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Comparative Study of the Compressive Strength of SCC with Sika ViscoCrete 3155N and Sika SIKACIM Concrete using Destructive Testing

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Abstract

Self-Compacting Concrete (SCC) is one of the key innovations in modern concrete technology, offering the ability to flow and fill formwork automatically without the need for mechanical compaction, made possible through the use of specialized chemical admixtures. This self-flowing property is derived from the high deformability of fresh concrete. To assess these characteristics, a slump flow test is conducted to evaluate the concrete's ability to spread under its own weight. This study focuses on the uniformity of compressive strength in SCC incorporating two different types of admixtures. The concrete specimens were cylindrical, with a diameter of 15 cm and a height of 30 cm. Two types of superplasticizers SIKA ViscoCrete 3155N and SIKA Sikacim Concrete were used in the SCC mixtures for each sample group. Subsequently, the uniformity of the concrete was evaluated through destructive testing, specifically compressive strength testing, to determine the resulting compressive strength values. Based on the compressive strength tests conducted at 3 days of age, the following average values were obtained: the control (normal) concrete yielded an average compressive strength of 15.14 MPa; the SCC with 0.8% SIKA ViscoCrete 3155N achieved an average strength of 21.04 MPa; while the 2% dosage of the same admixture resulted in a lower average strength of 11.68 MPa. For SCC with 1% SIKA Sikacim Concrete, the average compressive strength was 12.78 MPa, and at 2% dosage, the average strength was 13.38 MPa.

Introduction

Self Compacting Concrete (SCC) represents a significant advancement in concrete technology, characterized by its high flowability in the fresh state (Kanellopoulos et al., 2012). Due to this property, SCC exhibits minimal to negligible slump loss. This type of concrete utilizes chemical admixtures such as SIKA ViscoCrete 3115N and SIKA Sikacim Concrete to enhance its workability (Nasution et al., 2025; Simangunsong et al., 2025). The superior flowability of SCC allows it to fill complex formwork geometries, including narrow and congested areas, without the need for mechanical vibration (Jebitha et al., 2025; Motaghed et al., 2024).

SCC was first developed in Japan in the mid-1980s and began to be widely implemented in concrete construction projects in the early 1990s (Okamura & Ouchi, 2003; Hamdi et al., 2022). Standard specimens cast separately and easily compacted may not reliably represent poorly compacted, substandard concrete placed in situ (Khan, 2024). Therefore, it is essential

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to verify that in-situ cast SCC can provide a similar level of uniformity in key properties as that achieved with conventionally vibrated concrete (Zhu et al., 2001; Hwang & Khayat, 2012; Lee et al., 2004).

Agusri & Hartoyo (2021); Jamal et al. (2018); Suria et al. (2017) said that, Concrete is a material composed of cement, coarse aggregate, fine aggregate, water, and, when necessary, chemical admixtures. In general, normal concrete is widely used in construction due to its relatively simple production process and cost-effectiveness (Qasim, 2019; Demissew, 2022; Ahmed et al., 2016; de et al., 2018). However, issues often arise during the casting process of normal concrete, such as segregation between fine aggregate, cement, and water from the coarse aggregate, particularly when the spacing between reinforcement bars is too narrow (Navarrete, I., & Lopez, 2017; Dybeł, 2021; Kovler & Roussel, 2011; Evangelista & De, 2014).

Therefore, normal concrete has undergone continuous development to meet evolving construction demands. One such advancement is the development of Self Compacting Concrete (SCC) (Hamdani et al., 2018; Goodier, 2003; Ting et al., 2019). Sika® ViscoCrete-3115® N is a third-generation superplasticizer formulated for use in concrete and mortar applications. Its mechanism involves adsorption onto the surface of cement particles, creating a steric hindrance effect that enhances particle dispersion (Xu et al., 2023; Yang et l., 2024; Uchikawa et al., 1997; Ran et al., 2009).

The admixture is free from chlorides and other substances that could induce corrosion in steel reinforcement, making it suitable for both reinforced and prestressed concrete structures without limitations. Sika® ViscoCrete-3115® N extends the workability time of concrete, and depending on the mix design and quality of constituent materials, its self-compacting characteristics can be maintained for more than one hour at a temperature of 30 °C. (Lembar Data Teknis Sika® ViscoCrete-3115® N Sika® ViscoCrete-3115® N, nd).

