

Effect of added the polycarboxylate ether on slump retention and compressive strength of the high performance concrete

By

Jonbi Jonbi, Resti Nur Arini, Basori Anwar, and Mohamad Ali Fulazzaky

Introduction

The needs of high performance concrete (HPC) for construction in Indonesia will increase due to the government policies have been focusing on infrastructure development.

How to ensure the application of HPC in civil engineering industry can achieve the best performance with high workability is concern for many producers.

The use of superplasticizer (polycarboxilate ether) has been proven to be effective in fabricating a long retardation concrete setting and long slump retention.

Our objectives:

- (1) to obtain a proper quantity of PCE added into concrete's mixture for obtaining optimal composition of HPC**
- (2) to assess the performance of HPC as it can be verified from the values of long slump retention and high compressive strength.**

The benefit of this work can help producers in manufacturing HPC with an optimal composition of PCE.

Materials and Methods

The materials used consist of (1) type-1 Ordinary Portland Cement (OPC), (2) coarse aggregate of quarry Purwakarta, (3) fine aggregate from Galunggung quarry, (4) water, and (5) superplasticizer of PCE (Normet type Tamcem 21 RA).

Table 1. Concrete mix design with f_c 50 MPa

Material	Unit	BK0	BK1	BK2	BK3
OPC	kg/m ³	484,12	484,12	484,12	484,12
Fine aggregate	kg/m ³	793,12	793,12	793,12	793,12
Coarse aggregate	kg/m ³	971,04	971,04	971,04	971,04
Water	kg/m ³	193,65	193,65	193,65	193,65
PCE	L/m ³	0	2,42	4,84	9,68

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The addition of PCE was classified by a nomenclature that BK0 is the concrete's mix that designed for the addition of 0% PCE, BK1 for the addition of 0.5% PCE, BK2 for the addition of 1% PCE and BK3 for the addition of 2% PCE.

Table 2. Nomenclature and number of compressive strength test

Code	PCE	Age of concrete (d)				Number of Sample
		3	7	14	28	
BK0	0%	3	3	3	3	12
BK1	0.5%	3	3	3	3	12
BK2	1%	3	3	3	3	12
BK3	2%	3	3	3	3	12

The test of slump retention for the verification of decreasing slump flow according to the standard ASTM C 143-90. The measurements of slump retention were carried out at 0, 15, 30, 45, 60 and 75 minute.



Figure 1. Testing of slump retention

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The cylindrical tube of having deminsions of 150 mm external diameter and 300 mm high was used for the test to follow the standard ASTM 39. Compressive strength of the HPC samples was performed at 3, 7, 14 and 28 d of the concrete's age.



Figure 2. Testing of compressive strength

Results and Discussion

The workability of HPC is still able to be used in construction industry since the slump retention behavior of concrete with the compositions of 1 and 2% PCE can be maintained until 45 mn with a slump value of 10 cm.

The synthesis of designed HPC by adding 2% of PCE superplasticizer can have an optimal slump retention capability of 45 min, and then after 45 min the compressive strength slowly continues to decrease

