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Research Of Porous Concrete With Master Ease 5010 Mixed And Additional Rude Aggregate From Kedak Region

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A B S T R A C T

Porous Concrete is a type of Concrete that has a cavity in its structure that allows liquid to flow through the cavity. This study aims to determine the effect of adding Master Ease 5010 admixture on the compressive strength and absorption capacity of porous Concrete. The method used in this research is an experimental method by making different tests in the laboratory. The sample used is 10 x 20 cm with a concrete age of 28 days. The tests carried out include compressive strength testing and absorption testing. The absorption test used the falling head method based on the ACI 522R. The results of the normal compressive strength test = 0.28 Mpa, the addition of Master Ease 5010 3% = 0.31 Mpa, and the addition of Master Ease 5010 5% = 0.416 Mpa while testing the absorption of Normal Porous Concrete = 1.406 mm/s, addition of Master Ease 5010 3% = 1,946 mm/s, addition of Master Ease 5010 5% = 2.196 mm/s. From these results, it can be seen that the addition of Master Ease 5010 can increase the compressive strength and absorption value of porous Concrete.

INTRODUCTION

In implementing a construction project, the material has an important role. The material of a building can affect the quality of the building. Concrete is one of the most important building materials for a building [1][2]. One of the types of Concrete is porous Concrete. Porous Concrete is a type of Concrete that has a cavity in its structure that allows

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liquid to flow through the cavity. One of the applications of porous Concrete is in making paving [3].

Porous concrete paving itself is a building material composed of a mixture of cement, water, and coarse aggregate. Paving is widely used as an alternative tool for covering or hardening the soil surface. Various alternative soil cover models have been developed, but modified porous concrete paving has many advantages when compared to other materials. The most dominant advantages possessed are in terms of shape, color, size, pattern, and surface contour texture [4].

In making Concrete, one of the efforts to improve the quality of Concrete is to use added materials (admixture) [5]. The function of the added material (admixture) aims to change and improve the properties of Concrete, such as speeding up or slowing down bonding. One of the added ingredients is Master Ease 5010. Admixture Master Ease, according to the BASF brochure, is classified as type F, namely Water Reducing, High Range Admixtures which function to lower the viscosity of Concrete so as to facilitate pumping and to place Concrete with a relatively low ratio of water or cement.

Based on previous research carried out by Agata Iwan Candra, Suwarno, Heri Wahyudioni, Sulik Anam, Dwifi Aprilia Karisma (2020) regarding the Kuat Tekan Beton Fc' 21,7 Mpa Menggunakan Water Reducing and High Range Admixtures, it is known that the use of more admixtures is capable reduce the amount of water use [6][7]. The purpose of this study was to determine the effect of adding Admixture Master Ease 5010 on the compressive strength and absorbency of Concrete.

Concrete

Concrete is a construction material that is obtained from mixing cement, water, and aggregate with its own composition and occasionally needs to be added with additional materials [8][9]. Concrete is commonly used in construction because it has various advantages such as high strength, easy workability, long-lasting durability, water-resistance, and low maintenance costs. On the other hand, Concrete is resistant to fire. Concrete is widely used as load support because it has strong characteristics against compressive strength but is less likely to withstand tensile strength [10].

Porous Concrete

Porous Concrete is a special version of Concrete with high permeability characteristics. The weight of porous Concrete is quite light with little use of fine aggregate. Because of its character, this version of Concrete can be applied as paving which allows rainwater or river overflow water on the surface to be absorbed. This can minimize inundation and at the same

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time increase the groundwater table. The high porosity character is obtained because of the interconnected pores [11][12].

Porous Concrete is also called previous Concrete, which generally only uses coarse aggregate with a similar variation in gradient size so that it has a much larger pore size, which allows drainage to seep water through the pores. Porous Concrete has several advantages, including the average void ratio of porous Concrete by 30% so that it can be used to reduce runoff in drainage with a flow rate of 0.34 cm/second, making it effective for pavements rural roads, sidewalks, and inclines. Can be a construction alternative with a bad environmental impact and can protect water quality. Porous Concrete also has a much higher void ratio and permeability than conventional Concrete, so it can be used for the construction of wastewater treatment plants and as a seawall construction material. On the other hand, porous Concrete can also be used to refill groundwater [13].

