ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

Available online at
https://jurnalteknik.unisla.ac.id/index.php/CVL

https://doi.org/10.30736/cvl.v2i2

Compressive Strength of Concrete the Time Setting of Application of Plastiment® P-121 Additive Mixture

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A R T I C L E I N F O

Article History :
Article entry : 01-31-2024
Article revised : 02-12-2024
Article received : 03-15-2024

Keywords :
Addictive, Compressive Strength, Slump, Concrete

IEEE Style in citing this article:
A. Maysyurah, A. Rusdi, and A. Didik Setyo Purwantoro, "Compressive Strength Of Concrete The Time Setting Of Application Of Plastiment® P-121 Additive Mixture", civilla, vol. 9, no. 1, pp. 39–46, Mar. 2024.

A B S T R A C T

Infrastructure growth requires large quantities of concrete, a problem distance between the batching plant and the location of different casting locations, the process of mixing and transporting to the casting location requires time that can exceed the cement setting time. Plastiment helps improve the strength, durability, and general quality of concrete. This research aims to determine the compressive strength of concrete at setting times of 60, 90, and 120 minutes using 150 mm x 300 mm specimens with variations in addition to plastiment of 0.20% and 0.40% of the cement weight. Primary data the form of material testing data and concrete compressive strength for each variation and secondary data is in the form of additives and the properties of cement used. The test results show that the compressive strength of concrete at 60, 90, and 120 minutes by adding Plastiment® P-121R at a variation of 0.20% is 17.55, 18.12, and 18.85 MPa while giving a dose of 0.40% is 17 .27, 19.82, and 22.08 MPa. Addition of plaster can meet the slump value requirements at each time variation and in contrast to normal concrete the slump value is not met at each time variation with the concrete having dried during mixing.

1. Introduction

Concrete structures are still an option in every infrastructure development with the characteristics of being resistant to high temperatures and also easy to obtain the constituent materials. Along with the increase in the use and quality of concrete in the world, the use of additives is used to improve the quality of concrete. VZ Plastiment is an additive that can be used to improve the quality of concrete.

The addition and use of VZ Plastiment to concrete has an impact on the setting time process which affects the initial set and final set. The higher the height of the addition of VZ Plastiment, the longer the initial set and final set [1]. The materials that makeup concrete consist of water, cement, and aggregate. Where the proportion of the concrete mixture must produce concrete that meets requirements such as viscosity which allows easy, durable, compressive strength and economical concrete work. In general, it can be concluded that there was an increase in the

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

compressive strength test of FC'20 concrete, although not too high, and there was a decrease in the flexural strength test of FC'20 concrete [2].

In carrying out building construction that uses large quantities of concrete, mixing concrete requires a batching plant as a stationary mixing tool that has a large capacity. One factor that becomes more attention is if it has a different location from the casting location. Where the entire process of mixing concrete and transporting it to the casting location requires more time than the cement setting time. This will increase the temperature of the concrete, wear on the aggregate so that the aggregate breaks, loss of water so that additional water is needed, an increase in the slump value, and a decrease in the strength of the concrete. To obtain the optimum additive dosage percentage, the type of additive used is the Plastiment-VZ brand retarder and plasticizer, product of Sika Indonesia. The optimum dosage is achieved at the additive dosage with compressive strength and slump value [3][11].

To overcome the problem of increasing the slump value, chemical additives are used which can reduce the amount of water and slow down the setting time. Next, the problem arises of the influence of the length of mixing time on the compressive strength of concrete. Based on the explanation above, this research was carried out[12][13].

2. Research Method

Coarse aggregate comes from PT. PII Sorong city measures 10-20 mm while the fine aggregate used comes from the protected forest of the KM.14 natural tourism park which was washed and sieved with a passing size of #4[4]. Water absorption and specific gravity in the SSD state of sand are 4.54% and 2.51 and gravel are 2.62% and 2.72 respectively.

The cement used is Ordinary Portland Cement (OPC) cement which is widely available in Indonesia[14][15]. Plastiment® P-121R can be found in online media, based on ASTM C494-92 type D[16], it is a high-quality plasticizer and water reducer for concrete mixtures in liquid form and has the effect of slowing down the setting time (set retarder).

Table 1. Physical Properties of Aggregates

Aggregate Properties	Sand Km. 14 Protected forests (%)	Crushed stone 1/2 PT. PII (%)
SSD Specific Gravity	2,51	2,72
Water Absorption	4,54	2,62
Water content	2,69	2,85

Source: UNAMIN laboratory, Sorong city

It was determined that water-reducing chemical additives type A brands Sika and Plastiment® P-121R affect the workability and durability of concrete for urban buildings, highlighting the additives to cement, by obtaining finish and durability [5][17].

3. Description and Technical

The innovative work method applied to this project can optimize construction costs compared to other work methods [6]. All test objects were designed with a size of 150 mm x 300 mm, each with a variation of 5 samples with a water-cement factor of 0.48. The variation of Plastiment® P121R used is 0.20% and 0.40% of the weight of cement as seen in Table 1. After being mixed evenly, fresh concrete is added and compacted in a cylindrical mold. Then, leave it for 24 hours in a room with a temperature of 25ºC until the day of testing according to SNI 03-2834-2000[7].

