 ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

Available online at
https://jurnalteknik.unisla.ac.id/index.php/CVL

https://doi.org/10.30736/cvl.v2i2

Comparison of the Effectiveness of Immersion Curing and Burlap Sacks Curing on the Compressive Strength of Concrete with Superplasticizers

Dhiafah Hera Darayani[1*], Juanita[2], Hafiz Hamdani[3], Cindrawati[4]
[1*,2,4]*Engineering Faculty, Al-Azhar Islamic University*
[3]*Engineering Faculty, Muhammadiyah University*
Email: [1*] dhiafah.hera@gmail.com. [2]joanne_nita@ymail.com. [3]hafiz.hamdani@ummat.ac.id
[4]cindrawati275@gmail.com

ARTICLE INFO

Article History :
Article entry : 13-12-2025
Article revised : 13-01-2026
Article received : 10-04-2026

Keywords :
Concrete, Curing, Compressive Strength, Additives.

IEEE Style in citing this article :
D. H. Darayani, Juanita, Hafiz Hamdani, and Cindrawati, "Comparison of the Effectiveness of Immersion Curing and Burlap Sacks Curing on the Compressive Strength of Concrete with Superplasticizers", CVL, vol. 11, no. 1, pp. 67–76, Mar. 2026.

ABSTRACT

This study aims to examine the effectiveness of two concrete treatment methods with SikaCim superplasticizer on concrete compressive strength. The curing method was used by immersion in water and covering the concrete surface with wet gunny sacks. The compressive strength test was conducted when the concrete was 28 days old. The concrete used is normal concrete and normal concrete with additives. This study tested concrete with 24 cylindrical specimens (15 cm x 30 cm). The results of the concrete compressive strength study show that the values of normal concrete soaked in water, with normal concrete covered with burlap sacks shows an increase of 30.6%. For comparison, the concrete treatment of added superplasticizer soaked in water, with the concrete added superplasticizer covered with burlap sacks, increased by 25.4%. The conclusion is that the highest compressive strength occurs in concrete with superplasticizer additives, with treatment covered with wet burlap sacks, which is 25.57 MPa.

1. Introduction

The rapid population growth that occurs greatly affects the development of infrastructure. This is evidenced through various infrastructure development projects, such as the construction of roads, buildings, bridges, irrigation channels, dams, and others. The development of infrastructure is strengthened by the feasibility of the materials used. Significant developments in infrastructure increase the need for concrete as the main construction material because concrete has a very important role in building construction. Concrete is one of the structural materials in building construction because it has many advantages compared to other materials, including its relatively low price, resistance to fire, and easily available concrete materials, but concrete also has disadvantages, namely weak against tensile forces [1].

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

The compressive strength of concrete is one of the parameters that determines the quality of concrete. The greater the compressive strength of concrete, the better the quality of concrete. However, the quality of each concrete varies greatly. The quality of concrete is influenced by various factors. One factor that affects the quality of concrete is curing or concrete treatment. Concrete curing is very important to develop the durability and strength of concrete. The purpose of curing concrete is to maintain the humidity and temperature of the concrete, to avoid cracking on the surface of the concrete, and the hydration process runs perfectly.

In this study, the concrete curing method was used to soak the concrete in water by covering the concrete surface with wet gunny sacks. The curing of concrete is carried out after the concrete has undergone the hardening phase or after opening the concrete mold. To achieve high concrete strength, the amount of water must be reduced. But this will cause difficulties in concrete work. Therefore, additives are needed that can reduce water, so that the concrete will achieve maximum strength, while the workability of the concrete itself is maintained. The superplasticizer used in this research is the SikaCim concrete additive brand.

From the background above, the authors will examine the quality of concrete that occurs due to the influence of curing and the addition of additives to concrete with the title "Comparison of the Effectiveness of Immersion Curing and Burlap Bags Curing on the Compressive Strength of Concrete with Superplasticizers".

