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Strength properties evaluation of composite blocks incorporated with *Acacia nilotica* ash

Rajagopal Shanmugam[1], Rajendran Selvapriya[2], Muthukumar Soundar Rajan[3] and Sampath Anand kumar[3]
[1]Professor, Department of Civil Engineering, Muthayammal Engineering College, Rasipuram.
[2]Assistant Professor, Department of Civil Engineering, Muthayammal Engineering College, Rasipuram.
[3]Assistant Professor, Department of Civil Engineering, Sengunthar Engineering College, Tiruchengode.
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*to whom all correspondence should be addressed: e-mail: shanmugamrgeo@gmail.com
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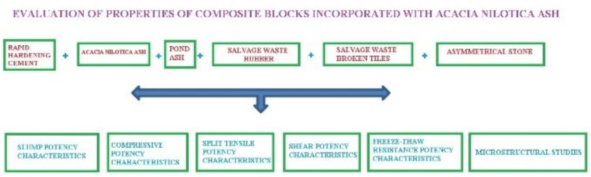
Graphical abstract



Abstract

Owing to the order of the day, we are searching for an eco-friendly binding ingredient instead of cement, which is now universally used in concrete. Almost everyone extensively exploits construction materials due to their good durability and compressive characteristics. The present study examines the use of *Acacia nilotica* ash as a cement substitute. It is known that *Acacia nilotica`s* aggressive roots are extremely presumptuous and invasive and spoil the foundation of buildings. By gripping water from adjoining areas, they change soil nitrogen and are a major source of affecting plant growth. In this work, the M_{35}-grade geocomposite was investigated by incorporating *Acacia nilotica* ash at 0%, 2.5, 5%, 7.5%, 10%, 12.5%, and 15% for fly ash. Mechanical and durability studies were carried out by changing the magnitude of *Acacia nilotica* ash and evaluating it with the standard composite samples.

Keywords: *Acacia nilotica* ash; Pond ash; Salvage waste rubber; Salvage waste broken tiles, Environmental sustainability.

1. Introduction

In the current scenario globally, we are utilising concrete, and it plays a vital role in the primary structural and construction activities of buildings, roads, bridges, canals, dams, etc. Concrete predominantly consists of cement, fine aggregate, and coarse aggregate, and as an internal element of every kind of infrastructure activity, utilising composites is inevitably appropriate to the augmentation of infrastructure. Concrete characteristics mainly rely on the attributes of aggregates. [Adamu, M. *et al.* 2023; Aginam *et al.* 2021; Uttu A J. *et al.* 2022] The potential of concrete pivots on the properties of aggregates to ease the utilisation of its ingredients. In the process of eliminating the usage of cement as a binding ingredient by exploiting other pozzolanic materials like fly ash, bagasse ash, and rice husk ash, in this work, *Acacia nilotica* ash is substituted with cement in an assured quantity to manufacture good-quality concrete. [Ahmed, J. U. *et al.* 2021; Arife, C.A.Z. *et al.* 2017; Baffa, A. A. *et al.* 2022] Concrete is a composite with versatility that is utilised in an array of structural elements. [Harun Mallisa and Gidion Turuallo 2017; Madumelu, M. *et al.* 2022; Mahdi Rafieizonooz a *et al.* 2016] Globally, the order of the day necessities focused amendment in expansion exercises. [Rajesh Guna R. and Mariappan M. 2023; Santosh Bharathy V. and Arun Kumar S. 2018; Sathish Kumar K. and Dilli Babu S. 2015] The development process suggests that construction progresses to significant expansion with government and private infrastructure expansion, including railway lines, road construction, airports, navigational works like ports, harbours, dams, and plentiful new noteworthy activities. To keep the infrastructure in vogue, we necessarily go with the use of concrete composites to achieve stupendous, awesome structures with compliant and normally exploited expansion.