The Constituent Material Of Porous Concrete

The constituent materials for porous Concrete include coarse aggregate, cement, and water with the following description:

1) Coarse aggregate

Coarse aggregate is the result of natural disintegration of rock or in the form of broken rock. Coarse aggregate is crushed stone obtained from the stone crusher industry[14]. The properties of coarse aggregates affect the final strength of the Concrete and its resistance to the disintegration of Concrete, weather and other destructive effects. This coarse aggregate must be clean from organic materials[15].

2) Semen Portland

Cement is a material in Concrete that functions as a binder for Concrete [16][17]. Cement is able to react in the presence of water [18]. With these properties, the cement in the concrete mixture functions as a binder for the aggregate material. Portland cement is a hydraulic cement which is produced by refining the clinker which mainly consists of calcium silicates which are hydraulic in nature with a plaster as an added material. [19].

3) Water

Water is needed to react with cement, as well as as a lubricant between the aggregate grains so that it is easy to work with and compact [20]. To react with cement, the water needed is only in the range of 25% by weight of cement, but in its authenticity, the value of the cement water factor used is less than 0.35. This excess water is used as a lubricant. The additional water for this lubricant should not be too much because the strength of the Concrete will be low and the Concrete is porous. Water that meets the criteria for drinking water also

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meets the criteria for a concrete mixture [21] In the presence of water, cement can react and form a paste that functions as a binder for aggregates. Adding too much water will make the mix easier to work with. However, this resulted in the event of cement moving up to the surface along with water or commonly known as degan bleeding. Bleeding causes the concrete adhesion between layers to decrease so that there will be a decrease in the compressive strength of the Concrete [22].

Master Ease

Master Ease 5010 is a concrete hardener product as an accelerator, chemicals in the form of addictive substances with accelerator characteristics are widely used for the manufacture of Concrete. The mixing of these addictive substances is carried out in addition to the place or area adjacent to the research site. Hence, the characteristics will be much more perfect [10].

According to the 1989 Concrete Guidelines SKBI.1.4.53.1989 and ASTM C.494[23], chemical additives (admixture) are divided into seven types with the following descriptions:

a. Type A (Water-Reducing Admixtures)
b. Type B (Retarding Admixture)
c. Type C (Accelerating Admixture)
d. Type D (Water Reducing and Retarding Admixtures)
e. Type E(Water Reducing and Accelerating Admixtures)
f. Type F (Water Reducing, High Range Admixtures)
g. Type G (Water Reducing, High Range Retarding Admixtures)

Compressive Strength

Compressive strength, namely the ability of Concrete to obtain a compressive force of broad unity[24]. The compressive strength of Concrete identifies the quality of a structure. The higher the level of structural strength desired, the higher the quality of the porous Concrete obtained [25]. Several factors such as the size and shape of the aggregate, the amount of cement used, the amount of water used, the proportion of the concrete mixture, the curing, age of the Concrete, the size and shape of the sample, can affect the compressive strength of the Concrete [26].

$$K = \frac{P}{A}$$

Description:

K = concrete compressive strength (N / mm²)

P = axial compressive force, expressed in newtons (N)

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A = Area of a cross-section of the test object (mm²)

Water Absorption (Permebilitas)

Water absorption, namely the ability of materials to absorb water. High water absorption will play an important role in the arrangement of the bricks and mixing because the water in the dough will be absorbed by the bricks so that the kneading hardener does not work and can result in the dough becoming soft[27]. If the Concrete can be impregnated with water, it can be said to be permeable. Otherwise, the Concrete is said to be impermeable. For permeability calculations on pourus Concrete, you can use the method on the ACI-522R. Falling head is one of the methods used to measure water permeability [28].

METHODS

This study used an experimental method by making test objects in the Civil Engineering Laboratory of Kadiri University.

Research Technical Description

The research was carried out by making a porous concrete specimen in the form of a cylinder 10 x 20 cm in size. The materials used include cement, coarse aggregate, and added material for Concrete, namely Master Ease 5010. The variations used are in the percentage of added material for Master Ease 5010, namely 0%, 3%, and 5% of the weight of cement. The tests carried out include testing of compressive strength and water absorption at 28 days of Concrete. The compressive strength test refers to the SNI 3421-2011 test standard using the INDOTEST brand Digital Compression Machine test equipment [29]. while the absorption test used the Falling Head method which refers to the ACI 522R.

