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RESEARCH ARTICLE

Benefits of Adding Corn Stalk Ash as a Substitution of Some Cement Against of Compressive Strength Concrete

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Abstract

Concrete is a very important building material used in the world of construction services, and it is generally known that the good and bad properties of concrete can be seen from its compressive strength. Concrete consists of Portland Cement (PC) or other hydraulic cement, fine aggregates, coarse aggregates, and water, with or without using additional materials. Cement is one of the main mixtures of concrete constituents composed of natural resources such as lime (CaO), Silica (SiO_3), alumina ($Al2O_3$), little magnesia (MgO), and alkali. Silica is also found in corn. according to (Roesmarkam and Yuwono, 2002) corn plants have a Silica content of 20.6%. This study aims to determine the effect of utilization of corn stalk ash on compressive strength and modulus of elasticity of concrete. Cornstalk ash is used as a partial substitute for cement, with a mixture composition of 2%, 4%, 6%, 8%, and 10%.

This study uses SNI 03-2834-2000 for mix design, with the added ingredient of 0.25% sikament NN. Cylindrical test specimen size (150 mm x 300 mm), the specimen was treated and tested at 28 days. Based on research using corn stalk ash 2%, 4%, 6%, 8%, and 10%. either without or using sikament NN the highest compressive strength at 8% is 20.8 Mpa and 20.4 Mpa, and decrease in usage of 10% corn stalk ash which is 18.2 Mpa and 18, 4 Mpa. The highest elastic modulus without or with sikament NN present in 8% ie 21656.14 Mpa and 21607.52 MPa. Modulus of Elasticity value decreased in the use of corn stalks 10% ash is 20366.28 Mpa and 20569.59 MPa. Based on the research, corn stalk ash can replace the role of part of cement in construction using corn stalk ash 8%.

Keywords : Concrete, Cornstalk Ash, Compressive Strength, Modulus of Elasticity, Sikament NN.

1. Introduction

Concrete is a very important building material used in the world of construction services, it is generally known that the good and bad properties of concrete can be seen from its compressive strength, the higher the compressive strength the better the concrete. Cement that we often encounter on the market is Portland cement, the main ingredient in making Portland cement is lime (CaO), Silica (SiO_3), alumina ($Al2O_3$), little magnesia (MgO), and alkali. Silica (SiO2) is one of the important components in making cement. In addition to the silica crust also found in plants.

Indonesia is an agrarian country where the majority of the population works in gardening and farming, one of which is corn farming. Corn is one type of agricultural crop that has the largest waste yield. Based on Roesmarkam and Yuwono (2002) maize plants have Silica content of 20.6%, so from this research was conducted by utilizing corn stalk ash as a partial substitute for cement in concrete mixtures. This is due to the presence of silica content where this content is also present in the cement content. Corn stalk ash is the ash from the combustion of corn stalks that pass the filter No.200. The components of old and ready-to-harvest corn plants consist of 38% seeds, 7% cob, 12% skin, 13% leaves and 30% stems

2. Literature Review

Corn Seed Additive Materials for Addition to Environmentally Friendly Lightweight Concrete Making". This study aims to determine the characteristics of lightweight concrete corn stalk ash and corn hump which includes weight, modulus of elasticity and compressive strength of concrete. The research was carried out by the experimental method, namely by making experiments in the form of specimens in the laboratory using corn stalk ash as an additive mixture of cement and corn cobs as a mixture of coarse aggregates in the manufacture of concrete. The results showed that 10% of the concrete with mixture of tebon corn with ash had lower compressive strength than ordinary concrete. The compressive strength at 7 days reached 92.43 kg / cm2, while at 14 days the concrete compressive strength reached 135 kg / cm2 and at 28 days, the concrete compressive strength reached 169.85 kg / cm2 or equivalent to 16.98 MPa. In the previous mix design calculation, the compressive strength of concrete at 28 days reached

25 MPa. Compressive strength Concrete with a mixture of 10% Ash is less than ordinary concrete, but concrete mixes have a more economical and lighter value.

Ahmad, et al. (2017), "Nature of Eco-friendly Concrete Workability." This research was conducted at the Material Testing Laboratory of the PTSM FTP Department. This study aims to describe in detail the workability of concrete using waste instead of cement. Fresh concrete specimens are made based on 20Mpa concrete quality with fas of 0.45. The percentage of ASP used is 0%, 5%, and 7.5% of the weight of cement.

The results of this study indicate that the higher the percentage of ASP, the slump value, the factor of density and bleeding is lower. Decreasing the slump value for 5% ASP specimens is 6.09% compared to the slump value for specimens that do not use ASP. Furthermore, 7.5% of the specimens experienced a significant decrease of 19.13% compared to the test object without ASP. But despite the decline of almost 20%.

