Study on preparation and properties of polycarboxylate superplasticizer with early-age strength

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Abstract. The shortcoming of polycarboxylate superplasticizer could delay the early strength of concrete, this limit its use in winter. In order to satisfy the application of polycarboxylate superplasticizer in the early strength constructional buildings. TEA was introduced into molecular chain of polycarboxylate superplasticizer, and the early-age strength of (3d and 7d) were investigated to find the optimal component. This type early-strength polycarboxylate superplasticizer has high superplasticizer, and it didn't impact the slumps and slump flow.

1 Introduction

With the wide application of concrete in the urbanization, the polycarboxylate superplasticizer develops fast[1-2].Some precast structures need enhance the early strength to speed up use of prefabricated mould[3-5]. In order to improve the early strength of concrete, generally we use low water-binder ratio or increase the dosage of cement[6-7] .Meanwhile this could cause the volume unstability of concrete and the cracking risk[8]. The introduction of inorganic chlorine salt can improve the early strength of concrete, but chloride ions can easily cause steel corrosion[9]. So it is necessary to development an kind of organic early strength agent[10].

2 Experimental

2.1 Chemicals and Equipment.

Prenyl alcohol ethoxylates (TPEG, Liaoning Kelong Chemical Co. LTD), Acrylic acid (AA,Wuhan Zhonghua Yongye Chemical Co. LTD), triethanolamine（TEA, Chinese medicine Co.LTD）, cholamine（Chinese medicine Co.LTD）, diethanolamine（Chinese medicine Co.LTD), Ammonium persulfate (Aps, Shanghai degussa-aj chemical Co. LTD), Chain transfer agent (TGA, Changzhou Yurong Chemical Co.LTD),sodium hydroxide(NaOH),HuaXin cement,P.O42.5 , WuGang II flyash,WuXin S95 silica fume. Cement paste mixer,NJ-160A,WuXi JianYi equipment Co. LTD ; Single horizontal-axis laboratory concrete mixer,HJW-60,ShenYang JuLin equipment Co. LTD.

2.2 Synthesis Process.

Put a flask within water and TPEG into water-bath heater, and stirried until the end of experiment; after TPEG dissolved, added the APS at 60°C, and dripped the AA, MA,TEA and TGA solution(mAA:mTEA=1:0.2-2.2); keep heating for certain hours, then decreased temperature; added the sodium hydroxide and water, and adjusted pH of the new product about 7; The new product would been gotten and its solid content was 40%.

2.3 Measurement.

The fluidity of cement slurry was tested according to Chinese Standard (GB/8077-2000). The water-cement ratio is 0.29, PCs dosage is 0.13%. Concrete water reducing

rate, setting time, air content and compressive strength were tested according to GB8076-2008 (concrete admixture), PCs dosage is 0.15%. Concrete compressive strength was tested according to Chinese Standard (GB/T50081-2002).

3 Results and Discussion

3.1 Effect on strength with different types of alcamines

Stable 1 is efforts of strength with different alcamines dosage. We can see from the stable1, three types of alcamines increased the strength of the concrete. PC with triethanolamine has a higher strength than PC with cholamine and PC with diethanolamine. Obviously they increased strength of 3Days and 7Days. PC with triethanolamine increased almost 8MPa by 7Days.

Stable1. Effect on strength with different alcamines

PC types	concrete grade	3Days(MPa)	7 Days(MPa)	28 Days(MPa)
Common PC	C35	12.1	22.8	39.2
PC with cholamine	C35	12.2	23.4	39.5
PC with diethanolamine	C35	12.7	28.3	41.2
PC with triethanolamine	C35	13.5	30.5	40.1

3.2 Effect on the dosage of triethanolamine

We can see from figure 1, the slump flow descreases with the dosage of triethanolamine increases, it effects the slump flow when triethanolamine exceed a certain dosage ,meanwhile Fig 2 shows that it doesn't have much contribution to strength since then.