The novelty of this research lies in the comparative testing of the effectiveness of curing methods for concrete through the use of superplasticisers. This research fills the information gap regarding whether the burlap bag covering method is able to match the total immersion method in facilitating perfect hydration in concrete that uses SikaCim additives.

Current developments in concrete technology are greatly influenced by the use of additives and innovations in constituent materials to achieve optimal compressive strength. One of the main focuses is the use of superplasticizers such as Sika Viscocrete. In a study in Kotabaru Regency, the use of Sika Viscocrete in concrete with a strength of f'c 20 MPa showed interesting results, where normal concrete achieved an average of 19.50 MPa, while the variant with additives produced an average of 13.79 MPa under certain test conditions [2]. However, the effectiveness of this additive greatly depends on its dosage concentration. This was proven in a study on 14-day-old K-300 concrete, which showed that the addition of Sika Viscocrete at levels of 1%, 2%, and 3% produced positive results; the higher the percentage of additive used (up to 3%), the greater the compressive strength produced [1]. The use of Superplasticizer additives significantly improves the mechanical quality of concrete compared to normal concrete without additives. The higher the dose of superplasticizer used (up to a limit of 1%), the higher the compressive strength value produced at 28 days [3].

Based on the results of testing K-300 concrete at 28 days of age, it can be concluded that the use of SikaCim Concrete Additive is proven to be effective in increasing the compressive strength of concrete beyond the planned standard [4]. The use of Sikacim Concrete Additive at a dosage of 1.75% of the cement weight effectively improves the mechanical performance of concrete [5].

In addition to workability, the additive is also integrated with water resistance features. The use of Damdex (waterproofing) in a 25 MPa concrete mix showed significant results at a dosage of 2%. This addition produced a compressive strength of 35.33 MPa, or 14.86% higher than normal concrete, while also accelerating the concrete hardening process with an increase of 19.37% [6].

Concrete innovation does not stop at chemicals, but also extends to aggregate modification and structural reinforcement. The use of styrofoam-based Artificial Lightweight Aggregate (ALWA) has been tested as a substitute for coarse aggregates in normal concrete and Self-Compacting Concrete (SCC). With a substitution variation of up to 100%, the use of ALWA in SCC mixtures can produce compressive strengths of up to 28.33 MPa [7]. On the other hand, mechanical durability was also improved by adding welded wire fibers to the mixture. Research shows that an 8% variation in wire fibers can increase the compressive strength of concrete to 21.51 MPa compared to normal concrete, which is only 20.10 MPa [8].

This study evaluates the effect of various curing methods on the compressive strength of concrete with a planned strength of 25 MPa at 28 days using 42 cylinder samples. The test results show that the 28-day water immersion method provides the most optimal result of 25.29 MPa [9].

The watering method is the most effective curing method because it produces the highest compressive strength of 29.604 MPa. This value surpasses the soaking method (25.267 MPa) and the

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

no-curing method (23.29 MPa), proving that the watering technique is the most optimal in supporting the cement hydration process to achieve maximum strength [10].

Well water with a neutral pH (7.1) proved to be more effective as a curing medium than Gajah Wong river water, which tends to be acidic (pH 6.7). The use of well water resulted in higher concrete compressive strength, namely 23.02 MPa, while river water resulted in 22.86 MPa [11]. The curing wrapping method for small aggregates (9.5–4.75 mm) is the best combination for producing pervious concrete with compressive strength (8.3 MPa) and maximum density [12]. In addition to the type of materials used, the curing temperature and duration significantly affect the overall performance of concrete [13]. Alternating dry or wet curing resulted in greater resistance to axial compressive [14]. For the minimum curing time required to achieve 80% of the specified compressive strength, the durability requirements, sorptivity, and UPV (Ultrasonic Pulse Velocity) are verified and satisfied to a significant degree with strengthened microstructures [15]. Rising steam curing temperatures initially enhanced compressive strength, but later caused a decline [16]. For all ages analyzed, the curing immersed in water proved to be more effective, reaching the highest strength averages because the curing stability avoids the formation of shrinkage and volume variation in the material [17]. The use of asbestos waste as a substitute for fine aggregate in the K-250 concrete mixture, with a variance of 10%, can be used because it meets or exceeds the compressive strength of K-250 concrete only in concrete with a 10% variance asbestos waste substitution, with a compressive strength value of 23.81MPa [18].