This paper focuses on finding optimal utilisation and establish the effectiveness of *Acacia nilotica* ash and crumb rubber for constructing civil engineering works. Identifying the fresh concrete chattels in incorporating crumb rubber and *Acacia nilotica* ash in concrete. Verifying the prospects of incorporating crumb rubber and *Acacia nilotica* ash in concrete composite mixes. The paramount objective of the present investigation is to exploit the repercussions of utilising throwaway derivatives of *Acacia nilotica* ash to partially surrogate cement, salvage waste rubber, partially surrogate fine aggregate, salvage waste broken tiles, and partially surrogate coarse aggregate. In this work, *Acacia nilotica* ash usage in concrete was investigated by J. Thanga Murugesan and C.J.Ganga lakshmi (2018) the attributes and characteristics of incorporating *Acacia nilotica* ash instead of cement in concrete in diverse proportions ranging from 0% to 15%, with an incremental increase of

2.5% in M_{30} grade. In this research, mechanical properties were assessed, and it was found that the characteristic strength was amplified, commencing with 7.5% to 12.5%, by incorporating *Acacia nilotica* ash instead of cement. [Arife C. A. Z. *et al.* 2017; Santosh Bharathy V. and Arun Kumar S. 2018]. Based on data from Santosh Bharathy, *et al.* (2018) it was established that *Acacia nilotica* ash usage in concrete was investigated as attributes and characteristics of incorporating *Acacia nilotica* ash instead of cement in concrete in diverse proportions, starting with 2%, 10%, and 15%. On the outcome of the investigation, it was assessed that a 10% incorporation of acacia ash would be optimal for the characteristics of bricks. Also, its production cost was reduced by 40% in comparison with standard clay bricks. In examining the strength properties of concrete, Mohd. Mohsin khan, et al *et al.* (2017) also looked into the crumb rubber usage in concrete was investigated, as were the attributes and characteristics of incorporating crumb rubber instead of fine aggregates with diverse proportions of 5%, 10%, and 15%. The outcome of the investigation established that usage of crumb rubber may be incorporated up to a certain quantity only and concluded that it was not desirable beyond 5%, which is optimal. The outcome of the investigation emphasises that the utilisation of 5% rubber in the mortar provides optimal compressive characteristics by Sulagno banerjee, *et al.* (2020).It was proven that the utilisation of 10% tyre dust makes mortar water absorption significantly higher, and compressive characteristics and strength were decreased rigorously to a very soaring level.The addition of rubber aggregate to concrete as a replacement for coarse and fine aggregate decreases the workability, modulus of elasticity, compressive, flexural, and tensile strengths but increases ductility and durability as compared to concrete. It was established that the utilisation of rubber aggregate and the incorporation of any form of aggregate in concrete will influence mechanical characteristics negatively but increase durability and ductility as weighed against concrete.Parth khandla *et al.* (2017) investigated crumb rubber usage in concrete and the attributes and characteristics of incorporating crumb rubber instead of fine aggregates. With diverse proportions of 0%, 2.5%, 5%, 7.5%, and 10% for M_{25} concrete, it was found that the compressive characteristics strength for all combinations was closer to 25 MPa. [Arife C. A. Z. *et al.* 2017; Shanmugam *et al.* 2023; Shanmugam R. *et al.* 2023; Vennila R. and Anuradha R. 2017] It was established that sand can be substituted using crumb rubber to the extent of 10% of the optimal flexural characteristics strength attained for 5% of crumb rubber.

2. Materials and methods

2.1. Mantle of cement in composite blocks

It is a known fact that binding ingredients in concrete cement are one of the core causes of the release of carbon dioxide hazardous to the environment, and the electricity required to manufacture cement is soaring. The cost of production of cement makes its cost high, which implicates construction costs. To conserve the cost of construction *Acacia nilotica* ash, a waste material was exploited to make the cost as minimal as a substitute for cement. In this investigation, the use of rapid-hardening cement was exploited. The attributes of cement are listed below in the Table 1. Cement exploited in this study is rapid hardening cement confirms IS 8041:1990.

Figure 1. Materials used in current study A) rapid hardening cement B) *Acacia nilotica* ash C) Pond ash D) Salvage waste rubber E) Asymmetrical stone F) Salvage waste broken tiles.