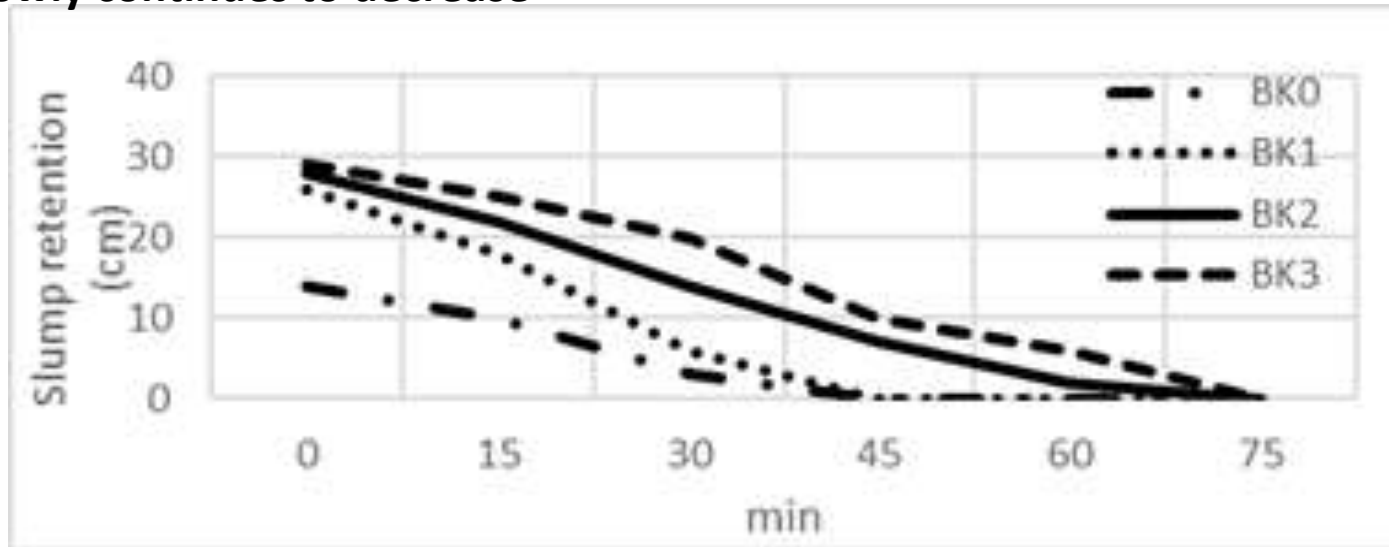
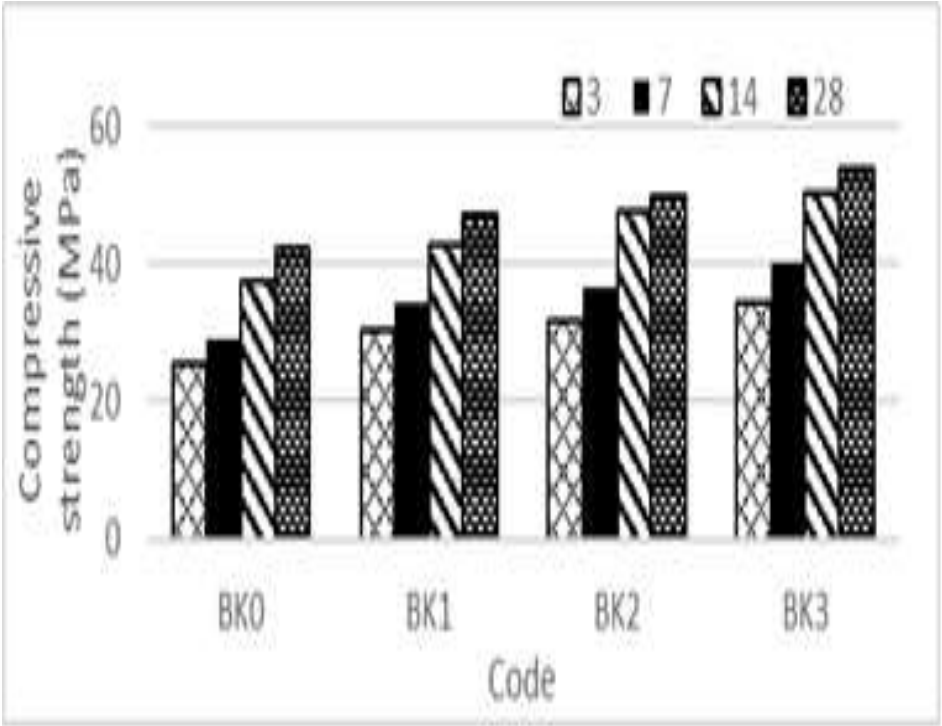


Figure 3. Results of testing the slump retention

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Age of 3 d, the increase in compressive strength from 25.62 to 30.26 to 31.93 to 34.22 MPa because of the addition of PCE into the mix of concrete increases from 0% to 0.5% to 1% and to 2%, respectively.

