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The Effect of Tap Water and Paddle Water on the Compressive Strength of Concrete in the Absence of Air Addition

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ABSTRACT

Concrete has become the most popular and frequently used construction material in various construction projects, such as structures, bridges, highways and dams, as it has a number of advantages over other construction materials. Along with technological advances, concrete continues to undergo innovations to better its characteristics, reduce costs and maintain environmental sustainability. Concrete consists of aggregates, cement and water, and the composition of this mixture effects the physical and mechanical properties of concrete. The study sought to enhance the quality of conventional concrete without air addition by using peat water and faucet water as variations of water in the mix. The results encompass the physical and mechanical properties of conventional concrete without air addition at various ages. The research is also pertinent in the context of infrastructure development in isolated locations that may have limited pure water supply. The results showed that the peat water variation concrete had a slightly higher dried volume weight and substantial compressive strength at various ages compared to the tap water variation concrete. The aggregate results show that water variation impacts the characteristics of conventional concrete, and the initial hypothesis stating the effect of water variation has been proven correct. This research can make a valuable contribution to the development of the construction industry and infrastructure development, and can be used as a reference in scientific journals and publications.

Keywords: limited water supply, water variation, concrete quality

I. INTRODUCTION

The advantages of shape diversity, resistance to high temperatures, ability to withstand large burdens, and minimal maintenance costs all contribute to concrete's significant role in contemporary construction. Rapid progress has been achieved in both the manufacturing process and the technology utilized in the execution of concrete. Additionally, the strength and durability of concrete are substantially influenced by the water quality incorporated into its mixtures. To prevent the brittleness and crumbling of concrete, it is vital to use water that is pure and devoid of harmful substances. A variety of water sources, including potable water and peat water, were utilized in this investigation to determine their impact on the strength of concrete.

The purpose of this research is to determine the impact of incorporating peat, rainfall, and potable water into air-entrained concrete mixtures. The outcomes of this research are anticipated to offer recommendations for determining the optimal water type to be utilized in the production of standard concrete. Additionally, it is anticipated that the outcomes of this research will aid in the advancement of civil engineering construction, enhance the quality of conventional concrete products, and aid researchers in attaining the intended level of excellence in construction endeavors. The urgency of this research stems from the fact that infrastructure development in remote areas confronted with the challenge of pure water availability is at stake.

II. METHODOLOGY

The research was carried out in the Materials and Construction Laboratory, under the Department of Civil Engineering, at the Faculty of Engineering at Tanjungpura University. The used approach is experimental, entailing the creation of test specimens in compliance with SNI testing standards to gather the necessary data. The acquired data will be examined to evaluate the influence of water fluctuation on the durability of concrete.

2.1 Materials
The materials utilized in this investigation comprise
1. PCC-type cement
2. Sand exhibiting a grain size not exceeding 4.75 mm
3. Stone with an upper limit of 40 mm in particle dimension
4. A diverse range of water sources, such as peat and municipal water
5. With the addition of air, the investigation sought to attain a normal compressive strength of 15 MPa.

2.2 Equipment
A compressive testing machine, bearing block, compressometer, cylinder mold, shieve sekker machine, material furnace, scales, mixer, Los Engeles machine, droop tool, organic plate, and additional supporting instruments are utilized in this experiment.

2.3 Research Procedure
The stages of executing this study are segmented into the subsequent components:

a) Material inspection and preparation
1. Thesis foundation and journal articles from prior research that provide support for this study.
2. Development and evaluation of materials

b) Mix arrangement

Following a thorough examination of the materials, preparations were made in accordance with SNI 7656-2012 to produce a standard concrete composition with a force-compaction value of 17 MPa and no additional air was incorporated. For the purpose of fabricating test specimens using two distinct types of water samples—peat water and potable water—calculations were performed.