Table 1. Attributes of cement

Attributes	Outcome
Fineness of Cement	337. 25m²/kg
Normal or Standard Consistency	32.75%
Initial Setting Time	37minutes
Final Setting Time	312 minutes
Specific Gravity	2.97
Water Absorption (%)	0.85
Bulk density (kg/m³)	1278

2.2. Acacia nilotica ash

Sticks of Acacia trunk wood were fetched and dried in the atmosphere for 5 days till they were free from complete moisture, and they were incinerated to get the ash. [Iyun, O. R. A. *et al.* 2022; Shanmugam R. 2023; Rajesh Guna R. and Mariappan M. 2023] An image of *Acacia nilotica* ash is illustrated below in Figure 1. Various attributes of Acacia ash are listed below in Table 2

Table 2. Attributes of *Acacia nilotica* ash

Attributes	Outcome
material of size	fewer than 100µ
Fineness	90%
Normal or Standard Consistency	37%
Initial Setting Time	39 min
Specific Gravity	2.67

2.3. Fine aggregate

2.3.1. Pond ash

Pond ash was exploited as fine aggregate in the present work to fill the voids in the coarse aggregate. [Titiksh A *et al.* 2023; Vennila R. and Anuradha R. 2017; Vidyadharaa V. B. Saurabhb R V. 2022]. The attributes of fine aggregate are listed below in the Table.3

2.3.2. Salvage waste rubberp

The salvaged waste rubber tyres were fetched and cut into tiny bits. The salvage waste rubber was transformed into chips and sieved through 4.75 mm for exploitation as fine aggregate. [Panigrahi M. *et al.* 2023; Shanmugam *et al.* 2023; Shanmugam R. *et al.* 2023] An image of salvage waste rubber is illustrated below in Figure 1. The attributes of salvage waste rubber are illustrated below in Table 4. Pond ash and waste rubber tyres were taken in equal proportion as fine aggregate.

Table 3. Attributes of Fine Aggregate

Attributes	outcome
Fineness Modulus	3.23
Specific Gravity	2.57
Water Absorption	1.35%
Bulking of sand	25%

Table 4. Attributes of salvage waste rubber

Attributes		outcome
Specific Gravity		1.175
Bulk Density	Loose	0.425 kg/lt.
	Compacted	0.575 kg/lt.

2.4. Coarse aggregate

Asymmetrical stone materials were fetched for exploitation as coarse aggregate, as illustrated in Table 5. Salvage waste broken tiles were fetched free of charge for exploitation as coarse aggregate is illustrated in Table 5. Asymmetrical stone material and salvage waste broken tiles were taken in equal proportion as coarse aggregate

Table 5. Attributes of asymmetrical stone material

Attributes	asymmetrical stone material	salvage waste broken tiles
Fineness Modulus	4.275	6.25
Specific Gravity	2.628	2.68
Water Absorption	0.817%	7.85%

2.5. Mix Design

In this experimental work, the M_{35} composite had a water-to-cement ratio of 0.40 [Sathish Kumar K. and Dilli Babu S. 2015; Sallau M. S. *et al.* 2022; Subramani T. 2017] Guidelines as suggested in IS 10262 (2009) for Concrete Mix Design were espoused in the mixing of the composite. Exploiting the M_{35} standard mix by adopting mechanical mixing. For experimenting, 21 cylinders, 21 cubes, and 21 prisms were cast in total. Each specimen, with diverse proportions, is illustrated below in Table 6. These samples are to be cured for 7, 14, and 28 days under normal ambient temperature conditions. On completion of the curing period, testing of mechanical characteristics is done.

Table 6. Narration of the cube, cylinder, and prism samples

Specimen	Samples dimensions	M_{35} grade of ANA Composite						
		0	2.5	5	7.5	10	12.5	15
Cube	150x150x150mm	3	3	3	3	3	3	3
Cylinder	300x150mm	3	3	3	3	3	3	3
Prism	100x100x500mm	3	3	3	3	3	3	3
L shape	175x100x75mm	3	3	3	3	3	3	3

Table 7. Mix Design

Blending nomen clature	Cement	*Acacia nilotica* ash	% of replacement	Fine aggregate		Coarse aggregate		water
				Pond ash	salvage waste rubber	Asymmetrical stone	Salvage waste broken tiles	
GC	426.64	0	0	351.74	351.74	558.34	558.34	170.66
GCANA1	426.64	10.666	2.5	351.74	351.74	558.34	558.34	170.66
GCANA2	426.64	21.332	5	351.74	351.74	558.34	558.34	170.66
GCANA3	426.64	31.998	7.5	351.74	351.74	558.34	558.34	170.66
GCANA4	426.64	42.664	10	351.74	351.74	558.34	558.34	170.66
GCANA5	426.64	53.330	12.5	351.74	351.74	558.34	558.34	170.66
GCANA6	426.64	63.996	15	351.74	351.74	558.34	558.34	170.66

