

The Effect of Concrete Mixture on Usage Fly Ash and Chicken Egg Shell Powder as Cement Substitutions in Concrete Compressive Strength

Farhan Fatahillah, Agung Sumarno

Teknik Sipil, Universitas Mercu Buana, Jl. Raya Kranggan No. 6, Jawa Barat 17433

Teknik Sipil, Jl. Raya Kranggan No. 6, Jawa Barat 17433

agung_sumarno@mercubuana.ac.id, farhan123fatahillah@gmail.com

Abstrak

The purpose of this study was to determine the effect of utilizing fly ash and chicken egg shell powder on the compressive strength of concrete, workability, density and water absorption. In this study, testing was carried out with the use of fly ash waste and chicken egg shell powder with variations of 15% fly ash waste and variations of chicken egg shell powder by 10% and 17.5% at the age of 3 days, 7 days, 14 days, and 28 days. for the test objects used measuring with a diameter of 10 cm and a height of 20 cm as many as 36 test samples by making variations of the day as many as 3 samples of test objects.

Concrete with a mixture of 15% Fly Ash waste and 10% Egg Shell Powder in test sample 2 obtained a compressive strength at the age of 28 days of 29.45 Mpa. Variation of the Normal Concrete sample got a compressive strength at the age of 28 days of 30.37 MPa. Variation of test sample 3 got a compressive strength at the age of 28 days of 21.16 Mpa.

1. Introduction

1.1. Background

Concrete is a composite material made from a mixture of aggregate and cement. The most common form of concrete is concrete with portland cement, which consists of coarse aggregate (gravel/split), fine aggregate (sand), cement and water. Concrete is the most widely used material as a construction material. Concrete is used because it is strong, durable, water-resistant, wear-resistant, and has very small shrinkage (Tjokrodinuljo, 1996).

The development of construction throughout the world is growing rapidly, as a result, the need for materials for the manufacture of concrete is getting higher. This triggers environmental problems because all the ingredients for making concrete come from mining. In today's development, there are many modifications of concrete making materials to solve problems that occur in the environment to be more environmentally friendly. The purpose of modifying the material for making concrete is to reduce limestone and sand mountain mining and make the environment more friendly. Because if limestone mountains and sand mountains are continuously mined, the materials for making concrete will be lost if they are not assisted with other modified materials.

Sand mining, especially illegal mining, causes various negative impacts, including; soil becomes prone to erosion, air pollution due to dust, noise pollution, road damage due to heavy equipment. silting of rivers, reduced clean water, to the threat of biodiversity around the mining area (Pitchaiah, 2017). According to previous research by adding fly ash in a high-quality concrete mixture as a substitute for cement, it was stated that the greater the concentration of fly ash in the concrete mixture, the higher the concentration of fly ash in the concrete mixture. will increase the compressive strength value, but the compressive strength will decrease if the use of fly ash is too much (Ervianto et al., 2016). Research using fly ash as a substitute for cement on the compressive strength of concrete. The concentration of fly ash used varies from 5% to 12.5% with an interval of 2.5%. The optimum compressive strength using fly ash with a concentration of 12.5% is 231.04 Kg/cm² (Setiawati, 2018). The use of fly ash in making mortar mixtures designed by weight provides cost savings of 50% to 60% while the heavy method provides cost savings of 9% to 16%, in this study fly ash was used as a cement substitute (Jain & Islam, 2013).

1.2 Problem Formulation

Based on the above background, the formulation of the problem in this study is as follows:

1. How is the effect of using fly ash and chicken egg shell powder as a substitute for cement in a concrete mixture on workability?
2. How is the effect of variations in the mixture of waste using fly ash and chicken egg shell powder on the compressive strength of concrete?
3. How is the effect of the mixture of fly ash and chicken egg shell powder on the density of the concrete?