2. Research Method

This research method starts from the preparation of materials, examination of fine and coarse aggregates, making test objects, treatment, and testing compressive strength. The research was conducted at the Faculty of Engineering Laboratory of Al-Azhar Islamic University, Mataram. In this study using cylindrical test objects measuring 15 x 30 cm were used, totaling 24 samples, with a mixture percentage of 1%.

3. Description and Technical

There are 4 kinds of test objects with 2 different treatments that can be seen in the table below Table 1. Slump Value.

Table 1. Slump Value

No.	Code test piece	Percentage additives	Number of objects soaked test in water	Number of objects covered test gunny sack
1	BN	Without superplasticizer	6	-
2	BNG	Without superplasticizer	-	6
3	BAR	1% superplasticizer	6	-
4	BAG	1% superplasticizer	-	6
Number of test pieces			12	12
Total number of objects			24	

Description:
BN = Normal concrete without additives, with test specimens immersed in water
BNG= Normal concrete without additives, with test specimens covered with gunny sacks
BAR= Concrete with 1% of additive admixture with water-soaked specimens
BAG= Concrete with 1% of additive mixture, with test specimens covered with gunny sacks

Data analysis and results can be done after the data is processed. The data processed from inspection to testing are as follows:
1. Fine aggregate inspection data
2. Coarse aggregate inspection data
3. Slump test
4. Absorption
5. Compressive strength test

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

4. Results and Discussions

The results and discussion of this research include the results of aggregate testing, slump testing, absorption, and compressive strength, which have been carried out at the Civil Engineering Laboratory of Al-Azhar Islamic University.

Aggregate Testing Results

The results of aggregate testing include coarse and fine aggregates; these tests are conducted first to determine the characteristics of the aggregate to be used.

Table 2. Recapitulation of Fine Aggregate Testing

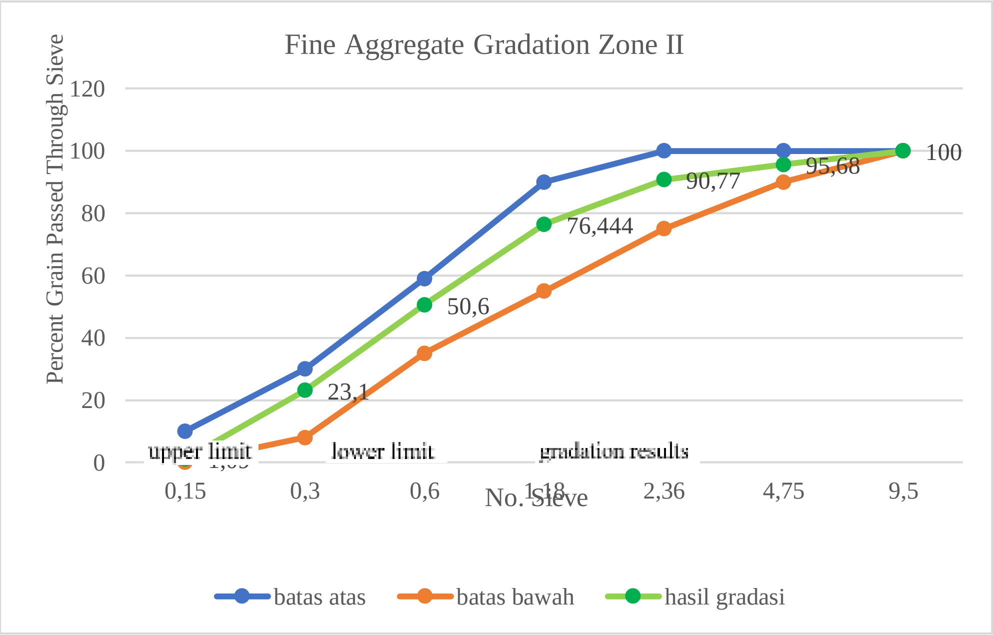
No.	Aggregate Characteristics	Test Results
1	SSD Specific gravity	2.37
2	Water Absorption	2.08
3	Unit Weight	
	a. Retrieved	1.48
	b. Solid	1.56
4	Sludge Content	5%
5	Fine Modulus of Grain	3.62