The value of the density factor for the mixture without ASP reached 0.996 cm which decreased to 0.987 cm and 0.982 cm respectively for 5% ASP and 7.5% ASP. the decrease in the value of bleeding for specimens 5% ASP was 41.33% compared with the value of bleeding for specimens that did not use ASP. Furthermore, for 7.5% ASP test specimens decreased significantly, which amounted to 58.67% compared to the test object without ASP.

Chandra (2013), "Study of Stress Strength and Modulus of Elasticity of Concrete with Addition of Corn Bark As Additive". This study was conducted to determine the feasibility of corncob waste as an additive material in concrete mixtures for Type I cement and how much influence the corn cobs ash influence on the strength of concrete pressure and modulus of elasticity in concrete. This study uses concrete mortar planning using ACI 211.1-1991 with a cement water (fas) factor of 0.54 and a variation in the ratio of addition of corn cobs to the weight of cement 4%, 8% and 12%.

The results showed that the concrete with hump ash had a high pressure compared to normal concrete. The results of the strong score urged 56 days at BN: 36.46 MPa; BJ4%: 37.67 MPa; BJ8%: 34.88 MPa; BJ12%: 34.28 MPa. While the modulus of elasticity of corncob ash concrete is greater than normal concrete. The results of the modulus of elasticity of corncob ash concrete are 0%, 4%, 8%, and 12% respectively at 23634.61 MPa; 23886.83 MPa; 24407.83 MPa; 23653.23 MPa.

Oladipupo (2012), "Strength Properties of Corn Cob Ash Concrete". This study aims to increase the reduction of corn waste and reduce the cost of producing concrete by using locally available ingredients. Compressive strength testing from this study shows that 10% of CCa as a substitute for cement is satisfactory in compressive strength requirements for a concrete mixture ratio of 1: 2: 4 at 7 days. However, it does not meet the standard strength at 14, 21 and 28 days. The use of 20% CCA for cement does not meet the strength requirements at all. CCA can be used as a partial substitute for cement in high-strength concrete, but CCA Concrete will take longer to achieve the strength designed and needed.

The results of the testing of compressive strength with the use of 10% CCA at the age of 7 days, 14 days, 21 days, and 28 consecutive days amounted to 13.18 MPa; 15.41 MPa; 19.41 MPa; and 20.00 MPa. While for testing compressive strength with the use of CCA 20% at the age of 7 days, 14 days, 21 days, and 28 consecutive days amounting to 9.18 MPa; 10.96 MPa; 12.74 MPa; and 13.78 MPa.

Novan (2010), "Effect of Concrete Press Strength with Addition of Sikament NN". This study aims to prove the effectiveness of the material added by Sikament NN on the compressive strength of concrete. The results of the study show that the age of the concrete also affects the addition of concrete compressive strength with the addition of Sikament NN at a dose of 1.5% of the weight of cement in a variation of 20% water reduction, i.e at 3 days there is an increase in concrete compressive strength of 3.3% of the concrete plan, the age of 14 days there was an increase in the concrete compressive strength of 28% of the planned concrete and the age of 28 days an increase of 48.13% of the concrete plan. Thus the test results turned out that Sikament NN with a dose of 15% at 28 days could reduce concrete compressive strength amounting to 48.13%.

Ramanuddin (2010), "Effect of Fineness and Levels of Rice Husk Ash on the Strength of Concrete with a Compressive Strength of 50Mpa." This study aims to determine the effect of using rice husk ash on the strength of concrete with different levels of fineness and content. split was carried out with cylindrical specimens with a diameter of 100 mm and a height of 200 mm.The addition of rice husk ash in this study was 5, 10, 15, 20, and 25% of the weight of cement.

The partial substitution of rice husk ash against cement was 5, 10, 15, 20 and 25% The optimum level of addition of rice husk ash is 10% of the weight of cement which results in a compressive strength of 47.82 MPa.The optimum partial substitution of rice husk ash is 10% of the weight of cement which results in a compressive strength of 51.71 MPa. optimum superplasticizer (Structuro 335) of 1% of the weight of cement which produces a compressive strength of 51.71 MPa.The best size of fineness is rice husk ash which passes the filter no 200 which produces a compressive strength of 51.71 MPa.

Table 4.1 Results of the percentage of fine aggregate escapes.

Sieve Number	$1\frac{1}{2}$	¾	½	3/8	#4	#8	#16	#30	#50	#100	#200
Sieve Size (mm)	38	19	12,7	9,6	4,8	2,4	1,2	0,6	0,3	0,15	0,075
Pass (%)	100	100	100	100	99,952	83,302	59,881	39,765	21,414	8,426	3,824