SikaCim® Concrete Admixture is a high-range water-reducing agent specifically formulated for the precast concrete industry, designed to meet the demand for faster formwork removal and higher early compressive strength development. It enables the concrete casting equipment to operate at full capacity. The admixture is effective across the entire range of recommended dosages (Aditif Beton SikaCim® HIGH RANGE WATER REDUCING DESKRIPSI, nd).

Methods

SCC Concrete, Concrete can be classified as Self-Compacting Concrete (SCC) if it exhibits certain characteristics, one of which is related to workability. According to SNI 1972:2008, the workability of concrete refers to the condition in which fresh concrete mixtures can be easily handled and placed. A concrete mixture can be considered as meeting the workability criteria for SCC if it satisfies the following conditions (Morib et al., 2025; Negara, 2021; Amalia & Riyadi, 2019) According to SCC specifications from EFNARC, the workability of fresh concrete mixtures can be classified as Self-Compacting Concrete (SCC) if it meets the following criteria: (1) Filling ability refers to the capability of SCC to fill the formwork completely. It is measured using the Slump Flow Test with an Abrams cone. The result is expressed as the diameter of the fresh concrete spread, typically ranging from 60 to 75 cm, as illustrated in Figure 1.

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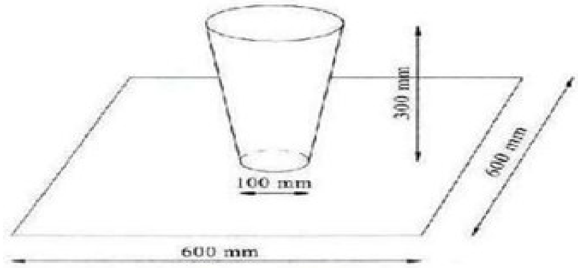

Figure 1. Slump Cone Tool

(2) Passing ability is the ability of SCC to flow through narrow spaces without segregation or blockage. This is evaluated using the L-box test. The blocking ratio (H2/H1) that satisfies the SCC criteria ranges from 0.8 to 1.0, as shown in Figure 2.

Figure 2. J-ring Tool

(3) Segregation resistance refers to the ability of the fresh concrete mixture to resist separation. To assess this property, a sieve stability test is conducted using a 5 mm diameter sieve, and the amount of fresh concrete passing through the sieve is measured. The segregation testing apparatus is illustrated in Figure 3.

Figure 3. Sieved Stability Tool

A concrete is grouped in an SCC if it has structural properties that are found in Table 1,

Table 1. Physical and mechanical properties of SCC

Property	Value Range
SCC Water-Cement Ratio (%)	25 – 40
Air Voids (%)	4.5 – 6.0
Compressive Strength (28 days) (MPa)	40 – 80
Compressive Strength (91 days) (MPa)	55 – 100

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Tensile Strength (28 days) (MPa)	2.4 – 4.8
Modulus of Elasticity (GPa)	30 – 36
Drying Shrinkage ($\times 10^{-6}$)	600 – 800

