

Synthesis on a type of polycarboxylate superplasticizer under room temperature

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Abstract. This investigation was undertaken to evaluate a new kind of polycarboxylate superplasticizer. Used polyoxyethylene ether (TPEG), acrylic acid (AA) functional monomer (A) and as the monomer, hydrogen peroxide (H₂O₂) as initiator, Vitamin C (Vc) as reducing agent, TGA as chain transfer agent, synthesised polycarboxylate superplasticizer with high water reducing rate under 15 °C ~ 27 °C. The effect of admixtures on fluidity and concrete slump were discussed in this paper. This investigation also evaluated the influence of different series of polyoxyethylene ether, the dosage of hydrogen peroxide (H₂O₂) and Vitamin C (Vc).

1 Introduction

Concrete is the world's largest building materials, widely used in various construction projects. Chemical admixture plays an important role in concrete, it could reduce water consumption and dispersion of cement particles, increase the strength of concrete, etc[1].

Polycarboxylate superplasticizers are the most important water reducing agent[2-4]. It replaced first generation and second generation water reducing agent, such as lignin sulfonate, naphthalene water reducer and aliphatic sulfate water reducer. It solved fast slump loss of naphthalene water reducer and delayed coagulation of lignin sulfonate[5]. In terms of chemical structure, these polymers have lots of advantages: better fluidity and slump flow with low dosage of PCs, wide adaptability for cement, higher water-reducing efficiency, large freedom of molecular structure, more synthesis technology, more room for improvement[6-7].

Most polycarboxylate superplasticizers adopt radical polymerization under 60-80°C, use persulfate as initiator[8-9]. Quantity of heat was needed during its synthesis. This could bring environment pollution, consume lots of energy[10]. Synthesis under room temperature means a lot to save energy and reduce the pollution of the environment.

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), Hydrogen peroxide (H₂O₂, Wuhan chemical Co. LTD), Vitamin C (Vc, Wuhan zhongxin materials 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 water and TPEG into a flask, and stirred until the end of experiment; wait until TPEG dissolved, then added the H₂O₂ at 60°C, and dripped the AA, functional monomer (A), Vitamin C (Vc) and TGA solution; keep stirring for certain hours, then added the sodium hydroxide and water, and adjusted pH of the new product about 7; The new product would be 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%.

3 Results and Discussion

3.1 Determination of monomer type

F108 and TJ-188 are synthesised by imported initiator, while F1088 and TJ-188C are synthesised by domestic initiator. The front two kinds of monomers are more active than back ones. The table shows F108 and TJ188 is more suitable for this method.

Table.1 Fluidity of cement paste with different monomer condition of PCs

Type	0min Slump flow(mm)	60min Slump flow(mm)
F108(Liaoning Kelong Chemical Co. LTD)	240/565	230/560
F1088(Liaoning Kelong Chemical Co. LTD)	240/560	220/480
TJ188(ShangHai TaiJie Chemical Co. LTD)	250/590	230/580
TJ188C(ShangHai TaiJie Chemical Co. LTD)	235/540	225/470

3.2 Determination of initiator Dosage

We can see from figure 1, with all other conditions being equal, concrete has the best dispersion performance when the dosage of initiator is 0.015mol. This is because low dosage of initiator causes little active centre, reaction is not complete; as high dosage of initiator causes too many active centre, the molecular weight is too small to the disadvantage of space steric hindrance.

