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Experimental Test of Compressive Strength of Concrete by Using Wastewater Tofu

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ABSTRAK

Tofu waste is one type of waste produced by many people in Indonesia because the type of tofu food is the easiest to get. This study used tofu wastewater as a substitute for water and as a concrete treatment with certain changes in cement water components. Tofu water waste is waste that comes from wasted soybean treatment residues that cannot be consumed and the result of this tofu water waste is usually only disposed of. The purpose in this study is to determine the compressive strength value of concrete using tofu waste water and treatment using tofu wastewater. In the implementation using laboratory experimental methods. From the results of the compressive strength test showing the lower compressive strength value of concrete using wastewater tofu obtained a higher compressive strength value compared to using normal water PDAM. The compressive strength value using tofu water is 71.80 kg / cm² at the age of 7 days, 92.30 kg / cm² at the age of 7 days, 119.10 kg / cm² at the age of 7 days 28 days and the compressive strength value of concrete using normal water PDAM Baubau City is 46.30 kg/cm² at the age of 3 days, 59.20 kg/cm² at the age of 7 days and 88.00 kg/cm² at the age of 28 days.

SEJARAH ARTIKEL
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KATA KUNCI
Concrete; Compressive Strength; Tofu Water; Waste

1. Introduction

A food with nutritional value and protein derived from soy is tofu. Soybean needs per year are 2.3 million tons, of which 40% is used to make tofu, 50% to make tempeh, and 10% to make soybean oil (Buchori et al., 2012). The tofu sector has the potential to boost the community's economy, but also risks damaging the environment because of the waste it produces (Matilda et al., 2016).

Tofu water waste is waste that comes from the waste of soybean treatment that is wasted and cannot be consumed by humans and the results of tofu water waste are generally disposed of or not used and utilized. Therefore, in this study, an experimental study will be carried out to utilize tofu water waste as an alternative material for concrete mixture, namely tofu water waste used is tofu liquid waste which is used as a substitute for water in making concrete. Physical characteristics include total solids, temperature, color and odor while chemical characteristics include organic matter, inorganic materials and gases (Agus, Setiawan, 2014).

According to (Husin, 2008) organic matter includes organic content (BOD, COD) of dissolved oxygen, nitrogen-total while inorganic matter includes pH, Ca, Pb, Fe, Cu, Na. The following are some of the most important properties of industrial wastewater: Tofu liquid waste has the following characteristics: temperature exceeding the typical temperature of the receiving water body (60-80 ° C), yellowish-white and hazy waste color, pH < 7, COD (Chemical Oxygen Demand) 1534 mg / L, BOD (Biochemical Oxygen Demand) 950 mg / L, TSS (Total Suspended Solid) 309 mg / L.

Several previous studies discussed the use of wastewater, namely wastewater used batik dipping (Candra Kusuma, 2017) sewer water as a mixture for making concrete (Hepiyanto & Kartikasari, 2018) and molasses waste water and zat *additive concrete* as a mixture of concrete making (Ansori et al., 2019).