3. Research Methods

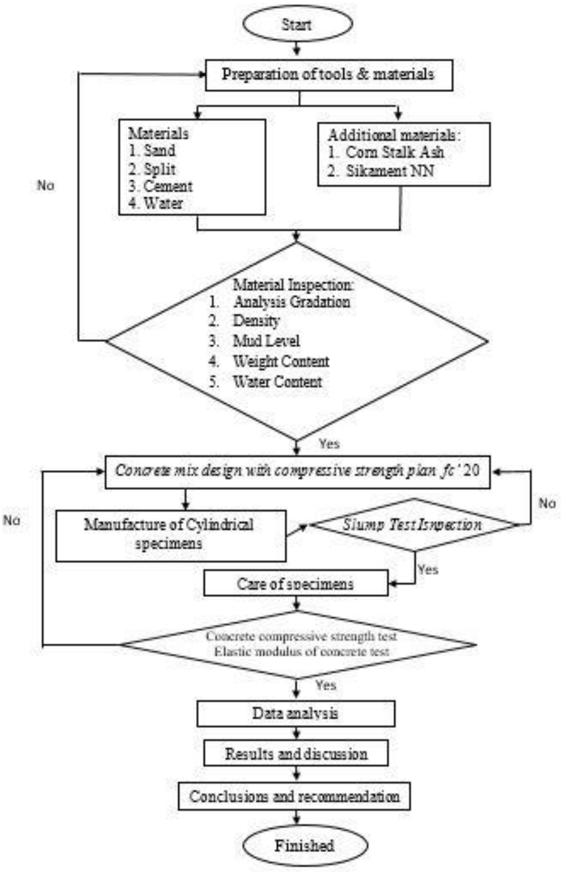

Fig. 1 Flowchart

4. Results And Discussion

4.1 Results of Fine Aggregate Examination

Fine aggregate gradation is expressed by the percentage value of the amount of fine agate left or through a 4.8 mm filter arrangement. Sand filter gradation analysis in sand area No.I, sand gradation boundary in sand area No.II, sand gradation boundary in sand area No.III, and sand gradation boundary in No.IV sand area. The results of filter analysis can be seen in Table 4.2 below. From Table 4.2 it can be seen that the percentage of fine aggregate escapes meets the zone II fine gradation requirements. Results can be seen in the size filter 0.15 mm the percentage of escape is 8.43%. Filter size 0.3 mm the percentage of escape is 21.52%. Filter size of 0.6 mm the percentage of escape is 39.76%. The 1.2 mm size filter passes the percentage of 59.88%. Screen size of 2.4 mm the percentage of escape is 83.30%. Screen size of 4.8 mm the percentage of escape is 99.95%. The size of the filter is 9.6 mm, the percentage is 100%, the size of the filter is 19 mm, the percentage is 100%, and the size of the filter is 38 mm, the percentage is 100%. Data can be seen that the percentage of passing through the fine aggregate filter is between the smooth zone II zone boundaries, namely the minimum and maximum limits for each filter size.

Table 4.2 Results of the percentage of fine aggregate escapes.

Table 5.1 The Results of percentage of sand pass.

Sieve Number	$1\frac{1}{2}$	¾	½	3/8	#4	#8	#16	#30	#50	#100	#200
Sieve Size (mm)	38	19	12,7	9,6	4,8	2,4	1,2	0,6	0,3	0,15	0,075
Pass (%)	100	100	100	100	99,952	83,302	59,881	39,765	21,414	8,426	3,824

4.2 Results of Rough Aggregate Examination

The results of the pass percentage can be seen in table 4.2 and the results of filter analysis with a gradation limit for a maximum grain size of 40 mm. By using a combination of coarse aggregate size 2/3 as much as 65% and coarse size 1/2 size as much as 35%. The results of filter analysis can be seen in Table 4.3 below.

Table 4.3 Results of percentage pass rough aggregate 2/3 and coarse aggregate ½

Sieve Number	$1\frac{1}{2}$	¾	3/8	#4	#8	#16	#30	#50	#100	#200
Sieve Size (mm)	38	19	9,6	4,8	2,4	1,2	0,6	0,3	0,15	0,075
Pass (%)	100	96,69	16,66	5,84	4,67	4,43	4,28	4,05	3,31	2,58

From Table 4.3 it can be seen that the percentage of rough aggregate passes with a 0.15 mm sieve has an escape percentage of 3.31%. The size filter 0.3 mm the percentage of escape is 4.05%. Size filter 0.6 mm pass percentage of 4.28%. The 1.2 mm size filter passes the percentage of 4.43%. The 2.4 mm size filter passed the percentage of 4.67%. The size filter is 4.8 mm, the pass percentage is 5.84%. And for the filter size of 9.6 mm the percentage of escape is 16.66%. The 19 mm size filter passes the percentage of 96.69% and the size of the 38 mm filter the percentage passes by 100%.

4.3 Inspection of Specific Gravity and Material Absorption.

Examination of specific gravity and water absorption of material is carried out to determine the saturated surface dry dry density and to obtain bulk density, and apparent density. The results of the examination can be seen in Table 4.4 below.

Table 4.4 Results of examination of specific gravity and material absorption.

