EFFECT OF USING DIFFERENT TYPES OF ADDITIVES AGAINST THE COMPRESSIVE STRENGTH OF CEMENT PASTE

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ABSTRACT

Cement as the main construction material is used for concrete, mortar and cement paste. Some problems with the use of cement are caused by shrinkage, cracking, so that these problems can reduce the compressive strength. This study analyzed the use of additives in overcome the weakness of cement paste. There are three types of additives used, namely, Intraplast Z, Cebex 100 and J-Additive. The percentages of additive use are 0.36%, 0.48%, 0.6% and 0.72% by weight of cement. The test object is a cube measuring 50 x 50 x 50 mm. The compressive strength test on cement paste was carried out at the age of 3, 7, 14 and 28 days. The results showed that for Intraplast Z and Cebex 100 the optimum percentage was 0.36% which resulted in an increase in compressive strength of 18% and 28%, respectively. As for the J-additive, there was an increase of 50% at a percentage of 0.36%. The benefits of the research resulted in the optimal percentage so that the use of additives became more efficient.

Keywords: *Concrete, mortar, cement paste, additives, compressive strength*
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INTRODUCTION

The use of concrete as a construction material is the main choice, because it has advantages such as easy to apply, easy to shape, has high compressive strength (Yang Z et al (2019) and Hou P (2017)). However, concrete has the disadvantage of frequent cracking due to shrinkage. Several efforts have been made to overcome these weaknesses, including using ice water, additives to reduce shrinkage, and expansive type additives (Zhao, et al (2022) and Kim JK (2001)).

In analyzing the properties of concrete, it can be seen from the properties of cement paste, namely a mixture of OPC cement with water. OPC is Ordinary Portland Cement which is widely used in construction materials because of its low level of material availability and environmental impact(Asadollahfardi G, et al (2019). In construction work such as duckting prestress cables, bearing plates, other precast elements, cement paste is required that does not shrink. For this reason, the use of expansive additives is an alternative choice (Corinaldesi V, et al (2015) and Liguo Wan, et al (2022)).

Several researchers have proven that the use of additives and cementitious materials can reduce shrinkage, increase compressive strength and resistance to sulfate attack (R. Palod, et al (2020), X. Han (2020) and W. Xuequan, et al (2019)). In the use of this expansive additive, it is necessary to pay attention to the percentage of the dose used, considering that the higher the dosage, the more expensive it is(I. Galan, et al (2019)). This study analyzes the use of additives to overcome the shrinkage that occurs in cement paste. While the additives used consist of 3 types, namely Intraplast Z, cebex 100, and J additive, to produce the optimal percentage of the three types of additives. The benefit of this research is that by producing the optimal percentage of the three types of additives, the efficiency of the economic value is obtained

METHOD

The additives used are produced by 3 different companies. The first additive is the Intraplast Z brand, ex PT Sika Indonesia, the second Cebex 100 brand, ex PT Fosroc Indonesia, the third J additive ex CV John Contrindo which can be seen in Figure 1. These three types of additives are in the form of expanding grout admixture with specifications based on existing technical data from the manufacturer. : Intraplast z in the form of powder with a dosage of 1-2% for 50 kg of cement, Cebex 100 with a dosage of 225 grams and J additive with a dosage of 1.5%

(a)

(b)

(c)

Figure 1. Three Types of Additives Used (a) J- Additive; (b) Cebex 100; (c) Intraplast Z

The main material used is cement type I-Ordinary Portland Cement (OPC) former three-wheel cement, with the chemical composition shown in Table 1.

Tabel 1. Chemical Composition Of Cement

	Cement (%)
CaO	61.89
MgO	3.05
SiO2	20.7
Fe2O3	3.35
Al2O3	4.61
SO3	2.4
LOI	2.16

The test object was made using a 50 x 50 x 50 mm cube in accordance with ASTM C109.

The proportion of the mixture of test objects can be seen in Table 2.

Table 2. Mix design test object

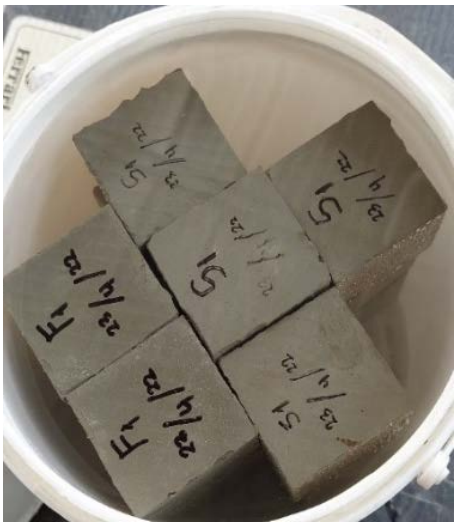
Kode Benda Uji	Semen (kg)	Bahan Additive			w/c
		Intraplast z	Cebex 100	J Additive	
P0	50	-	-	-	0,4
S1	50	0,36% (180 gr)	-	-	0,4
F1	50	-	0,36% (180 gr)		0,4
J1	50	-	-	0,36% (180 gr)	0,4
S2	50	0,48% (240 gr)	-	-	0,4
F2	50	-	0,48% (240 gr)	-	0,4
J2	50	-	-	0,48% (240 gr)	0,4
S3	50	0,6% (300 gr)	-	-	0,4
F3	50	-	0,6% (300 gr)	-	0,4
J3	50	-	-	0,6% (300 gr)	0,4
S4	50	0,72% (360 gr)	-	-	0,4
F4	50	-	0,72% (360 gr)	-	0,4
J4	50	-	-	0,72% (360 gr)	0,4

P0 is control cement paste, S1 is cement paste using Intraplast Z with 0.36% by weight of cement, F1 is cement paste using Cebex 100 with 0.36%, J1 is cement paste using J Additive with 0.36%. S2, F2, and J2 doses used were 0.48%. Then S3, F3, J3 used a dose of 0.6% and S4, F4, J4 used a dose of 0.72%. For cement used as much as 50 kg and water w/c 0.4 (2000 ml).