2.6. Investigational slate

Investigational slate was intended to evaluate the mechanical characteristics of composites, for instance, compressive potency characteristics, split tensile potency characteristics, shear potency characteristics, and flexural potency characteristics, on fractional substitution of cement using *Acacia nilotica* ash. The particulars of several samples and their dimensions are illustrated below in Table7.Production of the samples by blending, weighing, and casting of cubes, cylinders, ''L'-shaped cubes, and prisms was done in accordance with IS 10086-1982 and cured for 28 days in a water tank. [Shanmugam R. *et al.* 2023] The M_{35} concrete is premeditated, and the requirements for ingredients per cubic metre of composite with a water cement ratio of 0.40 are illustrated below in Table 7. All the ingredients were blended by weight and *Acacia nilotica* ash was taken by weight of cement, (GC- Graded concrete, GCANA1- GCANA6 – Graded concrete blended with Acacia nlotica ash).

2.7. Tests on fresh composite blocks

Workability is one of the physical criteria that implicates the characteristics, strength and durability of composites. It influences the outlay of the labour cost and the look of the finished phase of the composite. It allows for easy placement and compaction homogeneously without segregation or bleeding. It plays a prime role in composing without any honeycombs. In this investigation, a slump cone test was performed to find workability.The slump test is a regularly exploited method of evaluating the reliability of composites and can be utilised both in the laboratory and at the workplace. It may not evaluate the full features causative to work. However, it is employed practically as a gauge of direct assessment and provides a suggestion about composite consistency on each consignment. An image of the slump value (mm) of M_{35} composite blocks incorporated with *Acacia nilotica* ash cast composite specimens is illustrated below in Figure 2.

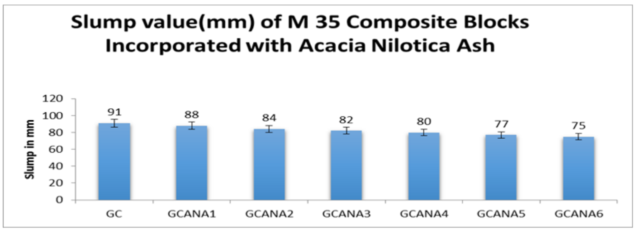


Figure 2. Slump value (mm) of M $_{35}$ composite bocks incorporated with *Acacia nilotica* ash

2.7.1. Tests on hardened composite blocks

To assess the characteristics of the hardened composite, it was tested with compressive, flexural, and tensile characteristics. The characteristics and strength of concrete play a crucial role in the elements of any building or construction activity. It is a matter of fact that only completely set and hardened composites will be able to be given the load, facilitating the distinction of whether the composite can be used for the specified infrastructure or structural element or not.

3. Results and discussion

With diverse fractions of substitution of cement exploiting *Acacia nilotica* ash (0%, 2.5%, 7.5%, 10%, 12.5%, and 15%), the results are illustrated in Figures 10, 11, 12, 13, 14, and 15.

3.1. The persuasion of Acacia nilotica ash on composite compressive potency

3.1.1. Compressive potency characteristics

The cube samples were examined using a compression testing machine. Samples were kept in the testing machine to keep the load appropriately axially applied to the cubes, such that the application of load on opposite sides and loading were done at a consistent rate until the cube failed. The ultimate load put into an application on the samples was noted. Figure 3 illustrates machines used for test study a) compressive strength b) split tensile strength c) flexural tensile strength d) Shear strength.

Figure 3. Machines used for test study A) Compressive strength B) Split tensile strength C) Flexural tensile strength D) Shear strength

The 7-day compressive potency characteristics of M_{35}-grade composite with a 2.5% substitution of cement exploiting *Acacia nilotica* ash diminished while evaluating it against conventional composite (M_{35}). The compressive potency characteristics were amplified for 7.5% substitution of cement when evaluating against 5% and 7.5% substitution. The compressive potency characteristics diminished further with a rise in substitution.