Material	Apparent density	Saturated surface density	Density	Absorption (%)	Explanation
Split 2/3	2,698	2,624	2,581	1,688	Qualify
Split ½	2,660	2,582	2,535	1,850	Qualify
Sand	2,655	2,582	2,538	1,729	Qualify

Based on Table 4.4 it can be seen that the saturated surface density of the coarse aggregate 2/3 is obtained 2.624, the saturated surface density of the coarse aggregate 1/2 is 2.582 and the density of the fine aggregate surface is 2.582. based on the value of the specific gravity of the material can meet the standard specifications for density, 2.58 to 2.83 gr / cm3 (Tjokrodimuljo, 1995). The dry density of the saturated surface is a handle for obtaining the aggregate density of the mixture which will be used to determine the approximate weight of the concrete in m³.

4.4 Results of Checking Mud Levels

Examination of this sludge uses the aggregate addition method that passes filter # 200 (0.075) which is intended as a reference in the handle to carry out the test and to do the amount after washing the test material, the results of the examination can be seen in Table 4.5 below.

Table 4.5 Results of aggregate sludge examination results.

Material	Mud Level %	Explanation
Spilt 2/3	0,709	Qualify
Split ½	2,581	Unqualify
Sand	3,824	Qualify

Source : Results of research analysis.

Based on Table 4.4 it can be seen that fine aggregates and coarse aggregates of 2/3 contain the levels of sludge in a safe state used for mixture of concrete mixtures, which according to SNI 03-6821-2002 for fine aggregate sludge content is 3.824% <5%, for coarse aggregate sizes 2/3 obtained 0.709% <1%, whereas for 1/2 size coarse aggregates in conditions that do not meet the conditions where the sludge content for 1/2 coarse aggregate is 2.581%> 1%, so coarse aggregate material 1/2 needs to be washed before use.

4.5 Results of Water Content Checks

Checking the water content aims to obtain a percentage of the water content contained in the aggregate, the results of the moisture content can be seen in Table 4.6 below.

Table 4.6 Results of aggregate water content checks.

Material	Water content (%)
Split 2/3	0,951
Split ½	1,123
Sand	3,525

Based on Table 4.6 it can be seen that after conducting a material check, the highest water content is found in fine aggregate of 3.525%. While the lowest water content is roughly 2/3 aggregate of 0.951.

4.6 Content Weight Check Results

Content weight is the ratio between the weight of the dry aggregate and its volume. The results of the examination of the weight of material contents can be seen in Table 4.7 below.

Table 4.7 Results of weight content checks.

Material	Weight content (gr/cm³)	
	Loose condition	Solid condition
Split 2/3	1,377	1,574
Split 1/2	1,420	1,584
Sand	1,318	1,497
Cement	0,364	0,961
Corn stalk ash	0,312	0,807

Based on Table 4.6 it can be seen that after examining the material, the highest content weight in loose conditions and solid conditions is found in the coarse ½ aggregate material which is equal to 1.420 gr / cm3 for loose conditions and 1.584 gr / cm3 for solid conditions. Whereas for the lowest content of weight is found in corn stalk ash which is equal to 0.312 gr / cm3 for loose conditions and 0.807 gr / cm3 for solid conditions.

4.7 Results of Concrete Mixing Inspections (SK SNI 03-2834-2000)

Planning concrete mix (mix design) aims to determine the proportion of the mixture between cement, fine aggregate, coarse aggregate and water. The results of planning mix (mix design) concrete for each m3 before correction of moisture content can be seen in table 4.7.

Table 4.7 Proportion of concrete mix (mix design) for each m3 after correction of SSD water content.

Mixed Proportion	Cement (kg)	Water (kg)	Sand (kg)	Split (kg)
Each M³	362,745	185	670,277	1141,282
Each 1 Zak of cement	50	25,5	92,390	157,312
Each mixed compotition	1	0,51	1,848	3,146

Based on table 4.7, it can be seen the use of cement, water, fine aggregate, and coarse aggregate in each m³, each 1 piece of cement and each mixture composition. After correction of water content, the proportion of concrete mixture for 3 cylindrical specimens can be seen in table 4.8.

Table 4.8 Proportion of concrete mixture (mix design) for 3 slinder specimens of size 15 cm x 30 cm after correction of water content

No	Mixed Material	The proportionn of mixture one time stir (kg)
1	Cement	7,509
2	Water	3,753
3	Split 2/3	15,243
4	Split ½	8,209
5	Sand	14,124
6	Sikament NN (0,25%)	0,0188

Based on table 4.8, it can be seen the proportion of concrete mixture used for 1 time stirring. This proportion is calculated according to the form and number of samples used. Can be seen for 3 cylindrical specimens needed Semen 7,509 Kg; Water 3,753 Kg; Coarse aggregate 2/3 15,243 Kg; Coarse Aggregate ½ 8,209 Kg; Fine Aggregate 14.124 Kg; and Sikament NN 0.0188 Kg.

