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EVALUATION OF POTENTIAL UTILIZATION OF SEA SAND IN LONTAR VILLAGE, KOTABARU REGENCY AS FINE AGGREGATE IN CONCRETE

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ABSTRACT

Not all areas have sufficient resources for concrete needs. Coastal areas are areas that are difficult to obtain suitable sand for concrete needs. One of these coastal areas is Lontar Village, Kotabaru Regency, because of this, the people of Lontar Village, Kotabaru Regency, choose to use sea sand as a concrete material. The use of sea sand in Lontar Village, Kotabaru Regency is not subject to any treatment even though sea sand has a high salt content and uniform and fine grains, this can reduce the strength of the concrete. In this study, several treatments were carried out, namely no treatment, washing treatment and flush treatment, and using percentage variations of 0%, 30%, 50%, 70% and 100% sea sand. The parameters reviewed in this study were the compressive strength of concrete, split tensile strength of concrete and flexural strength of concrete.

Concrete mix planning follows SNI 7626-2012. With untreated sea sand as a control, the sea sand treatment was followed by washing and flushing to reduce the salt content in the sea sand. Using several percentages of sea sand to add variety to the grain of sea sand. The treatment method used is fresh water immersion. The sample used was a mortar mixture in the form of a cube of 5 cm x 5 cm x 5 cm, and a concrete mixture in the form of a cylinder of 15 cm x 30 cm and a beam of 50 cm x 10 cm x 10 cm.

The results showed that the highest compressive strength of mortar was in 30% sea sand washing treatment with 29.71 MPa. The highest compressive strength of concrete is at 0% sea sand with 20.38 MPa. The highest split tensile strength of concrete is at 30% sea sand with 1.92 MPa. And the highest flexural strength of concrete is at 30% sea sand with a flexural force of 3.05 MPa.

***Keywords**:* Sea Sand, Compressive Strength, Split Tensile Strength, Flexural Strength.

1. INTRODUCTION

The use of sea sand as fine aggregate in concrete is rarely applied, because the content and characteristics of sea sand are not good for use as fine aggregate in concrete. Dumyati, et al. (2015) said that beach sand generally has the characteristics of fine and round grains, uniform gradation (large arrangement of grains) and contains salts that are not beneficial for concrete, so it is widely recommended not to use it in the manufacture of concrete. The fine and round granules and uniform gradation can reduce the adhesion between the grains and affect the strength and durability of the concrete.

Lontar Village is located in the coastal area of Pulau Laut, Pulau Laut Barat District, Kotabaru Regency. In Lontar village it is quite difficult to get building materials, usually local people use sea sand as a material for making bricks, mortar and even concrete. For the purposes of river sand, Lontar Village has to be brought in from the northern area of Pulau Laut which is far enough away so that it requires no small amount of money. Based on the above, it is necessary to research the sea sand of Lontar Village, Kotabaru Regency with various treatments as a fine aggregate in the concrete mixture.

Wora, et al. (2015) used sea sand from Ndao Ende Beach which is included in zone III sand as a substitute for fine aggregate in the concrete mixture. The results of the compressive strength using sea sand 0%, 10%, 20%, 30%, 40%, 50% respectively were 234.48 kg/cm², 273.94 kg/cm², 244.98 kg/cm², 232, 30 kg/cm², 205.59 kg/cm², and 165.66 kg/cm². This shows that sea sand can be used in concrete mixtures by 10-20% and increases the compressive strength of concrete to 16.83% of normal concrete.

Dumyati, et al. (2015) using sand from the beach of Sampur, Pangkalpinang city. The sand was treated differently, namely without treatment, watered, and washed with control sand from the Padang Baru area, Central Bangka Regency. The compressive strength of the control concrete was 28.68 MPa, while the untreated Sampur beach sand was 16.36 MPa, 17.52 MPa watered and 22.14 MPa washed. The greatest compressive strength of concrete is by washing treatment, which is 22.14 MPa.