The process of making test specimens for mixing cement, additives and water using a mixer machine with rpm 1500. The curing used was immersion of the test object in water according to ASTM C192.

In Figure 2, showing the test object, curing process, and compressive strength test equipment, the tests were carried out at the age of 3, 7, 14, and 28 days.

(a)



(b)

(c)

Figure 2. (a) test object, (b) curing, (c) compressive strength test equipment

RESULT AND DISCUSSION

Compressive Strength

The compressive strength of cement paste aged 3 days, 7 days, 14 days, and 28 days can be seen in Figure 3. The test results were compared to the control concrete (P0). The use of Intraplast Z additives with test specimen codes S1 to S4, there was a decrease in compressive strength at the ages of 3, 7, 14, and 28. However, for specimens S1 with an Intraplast Z percentage of 0.36%, there was an increase of 18%. Based on the results of the compressive strength test, it can be seen that the addition of the percentage of additives tends to decrease the compressive strength, this result is in line with research (Y. Renhe, et al (2021).

The results of the compressive strength test using Cebex 100 material, seen at the initial age of 3 days there was an increase in compressive strength, but at the next age there was a decrease. Significant results were shown in the F1 specimen with a percentage of 0.36%, an increase in compressive strength of 28% at the age of 28 days. While for the age of 7, 14 days there tends to be a decrease in compressive strength.

Then cement paste using J-Additive at the initial age of 3 days there was a decrease in compressive strength of 20-30 percent occurred in the J2 and J3 specimens, in the J1 test specimens there was an increase in compressive strength of 13% and J4 an increase of 4%. At the age of 28 days in general there is an increase in compressive strength of (5-50)%. These results indicate the use of J-additive maximum percentage of 0.36% and 0.72%.

The optimum percentage of additives is achieved at 0.36% by weight of cement, the results of this research show that the dosage of additives is lower than the use based on existing technical data.

For the three types of additives, it turns out that the highest compressive strength value is achieved at the percentage of additive use of 0.36%, if it is greater than that percentage, there will be a decrease.

Based on the optimum percentage, there is an efficiency of economic value of 76% of the price of the Intraplast Z, Cebex 100 and J-Additive products

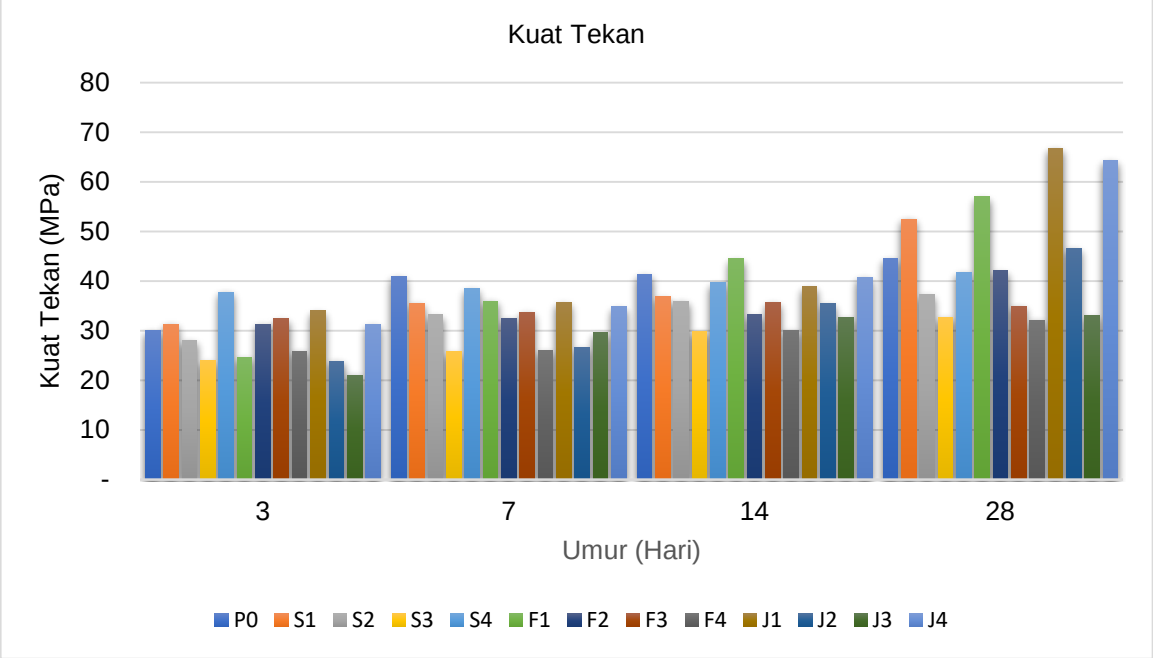


Figure 3. The results of the compressive strength of cement paste

CONCLUSION

Based on the results of the compressive strength test using the additive type, it can be concluded:

1. In Intraplast Z additive the optimum percentage is 0.36%, it can increase the compressive strength by 18%.
2. In Cebex 100 additive the optimum percentage is 0.36%, it can increase the compressive strength by 28%.
3. In the J-Additive additive the optimum percentage is 0.36%, it can increase the compressive strength by 50%.

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