Source: Ouchi et al., 2003

Destructive Testing

The compressive strength test is a widely accepted method in concrete engineering for evaluating the mechanical performance of hardened concrete. This method is classified as destructive testing, as it involves applying compressive loads to standard concrete specimens until failure occurs, thereby allowing direct measurement of the maximum load the material can withstand. In this study, cylindrical specimens (Ø150 mm × 300 mm) were used and tested at 3 and 28 days of curing. In this study, destructive testing was conducted due to several technical and methodological considerations underlying the selection of this method for testing Self-Compacting Concrete (SCC). Firstly, destructive testing particularly the cylindrical compressive strength test provides direct and accurate data on the maximum load-bearing capacity of the concrete, which is a key parameter for assessing the structural quality of concrete in accordance with standards such as SNI 1974:2011 and ASTM C39. Secondly, since this study aims to evaluate the effects of different types and dosages of admixtures on the early-age strength of concrete, a method capable of capturing the actual mechanical response of the concrete under investigation is required. While non-destructive methods such as the rebound hammer test or ultrasonic pulse velocity are useful for field inspections, they have limitations in accurately measuring concrete strength at early ages and are less sensitive to the brittle behavior and microstructural variability characteristic of SCC. Furthermore, SCC possesses self-flowing and self-compacting characteristics that may influence aggregate distribution and the formation of internal micro-defects factors that are more appropriately evaluated through compressive strength destructive testing. Therefore, the selection of destructive testing methods is more suitable in the context of this study, as it provides results that are more representative of the overall performance of SCC. In this research, three types of concrete samples were compared: normal concrete, normal concrete with the addition of Sika Superplasticizer 3155N, and normal concrete with the addition of SIKA Sikacim Concrete, each with varying admixture dosages. All mixtures were designed and tested in accordance with SNI 1974:2011standards. The results of the compressive strength test provide the characteristic compressive strength of concrete, expressed in MPa. This value is used as a primary parameter for assessing concrete quality in construction. The test is considered more accurate in determining concrete strength because it directly measures the maximum load that the specimen can withstand before failure (Shrestha & Giri, 2023; Erzar & Forquin, 2010; Hassan et al., 2012; Qasrawi, 2000; Ozyildirim & Carino, 2006).

According to SNI 1974:2011 and ASTM C39/C39M (National Standardization Agency, 1974), the equipment used in the compressive strength testing method includes the following: (1) Concrete Cylinder Specimen, Standard cylindrical specimens with a diameter of 150 mm and a height of 300 mm (Ø15 cm × 30 cm), cast from the concrete mix to be tested. After casting, the specimens are stored and cured according to standard procedures (typically for 28 days); (2) Capping, The process of leveling the top and bottom surfaces of the concrete cylinder specimen to ensure that the compressive load applied during testing is evenly and uniformly distributed across the entire surface. This procedure is mandatory if the concrete surfaces are not perfectly flat and parallel, as surface irregularities can lead to uneven stress distribution; (3) Compression Testing Machine, This machine is equipped with a hydraulic loading system capable of applying a uniform and controlled compressive load until the specimen fails. The machine must have a load capacity appropriate for the strength of the

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concrete being tested and should be equipped with a calibrated load cell.Alat Pengukur Dimensi dan Berat; (4) Caliper and Digital Scale, Used to accurately measure the diameter and height of the test specimens; (5) Dimensional Data, Accurate measurements are essential for calculating the cross-sectional area and determining the compressive strength of concrete, expressed in MPa (N/mm²). Concrete Cylinder Molds, Cylindrical molds made of steel or rigid plastic with standard dimensions of 150 mm × 300 mm, used for casting fresh concrete prior to the curing process. Curing Support Equipment, Such as immersion tanks or steam curing chambers, used to cure the test specimens until the testing age (typically at 7, 14, or 28 days). Verification and Calibration of the Compression Testing Machine, The machine must be regularly calibrated and its performance verified, including load measurement, loading rate, and load centricity. This ensures that the compressive strength test results are reliable and accurate (*Uji_Kuat_Tekan_Beton_SNI_1974_2011*, n.d.). Furthermore, for the visualization of the Compressive Strength Test, it can be seen in figure 4. Next

Figure 4. Compressive Strength Test Visulization

Preparation of Research Materials. The materials used in this study are: Coarse aggregates, Fine aggregates, Portland cement type I, trademark "Three Wheels" with 50 kg packaging, Clean water, Superplasticizer SIKA Viscocrete 3115n, Sika SIKACIM Concrete and Sulfur. The equipment used in this study includes: Scales for weighing the weight of materials and test objects, Sieve to test aggregate gradation, Measuring cups for measuring water and Sika Viscocrete 3115n, Sika SIKACIM Concrete, A piknometer to test the gravity of the sand, Oven for drying test materials, Slump test apparatus to test slump flow values, Flat plate as a base for slump flow testing, Filters, Stopwatch, Cylindrical molds with a diameter of 150 mm and a height of 300 mm for printing test pieces, Bars and calipers to measure the dimensions of the test object, 1 set of compressive strength test equipment.

