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The Effect of Concrete Treatment with Sea Water and Fresh Water against Compressive Strength of Concrete

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***Abstract*:** *Concrete is widely used as building material. It is chosen because of its advantages when compared with other construction materials. In manufacturingconcrete, good treatment greatly affects the durability of concrete. Concrete treatment is not only to obtain high strength but also to improve the quality of its durability, waterproofness, worn resistance, and stability of structural dimensions. In manufacturing the buildings that use concrete in coastal areas, contact with sea water is sometimes unavoidable, where the seawater contains compounds that will reduce the durability of the concrete. Contact with sea water is dangerous because during the treatment period, the concrete will always interact with sea water. These chemicals will gnaw the concrete until it is brittle and damaged. This will cause the obtained durability will not match the previous predicted. This study aims to determine the quality of planned concrete will affect the concrete which is treated with fresh water and the concrete that is treated with sea water. So that in the application in the field, it is noted the right water and provide maximum compressive strength to the concrete. The planned concrete quality is K250 with a 28 day test object, with a total of 20 samples each. The data analysis uses the provisions of SNI 03-1974-1990. From the results of the study, it showed that the use of salt water of ± 3% for the treatment of concrete with cube test object, obtained the average normal concrete compressive strength is 260 kg/cm^2. As for the concrete done treatment with salt water is 221kg/cm^2. The results showed that the use of seawater for the concrete treatment resulted in decreasing of compressive strength of concrete.*

Keywords: *concrete, sea water, fresh water, treatment.*

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I. Introduction

Concrete is a rock that occurs as a result of hardening of a particular mixture. It is obtained by mixing softaggregate (sand), or other hydraulic cement, and water, sometimes with additives (admixture) of a chemical or physical nature in certain comparisons, until it becomes a heterogeneous entity. The mixture will then harden like a rock.Concrete is produced from a collection of mechanical and chemical interactions of some of its constituent materials (Nawy, 1985: 8). So that to understand and to study the characteristics of each concrete-forming componentwhich consists of a mixture of soft aggregates and hard aggregates with water and cement as the binder.Portland cement is the main binder of concrete that is used to unite materials into a single strong entity. The type of cement used is one of the factors that affectthe compressive strength of the concrete. The factors affecting the strength of concrete are the factors of cement water and density, cement type, cement quantity, aggregate properties, efficiency and curing, and the age of the concrete. In manufacturing the concrete, good treatment greatly affects the durability of concrete. Good concrete treatment generally uses clean water/normal water (water that does not contain any compounds or minerals that can damage the concrete) as water immersion.Concrete is widely used as a building material in the area around the sea such as bridges, docks, breakwater, and so forth. It is chosen because of its advantages when compared with other construction materials. This is the reason why the concrete becomes the first choice as a construction material, especially in the area around the sea.

In the manufacture of buildings that use concrete in coastal areas, contact with sea water is sometimes unavoidable, where the seawater that contains compounds will reduce the durability of the concrete. Sea water itself has a high salt content that can undermine the strength and durability of concrete. This is due to the hydrochloric (Cl) substance contained in sea water is aggressive salt to other materials, including concrete. Contact with sea water is dangerous because during the treatment period the concrete will always interact with sea water. Sea salt seeps into the concrete with capillary action and fills the existing cavities. These chemicals will gnaw the concrete until the concrete is brittle and damaged. This will cause the obtained durability will not match the previous predicted.Damage can occur in concrete due to the reaction between aggressive seawater which penetrated into the concrete with compounds in the concrete resulting in partial loss of time, loss of strength and stiffness and accelerate the weathering process (Mehta, 1991).

The nature of the concrete properties is divided into two, namely when the concrete is still in the fresh state (fresh concrete) and when the concrete is in the hard state (hard concrete).

Good fresh concrete is fresh concrete that can be stirred, transported, poured, compacted, no segregation inclination (aggregate separation from mortar) and bleeding (separation of cement and water from mortar). This is because the segregation and bleeding resulted in the quality of the concrete obtained will be bad.Hard concrete behavior is the ability of concrete in carrying the structure of the building. Good hard concrete performance is demonstrated by high concrete compressive strength, good tensile strength, more detailed behavior, water and air dampness, sulfate resistance, low shrinkage and long-term durability. The compressive strength of the concrete identifies the quality of a structure. The higher the desired structure strength level, the higher the quality of the concrete produced.