2. THEORITICAL STUDY

- **Concrete Mixing Materials**

Concrete is obtained from mixing fine and coarse aggregate materials, namely sand, stone, crushed stone or other similar materials, by adding sufficient cement adhesive materials, and water as auxiliary materials for the purposes of chemical reactions during the hardening process and concrete treatment. (Dipohusoda, 1993).

- **Sea Sand**

Sea sand is one type of fine aggregate material that has availability in large quantities. In general, sea sand has the characteristics of fine and round grains, uniform gradation (large arrangement of grains), and contains chloride (Cl) and sulfate (SO4) salts with very unfavorable properties for concrete, so it is not recommended for use in concrete. making concrete (Mangerongkonda, 2007).

The need to remove salt from sea sand before use in concrete creates additional construction costs, and apart from certain construction projects, supply of freshwater is not sufficient. Against this background, the possibility of direct use without desalting in concrete has been explored. The direct use of sea sand without removing salt in concrete production is very attractive for marine and coastal projects, where the supply of river water and freshwater is limited while sea sand and sea water are locally available or even abundant. As a result, the topic of marine sand concrete has attracted the attention of many researchers around the world. (Zhao, et al., 2021)

Based on the description above, this study will be analyze and discuss the quality of sea sand used as aggregate in a concrete mixture and compare the strength of concrete using sea sand, river sand and mountain sand. The comparison of concrete strength are not only based on the use of sea sand, river sand and mountain sand but also analyzed the effect of concrete treatment using fresh water with salt water. Xiao, et al (2017) said the use of sea sand has been used in the construction world with the desalting (reducing salt content) which has been pioneered by the UK since 1960.

In general, sea sand can be divided into two conditions, namely sea sand which is not influenced by tides and sea sand that is submerged or affected by sea water conditions (tidal water). Dhondy et al (2018) also said that wet sea sand or affected by tides had a chloride content of 6.3%, while dry sea sand or not affected by tides had a chloride content of 1.1%.

3. METHOD

- **Preparation of Basic Materials**
  The initial stage of this research is to test the quality of the materials to be used.

1. Fine Aggregate

The fine aggregate used in this study consisted of normal sand and sea sand.

Sand Normal

The normal sand used in this study is the Barito river sand. Before being used, it is tested first in order to meet the requirements of the material for making concrete.

Sea Sand

The sea sand used in this study is the coastal sea sand of Lontar Village, Kotabaru Regency. Sea sand will be given three treatments before use, the treatments are: washing, watered , and without Treatment

2. Water

The water used in this study is PDAM water with normal pH (pH = 7). The water has met the water standards used to make concrete.

3. Coarse Aggregate

The coarse aggregate used in this study is cotton crushed stone material. Prior to use, testing is carried out in order to meet the requirements for the material for making concrete.

4. Cement

The cement used is Tiga Roda brand PCC cement.

- **Normal Concrete Mix Design**

In this study, SNI-7656-2012 was used to make a concrete mixture that was used as a reference in the manufacture of mortar and cylindrical specimens. The quality of the concrete used is 20 MPa, the planning of the concrete mix can be seen in Table 1.

Tabel 1 Material Requirement

Volume	Cement (Kg)	Water (liter)	Coarse Aggregate (Kg)	Fine Aggregate (Kg)				
				0%	30%	50%	70%	100%
m3	441,6	198,1	1400,3	0	326,6	544,4	762,2	1088
1 mortar	0,055	0,025	-	0	0,041	0,068	0,095	0,136
1 Cylinder	2,340	1,050	7,420	0	1,731	2,885	4,039	5,770

- **Mortar Production**

The process of making mortar refers to the proportion of the concrete mixture with a quality of 20 MPa which refers to SNI-7656-2012. The tests carried out were compressive strength tests at the age of 7 days, 14 days, and 28 days. The naming of the specimens and the number of mortar specimens carried out in this study can be seen in Table 2.