Mix Design

Concrete mix design determines the composition of materials to achieve maximum strength. The primary criteria are concrete strength and workability. The method used in this study is the trial-and-error approach.

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Slump Flow

The consistency of fresh concrete is typically assessed through a slump test. This test provides a slump value that can serve as a reference for the deformability of the fresh concrete mix, which is closely related to the level of workability. Slump Testing Procedure is carried out as follows: (1) Prepare the Abrams cone and base plate for testing.; (2) Place the clean base plate on a level surface to ensure that concrete flow is not disrupted during testing; (3) Fill a bucket with 6-7 liters of fresh SCC concrete and let it stand for approximately 1 minute; (4) While waiting, moisten the inner surface of the cone and the base plate using a damp cloth, then position the cone at the center of the plate; (5) Fill the Abrams cone with fresh SCC concrete without any tapping or vibration. Level the surface so that it is flush with the top edge of the cone. Remove any spilled concrete around the cone; (6) Lift the cone vertically in one smooth motion, allowing the concrete to flow freely. Simultaneously, start the stopwatch as soon as the cone loses contact with the base plate; (7) Stop the stopwatch when the leading edge of the flowing concrete first reaches a circle with a diameter of 500 mm. The test is considered complete when the flow stops naturally; (8) Measure the largest flow diameter (dmax) and the one perpendicular to it, with a precision of 5 mm. Clean the plate and cone after the test. The slump flow test apparatus is shown in Figure 5

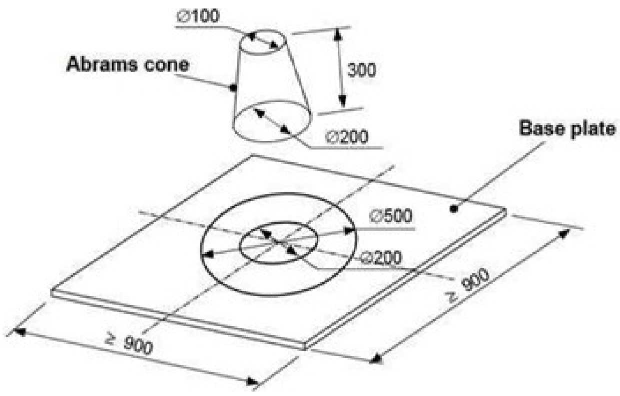

Figure 5. Slump Testing Equipment

Sieve Stability Test

The purpose of this test is to evaluate the resistance of fresh SCC concrete to segregation by measuring the amount of concrete passing through a 5 mm sieve. The greater the amount that passes through, the lower the concrete's stability. The results indicate whether the SCC mix is stable or not. The procedure is as follows: (1) Prepare a sieve with 5 mm openings, 300 mm in diameter, and 75 mm in height; (2) Prepare a weighing scale with an accuracy of ± 20 grams and a capacity of 10 kg; (3) Prepare a container with an appropriate shape and volume; (4) Fill a bucket with approximately 5 kg of fresh SCC concrete, then cover the bucket; (5) Place the bucket on a flat surface and let it rest for approximately 15 minutes; (6) Weigh the container (Wp) and place the sieve on top of it without moving the container from the scale. Tare the scale (set to zero), and pour the fresh SCC concrete into the center of the sieve from a height of approximately 50 cm; (1) Record the weight of the sample placed on the sieve (Wc); (2) Carefully lift the sieve and remove it from the top of the container without shaking it; (3) Weigh the container now containing the filtered concrete (Wps); (4) Clean the sieve and container after testing. The percentage of concrete that passes through the 5 mm sieve is calculated using the following equation:

$$SS = \frac{Wp - Wp \times}{Wc} 100 \quad (1)$$

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Tes J-Ring

This test is conducted to determine whether the fresh concrete mix can pass through the gaps between reinforcement bars or narrow formwork openings. The test procedure is as follows: (1) Prepare the SCC concrete for testing; (2) Moisten the base plate and slump cone; (3) Place the base plate on a level surface; (4) Position the J-Ring in the center of the base plate, surrounding the slump cone; (5) Fill the slump cone with fresh SCC concrete. Do not apply any compaction; simply level the top surface with a trowel; (6) Clean any spilled concrete around the cone; (7) Lift the cone vertically to allow the concrete to flow freely; (8) Measure the final spread diameter of the concrete in two perpendicular directions; (9) Calculate the average spread diameter from the two measurements (in millimeters); (10) Measure the height difference between the center area and the edge area along two perpendicular axes; (11) Determine the average height difference at four designated points (in millimeters); (12) Document any areas along the edge where mortar appears without coarse aggregate (indications of segregation). The following are the steps for preparing cylindrical concrete specimens: (1) Procure the required materials: sand, cement, and crushed stone; (2) Prepare the cylindrical mold with a diameter of 150 mm and a height of 300 mm; (3) Measure and weigh the materials according to the specified mix proportions; (4) Mix the weighed cement, crushed stone, and sand thoroughly using a mixing machine until a uniform consistency is achieved; (5) Add water according to the specified water-to-cement ratio (w/c); (6) Pour the mixed concrete into the mold corresponding to the shape and size of the test specimen; (7) Allow the mixture to dry for the hardening process. The curing method used in this study is natural (normal) curing. After 24 hours, remove the mold and immerse the concrete specimens in water for curing periods of 3 days and 28 days, starting from the time the concrete was cast.

Test Piece Care

Concrete curing was carried out after allowing the cylindrical specimens to set for 24 hours, followed by immersion in a water tank for 3 and 28 days. Concrete curing is performed once the material has reached its final setting time, indicating that it has hardened. In this study, the curing method involved submerging the cylindrical concrete specimens in a water-filled tank for the duration of the treatment period (Evert & Kushartomo, 2024; Pardede, 2020).

Sulfur Capping on the Surface

Surface capping is a critical stage in the compressive strength testing of concrete, including SCC. Properly executed capping ensures uniform load distribution, enhances the accuracy of test results, and complies with technical standards such as SNI 1974:2011 and ASTM C617. In SCC research, where results are highly influenced by procedural precision, capping must be carried out with a high degree of accuracy. Sulfur Capping Procedure Based on SNI 1974:2011 Objective: To ensure that the top and bottom surfaces of the cylindrical specimen are flat and parallel, so that the compressive load is evenly distributed during strength testing. The tools and materials required are capping material: sulfur compound mixture, electric stove or sulfur heater, heat-resistant metal melting pot, metal molds (metal rings) with a diameter matching the specimen (typically Ø150 mm), flat, heat-resistant base surface, and personal protective equipment (PPE) such as heat-resistant gloves, face shield, and adequate ventilation. The procedure steps include: (1) Preparation of Materials and Equipment: heat the sulfur compound in a metal container until it is fully melted (temperature ± 120–140°C), then prepare the metal mold (ring) and place it on a flat, heat-resistant surface. (2) Specimen Preparation: take the cylindrical concrete specimen that has completed the curing process, dry the top and bottom surfaces to remove any remaining water or debris, and place the specimen

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vertically on a flat working surface. (3) Capping Process: place the metal ring on the top surface of the concrete specimen, pour the molten sulfur into the ring until the entire surface is covered, allow it to cool and harden (approximately 2–3 minutes), and repeat the same process on the bottom surface of the specimen. (4) Final Inspection: ensure that the sulfur cap is fully hardened, smooth, crack-free, and level. Check that the thickness of the capping layer is within the allowable range (maximum 3 mm per side according to ASTM C617).

Compressive Strength Test

Before testing, the top and bottom surfaces of the concrete cylinder are capped with sulfur to ensure flat and parallel contact surfaces for accurate compressive strength measurements. The steps for testing compressive strength of concrete cylinders are as follows: (1) The cylindrical concrete specimens are removed from the curing tank after reaching the designated testing ages: 3 and 28 days, as planned; (2) The surfaces of the cylinders are cleaned from water and debris, then dried to ensure they are not slippery when placed on the testing machine; (3) The dimensions and weight of the specimens are measured, particularly the diameter and height, to ensure compliance with standards and to calculate the cross-sectional area; (4) The concrete cylinder is then positioned at the center of the base plate of the compression testing machine, standing vertically and symmetrically aligned with the loading axis; (5) The compression machine is operated, and the load is applied gradually and uniformly at a constant rate until the specimen cracks or fails completely; (6) The maximum load (P) at failure is automatically recorded by the machine (in kN); (7) The compressive strength (f'c) is calculated using the formula:

$$f'c = P / A$$

where P is the maximum applied load (in N), and A is the cross-sectional area of the specimen (in mm^2). The calculated compressive strength is then compared to the standard concrete strength requirement (e.g., K-250 = 25 MPa) to determine whether the concrete meets the required structural strength criteria