Based on the above description it is necessary to do a research to determine the effect of treatment by using seawater to the concrete and the comparison of treatment by using water to the concrete. So, in the field application, it is necessary to be considered the right water and provide the maximum compressive strength to the concrete.

II. Research Method

2.1 Supply of Concrete Materials

The concrete materials in this research are:

1. Cement used is portland type 1 cement, Semen Padang
2. Soft aggregate sand used from material stores taken from Binjai area.
3. Rough aggregates of broken stone used from material stores derived from Binjai.
4. Water from PDAM

2.2 Material Examination

a. Examination of Soft Aggregate Mud Degree

1. Objective: To check the mud degree in the sand
2. Research Guidance: The mud content is not justified to exceed 5% if it exceeds, the sand should be washed.
3. Research result: From the examination result, the mud degree in the sand is 2,21%. It is declared worthy of research.

b. Examination of Soft Aggregate Screen Analysis

1. Objective: To determine the gradation and modulus of sand smoothness (FM).
2. Research Guidelines:

$$FM = \frac{\Sigma\ \%\ \text{cumulative retained the sieve 0,150 mm}}{100}$$

From the analysis result of the sand sieve analysis obtained FM value = 2.65 included in medium sand (2.60 <FM <2.90).

c. Examination of Soft Aggregate Weight

1. Objective: To know the weight of sand content in the way of solid and loose way.
2. The study guidelines show that the sand being cornered or the solid way is greater than with the sand that is not lined or in a loose way.
3. From the examination results, it is obtained:

a. Weight of the way contents: 1310.35 kg/m^3

b. Weight of the way contents not to corners : 1231,70kg/m^3

d. Examination of Type Weight andSoft Aggregate Absorption

1. Purpose of the study: To determine the specific gravity and absorption of sand.
2. Study Guideline: Dry density <SSD density <Pseudo-weight.
3. From the research results obtained:

a. Dry density: 2.44 gr/cm^3

b. SSD density: 2.49 gr/cm^3

c. Pseudo-weight: 2.53 gr/cm^3

d. Absorption: 1.5%

4. 2.44 <2.49 <2.53, the sand is feasible for experiments.

e. Conclusion of Soft Aggregate Examination

Table.1 Results of Soft Aggregate Examination

Checking	Result
Mud Degree	2,21%
Scratch Analysis	2,65
Content Weight (UW)	1231,70 kg/m^3
Type Weight (SSD)	2,49 gr/cm^3
Absorption	1,5%

f. Examination of Rough Aggregate Mud Degree of Broken Stone

1. Objective: To check the degree of crushed stone mud
2. Research Guidance: The content of sludge on coarse aggregates does not exceed 1% when exceeding aggregate should be washed.

From the result of the research, the content of crushed stone sludge is 0, 73% so that crushed stone can be used in experiment.

g.Analysis of Rough Aggregate of Broken Stone

1. Objective: To examine the spread of gradation and determine the modulus of smoothness (FM).
2. Guidelines for Research

$$\text{FM} = \frac{\text{cumulative retained sieve 0.150 mm}}{100}$$

Rough aggregates which may be used in the concrete mixtures shall have a fineness modulus (FM) between 5.5 and 7.5. From the examination results obtained FM is 7.16 so it can be used in the experiment.

h. Examination of Rough Aggregate Content Weight of Broken Stone

1. Objective: To determine the content weight of broken stone bysolid and loose way.
2. Guidelines for Research: From the results of research the weightof the content by means of solid or cornering is greater than the weight of the contents in a loose or unobtrusive way.
3. From the research results obtained:

a. Weight content solid: 1785.40 kg/m^3

b. Loose content weight: 1680.04 kg/m^3

i.Type Weight Examination and Rough Aggregate Absorption

1. Objective: To determine the specific gravity and absorption of crushed stone water.
2. Guideline for research: Dry density <Weight of SSD<Pseudo-type
3. From the research results obtained:

a. Dry density: 2.53 gr / cm ^ 3

b. SSD type weights: 2.62 gr / cm ^ 3

c. Fake weight: 2.65 gr / cm ^ 3

d. Absorption: 1.74%

j. Conclusion of Rough Aggregate Examination

Table.2 Results of Rough Aggregate Examinations of Broken Stone

Examination	Result
Mud Degree	0,73%
Scratch Analysis	7,16
Content Weight (UW)	1680,04 kg/m^3
Type Weight (SSD)	2,62 gr/cm^3
Absorption	1,74%