Source: Research Documentation

Figure 1. Porous Concrete Specimen

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Research Flow

The stages of this research are described in the following flow chart:

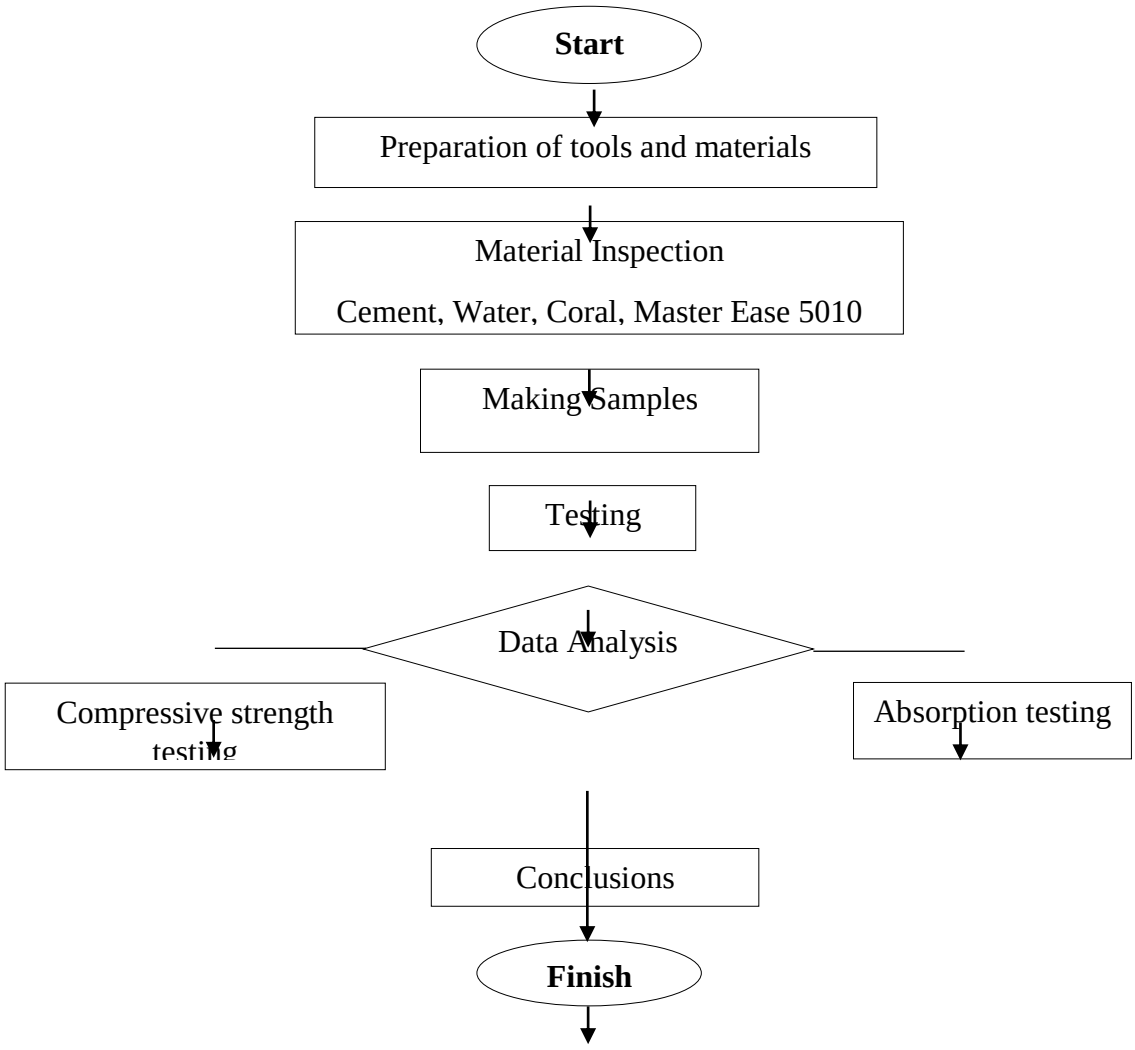

Figure 2. Research Flowchart

From Figure 2. it can be seen that the research begins with the preparation of materials for the manufacture of porous concrete specimens. Materials that have been prepared are tested to find out whether the materials used meet the required specifications. If the material meets the specifications, the next step is making the test object. The making of the test object was carried out in the laboratory using an electric concrete mixer. The test object that has been made is rested (Curing) with the closing method using a wet gunny sack for 28 days. After 28 days of testing the compressive strength and absorption capacity of the specimen. The results obtained were analyzed and then drawn conclusions.

