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Light Quality Concrete With Plastic as a Rude Aggregate for Peat Land Construction

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ABSTRACT

Riau Province is an area that has the largest peatland in Sumatra, namely 4.044 million ha (56.1% of the Sumatra peatland area or 45% of the land area of Riau Province). Peat soils have a low bearing capacity, a high degree of compressibility, and high water content. So peat is unfavorable to support building construction. Because it takes a foundation which is quite expensive so that a building can stand firmly to withstand the existing construction on it. Therefore it requires innovations in concrete. Concrete is a construction that is often used in infrastructure development. For peat areas, a light-weight concrete alternative is needed. This study aims to investigate the replacement of coarse aggregate (stone) with PET plastic by analyzing the concrete compressive test and the mass / weight of the concrete. Thus it can be seen which plastic mixture goes to lightweight concrete and is suitable for peatland construction. The benefit of this research is to create light concrete that can be used on peatlands. Replacement of coarse aggregate with PET plastic is made with various mixtures of 0%, 40%, 50%, 70%, and 100%. The results of the test mixture consisted of 70% and 100% light concrete, weighing 6.4 kg & 5.81 kg. In a 70% PET mixture, the quality of the K-193 concrete can be categorized as light concrete with medium strength so that it can be used in peatland construction.

Keywords— light concrete, PET plastic, compressive power of concrete, peatlands

1. INTRODUCTION

Lightweight concrete is concrete with the density that is lighter than the normal concrete. Lightweight concrete is good to be used for tall buildings to reduce the load of the building. Unlike the normal concrete, the weight of lightweight concrete can be arranged as needed. According to SNI 03-2847-2002[1], light-weight concrete contains light aggregate and has a unit weight of no more than 1900 kg/m³. Lightweight concrete is obtained by adding air pores to the concrete mixture.

Based on Dobrowolski[2], light-weight concrete is divided into(a) concrete with low compressive strength (Low-Density Concrete) with a density of 240-800 kg/m³ and compressive strength of 0,35-6,9 MPa, (b) moderate-strength lightweight concrete with the density of 800-1440 kg/m³ and compressive strength of 6,9–17,3 MPa, and (c)structural lightweight concrete with the density of 1440-1900 kg/m³ and compressive strength of more than 17,3 MPa[3].

The material used to form lightweight concrete and the composition are the same as the material used to form normal concrete, but in the manufacturing of lightweight concrete, the rough aggregate is changed with other material, which has lighter density, which is lightweight aggregate[4][5]. In accordance to SNI 03-3449-2002[1], lightweight aggregate is the aggregate with filling weight for the dry oven of a maximum 1100 kg/m³.

Based on the background above and the literature study that has been conducted, the authors took the initiative to examine the quality of lightweight concrete with a mixture of PET plastic waste as a substitute for coarse aggregate. By replacing coarse aggregate with PET plastic waste, the concrete mass will be light. So that the concrete can later be used on peat soil.

The results of this study are expected to provide positive input for the world of construction on peat soils by knowing the quality and weight of concrete produced from a mixture of plastic waste.

2. RESEARCH METHOD

This research was conducted experimentally in the Civil Engineering Laboratory of Abdurrab University, in the form of testing the characteristics of lightweight concrete with plastic bottle waste (PET) as filler. The test steps start from:

2.1. Property checks for concrete mix materials

This test starts w loose & solid weight testing, filter analysis, combined analysis, specific gravity, water absorption, sludge content, and organic content. Materials used: Semen Padang PCC, 1-2 crushed stone from Batu Bersurat, sand from Kampar Bingkuang Lake, PET plastic and water.

(a) (b) (c)

Fig 1. (a) Filter Analysis Testing, (b) Organic, (c) Loose weight

2.2. Creating the K-250 job mix design

The K-250 job mix design was based on the combined gradation of coarse and fine aggregates

2.3. Creating cube samples with various PET plastic mixtures 0%, 40%, 50%, 70%, and 100%

The creation of cube samples was obtained after calculating the material requirements of each mixture variation.

(a) (b) (c)

Fig. 2.(a) Slump tes, (b) Creating, (c) Caring

2.4. Sample treatment

The sample was removed from the mold after at least 8 hours. Then the sample was put into a soaking tub until the caring process goes well.

2.5. Weighing the mass of concrete aged 28 days

This weighing is carried out after the cube sample is removed from the soaking tub and left for at least 8 hours.

2.6. Testing the compressive strength of concrete aged 14 and 28 days

This test is carried out after the cube sample is removed from the soaking tub and left for at least 8 hours. The test is carried out with the SNI 03-1974-1990 standard.

2.7. Calculating the quality of the compressive strength of concrete aged 14 and 28 days

This research used the following equation:

$$K=P/A \quad (1)$$

where: K = compressive strength of concrete (kg/cm^2), P = maximum compressive load (kg), A = stressed cross-sectional area (cm^2).

3. RESULTS AND DISCUSSION

3.1. Mass of Concrete

Measurement of the concrete mass was carried out at age of concrete 28 days with the results shown in Fig. 3 and Table 1.