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Table 2. Mix Proportion concrete

Volume	Total Weight	Water	Cement	Sand	Crushed Stone
m^3	*kg*	*Liter*	*kg*	*kg*	*kg*
1	2352	7,81	3,75	14,73	17,29

Source: UNAMIN laboratory, Sorong city

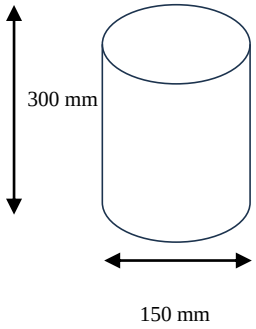

Figure 1. Cylindrical Test 150 mm x 300 mm

Calculate compressive strength using the equation:

$$f'c=P/A$$

Where :
P = Compressive Strength of Concrete (kN)
L = Area of Test Object (mm)

The definition of concrete compressive strength is the amount of load per unit area, which causes the concrete specimen to crumble when subjected to a certain compressive force produced by a pressing machine [8][18]. Concrete compressive strength is the most important characteristic of concrete quality compared to other properties[19][20]. The compressive strength of concrete is determined by setting the ratio of cement, coarse and fine aggregate, and water. The ratio of water to cement, the higher the compressive strength. A certain amount of water is needed to provide chemical action in hardening concrete, excess water increases workability but reduces strength [9].

4. Results and Discussions

Based on the data in **Figure 2**, it can be seen that the compressive strength of normal test specimens increases over time. On the 3rd day, the compressive strength reached 10.76 MPa, increased to 12.17 MPa on the 7th day, then to 15.57 MPa on the 14th day, and finally reached 20.10 MPa on the 28th day. Thus, the planned mix design by the compressive strength target of 20 MPa on the 28th day has been successfully achieved. This shows that the construction materials used have performance by the desired specifications so that they meet the specified design requirements.

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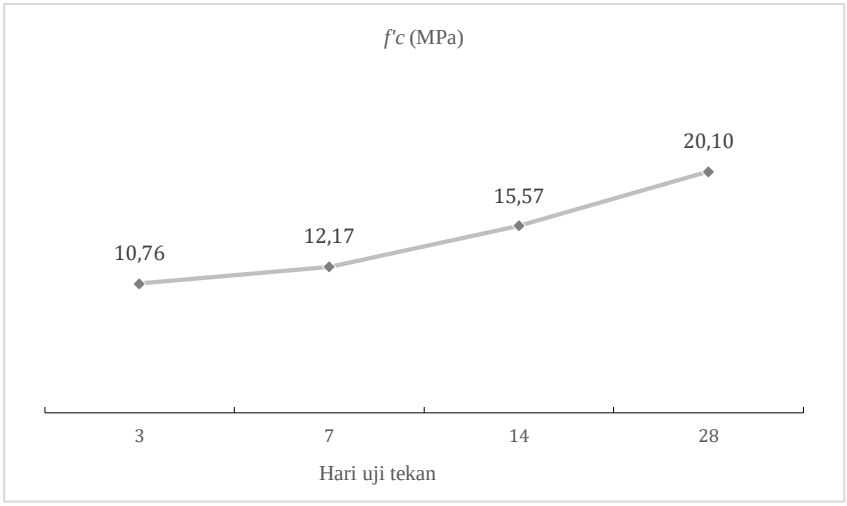

Figure 2. Normal concrete compressive strength test results

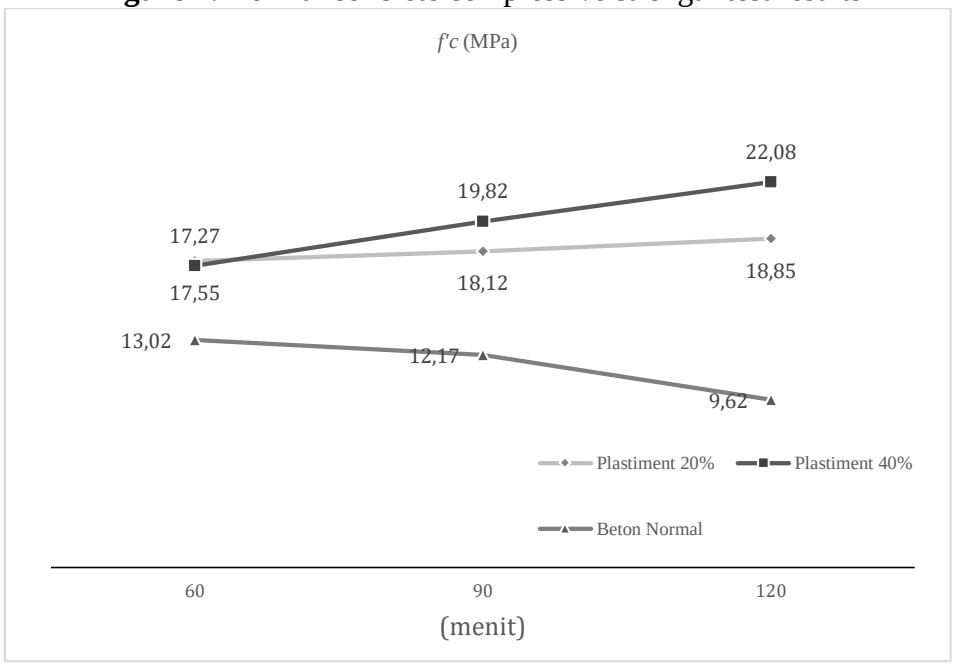

Figure 3. Concrete compressive strength test results for variations in plastiment application