2. Methodology

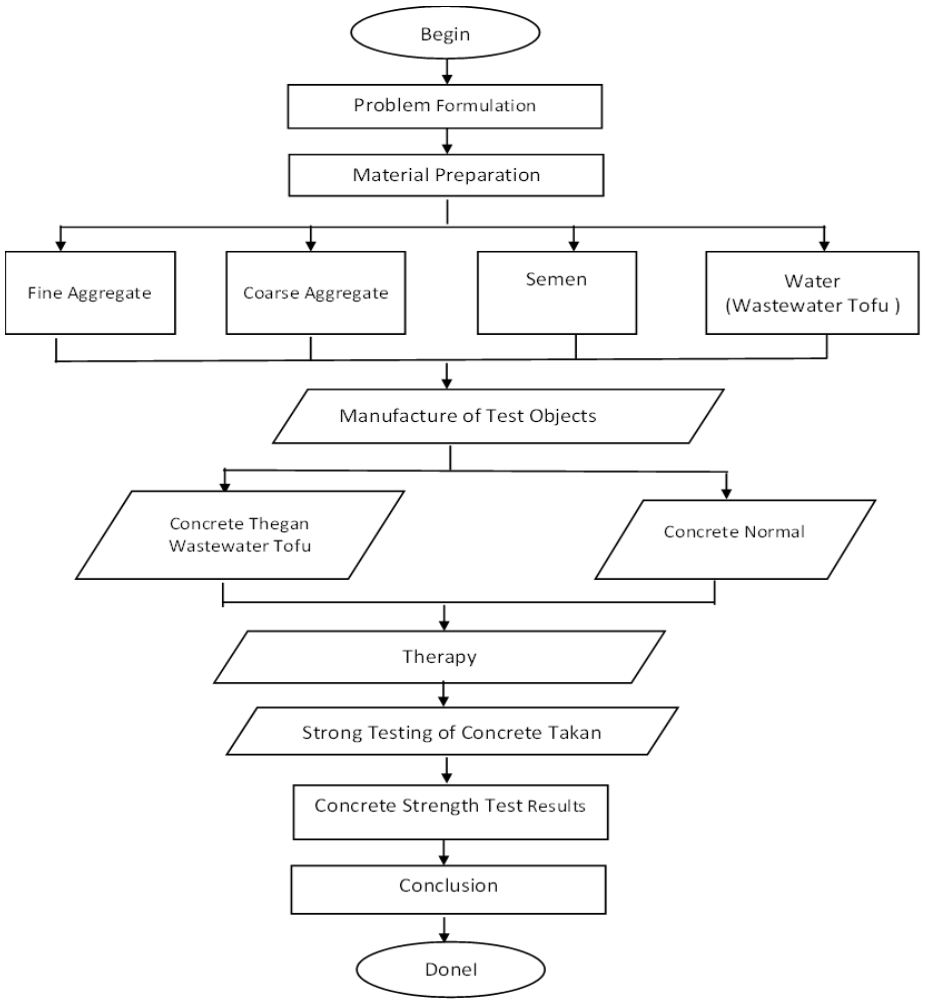

Figure 1. Experimental Test of Concrete Compressive Strength: Research Flowchart

This research was carried out at the Civil Engineering laboratory of the Faculty of Engineering, University of Muhammadiyah Buton with the implementation time starting in May 2022 – August 2022.

In this study using the following research materials:

a. Portland Cement type I Tonasa Cement {Formatting Citation} (SNI 2049-2015, 2015)
b. Aggregat Soft (sand) originating from the village of Kamelanta Kec. Kapontori Kab. Buton
c. Aggregat Rough (gravel) originating from the village of Burukena Kec. Batauga Kab. South Buton
d. Tofu Wastewater btained from the tofu factory located in Baubau City.

Some of the tools used in making concrete are:

a. Cylindrical Mold Size 15 cm x 30 cm
b. Man
c. Slump Test
d. Mixer
e. Shovel
f. Cement Spoon

Table 1. Planning the Number of Test Objects

No	Types of Test Materials	Concrete Age (Days)		
		3	7	28
1.	Concrete Normal	3 pcs	3 pcs	3 pcs
2.	Concrete using Waste Water Tofu	3 pcs	3 pcs	3 pcs
	Number of Test Objects	6 pcs	6 pcs	6 pcs
	Total Number		**18 pcs**	

Source: Data Analysis Results 2022

3. Result and Discussion

3.1. Material Characteristics

Several tests were carried out to obtain the characteristic values of fine aggregate and coarse aggregate materials such as sludge content, moisture content, volume weight, absorption, specific specific specific gravity and smoothness modulus.

Table 2. The result of the Fine Aggregate Rusteristic Examination (sand) of Kamelanta Village, Kapontori District

No.	Types of Examinations	Examination Results	Unit
1	Specific Gravity		
	- BJ. Pseudo	2,60	--
	- BJ. Bulk	2,26	--
	- BJ. SSD	2,39	--
	- Absorption	5,68	%
2	Loose Fill Weight	1,29	gr/cm^3
3	Solid Fill Weight	1,02	gr/cm^3
4	Mud Rate	13,47	%
5	Air Up	2,46	%
6	Sand Fineness Modulus	5,15	

Source: Data Analysis Results, 2022

Table 3. Results of Inspection of Rough Aggregate Rusteristics (Gravel) of Badena Village Kec. Batuga Kab. South Buton (Sayfullah & Musrifin, 2020)

No	Types of Examinations	Examination Results	Unit
1	Specific Gravity		
	Heavy Kind of Bulk	2,53	--
	Ssd Specific Gravity	2,45	--
	Heavy Kind of Pseudo	2,47	--
	Absorption	1,63	%
2	Heavy Last	0,37	gr/cm^3
3	Heavy Solid	0,35	gr/cm^3
4	Air Up	2,12	%
5	Up Lumpur	2,23	%

Source: Data Analysis Results, 2022

3.2 Mixed Design Planning in Accordance with the Composition of SNI K-200

Table 4. Mixed Planning Mix Concrete Design Sesuidengan Composition SNI K-200

Concrete Materials	Weight/M³Concrete (kg)	Ratio to Cement Amount	Weight For 1 Sample (kg)	Weight For 3 Samples (kg)
Water/Tofu Water	215.00	0.61	1.14	5.70
Semen	352.00	0.61	1.87	9.33
Pasir	731.00	0.61	3.88	19.38
Gravel	1031.00	0.61	5.47	27.33

Source: (*SNI Standard Number 7394 of 2008*, 2008)