2.3 Concrete Mix Design

The concrete mix design with the ratio of material weight is conducted to determine the strength of the desired concrete. This research used Development of Environment (DOE) method. The steps in planning of concrete mixture with DOE method according to SK SNI T - 15 - 1990 - 03 are as follows:

1. Setting the required concrete compressive strength.
2. Setting a standard deviation value/added value.
3. Calculating value added (M).
4. Calculating the average compressive strength needed.
5. Setting the type of cement and aggregate.
6. Determining the water factor of cement.
7. Setting the slump value.
8. Setting the maximum grain size.
9. Setting free water content.
10. Calculating cement needs.
11. Establishing appropriate cement requirements.
12. Determine the percentage of fine and coarse aggregates.
13. Calculating the aggregate SSD weights.
14. Determining the specific gravity of concrete.
15. Calculating the weight of each aggregate.
16. Correcting the aggregate weight and weight of water.

2.4 Determination of Type and Number of Test Objects

In this study the number of specimens each of them is planned 20 normal concrete test objects with fresh water treatment and 20 objects of normal concrete test with salt water treatment. Mold the cube-shaped specimen 15x15x15 cm^2.

2.5 Treatment (Curing)

The treatment of the test object is conducted by immersion. This concrete treatment aims to ensure the cement hydration process can take place perfectly, so that cracks on the surface of the concrete can be avoided as well as the desired quality of concrete can be achieved. In addition, the moisture surface of the concrete can also increase the resistance of concrete to the effects of weather and more impermeable. The way of immersion is as follows:

1. After 24 hours the cube mold is opened, then soaked to the concrete sample.
2. The immersion is conducted until the age of 28 days concrete.
3. Before the concrete is soaked, it is named on the surface first.

2.6 Strong Testing Press Concrete Samples

The compressive strength of concrete test is conducted at 28 days concrete age. The testing steps are:

1. The concrete cube is lifted from the bath, and then it is either aerated or wet to dry the surface
2. Considering and recording the weight of the concrete sample, then observed whether there are defects in the concrete as the report material
3. The compressive strength test is by using concrete press test machine
4. Putting the concrete sample into the tester, then turn on the machine and slowly press the concrete sample
5. Recording the compressive concrete strength for each sample.

III. Discussion

3.1 K 250 Concrete Mix Design

Table. 3 K 250 Concrete Mix Design

No.	Description	Table/Graphic	Value
1.	Required Strong Urges	Defined	K 250
2.	Standard Deviation (S)	Known	45 Kg/cm^3
3.	Added Value /margin M	-	73,8 Kg/cm^3
4.	Strong average urges to be achieved (f'cr)	1+3	324 Kg/cm^3
5.	Type of Semen	Defined	Semen Tipe I (Semen Padang)
6.	Hard aggregate type Soft aggregate type	Defined	Broken Stone Sand
7.	Water Cement Factor	Defined	0,6
8.	Maximum water cement factor	Defined	0,6
9.	Slump	Defined	180 mm
10.	Maximum aggregate size	Defined	20 mm
11.	Free water degree	Defined	205 Kg/cm^3
12.	Cement degree	11:8	341,67Kg/m^3
13.	Maximum cement level	Defined	325 kg/m^3
14.	Minimum cement level	Defined /SNI- 03-2834-200	341,67kg/m^3
15.	F.a.sadjusted	-	0,6
16.	Large arrangement of aggregate items	-	*Zone 3*
17.	Material percent <4,8 mm	-	55%
18.	Relative aggregate typr weight	-	2,430
19.	Concrete type weight	-	2280 kg/m^3
20.	Combined aggregate degree	19-12-11	1733.33 kg/m^3
21.	Soft aggregate degree	-	779,99 kg/m^3
22.	Hard aggregate degree	-	866,665 kg/m^3