4. How is the effect of variations in the mixture of waste using fly ash and chicken egg shell powder on water absorption in concrete

1.3. Purpose and Purpose

The aims and objectives of this research are as follows:

1. Knowing the effect of using a mixture of fly ash and chicken egg shell powder as a cement substitution material in concrete on the compressive strength test of concrete and the workability value of the concrete slump value test.
2. Knowing the variation of fly ash and chicken egg shell powder in the variation of the concrete mixture that has the strongest compressive strength.
3. Knowing the effect of using a mixture of fly ash waste and chicken egg shell powder on the compressive strength of concrete.
4. Knowing the effect of variations in the mixture of waste using fly ash and chicken egg shell powder on water absorption in concrete.

2. Literature Review

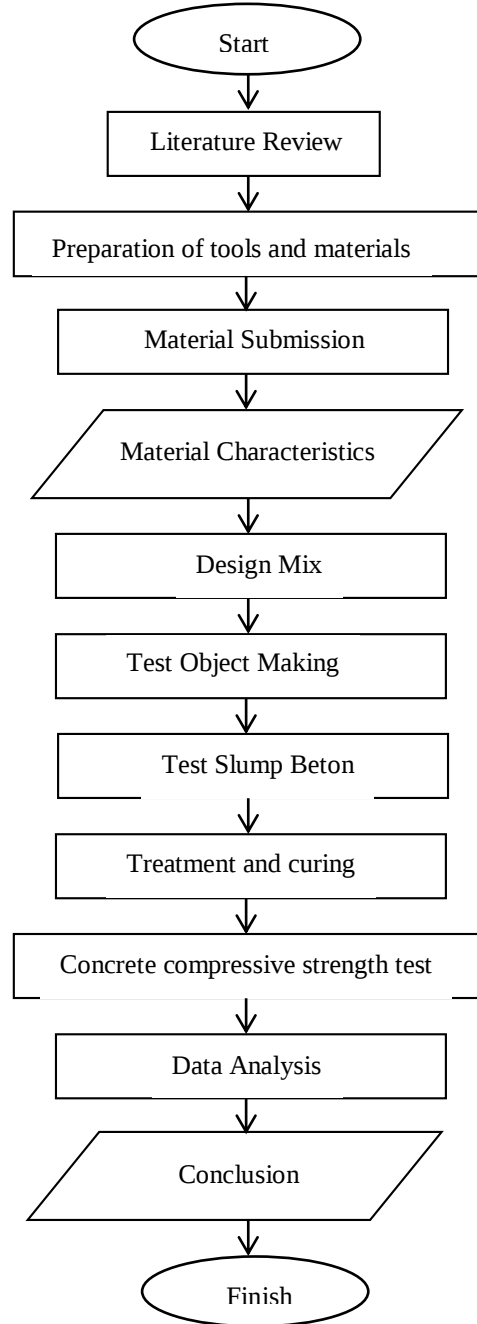
Concrete is the most widely used material as a construction material. Concrete is used because it is strong, durable, water-resistant, wear-resistant, and has very small shrinkage. Cement will react with water and bind the aggregate so that the material is hard and durable.

Sometimes one or more additive ingredients are added to the concrete to produce concrete with certain characteristics, such as ease of work, compressive strength, and speed up setting time. The basic materials supporting the manufacture of concrete are very supportive of quality, quality planning for concrete is very important to get maximum results.

3. Research Method

The research method used is the experimental method. The experimental method is a method to determine whether the cause (independent variable) affects the effect (dependent variable) (Hermawan, 2006).

Table 1.



4. Results and Discussion

4.1. Slump (Wokability)

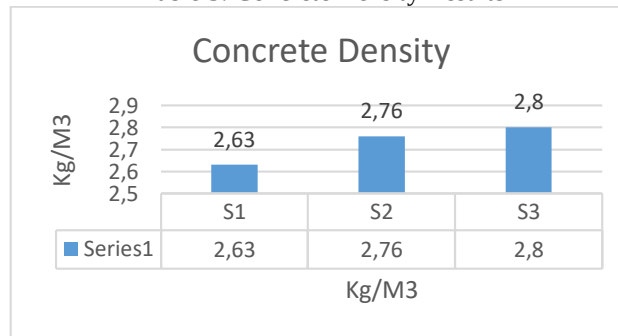
Table 2. Slump . Test Results

Sample Type	Slump Value	Unit
S1	100	mm
S2	100	mm
S3	100	mm

In concrete without substitution, the slump value was 100 mm and in the third sample it was increased to 140 mm.