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RESULTS AND DISCUSSIONS

The results and discussion that will be described regarding the results of the compressive strength test and the results of the absorption test are as follows:

Compressive Strength Test Results

The compressive strength test of porous Concrete was carried out at 28 days of Concrete. The test refers to the SNI 3421-2011 test standard using the INDOTEST brand Digital Compression Machine test equipment

Source: Research Documentation

Figure 3. Testing the compressive strength of porous Concrete

From Figure 3, it can be seen that the compressive strength test of cylindrical Porous Concrete using the INDOTEST brand Digital Compression Machine test tool with a compressive strength of 27 KN. The results of the compressive strength test are shown in **Table 1** and **Figure 4** with the following description

Table 1. Results of the Compressive Strength of Porous Concrete

Sample	Test Result (Mpa)	Average (Mpa)
Normal Concrete	0,28	0,28
	0,28	
	0,28	
Conctrete Variation 3%	0,29	0,31
	0,30	
	0,34	
Conctrete Variation 5%	0,38	0,416
	0,38	

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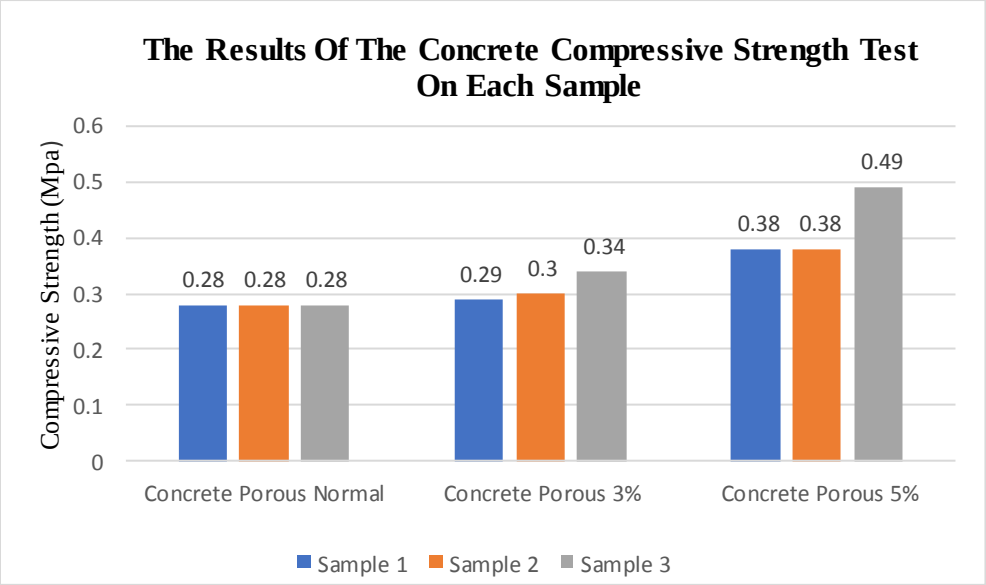
	0,49	

Source: Research Data

From **Table 1.** It can be seen that the compressive strength of Concrete has increased along with the addition of the percentage of Master Ease 5010.The average compressive strength of normal concrete is 0.28 MPa, concrete variation of 3% = 0.31 MPa, variation of 5% concrete = 0.416 MPa. From the table, the compressive strength value can be presented in graphical form with the following description:



Source: Research Data

Figure 4. Graph of the Compressive Strength of Porous Concrete

From Figure 4. It is known that the highest compressive strength is obtained from porous concrete samples with a variation of 5%. The highest compressive strength results obtained by the compressive strength value of 0.49 Mpa

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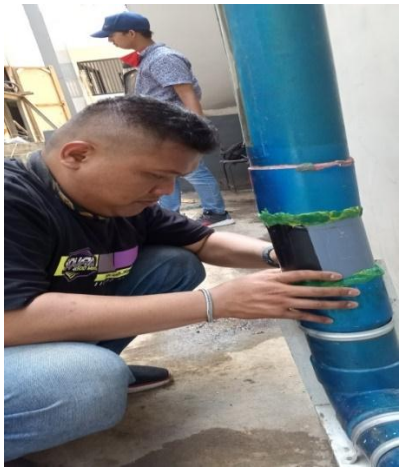
Source: Research Documentation

Figure 5. Cracks After Testing the Compressive Strength of Porous Concrete

Permeability Test Results

Concrete absorption test was conducted to determine the ability of Concrete to absorb water. If the Concrete can be impregnated with water, it can be said to be permeable. The absorption capacity test was carried out by using the Falling Head method, which is measuring the infiltration rate with the inundation height allowed to decrease.