3.3 Compressive Strength Test Results

Table 5. Test Results of Compressive Strength of Normal Concrete on unut 3 days, 7 days and 28 days

No	Age (Days)	Weight (Kg)	Strong Press (kN)	Compressive Strength Reading (Kg)	Area (cm^2)	fcu (Kg/cm^2)	fcu Rata2 (Kg/cm^2)
1	3	9.08	86.90	8948.09	176.625	50.7	46.3
2	3	9.03	81.50	8392.06	176.625	47.5	
3	3	8.42	69.70	7177.01	176.625	40.6	
4	7	8.99	79.10	8144.93	176.625	46.1	59.2
5	7	9.80	102.90	10595.61	176.625	60.0	
6	7	12.26	122.40	12603.53	176.625	71.4	
7	28	12.03	172.90	17803.51	176.625	100.8	88.0
8	28	12.17	168.20	17319.55	176.625	98.1	
9	28	12.00	111.60	11491.45	176.625	65.1	

Source: *Data Analysis Results, 2022*

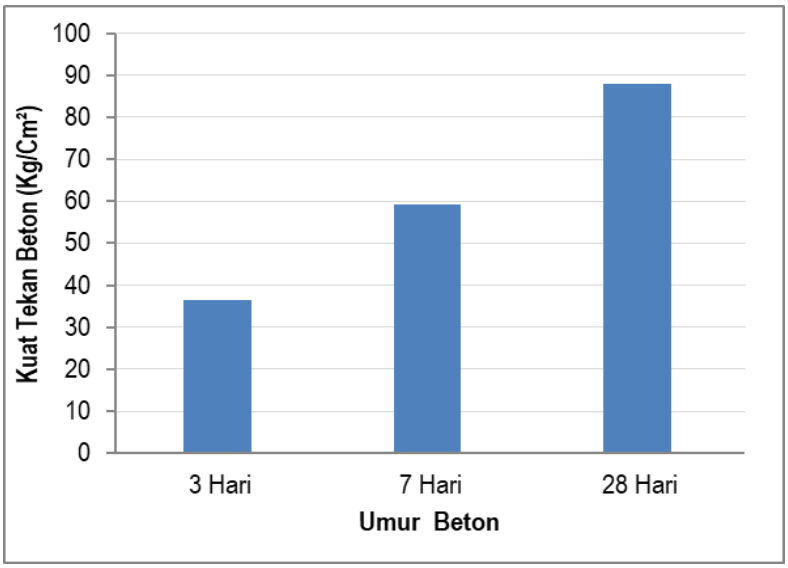

Figure 2. Comparison Graph of Concrete Compressive Strength Test Results using Tofu Wastewater and Normal Water PDAM

Source: Data Analysis Results, 2022

Graph of Normal Concrete Compressive Strength Test Results shows that as the concrete age increases , the resulting compressive strength value increases (*SNI 03-2834-2000*, 2000) with a concrete compressive strength value of 46.3 kg / cm² at the age of 3 days, 59.2 kg/cm² at the age of 7 days and 88.00 kg/cm² at the age of 28 days.

Table 6. Test Results of Compressive Strength of Concrete using Waste Water Tofu on unut 3 days, 7 days and 28 days

No	Age (Days)	Weight (Kg)	Strong Press (kN)	Compressive Strength Reading (Kg)	Area (cm²)	fcu (Kg/cm²)	fcu Rata2 (Kg/cm²)
1	3	11.84	120.00	12356.4	176.625	70.0	
2	3	11.96	145.00	14930.65	176.625	84.5	71.80
3	3	11.89	104.30	10739.77	176.625	60.8	
4	7	11.84	159.00	16372.23	176.625	92.7	
5	7	12.09	169.00	17412.23	176.625	98.6	92.30
6	7	11.94	147.00	15136.59	176.625	85.7	
7	28	11.74	198.70	20460.14	176.625	115.8	
8	28	12.18	217.50	22344.49	176.625	126.5	119.10
9	28	12.01	197.10	20295.39	176.625	114.9	

Source: *Data Analysis Results, 2022*

Table 6. The results of the Concrete Compressive Strength Test using Tofu Water Waste at the age of 3 days, 7 days and 28 days show that as the concrete ages, the resulting compressive strength value increases (*SNI 03-2834-2000*, 2000) with a compressive strength value concrete was 71.80 kg/cm² at the age of 3 days, 92.30 kg/cm² at the age of 7 days and 119.10 kg/cm² at the age of 28 days.