The 28, 60, 90, 120, and 365-day compressive potency characteristics of M_{35}-grade composite with 5% substitution of cement exploiting *Acacia nilotica* ash diminished while evaluating against conventional composite (M_{35}). The compressive potency characteristics were amplified for 10% substitution of cement when evaluating against 5% and 7.5% substitution. The compressive potency characteristics diminish further with amplification in a fraction of substitution. An image of the compressive characteristics of M $_{35}$ composite blocks incorporated with *Acacia nilotica* ash cast composite specimens is illustrated Figures 3, 4 and a narration of the compressive characteristics is illustrated below in Table 8.

Table 8. Narration of compressive characteristics of M $_{35}$ composite blocks incorporated with *Acacia nilotica* ash

S. No.	Blending nomen clature	%of replacement	Compressive strength in 7 days	Compressive strength in 28 days	Compressive strength in 90 days	Compressive strength in 120 days	Compressive strength in 180 days	Compressive strength in 365days
1	GC	0.0	18.27	35.86	36.003	36.075	36.220	36.365
2	GCANA1	2.5	17.89	37.025	37.099	37.173	37.248	37.397
3	GCANA2	5.0	17.97	34.925	34.995	35.065	35.135	35.276
4	GCANA3	7.5	24.12	38.025	38.101	38.177	38.254	38.407
5	GCANA4	10.0	20.19	40.125	40.205	40.286	40.366	40.528
6	GCANA5	12.5	19.75	29.87	29.930	29.990	30.050	30.170
7	GCANA6	15.0	19.725	29.815	29.875	29.934	29.994	30.114

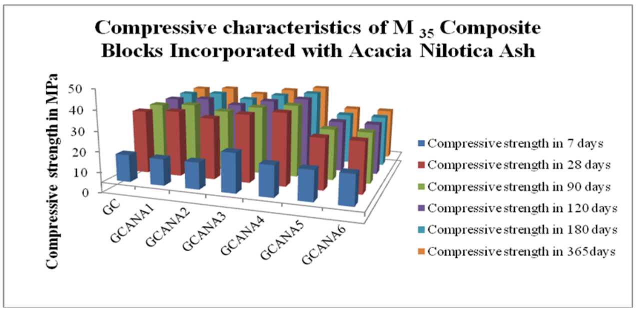


Figure 4. Variation of compressive potency characteristics

3.2. The persuasion of Acacia nilotica ash on composite split tensile potency:

Split tensile potency characteristics: The cylinder samples were examined using a compression testing machine. The load put into an application was increased continuously in a consistent proportion until the resistance of the samples to the surging load broke down. The ultimate load put into an application on the samples was noted. An image of the split tensile potency characteristics of M 35 composite blocks incorporated with *Acacia nilotica* ash cast composite specimens is illustrated in Figure 3. The 7-day split tensile potency characteristics of M35-grade composite with 5% substitution of cement exploiting *Acacia nilotica* ash diminished while evaluating against conventional composite (M35). The compressive potency characteristics were amplified for 7.5% substitution of cement when evaluating against 5% and 7.5% substitution. The split tensile potency characteristics diminished further with the addition of a fraction of substitution. The 28, 60, 90, 120, and 365-day split tensile potency characteristics of M35-grade composite with 5% substitution of cement exploiting *Acacia nilotica* ash diminished while evaluating against conventional composite (M35). The compressive potency characteristics were amplified for 10% substitution of cement when evaluating against 5% and 7.5% substitution. The split tensile potency characteristics diminish further with amplification in a fraction of substitution. An image of the split tensile characteristics of M 35 composite blocks incorporated with *Acacia nilotica* ash cast composite specimens is illustrated in Figures 3, 5 and a narration of the split tensile characteristics is illustrated in Table 9.