Results and Discussion

The first test result is a test of the physical properties of the material. For the results of the physical properties test are presented in the following table 2,

Table 2. Physical Properties Test Results

Materials	Testing	Result	Condition	Reference	Information
Fine aggregates	Specific gravity	2.450	1.6 – 3.2	SK SNI S-04-1989-F	OKE
Coarse aggregate	Specific gravity	2.419	1.6 – 3.2	SK SNI S-04-1989-F	OKES
Coarse aggregate	Abrasion	26.09	< 40%	SK SNI S-04-1989-F	OKE
Fine aggregates	Sludge Rate	2.041%	5%	SK SNI S-04-1989-F	OKE

Furthermore, to meet the criteria as SCC concrete, tests were carried out. testing with the following results,

Table 3. Physical Properties Test Results

Testing	Result	Condition	Information
Slump flow spread (cm)	69.2 cm	65–80 cm	OKE
J-ring flow test (cm)	–	65–80 cm	OKE
Sieved Stability Index (%)	16.78%	< 20%	OKE

The test is carried out after the concrete has undergone treatment and reaches a life of 3 days. The test results can be seen in Bar Chart. below,

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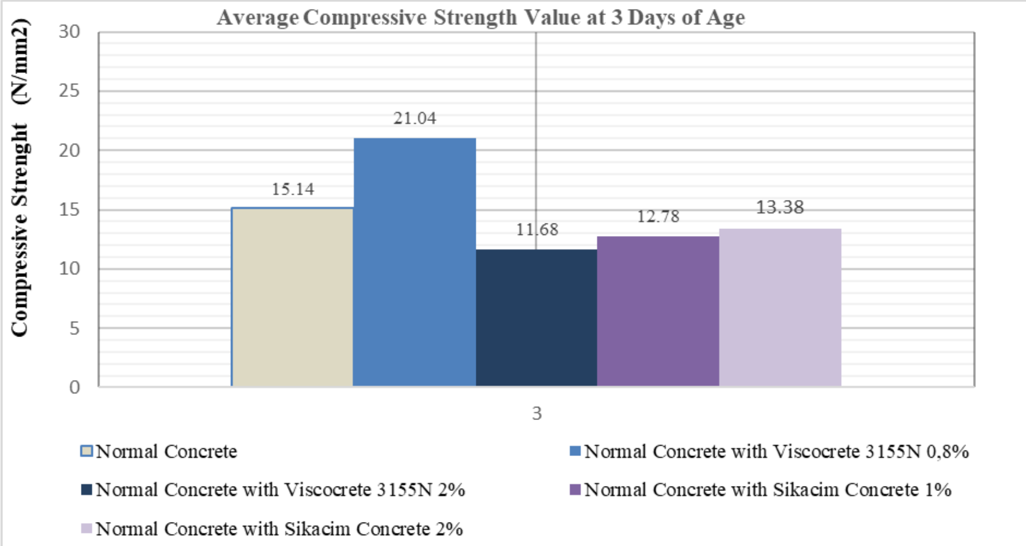

Figure 7. Comparison of Average Compressive Strength of Normal and Admixture-Modified Concrete at 3 Days

Here is a visualization of compressive strength testing on cylindrical concrete test pieces,

Figure 6. Compressive Strength Testing

Based on the test results presented in Table 4 above, there is a significant variation in the compressive strength values across different concrete mix variations. A notable difference is observed between the normal concrete and SCC at the age of 3 days. This is attributed to the inherent characteristics of SCC, which allow it to consolidate under its own weight without the need for external vibration. It is well recognized that the use of admixtures has varying effects on concrete performance. Normal concrete without any admixture achieved a compressive strength of 15.14 MPa and was used as a reference for comparison. The addition of ViscoCrete 3155N at a dosage of 0.8% yielded the most optimal result, with a compressive strength of 21.04 MPa. This indicates that at this dosage, ViscoCrete functions effectively as a superplasticizer with accelerating properties, promoting early cement hydration, enhancing concrete density, and resulting in higher early-age strength. On the other hand, when the dosage of ViscoCrete was increased to 2%, the compressive strength significantly decreased to 11.68 MPa. This reduction can be attributed to an overdosage effect, which may compromise the stability of the mix, cause segregation, or potentially result in bleeding the migration of water to the concrete surface due to excessive fluidity thereby weakening the bond between cement particles.

