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Effect of the Addition of Sikacrete-W and Viscocrete-3115n on the Compressive Strength of Concrete in Waterlogged Bore Pile Casting Work

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ABSTRACT

This research investigates the influence of *Sikacrete-W* and *Viscocrete-3115N* additives on the compressive strength of concrete in waterlogged bore pile casting. Concrete is a critical construction material; however, casting in submerged conditions often leads to washout and segregation, reducing its quality and structural performance. To address this challenge, the study applied *Sikacrete-W* in variations of 3%, 5%, and 10%, combined with 0.6% *Viscocrete-3115N*, aiming to enhance the cohesion and viscosity of the concrete mix. A series of compressive strength tests were conducted to evaluate the impact of these additives. The findings reveal that concrete with additives generally exhibited lower compressive strength compared to normal concrete, with the most significant reduction observed in the 10% *Sikacrete-W* mix. Nevertheless, the 5% *Sikacrete-W* mix demonstrated the best performance, achieving an optimal compressive strength of 31.74 MPa. These results indicate that the proportion of additives plays a crucial role in determining concrete quality, especially in challenging underwater casting conditions. The study highlights the importance of selecting the appropriate additive dosage to balance workability and mechanical properties. The findings can guide engineers and construction practitioners in optimizing additive use for bore pile applications, ensuring better durability and performance in waterlogged environments.

Keywords: Sikacrete-W; Viscocrete-3115N; Compressive Strength of Concrete

INTRODUCTION

Concrete is a construction material that is currently very commonly used. Many buildings today utilize concrete materials. The importance of the role of concrete construction demands an adequate quality of concrete. Numerous studies have been carried out to develop alternative innovations for the use of concrete in various fields precisely and efficiently, aiming to obtain better concrete quality (Zheng et al., 2023; Li et al., 2022). Concrete is a very important element, considering its function as one of the most widely used structural materials by the community (Wang & Chen, 2021). This situation is understandable because concrete construction systems have many advantages compared to other materials. These advantages include high compressive strength, the ability to follow the shape of the building freely, resistance to fire, and relatively low maintenance costs (Zhang et al., 2022; Wisconsin DOT, 2023). Another factor underlying the selection and use of concrete as a construction material is its effectiveness and level of efficiency. In general, *filler beton* (concrete fillers) are made from materials that are easy to obtain, easy to process (workability), and have durability and strength which are indispensable in construction (Sika USA, 2022; Sika GCC, 2021). Good quality concrete has several advantages, including high compressive strength, resistance to rust or decay caused by environmental conditions, wear resistance, and durability under weather effects such as heat, cold, sunlight, and rain. However, concrete also has several weaknesses, namely low tensile strength, expansion and shrinkage with temperature changes, difficulty in achieving perfect waterproofing, and brittleness (Tjokrodimuljo, 1996).

The concrete industry is one of the largest consumers of natural raw materials among industries and is also a major contributor to the formation of greenhouse gases in the earth's atmosphere. According to Kevin J. Folliard, on average, every person produces 1 (one) ton of concrete per year, so for approximately six billion people worldwide, about 6 (six) billion tons of concrete are produced annually (Politeknik Sriwijaya, 2025). Therefore, it can be said that the influence of the concrete industry on current environmental balance issues is quite significant and requires greater attention. Considering this trend, since the early developments in concrete technology, experts from Europe, America, and Japan have attempted to research the production of *"Sustainable Concrete"*. It is hoped that the discovery of such concrete can reduce greenhouse gas emissions in the atmosphere and mitigate damage to the natural environment (Atlantis-Press, 2025; ResearchGate, 2024). The development of sustainable and environmentally friendly high-performance concrete technology can serve as an alternative solution to reduce CO2 emissions globally. In developing countries like Indonesia, this issue should be a concern for the government, concrete construction practitioners, and experts, because the largest cement production occurs in the Asian region, of which Indonesia is part (Mohamed Lachemi, 2012).