4.8 Results and Analysis of Concrete Slump Values

The results of the examination of the slump test are aimed at checking the change in water content in the concrete mixture, while the slump value is intended to determine the workability of the concrete in accordance with the conditions specified, the lower the slump value, the thicker the concrete and the process compaction or concrete work will experience difficulties and take a long time. Meanwhile, the high slump value indicates that the concrete is runny, in the process of processing or compaction it is easier to implement and does not require a long time in the compaction process. The value of concrete slump with a mixture of corn stalk ash can be seen in table 4.9 and table 4.9.

Table 4.9 Concrete Slump Value with Corn Mixture of Corn without Sikament NN using 0.51 Cement Water Factor.

No	Percentage of corn stalk ash	Slump Value (mm)	Average Slump (mm)
1	0 %	110	146,7
		155	
		145	
2	2 %	120	135
		150	
		135	
3	4 %	70	115
		90	
		115	
4	6 %	70	85
		90	
		95	
5	8 %	45	53,3
		65	
		50	
6	10 %	40	38,3
		30	
		45	

Based on the results of research data in table 4.9 graphs can be made as shown in 4.1.

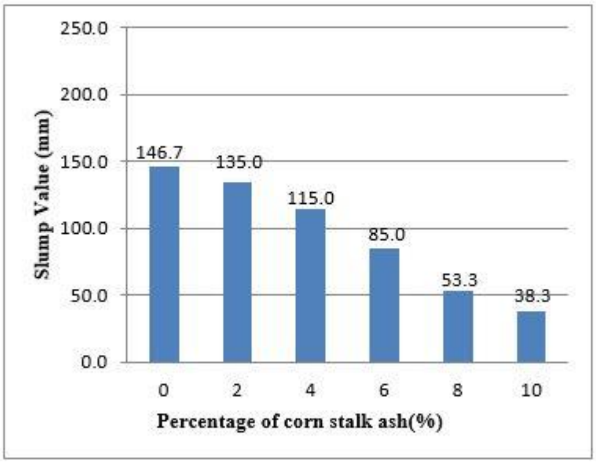

Fig 4.2 Graph of Relationship of Percentage of Corn Stems to Slump Value.

From Fig. 4.2, it can be seen that in normal concrete without mixture of corn stalk ash the slump value according to the requirements is 60 <146.7 <180, and it can be seen the higher the percentage of ash use, the smaller the slump value obtained, this proves that the use of ash corn stalk makes concrete stiff can be seen in the mixture of corn stalk ash slump value of 38.5.

Table 4.10 Concrete Slump Value with Mixture of Corn Corn + Sikament NN using Cement Water Factor 0.51.

No	Percentage of corn stalk ash	Slump Value (mm)	Slump Average (mm)
1	0 %	170	226,7
		270	
		240	
2	2 %	170	213,3
		260	
		210	
3	4 %	120	163,3
		130	
		160	
4	6 %	120	136,7
		130	
		160	
5	8 %	90	103
		120	
		100	
6	10 %	80	96,7
		120	
		90	

Based on the results of the research data in table 4.10 a graph can be made as shown in fig 4.2.

From Fig. 4.2 it can be seen that the addition of 0.25% of NN to the weight of cement has a large effect on the concrete stress. Can be seen in normal concrete without a mixture of corn stalk ash obtained slump value becomes very high beyond the normal limit, while for concrete with a mixture of 10% ash which previously has a value under the condition after given sikament NN has a slump value according to the requirements, namely 60 <96.7 <180.

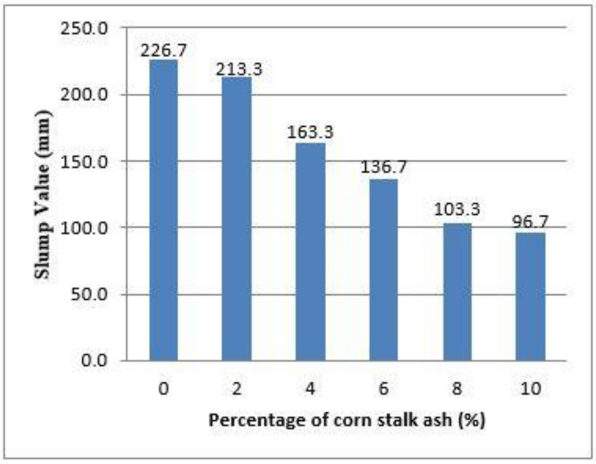

Fig. 4.3 Graph Relationship Percentage of Corn Rod + Sikament NN to Slump value.

4.9 Results of Concrete Press Strength Analysis

The concrete compressive strength test was carried out after the curing period of the 28-day old specimen, for each stirring of normal concrete and concrete with a mixture of corn stalk ash both with an additional 0.25% Sikament NN to the weight of the cement and without Sikament NN.

Table 4.12 Strong Concrete Press Test Results with a Mixture of Corn Rod Corn.