c) Analysis of test specimens decoiling

For each sample variation, a total of 13 cylinders measuring 30 cm in height and 15 cm in diameter, 5 cylinders measuring 20 cm in height and 10 cm in diameter, and 10 cubes measuring 15 cm in side were utilized to create test specimens. A concrete mixer machine provides assistance in the casting of test specimens.

d) Precautions regarding test specimens

For the purpose of treating test objects, they are submerged in a container of room-temperature water. The treatment period is from one day following casting to one day prior to testing.

e) Volumetric testing of weight

At the 3, 7, 14, 21, and 28-day ages of concrete slinders, their volume weight was determined utilizing electric scales with a precision of 0.05 kg.

f) Testing for compressive strength

In accordance with SNI 03-1974-2011, this study employs a 2000 kN-capacity, 5-kN-accurate MTB brand compressive testing equipment to determine the compressive strength of concrete at 3, 7, 14, 21, and 28 days.

g) Evaluation of split tensile strength

This research employs bearing block tools and an MTB brand compressive testing equipment with a capacity of 2000 kN and an accuracy of 5 kN at the 28-day mark to determine the split tensile strength in accordance with SNI 03-2491-2002.

h) Testing for elastic modulus evaluation

In accordance with SNI 03-2491-2002, this study employs modulus test apparatus and an MTB brand compressive testing machine with a 2000 kN capacity and a 5 kN accuracy at 28 days for split tensile strength testing.

2.4 Analysis Method
1. The formula for determining volume weight

$W_c = \frac{m}{V}$ (1)

Where :
Wc = volume weight (kg/m^3)
m =concrete weight (kg)
V = concrete volume (m^3)

2. Utilize the formula to determine the compressive strength:

$f_c = \frac{P}{A}$ (2)

Where
f_c = compressive strength value (MPa)
P = maximum test load (N)
A = contact area (mm^2)

3. The formula for determining split tensile strength:

$f'_{ct} = \frac{2P}{\pi tD}$ (4)

Where :

f'_{ct} = Strength of divided tensile concrete (N/mm2)
P = maximum compressive force required for a cylinder of concrete to divide or implode (N)
π = phi (3,14)
t = height/length of concrete cylinder(mm)
d = diameter of concrete cylinder (mm)

4. Modulus of Elasticity can be calculated by the formula:

$$E_c = \frac{S2-S1}{\varepsilon 2-0,00005} \quad (5)$$

Where :
E = modulus of elasticity (MPa)
S1 = intensity of compression during longitudinal tension 0,00005 (MPa)
S2 = compressive strength at 40% of maximum load
ε2 = generated longitudinal strain at the moment of S2

III. RESULTS AND DISCUSSION

3.1 Material Testing Results

Materials testing verifies that the constituents of concrete—water, fine aggregate, cement, and coarse aggregate—conform to the SNI's technical specifications. A mix design for the production of concrete test specimens will be developed subsequent to testing and data collection.

Fig 1. Results of organic content experiments

Fig 2. Gradation analysis graph of fine aggregate composed of moderately fine sand

Fig3: The results of a litmus paper pH test

The test findings indicated that the fine aggregate had a surface dry specific gravity of 2.710 g/ml, dry specific gravity of 2.709 g/ml, apparent specific gravity of 2.711 g/ml, and water absorption of 0.020%. The mean density was 1354.5 kg/m3. The gradation study revealed a fine modulus of 2.315, suggesting that the sand falls inside zone III, which corresponds to relatively fine sand as defined by SNI 03-2384-2000. The fine aggregate has a moisture content of 2.722% and a mud content of just 0.56%, both of which are far below the maximum limit set by SNI 03-2834-2000. This standard restricts the mud content to a maximum of 5%. The organic composition of test specimen number 3 complies with the concrete standard.