Tabel 2 Mortar test samples using variations of sea sand

No	Kode	Keterangan	Umur	Jumlah
1	PN100	Subtitusi pasir laut 0% dan pasir normal 100%	7, 14, dan 28 hari	9
2	PL30	Subtitusi pasir laut tanpa perlakuan 30% dan pasir normal 70%	7, 14, dan 28 hari	9
3	PL50	Substitusi pasir laut tanpa perlakuan 50 % dan pasir normal 50 %	7, 14, dan 28 hari	9
4	PL70	Substitusi pasir laut tanpa perlakuan 70% dan pasir normal 30%	7, 14, dan 28 hari	9
5	PL100	Substitusi pasir laut tanpa perlakuan 100% dan pasir normal 0%	7, 14, dan 28 hari	9
6	PLC30	Subtitusi pasir laut dicuci 30% dan pasir normal 70 %	7, 14, dan 28 hari	9
7	PLC50	Subtitusi pasir laut dicuci 50% dan pasir normal 50 %	7, 14, dan 28 hari	9
8	PLC70	Subtitusi pasir laut dicuci 70% dan pasir normal 30 %	7, 14, dan 28 hari	9

9	PLC100	Subtitusi pasir laut dicuci 100% dan pasir normal 0 %	7, 14, dan 28 hari	9
10	PLS30	Subtitusi pasir laut disiram 30% dan pasir normal 70 %	7, 14, dan 28 hari	9
11	PLS50	Subtitusi pasir laut disiram 50% dan pasir normal 50 %	7, 14, dan 28 hari	9
12	PLS70	Subtitusi pasir laut disiram 70% dan pasir normal 30 %	7, 14, dan 28 hari	9
13	PLS100	Subtitusi pasir laut disiram 100% dan pasir normal 0 %	7, 14, dan 28 hari	9
Total				117

- **Concrete Production**

Optimum content is one of the three treatments given to sea sand in the mortar mixture giving the highest compressive strength value. After the optimum levels were obtained, the specimens were made in the form of cylindrical concrete with a diameter of 15 cm and a height of 30 cm for compressive testing of concrete and beams measuring 50´10´10 cm for flexural testing. Testing the compressive strength of specimens aged 7, 14 and 28 days. split tensile test on the test object at the age of 28 days while the flexural strength test on the concrete beam test object at the age of 28 days.

Tabel 3 Test cylinder concrete samples using variations of sea sand.

No	Code	Description	Test	Age	Total
1	PN100	Substitution of 0% sea sand and 100% normal sand	Compressive strength and tensile strength	7, 14, and 28 days	12
2	PL*(30)	Optimum first mortar treatment using 30% sea sand and 70% normal sand	Compressive strength and tensile strength	7, 14, and 28 days	12
3	PL*(50)	Optimum first mortar treatment using 50% sea sand and 50% normal sand	Compressive strength and tensile strength	7, 14, and 28 days	12
4	PL*(70)	Optimum first mortar treatment using 70% sea sand and 30% normal sand	Compressive strength and tensile strength	7, 14, dan 28 days	12
5	PL*(100)	Optimum first mortar treatment using 100% sea sand	Compressive strength and tensile strength	7, 14, and 28 days	12
Total					60

Tabel 4 Samples of test beam concrete using variations of sea sand.

No	Code	Description	Test	Age	Total
1	PN100	Substitution of 0% sea sand and 100% normal sand	Flexural	28 Days	3
2	PL*(30)	Optimum first mortar treatment using 30% sea sand and 70% normal sand	Flexural	28 Days	3
3	PL*(50)	Optimum first mortar treatment using 50% sea sand and 50% normal sand	Flexural	28 Days	3
4	PL*(70)	Optimum first mortar treatment using 70% sea sand and 30% normal sand	Flexural	28 Days	3

5	PL*(100)	Optimum first mortar treatment using 100% sea sand	Flexural	28 Days	3
Total					15

4. RESULTS AND DISCUSSION

- **Mortar Compressive Strength Test Results**

Tabel 5 Compressive Strength Test Results of Mortar

Sampel	Kuat Tekan Pada Umur Ke-		
	7	14	28
PN100	18,89	19,80	22,08
PL30	18,24	23,98	25,26
PL50	17,95	20,49	22,95
PL70	13,63	19,62	20,99
PL100	11,86	11,49	13,42
PLC30	22,30	24,71	29,71
PLC50	18,13	25,34	26,69
PLC70	17,43	22,57	23,99
PLC100	11,45	15,11	16,41
PLS30	17,41	20,19	25,55
PLS50	13,30	18,38	20,82
PLS70	13,65	15,86	24,88
PLS100	11,37	11,32	11,49

