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Utilization of Marlstone Powder to Increase the Compressive Strength of Concrete

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ABSTRACT: Marl is limestone mixed with clay that is formed through the process of sedimentation. In this study, the authors used marl in the form of powder originating from the outskirts of the Komering Martapura river because marl has a very high silica content of 74.5%. The purpose and objective of this research is to find out how much influence the addition of marl powder has on the compressive strength of K300 concrete and what is the best percentage of adding marl powder to the compressive strength of concrete. This study used 30 cube-shaped test objects from 5 conditions with 6 kinds of variations. From the test results, the compressive strength of normal concrete characteristics is 303.591 kg/cm2, for the addition of 5% marl powder is 311.376 kg/cm2, for the addition of 10% marl powder is 320,713 kg/cm2, for the addition of 15% marl powder is 329.065 kg/ cm2, for the addition of 20% marl powder at 333.540 kg/cm2, and for the addition of 25% marl powder it is 327.491 kg/cm2. Based on the compressive strength test that has been carried out, it can be concluded that the increase in the maximum characteristic compressive strength in mixed conditions is 20%.

KEYWORDS: K300, Concrete, Marlstone, Compressive Strength

I. INTRODUCTION

Marl is limestone mixed with clay that is formed through the process of sedimentation. The deposition is usually due to being carried by water, air, and deposited somewhere. Marl is a type of fine-grained sedimentary rock with a fairly high carbonate content. Marl is rather hard when dry and crumbles easily when wet. Marlstone is gray-yellowish to blackish in color. Marl is also a natural resource that has not been utilized by the general public. The distribution of marl is found in mountainous areas, in hilly areas and also in riverbank areas. In South Sumatra, the distribution of marl is found in the Martapura area on the outskirts of the Komering river.

Concrete is one of the building materials that are currently widely used in Indonesia in physical construction. In general, the pure concrete mixture is cement, fine aggregate, coarse aggregate and water. Given the very large role of concrete, research is needed that aims to produce concrete that can last a long time, and is able to withstand loads above average.

In general, the composition of the constituent elements of concrete is 60%-75% coarse aggregate and fine aggregate, 1%-2% air voids, 25%-40% cement, and 30% water (Tjokrodimulyo, K, 1992).

The marl in this research is used as an alternative to cement mixture to be mixed into the concrete mix in the form of powder because marl has a very high silica content. Where this silica content is an element of chemical compounds contained in cement so that it is able to bind aggregates strongly and is a binder that can increase the compressive strength of characteristic concrete and be able to withstand or inhibit the occurrence of cracks or ruptures due to pressure that will arise.

This research aims to determine how much the effect of the addition of marl powder variations on the compressive strength of concrete and intends to find out what percentage of the addition of marl powder is best for the compressive strength of concrete.

II. MATERIALS AND METHOD

Concrete mix planning was done to determine the proportion of cement, coarse aggregate and fine aggregate and water that meets certain ratio requirements. In order for research in the laboratory to run smoothly, it is necessary to know and prepare the tools and materials that will be used. The materials to be used are first checked for quality.

A. Tools

1. Concrete mold
2. Shieve
3. Scale
4. Slump test equipment
5. Mix container
6. Oven
7. Volumetric flask
8. Los Angeles Machine
9. Concrete Mixer
10. Vibrator
11. Compressive Strength Machine
12. Shieve shaker

B. Material

1. Portland cement, the cement used in this study is type I cement, especially *Semen Padang* and *Semen Baturaja*.
2. Fine Aggregate, this research used fine aggregate in the form of class II sand originating from Tanjung Raja, Ogan Komering Ilir Regency.
3. Coarse Aggregate, in the form of crushed stone measuring 10-20 mm from Lahat Regency.
4. Water, this research uses water sourced from PDAM Tirta Musi.
5. Marl powder added material originating from the Martapura area, East Ogan Komering Ulu Regency.

The test objects made in this study were cube-shaped concrete with a total of 36 samples with 6 conditions, each condition consisting of 6 test objects measured 15cm x 15cm x 15cm, namely

1. Normal concrete,
2. Normal concrete with addition of 5% marl powder,
3. Normal concrete with addition of 10% marl powder,
4. Normal concrete with addition of 15% marl powder,
5. Normal concrete with addition of 20% marl powder,
6. Normal concrete with addition of 25% marl powder,

From the mixture for each condition, samples were taken and then a slump test was carried out to determine the slump value of each mixture.

After the concrete is 28 days old, the weight of the concrete is weighed and then the compressive strength of the concrete is tested at the Concrete Technology Laboratory, Muhammadiyah University of Palembang.

III. RESULTS AND DISCUSSION

In accordance with the purpose of this study, namely to determine the compressive strength of normal concrete using marl powder added with a percentage variation of 5%, 10%, 15%, 20%, 25%.