Age of concrete treatment (Days)	Compressive strength (Mpa)				
	2%ABJ	4%ABJ	6%ABJ	8%ABJ	10%ABJ
28	19,533	20,382	20,948	20,948	18,401
28	20,099	19,816	20,382	21,515	18,967
28	18,967	20,382	21,515	21,231	18,967
fc'r	19,533	20,193	20,948	21,231	18,778
fc'k	18,064	19,657	20,020	20,767	18,242

Based on the results of research data in table 4.11 graphs can be made as shown in 4.3.

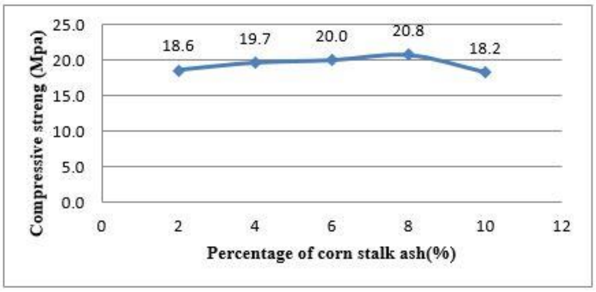

Fig. 4.4 Relationship of Percentage of Corn Stems Against Concrete Compressive Strength Without Sikament NN.

Each compressive strength is carried out at 28 days. It can be seen that the higher the percentage of the use of corn stalk ash, the higher the compressive strength obtained, but when the use of corn stalk ash is 10% the compressive strength decreases. Can be seen in the graph that the compressive strength reaches the maximum value in the mixture of 8% corn stalk ash, and decreases again at 10%. This proves that the level of silica in 10% corn cannot replace the role of 10% cement in a concrete mixture.

Table 4.13 Concrete Press Strength Test Results with Mixture of Corn Corn + Sikament NN.

Age of concrete treatment (Days)	Compressiev strength (Mpa)				
	2%ABJ + Sikament NN	4%ABJ + Sikament NN	6%ABJ + Sikament NN	8%ABJ + Sikament NN	10%ABJ+ Sikament NN
28	19,250	19,816	20,665	21,231	19,250
28	20,099	19,533	20,382	21,515	18,648
28	19,816	20,099	20,099	20,665	19,533
fc'r	19,722	19,816	20,382	21,137	19,155
fc'k	19,012	19,352	19,918	20,428	18,446

Based on the results of research data in table 4.12 graphs can be made as shown in Fig. 4.4.

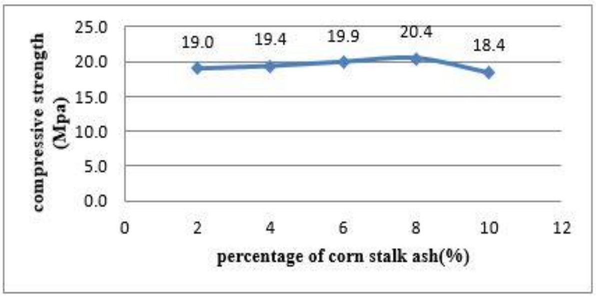

Fig. 4.5 Relation of Percentage of Corn Stem Ash to Concrete Strength + Sikament NN.

Each compressive strength test was carried out at 28 days. It can be seen in the graph that the addition of 0.25 percent of NN to the weight of cement does not affect the concrete compressive strength. Based on the graph the higher the percentage of the use of corn stalk ash, the higher the compressive strength obtained, but when the use of corn stalk ash 10% press decreased again. In table 4.12 the compressive strength of concrete reaches the maximum value also found in the mixture of 8% corn stalk ash which is 20.4 Mpa, and has decreased again at 10%, which is 18.4 Mpa.

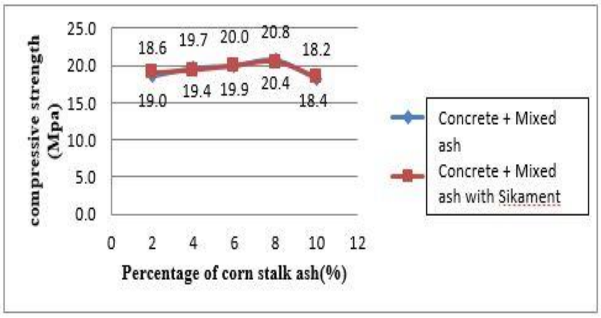

Fig. 4.6 Relationship of Percentage of Corn Mixture Concrete Concrete Without Sikament NN with Concrete Mixture of Corn Corn + Sikament NN.

It can be seen that in the use of corn stalk ash in the concrete mixture using or not using Sikament NN, the highest compressive strength was obtained by the percentage of the use of ash 8%. To be more clear, can be seen in Fig. 4.5.

Based on the picture, we can see that there is an increase in the quality of the percentage of 2% of the mixture of corn stalk ash to reach a maximum of 8% in the mixture of corn stalk ash. Here we can see that the silica content possessed by corn can almost react as a substitute for the function of cement at 8%, but experiences a decrease in quality at 10% due to the high level of reduced cement content. However, the optimum value achieved at 8% of the use of corn stalk ash is still not able to reach the compressive strength of the 21 Mpa plan.