Table 9. Narration of split tensile characteristics of M 35 Composite Blocks Incorporated with *Acacia nilotica* Ash

S. No.	Blending nomen clature	%of replacement	split tensile strength in 7 days	split tensile strength in 28 days	split tensile strength in 90 days	split tensile strength in 120 days	split tensile strength in180 days	split tensile strength in 365 days
1	GC	0.0	1.512	2.967	2.960	2.984	3.000	3.011
2	GCANA1	2.5	1.480	3.045	3.050	3.075	3.085	3.096
3	GCANA2	5.0	1.487	2.873	2.877	2.901	2.910	2.921
4	GCANA3	7.5	1.996	3.128	3.133	3.158	3.168	3.180
5	GCANA4	10.0	1.671	3.300	3.306	3.332	3.343	3.356
6	GCANA5	12.5	1.634	2.457	2.461	2.481	2.489	2.498
7	GCANA6	15.0	1.632	2.452	2.456	2.476	2.484	2.493

Table 10. Narration of flexural characteristics of M 35 Composite Blocks Incorporated with *Acacia nilotica* Ash

S.No.	Blending nomen clature	%of replacement	Flexural strength in 7 days	Flexural strength in 28 days	Flexural strength in 90 days	Flexural strength in 120 days	Flexural strength in 180days	Flexural strength in 365 days
1	GC	0.0	3.252	6.437	6.553	6.620	6.773	6.898
2	GCANA1	2.5	3.184	6.646	6.381	6.821	6.965	7.094
3	GCANA2	5.0	3.199	6.269	6.019	6.434	6.570	6.692
4	GCANA3	7.5	4.293	6.825	6.553	7.006	7.153	7.286
5	GCANA4	10.0	3.594	7.202	6.915	7.392	7.548	7.688
6	GCANA5	12.5	3.516	5.362	5.148	5.503	5.619	5.723
7	GCANA6	15.0	3.511	5.352	5.138	5.493	5.609	5.713

3.3. Modulus of rupture potency characteristics

The prism specimens were examined with two-point loading to generate flawless bending employing the flexural testing machine. By using a dry cloth, the bearing surface of the machine was cleaned so that the surface was free from any dusty or sandy materials. Over the specimen, two points of loading were applied gradually till it failed so that no longer loads were applied. The ultimate load put into an application to the sample was noted. An image of the flexural potency characteristics of M35 composite blocks incorporated with *Acacia nilotica* ash cast composite specimens is illustrated in Figure 7. The 7-day flexural potency characteristics of M35-grade composite with a 2.5% substitution of cement exploiting *Acacia nilotica* ash diminished while evaluating it against conventional composite (M35). The flexural potency characteristics were amplified for 7.5% substitution of cement when evaluating against 5% and 7.5% substitution. The flexural potency characteristics diminished further with amplification in a fraction of substitution. The 28, 60, 90, 120, and 365-day flexural potency characteristics of M35-grade composites with 5% replacement of cement with *Acacia nilotica* ash diminished while evaluating them against conventional composites (M35). The flexural potency characteristics were amplified for 10% substitution of cement when evaluating against 5% and 7.5% substitution. The flexural potency characteristics diminish further substitution. An image of the flexural characteristics of M35 composite blocks incorporated with *Acacia nilotica* ash cast composite specimens is illustrated in Figures 3, 6 and a narration of the flexural characteristics is illustrated w in Table 10.