4.2. Concrete Density

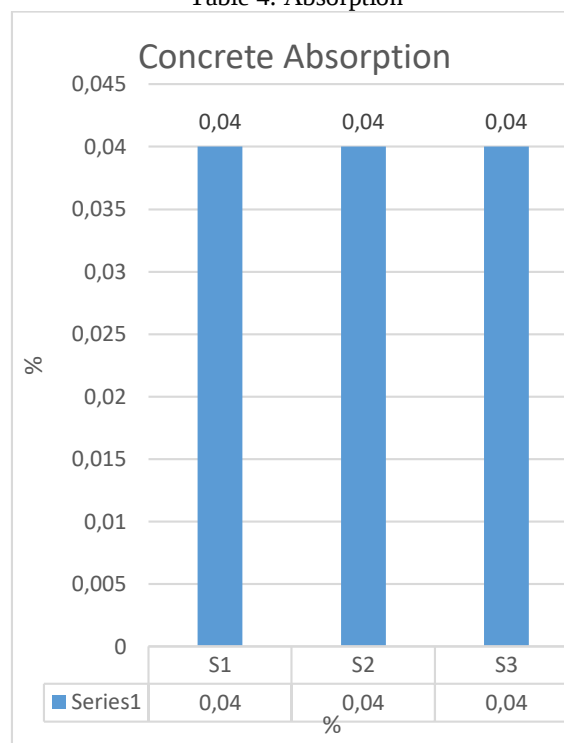
Table 3. Concrete Density Results



This table explains that the density of concrete with the following data, sample 1 with a normal variation obtained 2.63 kg/m³, sample 2 with a variation of 15% fly ash and 10% chicken egg shell powder obtained 2.76 kg/m³ and the sample to 3 with a variation of 15% fly ash and 17.5% chicken egg shell powder to 2.80 Kg/M³.

4.3. Water Absorption

Table 4. Absorption



This table explains that the absorption of concrete with the following data, sample 1 with a normal variation of 0.04%, sample 2 with a variation of 15% fly ash and 10% chicken egg shell powder obtained 0.04% and sample 3 with a variation of 15 % fly ash and 17.5% chicken egg shell powder got 0.04%.

4.4. Days Compressive Strength Test Results

Table 5. Day Compressive Strength Test Results

Sample Type	Test Object Code	Weight (Kg)	Density	3 days		Mpa	Mpa Average	Absorption Average
				Average Density	Load (Kn)			
S1	3.1	3.92	2.51		157.2	20		
	3.2	4.49	2.89	2.77	150.9	19.2	19.23	0.04
	3.3	4.52	2.9		145.9	18.5		
S2	3.1	4.35	2.8		127.2	16.1		
	3.2	4.37	2.82	2.61	125.4	15.9	16.57	0.05
	3.3	3.45	2.22		139.4	17.7		
S3	3.1	4.3	2.75		129.2	16.4		
	3.2	4.51	2.89	2.8	146.1	18.5	18.77	0.03
	3.3	4.3	2.75		168.7	21.4		

Based on the results obtained, the addition of the sample to 2 fly ash as much as 15% and chicken egg shell powder 10% and the 3rd sample fly ash as much as 15% and chicken egg shell powder 17.5% decreased from the normal concrete sample that has been made, p. This is because not all of the fly ash waste as much as 15% and 10% chicken egg shell powder binds intact, as much as in the concrete with the substitution of the 2nd sample getting a compressive strength of 16,567 MPa and the 3rd sample getting a compressive strength of 18.76.