Source: Al-Azhar Islamic University of Civil Engineering Laboratory (2024).

The results of the specific gravity check obtained an average SSD specific gravity of 2.37, which shows that the fine aggregate used as a concrete mix is a normal aggregate with a specific gravity between 2.3-2.5 [19].

The examination results of the loose unit weight of fine aggregates averaged 1.48 grams/cm3, and the result of checking the solid unit weight of fine aggregate averaged 1.56 grams/cm3. Therefore, the test results show that the fine aggregate material used belongs to the normal aggregate type, which has a unit weight between 1.2-1.6 [19].

Based on the examination of the results of the fine aggregate gradation analysis data above, it can be seen that the value of the grain fineness modulus is 3.62. So that it can meet the requirements of the grain fineness modulus of 5-8 [19]. The results of the examination of the fine aggregate gradation graph can be seen in the figure below:



Source: Al-Azhar Islamic University of Civil Engineering Laboratory (2024).
Figure 1. Fine Aggregate Gradation.

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

Based on the results of the graph above, the gradation of fine aggregate used in this study is included in the zone II gradation area, which is included in the specification of slightly coarse sand. Table 3. Recapitulation of Coarse Aggregates.

Table 3. Recapitulation of Coarse Aggregates

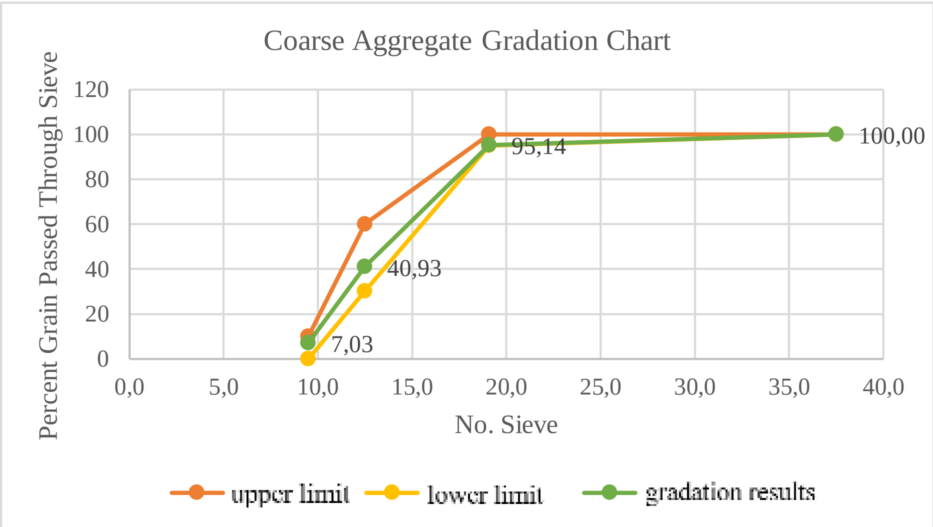
No.	Aggregate Characteristics	Test Results
1	SSD Specific gravity	2.66
2	Unit Weight	
	a. Retrieved	1.58
	b. Solid	1.64
3	Fine Modulus of Grain	4.56

Source: Al-Azhar Islamic University of Civil Engineering Laboratory (2024).

In addition to the above, it is important to note that the average weight of the aggregate in the SSD condition is 2.66, which indicates that the coarse aggregate used as a concrete mix is a normal aggregate with a weight between 2.5-2.7 [19].