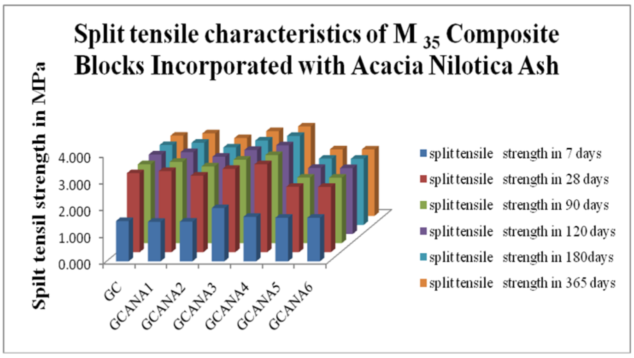


Figure 5. Variation of split tensile potency characteristics

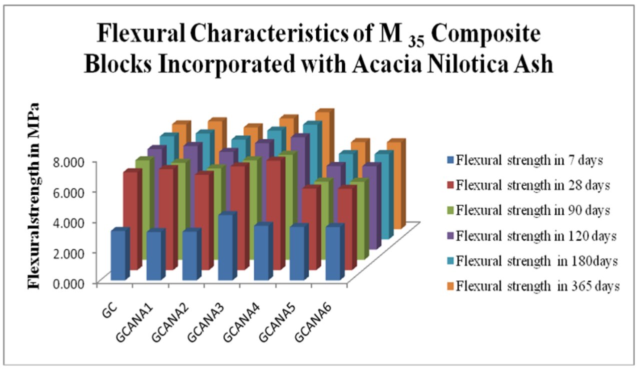


Figure 6. Variation of Flexural Potency Characteristics

3.4. The persuasion of Acacia nilotica ash on composite shear strength and potency characteristics

3.4.1. Shear potency characteristics

For testing shear strength, specific 'L' shape cubes of size [(175X175X175)-(75X100X175)] mm are cast by keeping a (75X100X175) mm wooden mould with (175X175X175) mm dimensions on one side, as illustrated in Figures 2 and 6. The said shear strength mould arrangement was placed in a compressive testing machine, and the load was applied to the specimen until failure on shear. The 7-day shear potency characteristics of M_{35}-grade composite with a 2.5% replacement of cement with *Acacia nilotica* ash diminished while evaluating it against conventional composite (M_{35}). The shear potency characteristics were amplified for 7.5% substitution of cement when evaluating against 5% and 7.5% substitution. The shear potency characteristics diminished further with amplification in a fraction of substitution.

The 28, 60, 90, 120, and 365 days of shear potency characteristics of M_{35}-grade composites with 5% replacement of cement with *Acacia nilotica* ash diminished while evaluating them against conventional composites (M_{35}). The shear potency characteristics were amplified for 10% substitution of cement when evaluating against 5% and 7.5% substitution. The shear potency characteristics diminish further with amplification in a fraction of substitution. The shear potency characteristics diminish further substitution. An image of the shear characteristics of M_{35} composite blocks incorporated with *Acacia nilotica* ash cast composite specimens is illustrated in Figures 3, 7 and a narration of the flexural characteristics is illustrated in Table 11.

Table 11. Narration of shear characteristics of M 35 Composite Blocks Incorporated with *Acacia nilotica* ash

S.No.	Blending nomen clature	%of replacement	Shear strength in 7 days	Shear strength in 28 days	Shear strength in 90 days	Shear strength in 120 days	Shear strength in 180 days	Shear strength in 365days
1	GC	0.0	18.27	35.86	36.003	36.075	36.220	36.365
2	GCANA1	2.5	17.89	37.025	37.099	37.173	37.248	37.397
3	GCANA2	5.0	17.97	34.925	34.995	35.065	35.135	35.276
4	GCANA3	7.5	24.12	38.025	38.101	38.177	38.254	38.407
5	GCANA4	10.0	20.19	40.125	40.205	40.286	40.366	40.528
6	GCANA5	12.5	19.75	29.87	29.930	29.990	30.050	30.170
7	GCANA6	15.0	19.725	29.815	29.875	29.934	29.994	30.114

Table 12. Narration of freeze-thaw resistance characteristics of M_{35} Composite Blocks Incorporated with *Acacia nilotica* Ash

S.No.	Blending nomen clature	0	50	100	150	200	250	300
1	GC	35.86	36.003	36.075	36.220	36.365	36.628	36.940
2	GCANA1	37.025	37.099	37.173	37.248	37.397	37.668	37.989
3	GCANA2	34.925	34.995	35.065	35.135	35.276	35.531	35.834
4	GCANA3	38.025	38.101	38.177	38.254	38.407	38.685	39.015
5	GCANA4	40.125	40.205	40.286	40.366	40.528	40.822	41.169
6	GCANA5	29.87	29.930	29.990	30.050	30.170	30.389	30.647
7	GCANA6	29.815	29.875	29.934	29.994	30.114	30.333	30.591