For the coarse aggregate test, the coarse aggregate had a surface dry specific gravity of 2.647 g/ml, dry specific gravity of 2.623 g/ml, apparent specific gravity of 2.676 g/ml and water absorption of 0.662%. The mean density was 1517.5 kg/m3. The test findings of the coarse aggregate gradation analysis indicated a fine modulus of 4.996, indicating that the coarse aggregate has a maximum size of 20 mm in compliance with the SNI 03-2834-2000 standard. The moisture percentage of the coarse aggregate is 6.383%. The coarse aggregate wear test reveals a wear percentage of 15.56%, which nevertheless fulfills the SNI 2417:2008 norm that requires the wear percentage to be no more than 50%.

The cement test revealed that the cement has a specific gravity of 3.06 g/cm3. The substance exhibits a typical texture with a penetration depth of 10 mm when the moisture level is at 27%.

The peat water in the water test had a pH of 6, indicating modest acidity. The TDS (Total Dissolved Solids) content of peat water was measured to be 296 mg/L, whereas tap water had a TDS of 286 mg/L. Both samples were found to be under the acceptable limit of 500 mg/L.
All of the evaluated material's qualities fulfill the SNI standards, indicating its suitability for usage.

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3.2 Concrete Mix Results

In accordance with SNI 7656-2012, the researcher intended to produce a 17 MPa concrete mixture devoid of any added air. The sag utilized varied between 75-100 mm.

Table1: Composition of Concrete Mix

No.	Material	Volume	Unit
1	Weight of Cement	340,485	Kg
2	Weight of Water	140,266	Kg
3	Weight of Coarse Aggregate	1057,653	Kg
4	Weight of Fine Aggregate	746,947	Kg
Total		2285,351	Kg

3.3 Volume Weight Testing

The volume weight test results are presented in Table 2 below:

Table1: Results of Volume Weight Testing

No.	Sample	Volume Weight Average Day (kg/m^3)				
		3	7	14	21	28
1	V1(Peat Water)	2.421,796	2.426,185	2.426 9,999	2.419,003	2.403,499
2	V2 (Tap Water)	2.405,068	2.423,967	2.402 ,866	2.405,425	2.399,726

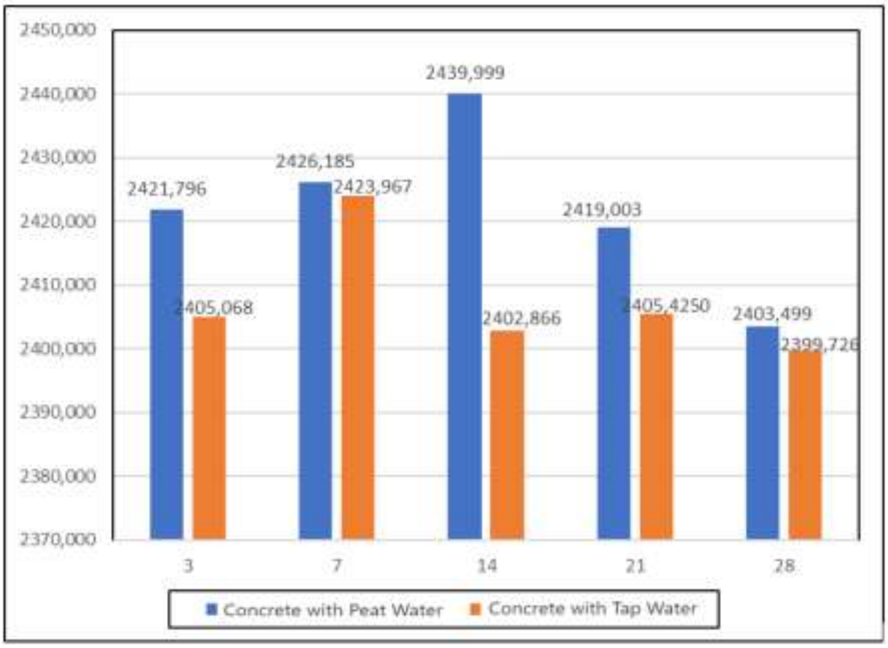

Fig4: Average Volume Weight Comparison of Concrete Mixed with Peat Water and Tap Water in a Bar Chart

According to the bar chart, it can be inferred that concrete formulations using peat water exhibit comparatively greater volume weight measurements than concrete combinations utilizing tap water. This is seen in the comparison of the

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weight of concrete made using peat water vs concrete made with tap water, where the former outweighs the latter.