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Meanwhile, the use of Sikacim Concrete admixture showed a less significant effect on the improvement of compressive strength at 3 days compared to normal concrete. At a 1% dosage, the resulting compressive strength was 12.78 MPa, and at 2%, it slightly increased to 13.38 MPa. These results suggest that Sikacim, which is likely a conventional water-reducing admixture, is less effective in accelerating early strength development compared to ViscoCrete 3155N, a high-range water reducer. In fact, increasing the dosage did not result in a substantial performance gain and instead showed limited effectiveness. This indicates that both the type of admixture and the dosage used play a critical role in determining the final strength performance of concrete, particularly at an early age. Therefore, the selection of admixtures must be aligned with the intended objectives of the concrete design, and must be supported by trial mixes to determine the most effective dosage (Nursandah et al., 2018; Mulyono, 2019). The variation in the type and dosage of admixtures in concrete mixtures has a differing impact on compressive strength characteristics, particularly at the early age of the concrete. Each admixture possesses distinct chemical compositions and mechanisms of action, resulting in varying effectiveness in either accelerating or delaying the strength development of concrete.

The use of ViscoCrete 3155N, a polycarboxylate ether (PCE)-based superplasticizer, has been proven to significantly enhance compressive strength at 3 days of age, particularly at a 0.8% dosage, which yielded the highest strength of 21.04 MPa. This indicates that at this dosage, ViscoCrete performs optimally by reducing the water-to-cement ratio without compromising workability, accelerating hydration, and increasing the density of the concrete's microstructure. Conversely, increasing the dosage of ViscoCrete to 2% resulted in a decrease in compressive strength to 11.68 MPa, suggesting an overdosage effect that may disrupt mix stability and deteriorate the concrete structure at early stages. Meanwhile, Sikacim Concrete, which is considered a conventional plasticizer or normal water-reducing admixture, demonstrated a lower impact on early strength development. The compressive strengths of concrete with 1% and 2% Sikacim additions were 12.78 MPa and 13.38 MPa, respectively, both lower than that of the control (normal concrete). This indicates that Sikacim is less effective in enhancing early-age strength and may be more suitable for other purposes such as improving workability or enhancing long-term durability.

Conclusion

Based on the analysis of the influence of admixture type and dosage variation on the compressive strength of concrete at 3 days of age, it can be concluded that the use of chemical admixtures has a significant impact on early strength development. However, the effectiveness is highly dependent on both the type and quantity of admixture used. ViscoCrete 3155N, a polycarboxylate ether (PCE) based superplasticizer, was shown to be the most effective in enhancing early compressive strength, particularly at a 0.8% dosage, which resulted in the highest strength of 21.04 MPa. ViscoCrete's ability to reduce the water-to-cement ratio and accelerate cement hydration makes it superior to other admixtures for early-age performance. In contrast, the use of Sikacim Concrete, categorized as a conventional plasticizer, demonstrated lower effectiveness. At 1% and 2% dosages, the compressive strengths were 12.78 MPa and 13.38 MPa, respectively both lower than the strength of the control concrete. This suggests that Sikacim may be more suitable for improving workability or for long-term applications rather than for enhancing early-age strength. Therefore, it can be concluded that the selection of admixture type and dosage must be carefully aligned with the intended use of the concrete. Superplasticizers like ViscoCrete are more effective for accelerating early strength development acting as accelerators while plasticizers like Sikacim, which function primarily as water reducers, require further evaluation if used for similar

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purposes. Laboratory testing is essential to determine the optimal dosage and to ensure that the concrete meets the required specifications.

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