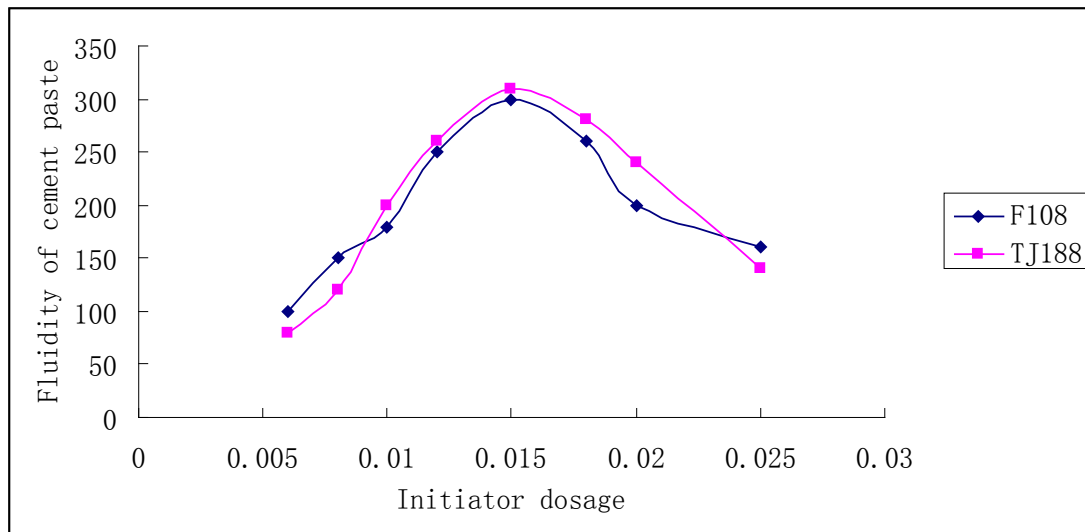


Fig.1 Fluidity of cement paste with different density of initiator

3.3 Determination of reaction time

According to time temperature equivalence principle, we studied the influence of reaction time on the properties of polycarboxylate superplasticizers. We can see from figure 2 that 4h is the most suitable reaction time: reaction is not complete less than 4h, it is helpless more than 4h.

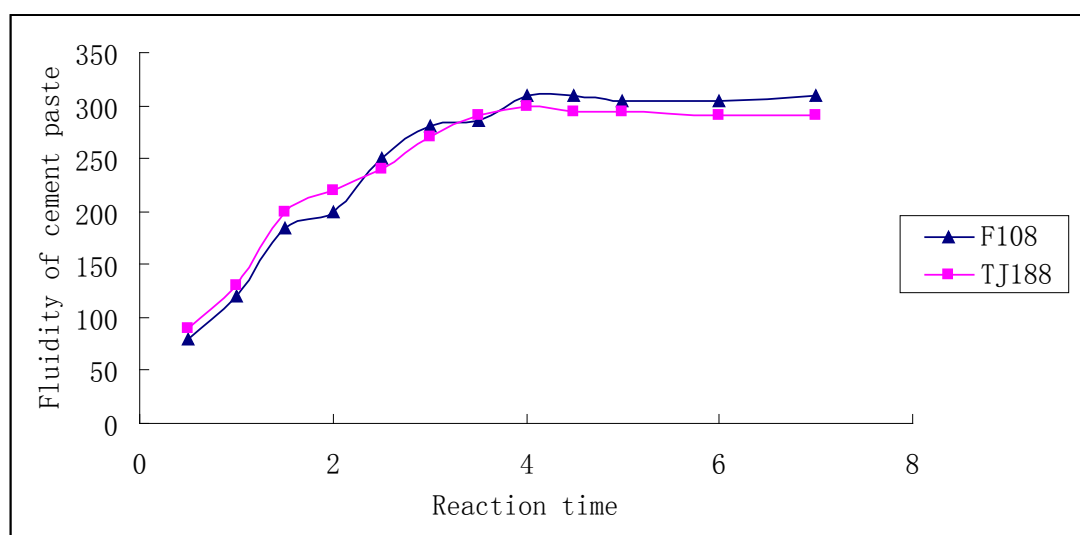


Fig.2 Fluidity of cement paste with different reaction time

4 Conclusion

By discussing various factors that impact the performance of PCs, we confirm a suitable process conditions which a new type of polycarboxylate superplasticizer was synthesized under room temperature. The influencing factors of reaction include proportion of initiator concentration and reaction time. It is possible to realize industrial production under room temperature, then save energy and reduce the pollution of the environment.

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