4.5. Days Compressive Strength Test Result

Table 6. Day Compressive Strength Test Results

Sample Type	Test Object Code	Weight (Kg)	Density	7 Days		Mpa	Mpa Average	Absorption Average
				Average Density	Load (Kn)			
S1	7.1	3.97	2.56		175.3	22.3		
	7.2	4.56	2.5	2.52	116.9	14.8	19.63	0.05
	7.3	4.51	2.5		172	21.8		
S2	7.1	4.37	2.8		137	17.4		
	7.2	4.39	2.82	2.8	127.1	16.1	16.63	0.03
	7.3	4.33	2.77		129.2	16.4		
S3	7.1	4.36	2.8		186.4	23.7		
	7.2	4.51	2.89	2.84	167.9	21.3	23.4	0.04
	7.3	4.39	2.82		198.2	25.2		

Based on the results obtained, the addition of sample to 2 fly ash as much as 15% and chicken egg shell powder 10% and sample 3 fly ash as much as 15% and chicken egg shell powder 17.5% decreased in sample 2 and increased in sample 3 with The comparison of normal concrete that has been made, the second sample gets 16.63 mpa lower than the 1st sample, which is normal concrete 19.63 and in the 3rd sample it gets 23.4 mpa.

4.6. Press strength test results 14 Days

Table 7. Compressive Strength Test Results 14 Days

14 Days									
Sample Type	Test Object Code	Weight (Kg)	Density	Average Density	Load (Kn)	Mpa	Mpa Average	Absorption	Absorption Average
S1	14.1	4.49	2.88	2.73	197.6	25.14	23.96	0.04	0.05
	14.2	3.82	2.45		197.6	25.14		0.04	
	14.3	4.46	2.86		170	21.6		0.04	
S2	14.1	4.46	2.87	2.83	129.1	16.43	21.38	0.05	0.06
	14.2	4.31	2.78		208.2	26.4		0.06	
	14.3	4.42	2.84		167.6	21.3		0.05	
S3	14.1	4.42	2.85	2.8	114.5	14.5	13.6	0.06	0.05
	14.2	4.28	2.75		94.8	12		0.05	
	14.3	2.35	2.8		112.6	14.3		0.06	

Based on the results obtained, the addition of the sample to 2 fly ash as much as 15% and chicken egg shell powder 10% and the 3rd sample fly ash as much as 15% and chicken egg shell powder 17.5% decreased from the normal concrete sample that has been made, p. This is because not all fly ash waste is 15% and 10% chicken egg shell powder binds intact, as much as in concrete with the substitution of the 2nd sample getting a compressive strength of 21.37 MPa and in the 3rd sample obtaining a compressive strength of 13.6 mpa, the 3rd sample experienced a very high decrease due to the 3rd sample material 15% fly ash waste and 17.5% chicken egg shell powder were not mixed evenly.

4.7. Days Compressive Strength Test Results

Table 8. Compressive Strength Test Results 28 Days

28 Days									
Sample Type	Test Object Code	Weight (Kg)	Density	Average Density	Load (Kn)	Mpa	Mpa Average	Absorption	Absorption Average
S1	28.1	3.95	2.54	2.52	250.7	31.9	30.37	0.05	0.05
	28.2	3.92	2.5		236.3	30		0.02	
	28.3	3.89	2.52		230	29.2		0.08	
S2	28.1	4.35	2.82	2.83	229.8	29.2	29.45	0.09	0.06
	28.2	4.43	2.85		239	30.4		0.05	
	28.3	4.4	2.83		225.9	28.75		0.05	
S3	28.1	4.27	2.71	2.76	176.4	22.45	21.16	0.05	0.05
	28.2	3.39	2.82		181.8	23.13		0.04	
	28.3	4.28	2.76		141	17.9		0.06	

Based on the results obtained, the addition of the sample to 2 fly ash as much as 15% and chicken egg shell powder 10% and the 3rd sample fly ash as much as 15% and chicken egg shell powder 17.5% decreased from the normal concrete sample that has been made, p. This is because not all of the fly ash waste as much as 15% and 10% chicken egg shell powder binds intact, as much as the concrete with the substitution of the 2nd sample obtained a compressive strength of 29.45 Mpa and the 3rd sample obtained a compressive strength of 21.16 Mpa, this decrease was due to the mixture The waste of the 2nd fly ash sample was 15% and the chicken egg shell powder 10% was not completely glued and the 3rd fly ash sample was 15% and the 17.5% chicken egg shell powder was not completely mixed evenly.