Based on the data in **Figure 3**, it can be seen that the compressive strength test results for variations in Plastiment®P-121R administration at levels of 20% and 40% showed a significant increase at the 90th and 120th minutes. At a 20% administration level, there was an increase of 1.70 MPa at the 90th minute and 3.23 MPa at the 120th minute. This shows that the use of Plastiment® P-121R effectively increases the compressive strength performance of concrete, with its performance primarily slowing down the setting time of cement. Thus, it can be concluded that the addition of Plastiment® P-121R to the concrete mixture can provide better results in terms of compressive strength, as well as extending the cement bonding time, which is a positive indication of the performance and characteristics of the concrete.

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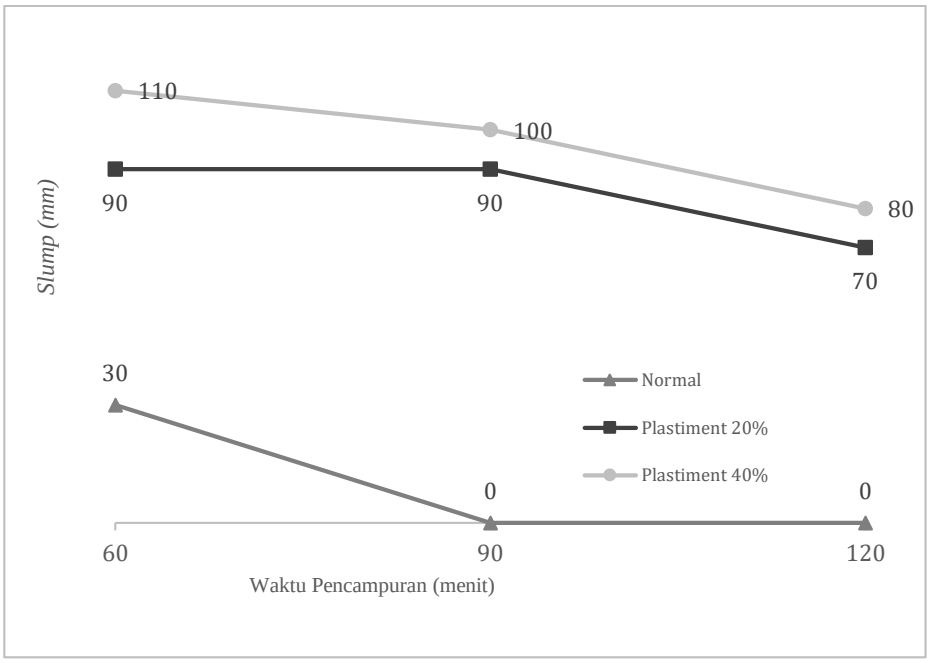

Figure 4. Test results for concrete compressive strength against slump value

In **Figure 4** which refers to PBI 1971 N.I.-2 and table 4.4.1[10], it can be seen that the slump value, even though there is the addition of Plastiment® P-121R to the concrete mixture, is still within the specified standard range, namely between 80 mm up to 110 mm. This indicates that even though there is the addition of Plastiment® P-121R, the consistency of the concrete mixture remains within the range considered to be by the standards set by PBI 1971 N.I.-2. Thus, the addition of these additives not only affects the performance of the concrete in terms of strength but also maintains the flow characteristics expected for the construction process.

5. Conclusion and Suggestion

5.1 Conclusion

Plastiment is an additive in concrete production that functions to increase the flow or tendency of concrete to pour more easily. This function allows the concrete to become more fluid without losing strength or quality. Data on the compressive strength of concrete with test specimens measuring 150 mm x 300 mm shows that with the addition of Plastiment® P-121R of 0.20% and 0.40% of the cement weight, there is an increase in the compressive strength value. With a variation of 0.20%, the compressive strength values at 60, 90, and 120 minutes are 17.55 MPa, 18.12 MPa, and 18.85 MPa respectively. Meanwhile, when administering a dose of 0.40%, the compressive strength values were 17.27 MPa, 19.82 MPa, and 22.08 MPa at the same time. This shows that the addition of Plastiment at higher doses tends to produce a greater increase in compressive strength in concrete. In addition, the addition of Plastiment makes it possible to meet the slump value requirements at any time variation. On the other hand, normal concrete without the addition of Plastiment does not meet the slump value at any time variation because the concrete has dried out during mixing. This confirms that Plastiment helps maintain the consistency and flow of concrete, which directly affects its constructive properties.

5.1 Suggestion

The suggestion is an analysis of advanced research was continued to increase the mixing time until the concrete reached maximum serviceability.

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

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