3.4 Compressive Strength Testing

The results of the compressive strength testing of concrete are presented in the following table3.:

Table2: The results of concrete compressive strength tests.

No.	Sample	The Average Compressive Strength (Days)(MPa)				
		3	7	14	21	28
1	V1(Peat Water)	15,722	23,034	28,704	29,813	37,197
2	V2 (Tap Water)	14,636	20,423	26,934	30,570	35,499

The concrete mixture containing peat water has a comparatively higher compressive strength value than the concrete mixture containing faucet water, as shown in the table above.

3.5 Tensile Strength Testing

The outcomes of the split tensile strength examination conducted on concrete after 28 days are presented in the subsequent table 4:

Table3: Results of divided tensile strength tests

No.	Sample	Strength Average Of Divided Tensiles
1	V1(Peat Water)	3,065
2	V2 (Tap Water)	3,065

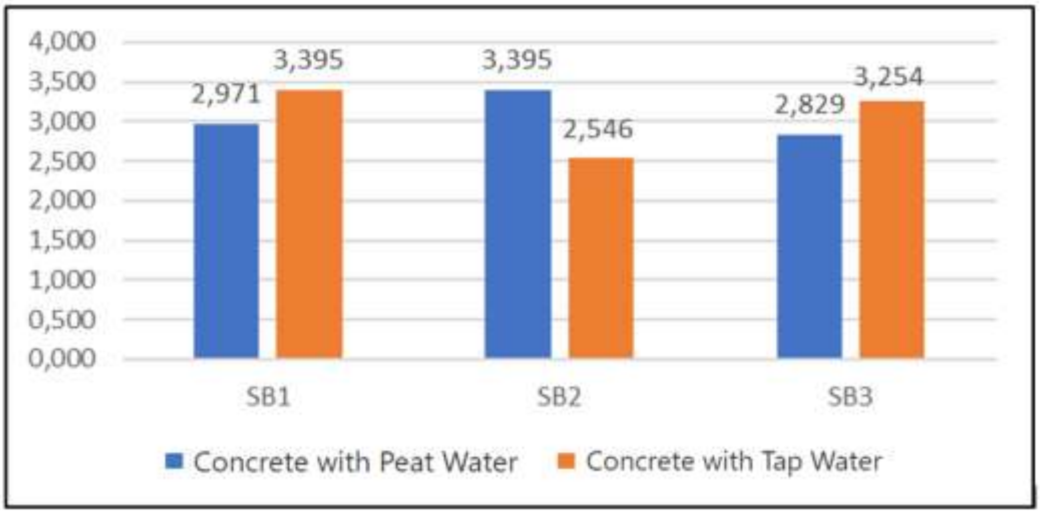

Fig5: Comparison of the split tensile strength of concrete mixed with peat water and potable water using a bar chart

Based on the data presented in the table and bar chart, it can be inferred that the split tensile strength values of concrete mixtures containing peat water are comparatively comparable to those of concrete mixtures containing potable water, with an average value of 3.065 MPa.

3.6 Modulus of Elasticity Testing

The following information was obtained from the elastic modulus measurement of RPC concrete using three samples of each variation and a sample size of 150 mm x 300 mm:

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Table4: Results of Concrete Modulus of Elasticity Tests

No	Sample	Average Modulus Of Elasticity (Ec) MPa	
		Practicum Analysis Result	The Result Of Formula Calculation
1	V1(Peat Water)	2.613,540	24749,12
2	V2 (Tap Water)	32.002,900	28291,88