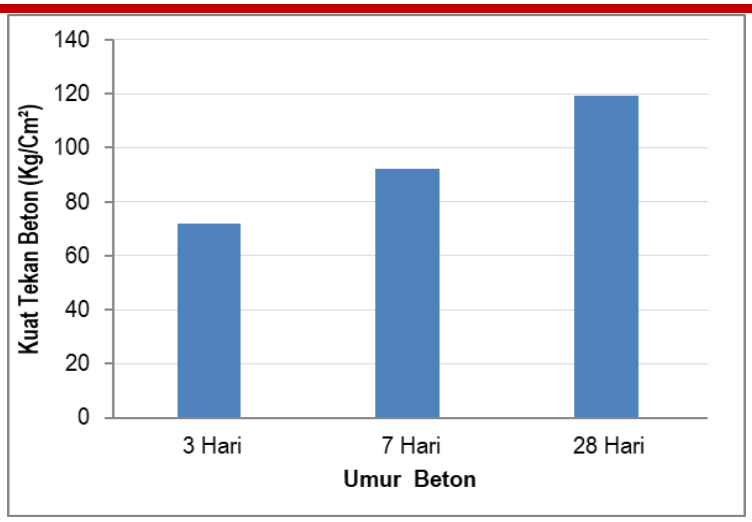

Figure 3. Graph of Concrete Compressive Strength Test Results using Tofu Water Waste

Source: Data Analysis Results, 2022

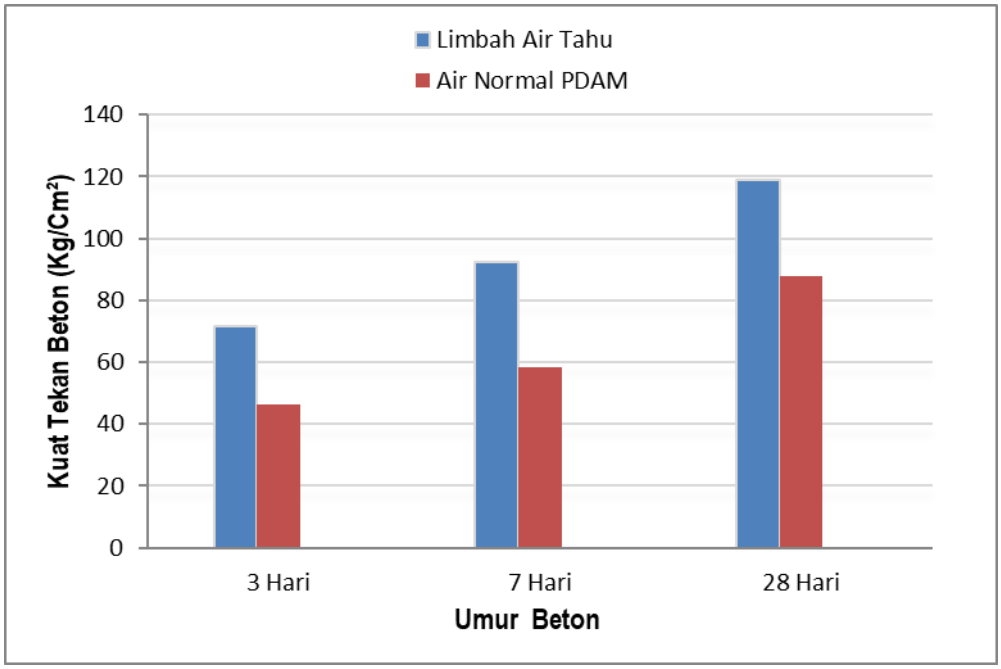

Figure 4. Comparison Graph of Concrete Compressive Strength Test Results using Tofu Wastewater and Normal Water PDAM

Source: Data Analysis Results, 2022

Figure 4. Comparison of Concrete Compressive Strength Test Results using Tofu Wastewater and Normal Water PDAM shows that the results of the average compressive strength value of concrete using tofu water wasteobtained a higher compressive strength value compared to concrete using normal water PDAM. The maximum average compressive strength result for concrete using tofu wastewater is 71. 80 kg/cm² at the age of 3 days, 92. 30 kg/cm² at the age of 7 days and 119. 10 kg/cm² at the age of 28 days while the result of concrete using normal water PDAM was 46. 30 kg/cm² at the age of 3 days, 59. 20 kg/cm² at the age of 7 days, 88. 00 kg/cm² at the age of 28 days.

4. Conclusion

The result of the Concrete Compressive Strength Test using Tofu Water Waste and Normal Water PDAM show that the results of the average compressive strength value of concrete using tofu water waste have a higher compressive strength value compared to concrete using normal water PDAM. The maximum average compressive strength result for concrete using tofu wastewater is 71.80 kg/cm² at the age of 3 days, 92.30 kg/cm² at the age of 7 days and 119.10 kg/cm² at the age of 28 days while the result of concrete using normal water PDAM is 46.30 kg/cm² at the age of 3 days, 59.20 kg/cm² at the age of 7 days, 88.00 kg/cm2 at the age of 28 days.

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