This research is based on the work of casting the bore pile foundation in a project where bore pile casting conditions occur below the groundwater level. Because concrete work carried out below the groundwater level allows *washout* to occur—where the mixed concrete can be rinsed away by the water at the casting site—concrete segregation caused by water rinsing during casting is very possible and will affect the quality of concrete. This results in a decrease in concrete quality, potentially causing construction failure (Fahrizal & Lubis, 2020; EFNARC, 2015). To maintain the quality of concrete, it is necessary to add additives in this concreting process (Hernandez & Kushartomo, 2023). To increase the viscosity of concrete, additives can be added in the form of *anti-washout* agents. One such additive is *Sikacrete-W*, which can reduce washout when casting concrete under the water surface. The primary mechanism of this additive is to increase the cohesion of the concrete, reducing the likelihood of washout (Mohamed Lachemi, 2012). The use of *Sikacrete-W* additives makes the concrete solid. For ease of casting, it is necessary to add another additive, *Viscocrete-3115N*. With the use of *Sikacrete-W* and *Viscocrete-3115N*, further research is needed to determine the compressive strength of the concrete produced through sample testing with variations of *Sikacrete-W* at 3%, 5%, and 10%, and *Viscocrete-3115N* at 0.6% (Abdullah et al., 2020; Ibnu & Herlina, 2023).

Previous studies have examined anti-washout admixtures and their role in underwater concrete performance, but gaps remain in the context of bore pile casting (Sika Indonesia, 2022; Kamal et al., 2017; Ponikiewski & Gołaszewski, 2012; Wisconsin DOT, 2023). Mohamed Omar et al. (2016) explored how variations in water-to-cement ratio, silica fume, and anti-washout admixtures (AWA) affect washout resistance and compressive strength, finding that AWA significantly enhances cohesion and reduces material loss. However, this study did not address the use of commercial additives like *Sikacrete-W* and *Viscocrete-3115N*, nor did it focus on bore pile applications. Similarly, Larisch (2020) documented various defects in bored piles, such as segregation and bleeding due to insufficient admixture use, emphasizing the importance of chemical additives but without quantifying their effects on compressive strength. This research addresses these gaps by empirically testing the combination of *Sikacrete-W* and *Viscocrete-3115N* with variations of 3%, 5%, and 10% for *Sikacrete-W* and 0.6% for *Viscocrete-3115N* to determine their optimal dosage under waterlogged conditions.

The urgency of this study lies in the high risk of washout and structural defects during bore pile casting below groundwater levels, which can compromise concrete quality and lead to construction failure. Therefore, the objective is to identify the optimal admixture composition that ensures the highest compressive strength while maintaining workability. The findings are expected to provide practical recommendations for engineers and contractors, improving the performance, safety, and sustainability of bore pile construction in challenging environments.

RESEARCH METHOD

Ingredient Preparation

In this study, *ready mix* concrete material fc' 28 MPa was used with the calculation of mix design and phase value that has been determined based on the formula or graph of the *batching plant*. Aggregate testing in this study has been carried out by a batching plant that provides ready mix concrete where the results of the trial mix have been approved by the Supervisory Consultant and TPAK for the Structural Sector. The manufacture of test specimens in the form of normal concrete uses ready-mix concrete material directly without any additional additives.

Figure 1. Concrete trial mix at the batching plant

Planning of Sikacrete-W and Viscocrete 3115N Mixtures

For the manufacture of test specimens with additional additives, variations of *Sikacrete-W* with concentrations of 3%, 5%, and 10% and the addition *of Viscocrete-3115N* with a concentration of 0.6% were used

Concrete Stirring

In this study, stirring normal concrete and concrete with additional additives is carried out in stages according to the variation in proportions to be used in the study. The prepared and measured ingredients are put into the concrete mixer, *Sikacrete-W* and *Viscocrete-3115N* are put little by little until they run out into the concrete mixer, according to the set dose. The stirring process is carried out for at least 3 minutes to obtain a homogeneous mixture. Documentation of the preparation of additive additions can be seen in Figure 2.

Figure 2. Addition Preparation Sikacrete-W dan Viscocrete-3115N

The Sikacrete-W *documentation* as seen in figure 3

Figure 3. Sikacrete-W

For documentation of *Viscocrete-3115N* can be seen in figure 4

Figure 4. ***Viscocrete-3115N***

Documentation of additive pouring on the concrete mixer can be seen in figure 5

Figure 5. Additive Pouring

Slump Testing

Slump testing (*slump test*) is a test to measure and determine the level of adhesion of the fresh concrete mix produced. Slumo testing was carried out on each concrete mixture with variations of the addition of *Sikacrete-W* with concentrations of 3%, 5%, and 10% and the addition of *Viscocrete-3115N* with a concentration of 0.6%.