5. Conclusion

There are several conclusions that can be drawn from this study regarding the effect of Fly Ash and Eggshell Powder as a substitute for cement as a cement mixture against concrete that has been carried out, namely:

1. The slump value using Fly Ash and Eggshell Powder is in the range of 10 cm - 14 cm, so it can be concluded that the use of Fly Ash and Eggshell Powder affects the workability of concrete. The higher the variation of the Telot Shell Powder, the higher the slump value will be.
2. The research proves that Fly Ash and Eggshell Powder have a significant effect on the compressive strength of concrete. Concrete with a mixture of 15% Fly Ash waste and 10% Egg Shell Powder in test sample 2 obtained a compressive strength at the age of 28 days of 29.45 Mpa. Variation of the Normal Concrete sample got a compressive strength at the age of 28 days of 30.37 MPa. Variation of test sample 3 got a compressive strength at the age of 28 days of 21.16 Mpa.
3. The use of waste fly ash and egg shell powder in the concrete mixture produces a density at the age of 28 days which is relatively stable in the range of 2.76 – 2.8 Kg/m³. For normal concrete samples at the age of 28 days, it is 2.63 kg/m³
4. The research proves that waste Fly Ash and Eggshell Powder does not affect the water absorption factor in concrete, in concrete with a mixture of 15% Fly Ash waste and 10% Eggshell Powder gets 0.04% water absorption, in the concrete sample mixture of waste Fly Ash 15% and Egg Shell Powder 17.5% got 0.04% water absorption and for normal concrete samples, water absorption was 0.04%.

6. Suggestions

There are several suggestions in this study regarding the effect of Fly Ash and Eggshell Powder as a substitute for cement as a cement mixture against concrete that has been carried out, namely:

1. In the study of powdered chicken egg shells, it must be really very smooth because in In my research, I used only a 100 size sieve, it would be better if the chicken egg shell powder was in a 200 filter or pan.
2. In the process of making the test object when it is inserted into the mixer, the materials must be considered carefully so that the ingredients for making concrete are evenly mixed.
3. In the process of making test objects, many things must be considered to reduce errors in data collection, from the materials used, equipment and manufacture of test objects.
4. In the process of making the test object when it is inserted into the cylinder, care must be taken to avoid the occurrence of porous concrete.

References

- Ervianto, M., Saleh, F., & Prayuda, H. (2016). Kuat Tekan Beton Mutu Tinggi Menggunakan Bahan Tambah Abut Terbang (Fly Ash) Dan Zat Adiktif (Bestmittel). *Sinergi*, 20(3), 199. <https://doi.org/10.22441/SINERGI.2016.3.005>
- Hermawan, A. (2006). Penelitian Bisnis Paradigma Kuantitatif. Grasindo. <https://onesearch.id/Record/IOS13428.JATEN-02110000000240>
- Jain, A., & Islam, N. (2013). Use Of Flyash As Partial Replacement Of Sand In Cement Mortar. Undefined.
- Pitchaiah, P. S. (2017). Impacts of Sand Mining on Environment—A Review. *International Journal of Geoinformatics and Geological Science*, 4(1), 1–6. <https://doi.org/10.14445/23939206/ijggs-v4i1p101>
- Setiawati, M. (2018). Fly Ash Sebagai Bahan Pengganti Semen Pada Beton. *Prosiding Semnastek*, 0(0). <https://jurnal.umj.ac.id/index.php/semnastek/article/view/3556>
- Tjokrodinuljo, K. (1996). *Teknologi Beton*. Nafiri.