The results of the examination of the loose unit weight of coarse aggregate averaged 1.58 grams/cm3, and the results of checking the solid unit weight of coarse aggregate averaged 1.64 grams/cm3. This shows that the coarse aggregate material used belongs to the normal aggregate type, which has a unit weight between 1.2-1.6 [19].

Based on the examination of the results of the coarse aggregate gradation analysis data above, it can be seen that the value of the fine grain modulus is 4.56. So that it has not been able to meet the requirements of the grain fineness modulus of 5.0-8.0% [19]. The MHB, which is less than 5, will affect the composition of the mixture. The results of the examination of the fine aggregate gradation graph can be seen in the figure below:



Source: Al-Azhar Islamic University of Civil Engineering Laboratory (2024).
Figure 2. Coarse Aggregate Gradation.

Based on the results in the Table above, a coarse aggregate graph was created to determine the maximum grain size of the coarse aggregate. In the figure above, it can be seen that the maximum grain size of coarse aggregate is 20 mm.

Mix Design Results

In the design of the concrete mixture, the calculation procedure refers to SK SNI 03-2834-2000. The mix design aims to determine the proportion and composition of the mixture of concrete constituents so that concrete of the planned quality can be obtained. In this planning, the planned quality is f'c = 25 MPa for 28 days of concrete age. The composition of the mixture can be seen in the following table:

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

Table 4. Normal Concrete Mix Design.

Water (lt)	Cement (kg)	Sand (kg)	Gravel (kg)
3.26	6.52	11.22	15.49

Source: Al-Azhar Islamic University of Civil Engineering Laboratory (2024).

For a normal concrete mix, the water requirement is 3.26 liters, the cement is 6.52 kg, the sand is 11.22 kg, and the gravel is 15.49 kg.

Table 5. Superplasticizer Concrete Mix Design.

Water (lt)	Cement (kg)	Sand (kg)	Gravel (kg)	Superplasticizer (grams)
3.19	6.52	11.22	15.49	65.2

Source: Al-Azhar Islamic University of Civil Engineering Laboratory (2024).

For concrete mixtures with added ingredients, the water requirement is 3.19 liters, cement is 6.52 kg, sand is 11.22 kg, gravel is 15.49 kg, and superplasticizer is 65.2 grams. The addition of 1% superplasticizer is obtained from the weight of cement multiplied by 1%, while the water reduction in concrete with added ingredients is obtained from water minus superplasticizer.

Table 6. Slump Value Results.

Test Item Code	Sample Quantity	Slump Value (cm)
BN	6	9
BNG	6	9
BAR	6	8
BAG	6	8

Source: Al-Azhar Islamic University of Civil Engineering Laboratory (2024).

Based on the table above, it is found that the concrete with superplasticizer additives slump (BAR and BAG) value decreases, this is due to the reduction in water content in the mixture.

Water Absorption Test Results

The absorption value is used to determine the amount of water that can be absorbed into the concrete. Absorption testing was carried out after 28 days of concrete age with a total of 24 specimens.

a. Immersed in Water b. Covered with a Burlap Sack

Source: Al-Azhar Islamic University of Civil Engineering Laboratory (2024).

Figure 3. Concrete Curing.

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

Table 7. Absorption

Type Concrete	Average absorption
BN	0.35
BNG	0.25
BAR	0.17
BAG	0.13

Source: Al-Azhar Islamic University of Civil Engineering Laboratory (2024).

Based on the table above, it is obtained that the absorption of normal concrete with curing soaked in water has higher absorption than normal concrete covered with burlap sacks while concrete with superplasticizer additives with curing soaked in water has higher absorption than concrete with superplasticizer additives has a low absorption value, a lower absorption value in concrete with additives because concrete covered with burlap sacks absorbs less water due to burlap sacks watered in 1 time 2 days.