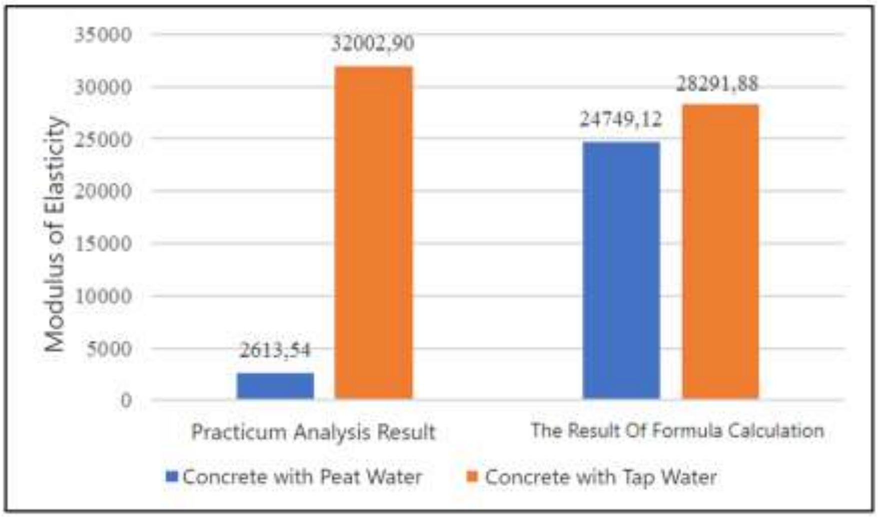

Fig6. Comparative bar graph of the modulus of elasticity of concrete containing peat water and potable water

On the basis of the data presented in the table and bar chart, it can be deduced that concrete mixtures containing peat water exhibit reduced elastic modulus values in comparison to those containing stream water.

IV. CONCLUSIONS

Based on the findings and research conducted, a number of conclusions can be deduced, specifically:

1. According to the results, peat-watered concrete exhibited a greater dried volume weight and superior compressive strength in comparison to stream water-watered concrete.
2. Furthermore, the modulus of elasticity of peat water concrete is inferior to that of tap water concrete.
3. The overall conclusion is that peat-water concrete improves conventional concrete more effectively than tap water, thus providing support for the research's initial hypothesis

REFERENCE

[1]. S. Fuad and B. Asmawi, "PENGARUH PEMAKAIAN AIR RAWA TERHADAP KUAT TEKAN DAN KUAT TARIK BELAH BETON," JURNAL DESIMINASI TEKNOLOGI, vol. 8, no. 2, 2020, doi: 10.52333/DESTEK.V8I2.642.

[2]. Kuat Tekan dan Porositas Beton menggunakan Air Gambut dan Kapur Tohor untuk Konstruksidi LingkunganGambutJURNAL TEKNIK." https://journal.unilak.ac.id/index.php/teknik/article/view/3894 (accessed May 15, 2023).

[3]. Kuat Tekan Dan Porositas Beton Pcc Menggunakan Crumb Rubber Dan Abu Sekam Padi Dengan Air Gambut Sebagai Mixing Dan Curing Water | Fajri | Jurnal Online Mahasiswa (JOM)Bidang Teknik dan Sains." https://jom.unri.ac.id/index.php/JOMFTEKNIK/article/view/31457/0 (accessed May 15, 2023).

[4]. Kurniawandy, Alex , Dkk, 2012, "Pengaruh Intrusi Air Laut, Air Gambut, Air Kelapa dan Air Biasa Terhadap Kuat tekan Beton Normal", Jurnal Sains dan Teknologi 11 (2), September 2012, hal 51-58.

[5]. Mulyono, Tri, (2004). "Teknologi Beton", Andi, Yogyakarta.

[6]. P. Kandungan Kimia Air, R. Dedi Iman Kurnia, S. Fonna, and S. Huzni, "PENGARUH KANDUNGAN KIMIA AIR TERHADAP KUAT TEKAN BETON," TERAS JURNAL : Jurnal Teknik Sipil, vol. 10, no. 1, pp. 81–88, Aug. 2020, doi: 10.29103/TJ.V10I1.260.