Before the concrete mixture is put into the cube mold, the mortar is first checked for viscosity using a slump test tool. In order to produce accurate data, the slump test should be carried out three times in one mix. Slump testing on normal concrete and concrete with the addition of marl powder can be seen in the following table:

Table 1. Slump Test Value

No.	Type of Concrete Mix	Reduction (cm)
1.	Normal Concrete	4,6
2.	Normal Concrete + 5 % Marl Powder	4,4
3.	Normal Concrete + 10 % Marl Powder	4,1
4.	Normal Concrete + 15 % Marl Powder	3,8
5.	Normal Concrete + 20 % Marl Powder	3,5
6.	Normal Concrete + 25 % Marl Powder	3,2

Based on table 1. the higher the percentage of marl powder addition, the more viscous the concrete mix will be. This is because the lime contained in cement is no longer able to react with silica and results in water absorption at each addition of marl powder, so that the concrete mix becomes thick.

After testing the planned compressive strength of concrete on 28-day old concrete, data obtained from the laboratory on each sample condition (σ bi) and the average compressive strength in each condition (σ bm), can be seen in the following table

Table 2. Characteristic Compressive Strength of 28 Days Old Concrete

Concrete Type	Test Object Weight (Kg)	Load		Area (cm^3)	Compressive Strength (kg/cm^2)	Average Compressive Strength	Deviation Standard	Characteristic Compressive Strength (Kg/cm^2)
		Ton	Kg					
Normal	8,10	71,25	71250	225	316,666	310,932	4,476	303,591
	8,30	69,50	69500	225	308,888			
	8,28	70,75	70750	225	314,444			
	8,34	68,80	68800	225	305,777			
	8,15	69,50	69500	225	308,888			
Normal + 5% Marl Powder	8,32	72,28	72280	225	321,244	318,266	4,201	311,376
	8,32	70,21	70210	225	312,044			
	8,53	71,32	71320	225	316,677			
	8,49	71,59	71590	225	318,177			
	8,29	72,65	72650	225	322,888			
Normal + 10% Marl Powder	7,99	72,99	72990	225	324,400	326,995	3,830	320,713
	7,86	73,54	73540	225	326,844			
	8,25	73,80	73800	225	328,000			
	8,53	74,89	74890	225	332,844			
	8,19	72,65	72650	225	322,888			

Normal + 15% Marl Powder	8,46	74,23	74230	225	329,911	337,039	4,862	329,065
	8,26	75,45	75450	225	335,333			
	8,15	75,79	75790	225	336,844			
	7,98	76,83	76830	225	341,466			
	7,91	76,87	76870	225	341,644			
Normal + 20% Marl Powder	8,05	75,89	75890	225	337,288	339,679	3,743	333,540
	8,18	75,63	75630	225	336,133			
	8,25	76,42	76420	225	339,644			
	8,15	76,39	76390	225	339,511			
	7,94	77,81	77810	225	345,822			
Normal + 25% Marl Powder	7,92	76,87	76870	225	341,644	335,324	4,776	327,491
	8,15	75,27	75270	225	334,533			
	8,15	76,20	76200	225	338,666			
	7,96	74,38	74380	225	330,577			
	8,13	74,52	74520	225	331,200			

From the data processing of the compressive strength of concrete, the percentage comparison between the compressive strength of normal concrete and the compressive strength of concrete with the addition of marl powder with the percentage addition of 5%, 10%, 15%, 20%, and 25% can be seen in the table below.

Addition percentage of marl powder	**The compressive strength of concrete at the age of 28 days**	**Percentage increase (%)**
0 %	303,591	0,00
5 %	311,376	2,56
10 %	320,713	5,63
15 %	329,065	8,39
20 %	333,540	9,86
25 %	327,491	7,87

The increase in the compressive strength of concrete is due to the silica (SiO_2) content in the marl powder which can bind cement compounds at a certain percentage of the mixture. From the results of the research above, it can be seen that the addition of marl powder can increase the compressive strength of concrete by a certain percentage and it can be seen that the addition of 20% marl powder to cement produces a maximum concrete compressive strength of 333.540 (kg/cm^2) with an increase in compressive strength of 9,86%. At the time of adding 25% marl powder, the compressive strength of the concrete decreased but was still greater than the compressive strength of normal concrete. The addition of marl powder as much as 25% experienced an increase in compressive strength of 327.491 (kg/cm^2) with an increase of 7.87% from normal concrete.

IV. CONCLUSIONS

After testing the specimens under 6 test conditions using marl powder as an additive to the concrete mixture and testing carried out on 28-day-old concrete, it was concluded that the use of marl powder added in normal concrete experienced an increase in the maximum characteristic compressive strength under conditions a mixture of 20% with a concrete compressive strength of 333.540 (kg/cm2). This means that with the addition of marl powder, it can increase the compressive strength of concrete by 9.86% of the compressive strength of normal concrete. In line with the addition of marl powder to the concrete mixture, the slump test value will also decrease.

V. RECOMMENDATION

From a series of studies that have been carried out, the authors can provide suggestions for further research to use different types of cement.

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