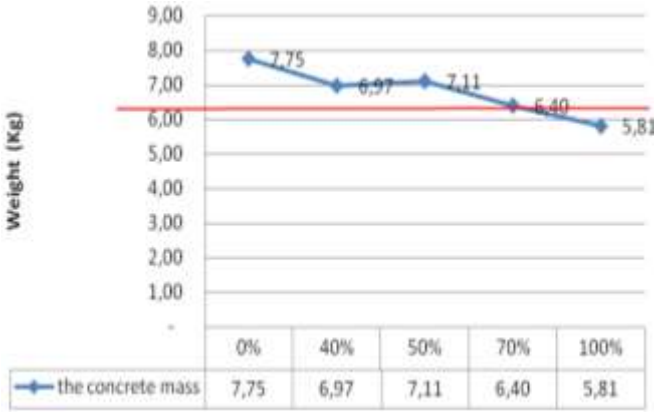

Fig. 3. The weight of cube aged 28 days

Table I. The results of the compressive strength test at the age of 28 days

No. Test Object	PET Variation (%)	Test Object Weight (Kg)	Average Object Weight (Kg)	Standard Cube Weight (Kg)
1	0	7,75	7,75	6,40
2	40	6,93	6,97	6,40
3		6,93		
4		7,06		
5	50	6,74	7,11	6,40
6		7,75		
7		6,83		
8	70	6,43	6,40	6,40
9		6,40		
10		6,38		
11	100	5,81	5,81	6,40
12		5,80		
13		5,82		

From the variation of lightweight concrete mixtures, there is a mixture of 70% & 100% PET with a weight of 6.4 kg and 5.81 kg.

3.2. Testing of Concrete Quality

Concrete quality testing was carried out at the age of 14 and 28 days. It can be seen in Table II, Table III, Fig. IV, and Fig. 5.

Table II. The results of the compressive strength test at the age of 14 days

No. Test Object	PET Variation (%)	Test Object Weight (Kg)	Cross-Sectional Area (Cm2)	Press Force 525	Concrete Quality (Kg/Cm2)	Concrete Age Factor	Concrete Quality (Kg/Cm2)	Average Quality (Kg/Cm2)
1	0%	7,90	225	585	265,20	0,88	301,36	247
2		7,46		480	217,60		247,27	
3	40%	7,43	225	520	235,73	0,88	267,88	250
4		7,30		455	206,27		234,39	
5		6,90		395	179,07		203,48	
6	50%	6,94	225	425	192,67	0,88	218,94	205
7		6,96		375	170,00		193,18	
8		6,62		330	149,60		170,00	
9	70%	6,70	225	340	154,13	0,88	175,15	179
10		6,56		375	170,00		193,18	
11		5,90		300	136,00		154,55	
12	100%	5,81	225	300	136,00	0,88	154,55	154
13		5,82		295	133,73		151,97	

Table III. The results of the compressive strength test at the age of 28 days

No. Test Object	PET Variation (%)	Test Object Weight (Kg)	Cross-Sectional Area (Cm2)	Press Force (KN)	Concrete Quality (Kg/Cm2)	Concrete Age Factor	Concrete Quality (Kg/Cm2)	Average Quality (Kg/Cm2)
1	0	7,75	225	585	265,20	1	265,20	265
2		6,93		435	197,20		197,20	
3	40	6,93	225	670	303,73	1	303,73	235
4		7,06		450	204,00		204,00	
5		6,74		475	215,33		215,33	
6	50	7,75	225	475	215,33	1	215,33	214
7		6,83		465	210,80		210,80	
8		6,43		435	197,20		197,20	
9	70	6,40	225	435	197,20	1	197,20	193
10		6,38		405	183,60		183,60	
11		5,81		325	147,33		147,33	
12	100	5,80	225	310	140,53	1	140,53	143
13		5,82		310	140,53		140,53	

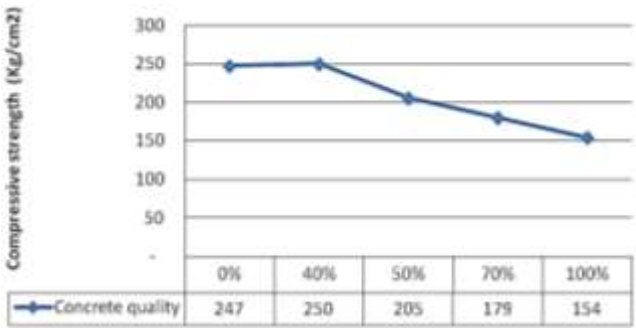

Fig. 4. Compressive strength of cube at the age of 14 days

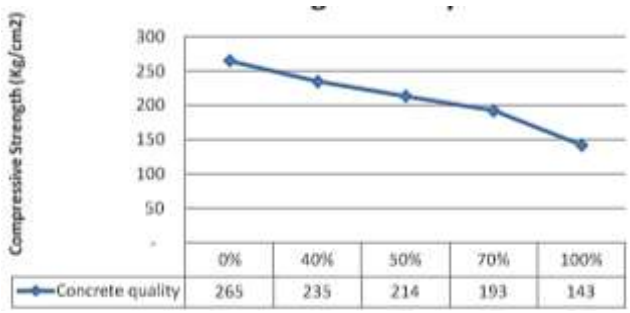

Fig. 5. Compressive strength of cube at the age of 28 days

From the results of the cube compressive strength test at the age of 14 days, there was a decrease in the quality of the concrete. At 0% PET, the quality of K-247 concrete drops to K-154 at 100% PET. Likewise, the quality of concrete at the age of 28 also decreased from K-265 at 0% PET to K-143 at 100% PET.

It happened because the coarse aggregate using natural stone was replaced with artificial stone from PET plastic, where PET plastic is slippery, has lower strength and is lighter in weight than natural stone.

4. CONCLUSION

From the results above, it can be concluded that the higher the PET mixture as a substitute for coarse aggregate, the lighter the mass-weight of the concrete and the lower the quality of the concrete. At 0% PET the weight of concrete was 7.75 kg, and at 100% PET the weight of concrete was 5.81 kg. Meanwhile, the quality of concrete aged 28 days at 0% PET was K-265, and at 100% PET the quality of concrete drops to K-143.

Included in lightweight concrete are 70% and 100% PET with a weight of less than or equal to 6.4 kg. For a mixture of 70% PET, it was obtained a light concrete with medium quality K-193. And this 70% PET mixture can be used in peatland construction.

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