Volume Weight Check of Concrete

This concrete inspection aims to determine the weight of concrete before testing the compressive strength of concrete. The specific gravity of concrete is a measure of how much concrete there is in each cubic meter. From the results, the average concrete weight of normal concrete soaked in water is 2184.28 kg/m3, normal concrete covered with burlap sacks is 2209.65 kg/m3, additive concrete immersed in water is 2248.43 kg/m3, and additive concrete covered with burlap sacks is 2309.31 kg/m3. The average weight value of concrete produced in normal concrete covered with burlap sacks, additive concrete soaked in water, and additive concrete covered with burlap sacks is included in the type of normal concrete, with a weight ranging from 2200 - 2500 kg/m3 [20].

Compressive Strength Test Results

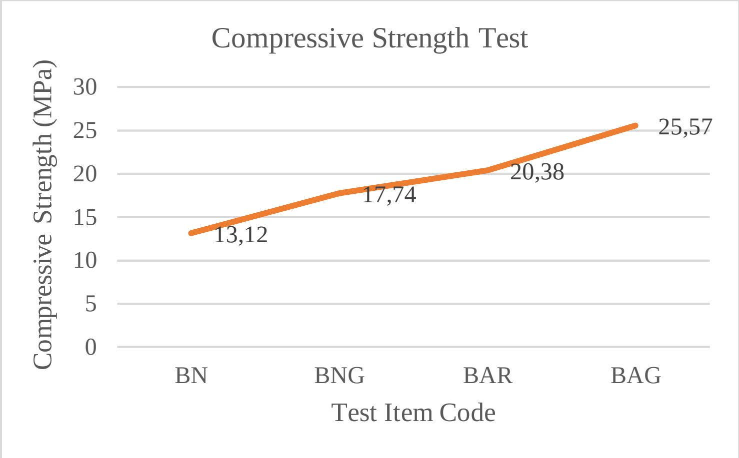
Testing the compressive strength of concrete cylinders is carried out using a Compression Testing Machine. In this study, there are two kinds of test objects with two variations of treatment, namely, covered with wet burlap sacks and soaked in water. The types of test objects are normal concrete and concrete with 1% superplasticizer additives. Concrete treatment was carried out for 28 days. For treatment with a wet burlap sack, watering is done once every 2 days. Compressive strength testing was carried out when the concrete was 28 days old.

Source: Al-Azhar Islamic University of Civil Engineering Laboratory (2024).
Figure 4. Compressive Strength Testing.

Based on the results of the concrete compressive strength test, the average results during 28 days of treatment for BN (normal concrete) were 13.12 MPa, for BNG (normal concrete covered with wet

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

burlap sacks) were 17.74, BAR (concrete with 1% additive with water immersion) was 20.38, and for BAG (concrete with 1% additive with treatment covered with wet burlap sacks) was 25.57.



Source: Al-Azhar Islamic University of Civil Engineering Laboratory (2024).
Figure 5. Compressive Strength Test Chart.

From the graph of compressive strength of normal concrete with treatment soaked in water, normal concrete with treatment covered with burlap sacks, and concrete additives with treatment soaked in water have not reached the required compressive strength of concrete, while concrete additives with treatment covered with burlap sacks have met the required compressive strength of concrete. Another factor that makes the quality of concrete less than optimal is that during the process of making concrete, the mixture in normal concrete has more water than concrete with additives. This additive serves as a water reducer. By reducing the need for water in the concrete mixture, this additive accelerates the hardening process so that an increase in compressive strength occurs.

The highest compressive strength value is obtained in concrete with superplasticizer additives, with concrete curing covered with burlap sacks. The compressive strength with the burlap sack curing method is obtained because it has little absorption due to the burlap sack concrete curing watered every 1 time in 2 days, which causes the results of the compressive strength test value to reach the planned quality.

The compressive strength of normal concrete without additives does not reach the planned quality because it has a low compressive strength due to the mixture in normal concrete has level of liquid or water, with the addition of this additive serving to reduce the use of water which resulting in the value of compressive strength increasing and meeting the planned quality.

From the table of absorption results and compressive strength test results, it can be concluded that the higher the absorption value in concrete, the lower the compressive strength test value; on the contrary, the lower the absorption value of concrete, the higher the compressive strength test value of concrete.