The compressive strength has never reached at $f'c$ 45 even at age of 28 d without addition of PCE.



The compressive strength reaches at higher than its planned compressive strength of $f'c$ 45 at age of 28 d for BK1 and at ages of 14 and 28 d for BK2 and BK3.

Figure 4. Results of testing the compressive strength

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The results of testing at age of 28 d with the variable of PCE added by 0%, 0.5%, 1% and 2% have the compressive strengths of 42.47, 47.05, 49.81, and 53.84 MPa, respectively.

The maximum value of compressive strength was verified to reach at 53.84 MPa the workability of HPC of added 2% PCE with an increase in compressive strength of 26.77% compared to that of added 0.5% PCE.

Table 3. Results of increasing the compressive strength

Addition of PCE (%)	Compressive strength (MPa)	Increase of compressive strength
0	42.47	0%
0.5	47.05	10.80%
1	49.81	17.29%
2	53.84	26.77%

The results of plotting a correlation between the slump retention and the compressive strength reveals that the decreasing of slump retention does not make a significant decrease in compressive strength of the HPC.

The compressive strengths of testing at 0, 15 and 30 min have not clearly effect the value of slump retention at the performance of HPC measured at the ages of 7 and 28 day.

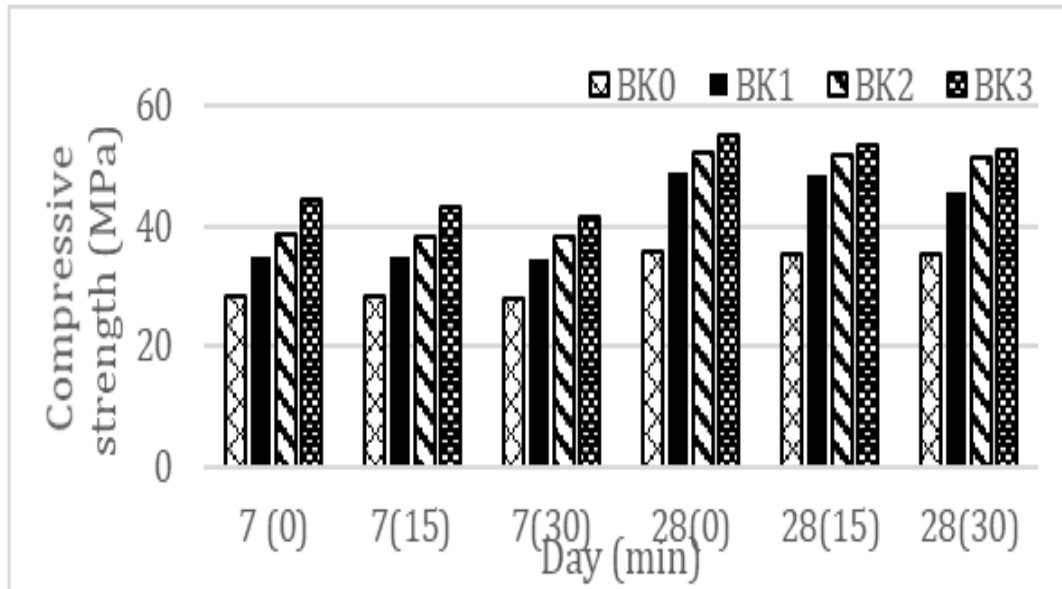


Figure 5. Correlation between the slump retention and the compressive strength

Conclusions

According to the results of slump retention and compressive strength can conclude that:

- (1) The optimal slump retention of 45 mn with its value of 10 cm can be achieved by adding 1 and 2% of PCE.**
- (2) A very high compressive strength of 53.84 MPa for HPC can be achieved by adding 2% of PCE, there is an increase in the compressive strength of 26.77% compared to the control sample of HPC without addition of PCE.**
- (3) Slump retention does not affect the compressive strength of HPC.**



Thank you