- **Test Results of Concrete Compressive Strength**

Tabel 6 Test Results of Concrete Compressive Strength

Sampel	Kuat Tekan Pada Umur Ke-		
	7	14	28
PN100	13,40	15,66	20,38
PLC30	12,83	17,55	20,19
PLC50	8,30	11,13	13,23
PLC70	10,00	8,87	11,13
PLC100	6,04	8,49	10,38

- **Test Results of Concrete Split Tensile Strength**

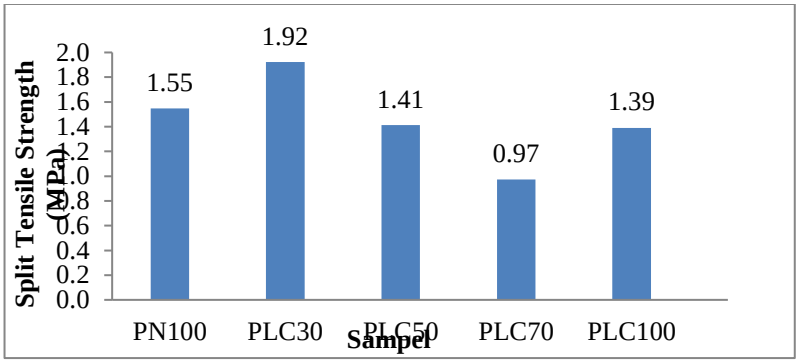

Figure 1 Split Tensile Strength Test Results

The optimum split tensile strength is found in PLC30 concrete with an average tensile strength of 1.92 MPa and the lowest split tensile strength value is in PLC70 concrete with an average tensile strength. average 0.97 MPa.

- **Test Results of Bending Strength of Concrete**

Tests were carried out at the age of 28 days with 3 specimens of each test object. The test results can be seen in Table 13 and the calculation results are in Table 14.

Tabel 7 Results of Flexural Strength

Sampel	Umur(Hari)	Jarak Antar Tumpuan (mm)	b(mm)	h(mm)	Beban(N)		
PN100	28	450	100	100	11875	13091	11434
PLC30	28	450	100	100	13797	14160	12179
PLC50	28	450	100	100	12356	10571	8943
PLC70	28	450	100	100	2010	1765	1059
PLC100	28	450	100	100	1225	4177	5942

Table 1 Bending Force Calculation Results

Sea Sand (%)	q (kN.m)	P (kN)	1/2P (kN)	VA (kN)	VB (kN)	M Bending (kN.m)	F Bending (Mpa)	Increase (%)
0	0,235	12,134	6,067	6,120	6,120	0,46	2,77	
30	0,235	13,379	6,689	6,74	6,74	0,51	3,05	10,13
50	0,235	10,623	5,312	5,36	5,36	0,40	2,43	-12,29
70	0,235	1,611	0,806	0,86	0,86	0,07	0,40	-85,60
100	0,235	3,781	1,891	1,94	1,94	0,15	0,89	-67,95

5. CONCLUSIONS

From the results of research conducted on the effect of the use of sea sand on concrete, the following conclusions can be drawn :

1. The washing treatment of sea sand in the manufacture of mortar is the optimum treatment;

2. The percentage of 30% sea sand (PLC30) as the optimum percentage that can increase the split tensile strength and flexural strength of concrete;
3. Control concrete (PN100) and 30% sea sand (PLC30) have a small difference in concrete compressive strength of 0.19 Mpa;
4. In the split tensile strength test at the age of 28 days, PLC30 concrete has an increase of 24.25% compared to control concrete (PN100);
5. In the flexural strength test at the age of 28 days, PLC30 concrete has an increase of 10.13% compared to control concrete (PN100);

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