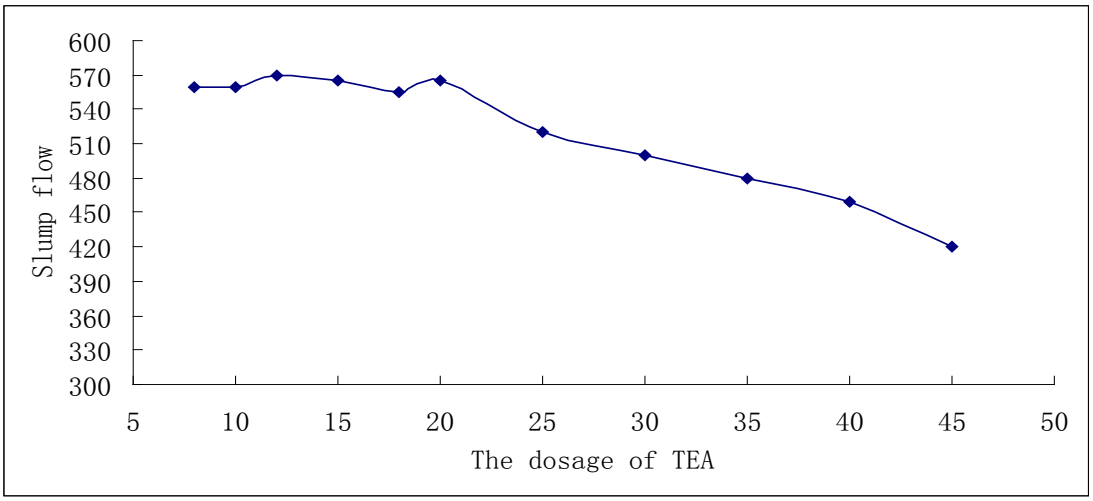


Fig.1 Slump flow with different dosage of triethanolamine

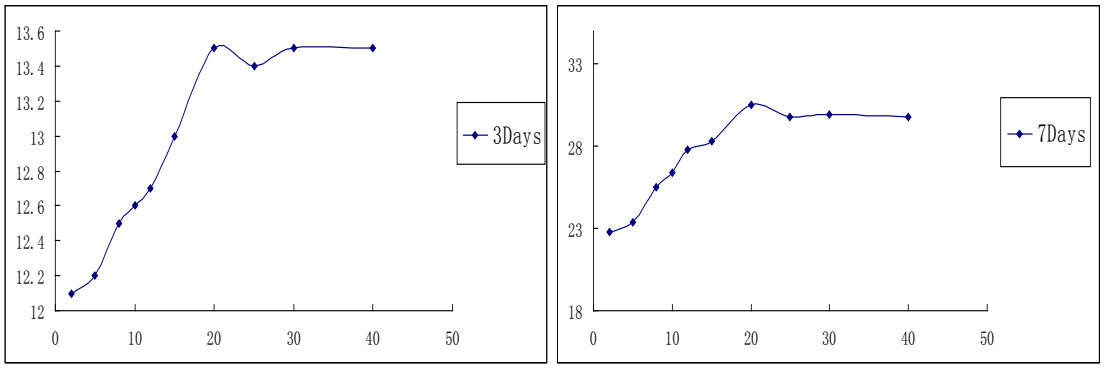
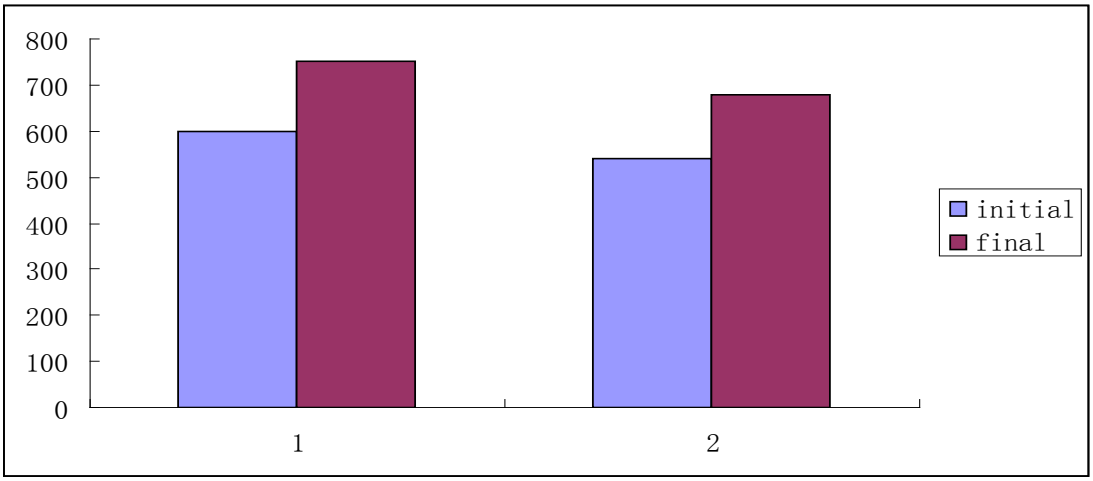


Fig.2 3Days and 7Days strength with different dosage of triethanolamine

3.3 Effect on the setting time of concrete

Setting time is tested on regular PC and PC with TEA, the result is shown in Fig 3. It shows that initial setting time of PC with TEA is 60min early than regular PC, final setting time is also 70min early than regular PC. We can perorate that PC with TEA can accelerate hydration of cement.



(1: regular PC; 2: PC with TEA)

Fig.3 Setting time with different concrete

4 Conclusion

This paper synthesizes a kind of early strength polycarboxylic superplasticizer using radical polymerization. This polycarboxylic superplasticizer introduces TEA, amino in TEA can accelerate hydration of the cement in the concrete, so as to improve the strength of the concrete. This polycarboxylic superplasticizer doesn't affect initial water reducing rate, 7ays strength can improve 8MPa. It descreases the potential risk of corrosion with chloridion. It can also reduce the possibility of alkali-aggregate reaction. This can ensure durability of the concrete.

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