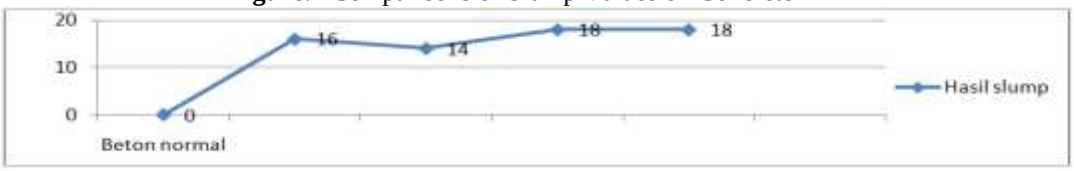
3.2 Slump Value

Calculation of slump value on concrete is basically a simple experiment to know the workability of fresh concrete before applied in casting. The experiments were performed using a cone of abrams, which has 10 cm diameter and lower diameter 20 cm. The study refers to SNI 1972: 2008. On testing of normal concrete slump is planned for 16 - 18 cm.

Table. 4 Data of Normal Concrete Slump Test Result

Sample	Slump Value (cm)
1	16
2	14
3	18
4	18
Average	16,5

Figure.1 Comparisons of Slump Values on Concrete Mix



3.3 Testing of CompressiveStrengthofCube Material Test

The compressive concrete test aims to find out the compressive strength of normal concrete with characteristic K 250 (with fresh water treatment and salt water). In this study, the compressive strength test was performed after 28 days from the manufacture of the specimen and basically the compressive strength testingrefers to SNI 03 - 1974 - 1990 "Method of Compressive Strength of Concrete". Whenever it is appropriate with the procedure, then it can be compared the compressive strength of normal concrete and concrete made treatment with salt water.

Table.5 Data of Normal Compressive Concrete Test (with Freshwater Treatment)

No. of Sample	Fas	Slump (Cm)	Area Surface (Cm^2)	Material Weight (Kg)	P Max (KN)	Compressive Strength (Kg/Cm^2) (x)	$(x - \bar{x})$	$(x - \bar{x})^2$
1	0,6	18	225	8,406	580	257,78	-2,22	4,94
2	0,6	18	225	8,445	600	266,67	6,67	44,44
3	0,6	18	225	8,499	600	266,67	6,67	44,44
4	0,6	18	225	8,526	620	275,56	15,56	241,98
5	0,6	18	225	8,34	610	271,11	11,11	123,46
6	0,6	18	225	8,441	580	257,78	-2,22	4,94
7	0,6	18	225	8,282	560	248,89	-11,11	123,46
8	0,6	18	225	8,324	560	248,89	-11,11	123,46
9	0,6	18	225	8,341	570	253,33	-6,67	44,44
10	0,6	18	225	8,34	580	257,78	-2,22	4,94
11	0,6	18	225	8,342	560	248,89	-11,11	123,46
12	0,6	18	225	8,352	570	253,33	-6,67	44,44
13	0,6	18	225	8,415	600	266,67	6,67	44,44
14	0,6	18	225	8,518	630	280,00	20,00	400,00
15	0,6	18	225	8,481	600	266,67	6,67	44,44
16	0,6	18	225	8,314	600	266,67	6,67	44,44
17	0,6	18	225	8,378	600	266,67	6,67	44,44
18	0,6	18	225	8,218	560	248,89	-11,11	123,46
19	0,6	18	225	8,338	570	253,33	-6,67	44,44
20	0,6	18	225	8,512	550	244,44	-15,56	241,98
Average				**8,390**	**585**	**260,00**		**95,80**

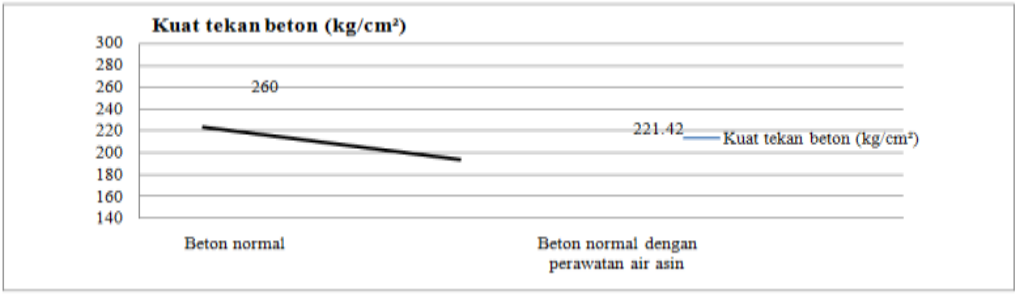
(Source: Research results)