[7]. P. Penggunaan Solutan Berbagai Sumber, M. Firdaus Kamil, M. P. Agung Hadi, H. Ashad, A. Fadhil, and M. B. Syarif, "Pengaruh Penggunaan Solutan (Air Pencampur) Berbagai Sumber Terhadap Sifat-Sifat Mekanik Beton," Jurnal Ilmiah Mahasiswa Teknik Sipil , vol. 4, pp. 97–105, Jan. 2022, Accessed: May 15, 2023. [Online]. Available: https://jurnal.ft.umi.ac.id/index.php/JILMATEKS/article/view/512

[8]. Penggunaan Variasi Ph Air (Asam) Pada Kuat Tekan Beton Normal F'c 25 Mpa - Neliti." https://www.neliti.com/id/publications/262496/penggunaan-variasi-ph-air-asam-pada-kuat- tekan-beton-normal-fc-25-mpa (accessed May 15, 2023).

[9]. S. B. Mulyono and N. Prayitno, "STUDI PENGARUH PENGGUNAAN AIR PAYAU DALAM MIX DESIGN BETON UNTUK PEMBUATAN KONSTRUKSI DERMAGA AKIBAT RENDAMAN AIR LAUT," Konstruksia, vol. 7, no. 1, 2015, Accessed: May 15, 2023. [Online]. Available: https://jurnal.umj.ac.id/index.php/konstruksia/article/view/650

[10]. S. T. , M. T. ; Erwin Sutandar, "Pengaruh Penggunaan Air Gambut Sebagai Campuran Beton Normal", Accessed: May 15, 2023. [Online]. Available: //172.16.40.35%2Findex.php%3Fp%3Dshow_detail%26id%3D6503

[11]. SNI-03-1968, (1990). "Analisa Saringan Agregat Halus dan Kasar" , Badan Standarisasi Nasional, Jakarta.

[12]. SNI-03-1974, (1990). "Metode Pengujian Kuat Tekan Beton" , Badan Standarisasi Nasional, Jakarta.

[13]. SNI-03-4142, (1996) "Pengujian Kadar Lumpur Lolos Saringan No.200", BadanStandarisasi Nasional, Jakarta.

[14]. SNI-03-4804, (1998) "Metode Pengujian Berat Isi dan Rongga Udara Dalam Agregat", Badan Standarisasi Nasional, Jakarta.

[15]. SNI-15-2530, (1991) "Metode Pengujian Kehalusan Semen Portland", Badan Standarisasi Nasional, Jakarta.

[16]. SNI-15-2531, (1991). "Pengujian Berat Jenis Semen", Badan Standarisasi Nasional, Jakarta.

[17]. SNI-1969, (2008) "Cara Uji Berat Jenis dan Penyerapan Air Agregat Kasar", BadanStandarisasi Nasional, Jakarta.

[18]. SNI-1970, (2008) "Cara Uji Berat Jenis dan Penyerapan Air Agregat Halus", BadanStandarisasi Nasional, Jakarta.

[19]. SNI-1971, (2011) "Cara Uji Kadar Air Total Agregat Dengan Pengeringan", Badan Standarisasi Nasional, Jakarta.

[20]. SNI-2417, (2008) "Cara Uji Keausan Agregat Dengan Mesin Abrasi Los Angeles", Badan Standarisasi Nasional, Jakarta.

[21]. SNI-2847, (2013) "Persyaratan Beton Struktural Untuk Bangunan", Badan Standarisasi Nasional, Jakarta.

[22]. SNI C597:2012, (2012) "Tata Cara Pemilihan Campuran Beton Normal, Beton Berat Dan Beton Massa", Badan Standarisasi Nasional, Jakarta.

[23]. Tjokrodimuljo, (2007) "Teknologi Beton", Biro Penerbit, Yogyakarta