Figure 6. Slump Test on 3% mixture *Sikacrete-W*

Here is the documentation of the 5% Sikacrete-W mixed slump test *documentation*

Figure 7. Slump Test on 5% mixture *Sikacrete-W*

For the documentation of the 10% Sikacrete-W mixed slump test is as follows

Figure 8. Slump Test on 10% mixture *Sikacrete-W*

Manufacture of test pieces

After adding additives according to the composition of the plan and slump testing, a cylindrical test piece (15cm × 30cm) was made for each variation of the mixture. Concrete pouring is carried out in a container filled with water. The number of test specimens made is listed in the following table:

Table 1. Number of Test Pieces

Code	**Until**	**Number of test pieces (fruit)**			**Total test piece (fruit)**
		Concrete lifespan (days)			
		8	14	28	
Normal	-	3	3	3	9

Code	**Until**	**Number of test pieces (fruit)**			**Total test piece (fruit)**
		Concrete lifespan (days)			
		5	**16**	**30**	
Sikacrete-W + *Viscocrete 3115N* 0,6%	3%	3	3	3	9
	5%	3	3	3	9
	10%	3	3	3	9

Test Piece Care

The treatment of the test specimen is carried out by immersing the sample in a tub of water to avoid evaporation to avoid cracking. The immersion time depends on the life of the plan that has been established for concrete testing.

Figure 9. Test Piece Care

Compressive Strength Testing

After the test piece reaches the age specified for testing, the compressive strength test is performed as follows:

1. The test specimen is lifted from the immersion pool and then aerated.
2. The cylinder is measured starting from the diameter, height and weight of the concrete.
3. The uneven upper surface of concrete is installed.
4. After the concrete is measured and the pieces are assembled, the test specimen is placed on the pressure testing machine and then given

Figure 10. Compressive Strength Testing

Research Parameters

Here are some of the research parameters in this study, namely:

1. The compressive strength of the targeted test specimen is 28 MPa.
2. The test specimen is cylindrical with a diameter of 15 cm and a height of 30 cm.
3. The test specimen is made in 27 cylinders for a mixture of 3%, 5%, and 10% additives with 3 cylinder tests for ages 5, 16, and 30 days.
4. The additional materials used have the function of producing concrete with a very high level of cohesion and maintaining the flow properties of the mixture. *Sikacrete-W* is able to reduce the erosion of concrete during underwater concrete pouring and this *material Viscocrete 3115n* was specifically developed to produce high flowing concrete characteristics while maintaining the reference properties of flow without causing segregation, and separation of materials. However, in the study it did not reduce and increase the amount of water so that there was an increase in the slump value.
5. Concrete is assumed to be used for the construction of the Building
6. Concrete is assumed to be used in submerged conditions.

RESULTS AND DISCUSSION

Test Results

After the manufacture of the test specimen is carried out, it is continued with the testing of the compressive strength of the concrete on each test specimen with the planned mixture variation. The following table 2 is a recap of the results of the compressive strength test on Normal concrete.

Table 2. Normal Concrete Compressive Strength Test Results

Code	Dose	Average Compressive Strength of Concrete, fc' (Mpa)		
		Age (days)		
		8	14	28

Usual	0%	32,63	32,308	36,071

Meanwhile, a recap of the compressive strength test results of each variation of concrete mixture with the addition of additives is shown in table 3.

Table 3. Test Results of Compressive Strength of Concrete with *Sikacrete-W* + *Viscocrete 3115N mixture 0.6%*

Code	Dose	Average Compressive Strength of Concrete, fc' (Mpa)		
		Age (days)		
		5	16	30
Sikacrete-W +	3%	23,77	28,536	30,277
Viscocrete 3115N	5%	25,59	30,847	31,74
0,6%	10%	24,616	28,479	30,016

Based on the data above, it was found that concrete with the addition of *Sikacrete-W* + *Viscocrete 3115N* 0.6% resulted in a decrease in the compressive strength of concrete when compared to the compressive strength of concrete achieved in normal concrete. For a graph of the comparison of normal concrete compressive strength with the compressive strength of concrete with the addition of *Sikacrete-W* + *Viscocrete 3115N* 0.6% can be seen in the following figure 11.

