℃, the dosage of slump increases by 0.2%, can make the slump loss of concrete mixture 2h loss control at 0mm~5mm, the extension loss control 0mm~10mm[7];
- In the temperature range of 35℃ ~45℃, the slump mixing range is 1.8%~2.2%, the ambient temperature increases every 5℃, the slump mixing content increases by 0.2%, can make the slump of concrete mixture 2h after loss control at 0mm~5mm, extension after loss control 0mm~10mm;
- It is worth noting that in the ambient temperature of 15℃ ~20℃ and 30℃ ~35℃, the increase of 5℃ increases by 0.4%, indicating that the loss performance of the concrete mixture in these two temperature ranges is abrupt, so the increase of slump inclusion is greater[8].

5 The conclusions and recommendations

Most countries in the world a year different season environmental temperature change, big temperature difference between day and night, through the test and the environmental temperature of the concrete mix after the loss performance, construction performance, in order to ensure the concrete structure engineering smooth construction and the quality and safety of concrete structure engineering, combined with the test situation gives the conclusion and Suggestions are as follows:

- The loss performance of concrete mixture is closely related to the environmental temperature. With the increase of environmental temperature, it is necessary to pay attention to whether the loss loss of concrete meets the construction requirements and adjusts in time[9];
- When the ambient temperature is 35℃, if effective measures cannot be taken to control the loss of concrete, the concrete mixture will cause construction quality accidents due to the loss;
- Generally speaking, for the adjustment of concrete menstrual loss, the use of slump agent can obtain good results, 5℃ ~15℃ ambient temperature range, ambient temperature increase every 5℃, the slump content increase 0.1%, 20℃ ~45℃ temperature increase every 5℃, the slump content increase 0.2%, can ensure that the menstrual loss performance of concrete mixture to meet the construction requirements;
- Concrete after the loss in addition to the influence of environmental temperature, and the aggregate mud content, powder content, material, water demand, and the adaptability of admixture are associated, ready-mixed concrete in daily production should pay attention to the performance of the raw material to change, if change,

concrete test, by adjusting the slump dosage, make the concrete mixture after loss performance to meet the requirements of ;

- There is a reasonable range of slump agent, if the added amount is too much, will make the concrete mixture after the loss of flow, exceed the construction performance requirements, and even segregation of concrete mixture, so the first use of slump agent, need to carry out test in advance to determine the optimal mixing range[10].

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