4.10 Results of Modulus Analysis of Concrete Elasticity.

The testing of concrete elasticity modulus is carried out after the curing period of the 28-day-old test object, testing the elastic modulus is carried out simultaneously when testing the concrete compressive strength.

Table 4.14 Elastiitas Concrete Modulus Test Results with a Mixture of Corn Stems

Age of concrete treatment (Days)	Modulus of elasticity (Mpa)				
	2%ABJ	4%ABJ	6%ABJ	8%ABJ	10%ABJ
28	20772,14	21218,91	21511,60	21511,60	20161,06
28	21071,04	20922,13	21218,91	21800,36	20468,88
28	20468,88	21218,91	21800,36	21656,46	20468,88
Ec Average	20770,69	21119,98	21510,29	21656,14	20366,28

Source : Results of research analysis.

Based on the results of the research data in table 4.13, a graph can be created like Fig. 4.6.

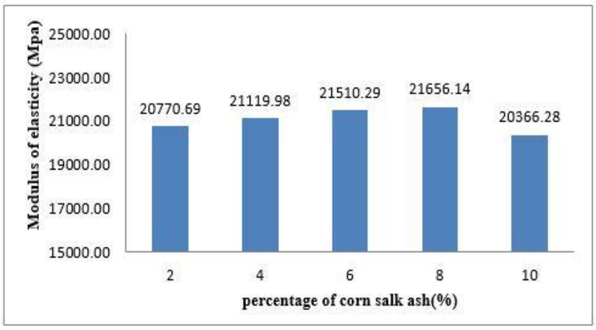

Fig. 4.7 Relationship of Percentage of Corn Stems Against Modulus of Concrete Elasticity.

It can be seen in Fig. 4.6 that the higher the percentage of the use of corn stalk ash, the more rigid the concrete is obtained, but it can be seen in the use of corn stalk ash 10% the level of concrete stiffness decreases. Based on the graph of the Modulus value, the highest elasticity is found in the mixture of 8% ash, which is 21656.14 Mpa and gets a minimum value of 10% mixture, namely 20366.28 Mpa.

Table 4.15 Modulus of Concrete Elasticity Test Results with Mixture of Corn Corn + Sikament NN.

Age of concrete treatment (Days)	Modulus of Elasticity (Mpa)				
	2%ABJ + Sikament NN	4%ABJ + Sikament NN	6%ABJ + Sikament NN	8%ABJ + Sikament NN	10%ABJ+ Sikament NN
28	20621,07	20922,13	21365,,75	21656,46	20621,07
28	21071,04	20722,14	21218,91	21800,36	20315,56
28	20922,13	21071,04	21071,04	21365,75	20722,14
Ec average	20871.41	20921,77	21218,57	21607,52	20569,59

Source : Results of research analysis.

Based on the results of the research data in table 4.14 graphs can be made as shown in 4.7.

Can be seen in the graph, the mixture of corn stalk ash with the addition of 0.25% Sikament NN to the weight of cement has increased stiffness from the level of use of corn stalk ash 2% to 8% use of corn stalk ash, but the stiffness of concrete decreased on the use of corn stalk ash of 10 %. From this it can be seen that the optimum use of corn corn stem ash is at the level of 8%. Based on the graph of the Modulus value, the highest elasticity is found in the percentage of mixture of 8%, which is 21607.52 Mpa and the minimum value is at the percentage of 10%, namely 20568.59 Mpa. From table 4.13 and table 4.14 it can be seen that the use of sikament NN does not affect the modulus of elasticity of concrete.

4.11 Research Comparative Results with Previous Researchers

Previous research that will be compared with this research is Chandra (2013). The research that the authors do is that there are differences in the type of ash and the percentage of ash use, where previous researchers used corn cobs with a percentage level of 4%, 8%, and 12%. In addition there are differences where the previous researcher conducted a test of the strength of pressure and modulus of elasticity while testing this for compressive strength and modulus of elasticity. Based on that, a comparison is made to test the concrete elastic modulus as in table 4.15.

Table 4.16 Research Comparative Results with Previous Researchers.

Percentage of corn stalk ash	Result of modulus of elasticity test (Mpa)	
	Researcher, 2018	Chandra, 2013
2%	20770,69	-
4%	21119,98	23886,83
6%	21510,29	-
8%	21656,14	24407,83
10%	20366,28	-
12%	-	23653,23

Source : Results of research analysis.

In this study and previous research (Chandra, 2013) have differences in the quality of plans and materials used.

The results of modulus of elasticity analysis in this study showed the highest value was found in the percentage of 8% use of corn stalk ash, namely 21656.14 MPa and decreased in the percentage of use of corn stalk ash 10%, whereas the analysis of modulus of elasticity in previous studies (Chandra, 2013) the highest value was found in the percentage of 8% corn weevil ash use which was 24407.83 Mpa and decreased in the percentage of use of corn weed ash 12%, it can be concluded from the results of this study with previous research (Chandra, 2013) that the percentage of use of corn ash is good corn as well as corn stalk ash reached the maximum modulus of elasticity at 8%.