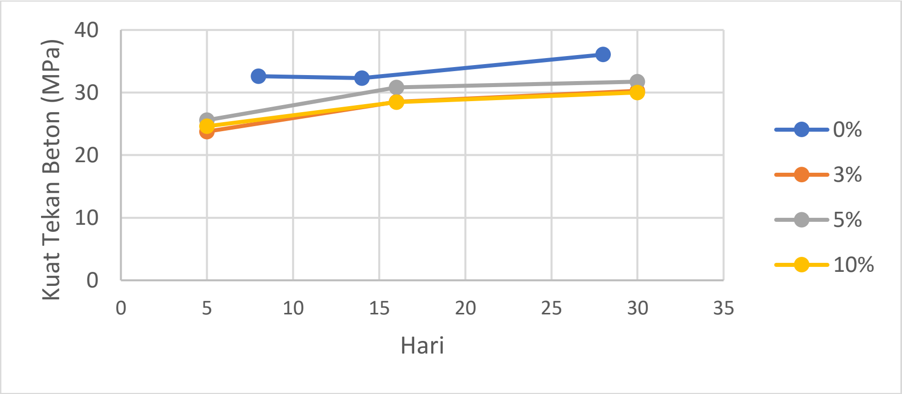

Figure 11. Compressive Strength Graph Normal concrete and Concrete with addition of Sikacrete-W + Viscocrete 3115N 0.6%

The most optimal compressive strength value of concrete is obtained in concrete with a mixture *of 5% Sikacrete-W + 0.6% Viscocrete 3115N.* It can be seen from the 5% mixed concrete compressive strength graph which is closest to the normal concrete compressive strength graph. The percentage of additive addition to concrete does not have the effect of increasing the compressive strength of the concrete which is linear, in the mixture of 10% the compressive strength of the concrete achieved experienced the greatest decrease with a value of 20.677% as can be seen in table 4.

Table 4. Percentage decrease in Compressive Strength of Concrete against normal concrete

Code	Dose	Percentage decrease in Compressive Strength of Concrete against normal concrete (%)		
		Age (days)		
		5	16	30
Sikacrete-W +	3%	37,183	24,588	19,987
Viscocrete 3115N	5%	32,373	18,480	16,121
0,6%	10%	34,947	24,738	20,677

The percentage of compressive strength of concrete achieved against the life of concrete 30 days is as follows

Table 5. Percentage of Compressive Strength of Concrete to 30 days

Code	Dose	Percentage of Compressive Strength of Concrete to 30 days of age (%)		
		Age (days)		
		5	16	30
Sikacrete-W+	3%	78,508	94,250	100
Viscocrete 3115N	5%	80,624	97,187	100
0,6%	10%	82,010	94,879	100

Based on table 5, it was found that in a mixture of 3% the compressive strength of 5-day concrete reached 78.508%, the age of 16 days reached 94.250%, for the 5% mixture the compressive strength of 5-day concrete reached 80.624%, the age of 16 days reached 97.187%, and for the mixture 10% of concrete tensile strength 5 days reached 82.010%, the age of 16 days reached 94.879%.

CONCLUSION

Based on the results of the study, several important findings were obtained: first, the average compressive strength of the test specimens with the addition of *Sikacrete-W* and *Viscocrete-3115N* additives was 0.6% lower than that of the specimens without additives. Second, the largest decrease in compressive strength in the 30-day-old test specimens occurred in the mixture with the addition of 10% *Sikacrete-W* and 0.6% *Viscocrete-3115N*, showing a reduction of 20.677%. Third, the most optimal addition of *Sikacrete-W* and *Viscocrete-3115N* 0.6% additives was achieved in a mixture of 5% *Sikacrete-W* and 0.6% *Viscocrete-3115N*, with a compressive strength value of 31.74 MPa. Future research could focus on the long-term durability, microstructural analysis, and environmental impact of these additives to develop more sustainable and high-performance underwater concrete solutions.

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