Source: Research Documentation

Figure 6. The falling head method permeability test

The results of the calculation of permissibility of Concrete are presented in table 2 with the following description:

Tabel 2. Permeability Test

Sample	Time (t)	Permeability (k)	Average
	second	mm/second	
Normal Concrete	35,44	1,517	1,406
	39,96	1,345	
	39,6	1,357	
Conctrete	27,47	1,957	1,946

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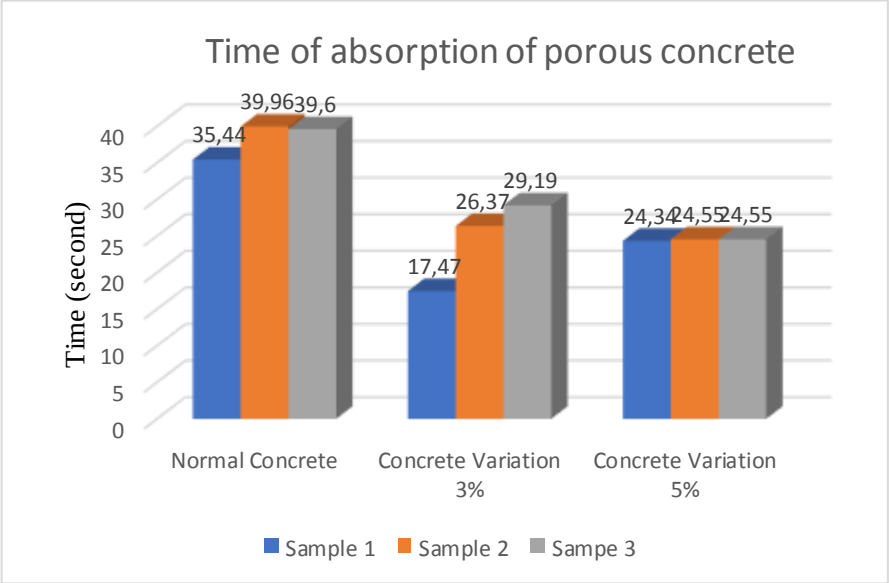
Variation 3%	26,37	2,039	
	29,19	1,842	
Conctrete Variation 5%	24,34	2,209	2,196
	24,55	2,190	
	24,55	2,190	

Source: Research Data

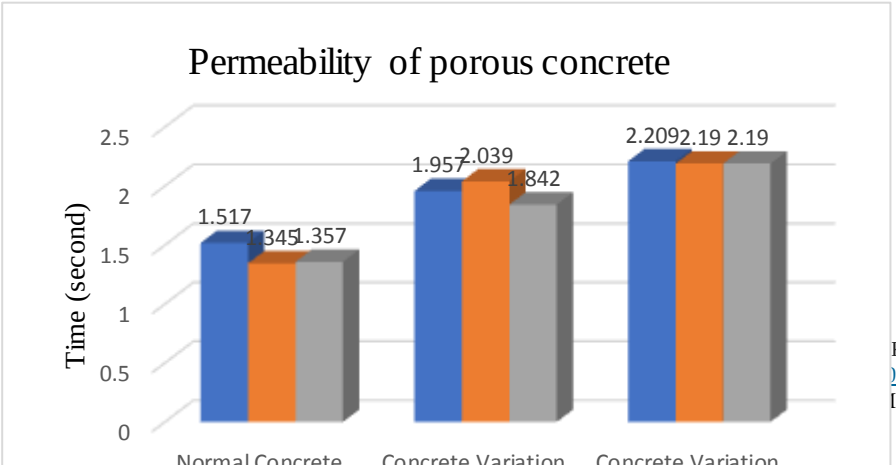
From table 2. It can be seen that the time required has decreased with the addition of the Master Ease percentage. The average permeability results have increased along with the percentage addition of Master Ease. From Table 2, a graph of the absorption capacity of porous Concrete with uraia can be presented as follows



Source: Research Data

Figure 7. Graph of Porous Concrete Absorption Time

From Figure 7 it can be seen that the highest time (39.96 seconds) required by normal Concrete. Meanwhile, the time required for Concrete with the addition of Master Ease is lower than normal Concrete.