5. Conclusions And Suggestions

5.1 Conclusions

- Based on the research, the higher the percentage of corn stalk use as a substitute for cement, the higher the compressive strength obtained, but the use of corn stalk ash 10% compressive strength decreased. Can be seen in the use of 8% corn stalk ash concrete strength of 20.8 Mpa and the use of 10% corn stalk ash compressive strength of 18.2 Mpa. The silica content possessed by new corn can almost react as a function of cement at 8%, but experiences a decrease in quality at 10% due to too high levels of reduced cement content. It can be seen that the optimum level of use of corn stalk ash as a partial substitute for cement is at 8%.
- Based on research, the stiffness of concrete increased from the use of 2% corn stalk ash to 8% use of corn stalk ash, but decreased stiffness in the use of 10% corn stalk ash. Can be seen in the use of 8% corn stems obtained Modulus of Elasticity of 21,656.14 Mpa and the use of 10% of corn stalks obtained Modulus Elasticity value of 20,366.28 Mpa.
- The optimum compressive strength in this study was reached at the percentage mixture of 8%, with a compressive strength of 20.8 Mpa.
- It can be seen that corn stalk ash can replace the role of part of cement in a concrete mixture with a level of use of 8% corn stalk ash.

5.2 Suggestions

- Further research is needed using corn stalk ash using a percentage level of between 7% and 9%.
- For further research, it is recommended to do a detailed study of the chemical elements of corn stalks in order to determine a good percentage level.

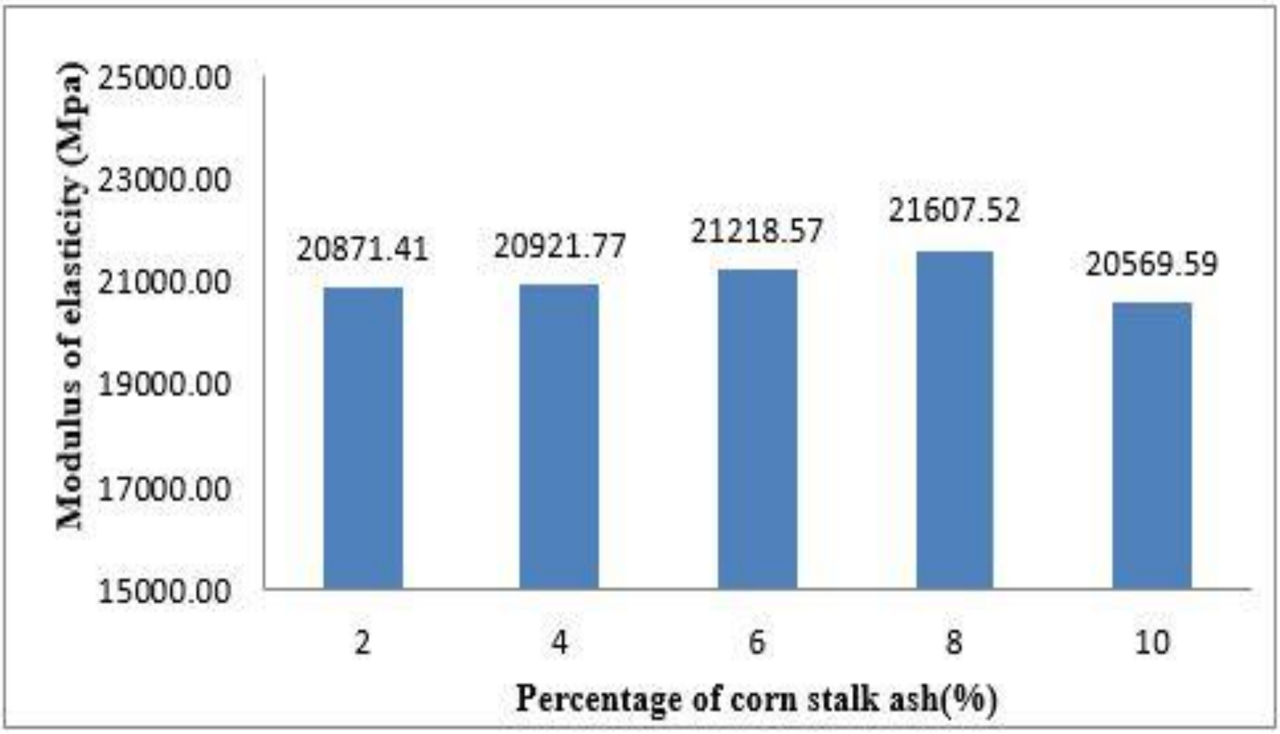

Fig. 4.8 Relationship of Percentage of Corn Stems + Sikament NN Against Modulus of Concrete Elasticity.

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