Effect of molecular weight of a superplasticizer on the fluidity of cementitious material.

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1.Introduction.

A superplasticizer of sulphonic polymer containing methacrylic acid has shown superior fluidization capacity . Since fluidization capacity is known to be related to adsorbity, which is on the other hand related to molecular weight, there is a need to investigate its effect. In this paper improvement of fluidization performance of the superplasticizer attained by optimizing its molecular weight is reported.

2. Experiment.

2.1 Materials.

The type of cement used was normal portland cement of specific gravity of 3.14 while blast furnace slag of 6000cm² /g(Blain) was used as a replacement material. The type of fine aggregate used was crushed trachyte quartzite of specific gravity of 2.54, 1.9% absorbed water and fineness modulus of 2.51, while the type of coarse aggregate used was trachyte quartzite of 20mm maximum size , 0.31% absorbed water , 2.67 specific gravity and 6.55 fineness modulus.

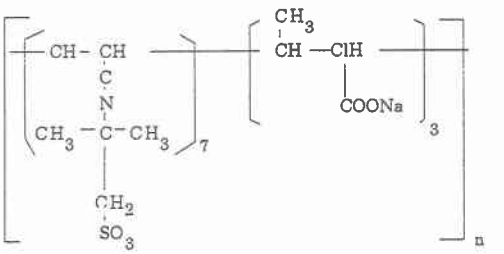

Fig 1.Chemical formation of the monomer

Table 1. Mix. proportion. (1m³)

W (Kg)	C (Kg)	P* (Kg)	W/(P+C) (%)	S (Kg)	G_1 (Kg)	G_2 (Kg)	s/a (%)
175	400	100	35	839	498	332	51

Dosage of SP: 0.22%(C)[Kg] *: BFS powder

The molecular weights of superplasticizer were between 49000 and 230000.

2.2 Methods and procedure.

(1)Effect of molecular weight on slump, slump flow and flowing time of concrete.

In this test, slump, slump flow and flowing time were determined for the superplasticizer at various molecular weights where the fixed dosage was based on 22cm slump of the original superplasticizer (C) whose molecular weight is 60000. Figure.1 shows the chemical formation of the monomer where "n" is the degree of polymerization , while table 2 shows the typical mix proportion for the concrete test.

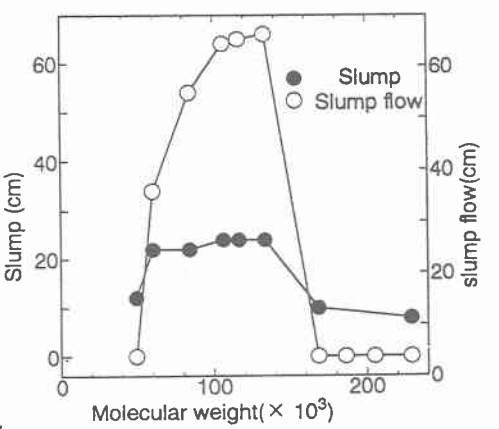

Fig 2.Relation MW and slump,slump flow.

(2)Effect of molecular weight on coefficient of viscosity and yield value of cement paste.

In this test , an L- shaped flow-pipe was used. Viscosity and yield values were obtained using consistency curves ,W/(C+P) was 0.35 while dosage of superplasticizer was 0.28% of cement weight.

(3)Effect of molecular weight on Zeta -potential of cement paste.

Cement paste prepared in advance was diluted to distilled water 500 times it's volume. For this sample, a test was carried out using a particle electrophoresis equipment .W/C was 30% and the dosage was varied.

3. Test results and discussion.

3.1 Slump, slump flow and flowing time of concrete.

It can be seen from figure 2 that , slump and slump flow were increased by increasing molecular weight from 49000 to 90000, and then the values were substancially constant up to the molecular weight of 160000 when the values descended sharply to the ones equivalent to stiff concrete. It can also be seen from figure 3 that the relation between flowing time and flow deccreased to molecular weights of about 120000 where it again ascended to moleclar weights of 130000. At molecular weights beyond 130000 and below 60000, the concrete showed practically no flow. It can be understood that fluidization capacity of the superplasticizer was greatly varied by its molecular weight.

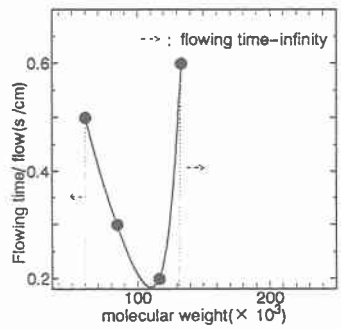

Fig.3 Flowing time-MW relation.

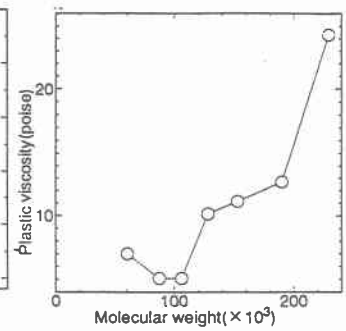

Fig.4 Viscosity-MW relation.

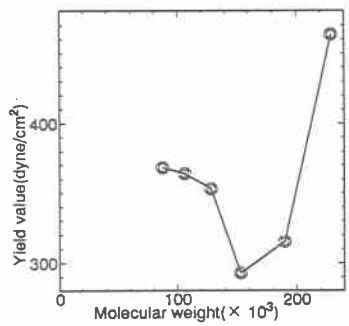

Fig .5 Yield value-MW relation.

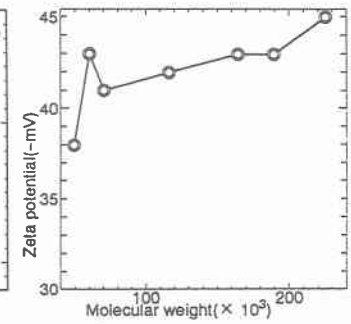

Fig.6 ξ Potential-MW relation.

3.2 Plastic viscosity and yield value of cement paste.

It is noted from figure 4 that, plastic viscosity was decreased with decreasing molecular weight and the minimum values were observed at between 90000 and 110000 following the same tendency as in concrete and thus confirming results for concrete test, while figure 5 shows that, yield value was also changed similarly.

3.3 ξ-potential.

It can be seen from figure 6 that the maximum absolute value of Zeta potential for different molecular weight was increased gradually with increasing molecular weight. At these values, ξ-potential was constant with increased dosage of superplasticizer which was probably caused by saturated adsorption of the superplasticizer.

4.Conclusion.

Fluidization characteristics of the superplasticizer is varied with molecular weight having a peak at molecular weight between 90000 to 150000 while variation of ξ-potential is not changed with molecular weight.