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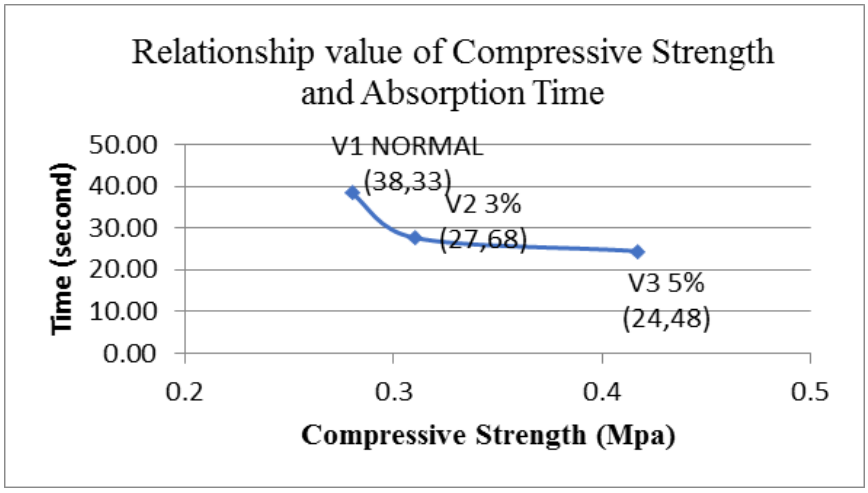
Source: Research Data

Figure 8. Permiability Graph of Porous Concrete

From Figure 8, it can be seen that the highest permeability (2.190 mm / s) is obtained in the 5% variation of porous Concrete. Concrete permeability increases with the addition of Master Ease. Relationship of Compressive Strength and Absorption Time of Porous Concrete

Relationship Compressive Strength and Absorption of Porous Concrete

From the results obtained regarding the compressive strength of concrete and absorption time, this value can be related to the results presented in Figure 9 below:



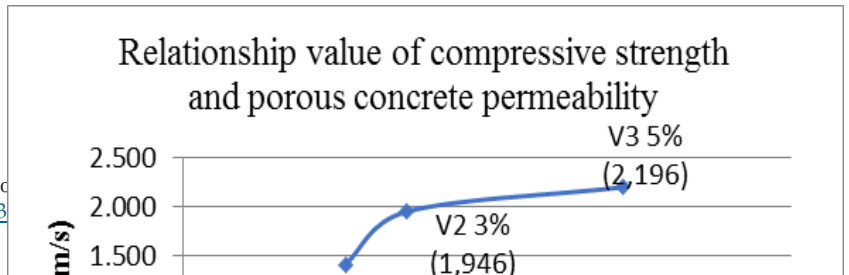
Source: Research Data

Figure 9. Graph of Relationship between Compressive Strength and Absorption of Porous Concrete

From Figure 9 it can be seen that the greater the compressive strength value of a concrete, the smaller the absorption time. The highest compressive strength obtained is 0.49 MPa with a time required of 24.55 seconds.

4.1 Relationship Compressive Strength and Permeability of Porous Concrete

From the results obtained regarding the compressive strength of Concrete and the permeability of Concrete, this value can be related to the results presented in Figure 10 below:



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Source: Research Data

Figure 10. Graph of Compressive Strength and Permeability of Porous Concrete

From Figure 10 it can be seen that the greater the compressive strength value, the greater the permeability of porous Concrete. With the highest compressive strength, namely 0.49 Mpa, the permeability value is 2.196 mm/s

CONCLUSION

Based on data analysis and discussion, in this study conclusions can be drawn related to the physical mechanical characteristics of the variation of the addition of Master Ease 5010 to Porous Concrete, which are as follows:

1. Compressive strength Porous concrete with variations in the addition of Master Ease 5010 with a variation of 5% produces the optimum compressive strength with a value of 0.416 MPa.
2. The results of the Porous Concrete Absorption Test with the addition of Master Ease 5010 with a variation of 5% addition resulted in the optimum absorption strength with a value of 2.196 mm / s.

From the results of the research that has been done, it can be seen that the addition of Master Ease 5010 increases the compressive strength and absorption capacity of porous Concrete.

Suggestion

It is recommended that in the manufacture of Porous Concrete not to add too much fash because Porous Concrete requires a different manufacturing method from Concrete in general and further research needs to be carried out with various other comparative compositions.

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