We are a large-scale manufacturer specializing in producing various mining machines, including different types of sand and gravel equipment, milling equipment, mineral processing equipment, and building materials equipment.

5. Conclusion and Suggestion

5.1 Conclusion

Based on the results of research that has been done on normal concrete and concrete with superplasticizer additives as much as 1% of the weight of cement with two variations of treatment, namely soaked in water and covered with burlap sacks, the following conclusions can be drawn:

1. From the results of the study, the addition of additives affects the compressive strength value of concrete. The value of normal concrete with treatment in water is 13.12 MPa, while concrete with additives is 20.38 MPa. Concrete with additives increased compressive strength by 55.3%. For normal concrete covered with gunny sacks, it is 17.74MPa, and additive concrete covered with gunny sacks is 25.57 MPa. The concrete with the additive was increased by 44.1%.

2. From the results obtained, the average compressive strength value of normal concrete soaked in water is 13.12 MPa, normal concrete covered with wet burlap sacks is 17.74 MPa, concrete with superplasticizer additives with treatment soaked in water is 20.38 MPa, and concrete with superplasticizer additives with treatment covered with wet burlap sacks is 25.57 MPa with a length of treatment for 28 days. Comparison of the compressive strength value of normal concrete soaked in water with normal concrete covered with burlap sacks shows an increase of 30.6%. For comparison, of concrete treatment of added ingredients soaked in water, with concrete added ingredients covered with burlap sacks, increased by 25.4%.

5.2 Suggestion

Based on the results of the research and experience in laboratory research, suggestions can be made that may be used for further research.

1. For those who conduct further research on concrete curing can do so with other treatments, such as watering concrete every day (once a day).
2. For those who conduct further research for additives in concrete mixtures, it is recommended to use a different brand (cycament LN) with a different percentage.
3. For further research, the gradation of coarse aggregate based on the required MHB value should be made.

References

[1] R. R. S. Riwayati and R. Habibi, "Pengaruh Penambahan Zat Aditif Sika Viscocrete Terhadap Kuat Tekan Mutu Beton K-300 Umur 14 Hari," *Jurnal Tekno Global UIGM Fakultas Teknik*, vol. 9, no. 2, 2021, doi: 10.36982/jtg.v9i2.1293.

[2] S. Permatasari and K. Bintang, "Pengaruh Bahan Tambah Sika Viscocrete (1003) Terhadap Kuat Tekan Beton f'c 20 MPa Menggunakan Agregat Kasar Dan Agregat Halus Di Kabupaten Kotabaru," *TAPAK*, vol. 10, no. 1, 2020.

[3] R. Sitanggang, N. S. Hutabarat, and R. Ginting, "PENGGUNAAN SUPERPLASTICIZER PADA BETON MUTU F'c 25 MPa," *JURNAL ILMIAH TEKNIK SIPIL*, vol. 11, no. 2, 2022, doi: 10.46930/tekniksipil.v11i2.2707.

[4] I. Trisnawati, W. H. Hidayat, A. Ismail, and K. Korizon, "Analisa Kuat Tekan Beton K 300 Dengan Penambahan SikaCim Concrete," *Jurnal Teknik Sipil*, vol. 13, no. 2, 2024, doi: 10.36546/tekniksipil.v13i2.1084.

[5] D. N. E. Al Munawar and E. Widyaningsih, "Pengaruh Additive Sikacim Concrete terhadap Kuat Tekan Beton Normal," *Prosiding FTSP Series 2024*, 2024.

[6] O. T. R. Zai, "PENGARUH PENGGUNAAN BAHAN TAMBAH DAMDEX," Bandung, 2023. Accessed: Nov. 29, 2025. [Online]. Available: https://elibrary.unikom.ac.id/id/eprint/8898/

[7] D. H. Darayani, T. Tavio, I. G. P. Raka, and P. Puryanto, "The Effect of Styrofoam Artificial Lightweight Aggregate (ALWA) on Compressive Strength of Self Compacting Concrete (SCC)," *Civil Engineering Journal*, vol. 4, no. 9, p. 2111, Sep. 2018, doi: 10.28991/cej-03091143.