Table. 6 Data of Normal Compressive Concrete Test (with Salt Water Treatment)

No. of Sample	**Fas**	**Slump (Cm)**	**Area Surface (Cm^2)**	**Material Weight (Kg)**	**P Max (KN)**	**Compressive Strength (Kg/Cm^2)(x)**	**$(x - \bar{x})$**	**$(x - \bar{x})^2$**
1	0,6	18	225	8,324	510	226,67	5,25	27,53
2	0,6	18	225	8,412	500	222,22	0,80	0,64
3	0,6	18	225	8,398	490	217,78	-3,64	13,27
4	0,6	18	225	8,536	492	218,67	-2,75	7,58
5	0,6	18	225	8,423	500	222,22	0,80	0,64
6	0,6	18	225	8,512	520	231,11	9,69	93,92
7	0,6	18	225	8,199	492	218,67	-2,75	7,58
8	0,6	18	225	8,277	492	218,67	-2,75	7,58
9	0,6	18	225	8,099	540	240,00	18,58	345,22
10	0,6	18	225	8,179	510	226,67	5,25	27,53
11	0,6	18	225	8,231	494	219,56	-1,86	3,48
12	0,6	18	225	8,221	498	221,33	-0,09	0,01
13	0,6	18	225	8,501	530	235,56	14,14	199,81
14	0,6	18	225	8,509	500	222,22	0,80	0,64
15	0,6	18	225	8,312	496	220,44	-0,98	0,95
16	0,6	18	225	8,113	500	222,22	0,80	0,64
17	0,6	18	225	8,091	420	186,67	-34,75	1207,79

18	0,6	18	225	8,011	488	216,89	-4,53	20,53
19	0,6	18	225	8,099	492	218,67	-2,75	7,58
20	0,6	18	225	8,278	500	222,22	0,80	0,64
Average				**8,320**	**498,2**	**221,42**		**98,68**

Figure.2
Comparison of Compressive Strength of Concrete Results on Average



From the results of the compressive strength test, it is obtained the average relationship of normal and the concrete that is treated with salt water. The result of the normal concrete compressive strength of 260.00 kg/cm^2 and the average compressive strength of concrete treated with salt water is 221,42kg/cm^2, so that the characteristic of the concrete originally K 250 is reduced to almost reaching K 200 (or percentage of about 1.5%). Concrete materials are examined and analyzed well so that the estimation of the compressive strength determination is slightly larger than planned.

The use of salt water in normal concrete treatment causes the erosion on the concrete which is being treated. It is advisable to recommend the use of salt water in concrete treatment is avoided due to the reduction of compressive strength of concrete because the salt content ± 3% in salt water will lead to corrosion in the concrete. On the surface of the specimen, the erosion occurs on the specimen treated with salt water. Salt deposits cover the entire surface of the specimen.

IV. Conclusion

Based on the results of research and discussion that have been described before, some conclusions can be drawn as follow: The average normal compressive strength of concrete is 260 kg/cm^2. As for the concrete is treated with salt water is 221.42 kg/cm^2.The treatment by using salt water reduces the compressive strength of concrete. This is due to the nature of the salt in the salt water is corrosive to erode the surface of the concrete. The planning of K 250 mixed design and conducted the treatment by using salt water turned down the quality of the concrete to almost reach K 200 because of the nature of the salt.The salt water used for concrete treatment is the salt water with salt degree of about ± 3%. The treatment by using salt water should be avoided because it can damage the surface of the concrete due to its salt content. There is abrasion on the surface of the specimen treated with salt water so that the shape of the specimen no longer resembles a perfect cube. In the saltwater treatment basin, salt deposition occurs on the bottom of the treatment basin. As well as salt deposition also envelop all the test specimens that are being treated with salt water. The use of type 1 cement is not suitable for any buildings to be built in coastal areas or that would interact directly with saltwater.

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