[8] D. Renjani Putra, "PENGARUH PENAMBAHAN KAWAT BENDRAT PADA CAMPURAN BETON TERHADAP KUAT TEKAN," 2021.

[9] V. Fernando, E. Hunggurami, and T. M. W. Sir, "Pengaruh Perawatan Beton (Curing) menggunakan Water Curing dan Membrane Curing terhadap Kuat Tekan Beton," *Jurnal Teknik Sipil*, vol. 12, no. 2, 2023.

[10] T. Purnomo Adi, "PENGARUH PERAWATAN BETON (CURING) TERHADAP KUAT TEKAN BETON NORMAL," *JITSi : Jurnal Ilmiah Teknik Sipil*, vol. 3, no. 2, 2023, doi: 10.36423/jitsi.v3i2.1489.

[11] E. Erlina and C. K. Permatasari, "PENGARUH CURING MENGGUNAKAN AIR SUNGAI DAN AIR SUMUR TERHADAP KUAT TEKAN BETON," *CivETech*, vol. 6, no. 1, 2024, doi: 10.47200/civetech.v6i1.2243.

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

[12] D. S. Nugroho *et al.*, "Penggunaan Limbah Hasil Pembakaran Batu Bara dan Sugar Cane Bagasse Ash (SCBA) pada Paving Geopolimer dengan Proses Steam Curing," vol. 4, no. 2, 2015.

[13] H. Hamada, A. Alattar, B. Tayeh, F. Yahaya, and I. Almeshal, "Influence of different curing methods on the compressive strength of ultra-high-performance concrete: A comprehensive review," *Case Studies in Construction Materials*, vol. 17, Dec. 2022, doi: 10.1016/j.cscm.2022.e01390.

[14] B. R. Machado, L. S. Silva, M. Amario, A. N. Haddad, A. S. de Vargas, and C. M. Stolz, "Effect of curing methods on the long-term properties of concrete containing crystallizing additives," *Next Materials*, vol. 8, Jul. 2025, doi: 10.1016/j.nxmate.2025.100759.

[15] A. Kumar, G. J. Singh, B. L. Chauhan, and R. Kumar, "Curing sensitivity and rational curing period for recycled aggregate concrete," *CEMENT*, vol. 24, p. 100175, Jun. 2026, doi: 10.1016/j.cement.2026.100175.

[16] M. Davraz, N. Isildar, and A. N. Kaplan, "Investigation of the effects of steam curing of concrete at different temperatures on cost and compressive strength by response surface methodology," *Constr. Build. Mater.*, vol. 470, Apr. 2025, doi: 10.1016/j.conbuildmat.2025.140589.

[17] C. Cremonez, J. Maria McCartney da Fonseca, A. Carolina Seguro Cury, E. Otto Ferreira, and W. Mazer, "Analysis of the influence of the type of curing on the axial compressive strength of concrete," *Mater. Today Proc.*, vol. 58, pp. 1211–1214, Jan. 2022, doi: 10.1016/j.matpr.2022.01.430.

[18] A. Ridwan, Y. Cahyo Setianto Poernomo, and E. Garjito, "Analysis of Concrete Strength Analysis K-250 With Additional Asbestos Waste Powder as a Substitute of Fine Aggregate," *Jurnal Teknik Sipil Universitas Islam Lamongan*, vol. 09, no. 1, pp. 109–118, 2024, doi: 10.30736/cvl.v2i2.

[19] K. Tjokrodimuljo, "Teknologi Beton, Buku Ajar," *Jurusan Teknik Sipil–Magister Teknologi Bahan Bangunan–Universitas Gadjah Mada, Yogyakarta, Yogyakarta*, 2007.

[20] S. 7656-2012, "SNI 7656-2012," *Экономика Региона*, 2012.