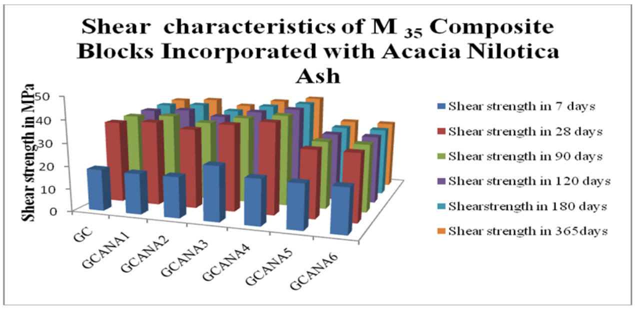


Figure 7. Variation of shear potency characteristics

3.5. The persuasion of freeze-thaw resistance potency characteristics and strength by Acacia nilotica ash on composite

The vital procedure causing a fatalistic effect on the mechanical performance of the composite generates the declination of the composite that takes place in saturated circumstances as a consequence of alternating freeze and thaw cycles. This investigation focuses on the performance of composite specimens after 50, 100, 150, 200, and 250 cycles of freezing and thawing.Owing to the increase in the volume of pore water through freezing, inner tensile characteristics are formed, leading to the blooming of interior fissures. Progressively, the fissure will inhabit the exterior stratum of the composite. Diverse assessments investigated the correlation between the number of freezing-thawing cycles and the characteristics of composites. As per the experiment outcome, the compressive characteristics are appreciable after 100 cycles of freeze-defrost condensed to 44.7 percent, though the compressive characteristics are appreciable after 125 patterns of freezing-thawing reduced to 61.75 percent of the preliminary assessment. The instigation and drawout of the fissure base by the freezing-thawing phase are associated with diminished compressive characteristics. The surrounding substance's hydraulic force surges as the number of freezing-thawing cycles amplifies the basis for a fissure to form. As an outcome of the configuration of the fissure, the characteristics of these trials are condensed, as illustrated in Table 13 and Figure 14. The noteworthy lower compressive characteristics trouncing exhibit the role of salvage waste rubber and salvage waste broken tiles on the amplified resistance to freezing-thawing of composite suitable to densification of surrounding substance due to the configuration of supplementary C-S-H gels in pozzolanic effect. The *Acacia nilotica* Ash inhabits the capillary aperture, which takes part in the crucial task of escalating the freezing and thawing resistance of the composite. An image of the shear characteristics of M_{35} composite blocks incorporated with *Acacia nilotica* ash cast composite specimens is illustrated in Figure 8 and a narration of the flexural characteristics is illustrated in Table 12.

3.6. Microstructural studies on Acacia nilotica ash on composite

The illustrated outcome of the results shown as Figure 9, specifies that the calcium silicates in hydrated spells containing hydration calcium aluminates with the composition hydroxide of calcium have a greater element comprising cement's hydrating instance.

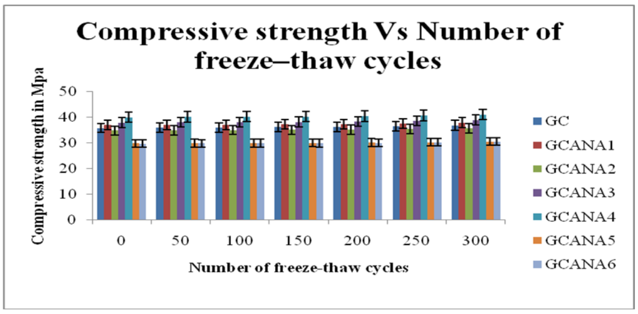


Figure 8. Variation of freeze-thaw resistance strength by *Acacia nilotica* ash on composite

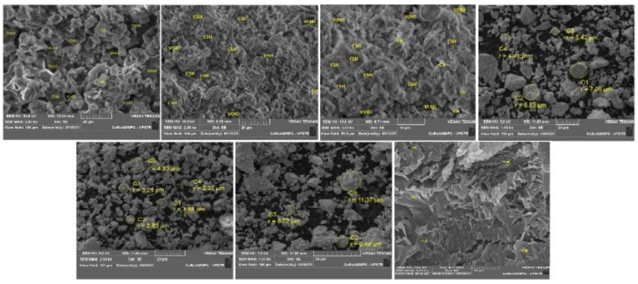


Figure 9. Microstructural studies on *Acacia nilotica* ash composite (GC, GCANA1 to GCANA6)

Colossal, crystalline, and hexagonally shaped elements were attained. It was also established that calcium silicate hydrate is the prime and most momentous feature determining the mechanical potency of hardened cement glue. It was demonstrated that *Acacia nilotica* ash specimens were thicker, denser, less permeable, and porous than conventionally proportioned concrete. These results illustrate the enhancement of aperture formation in *Acacia nilotica* ash mixes on evaluation with the conventional proportioned composite.

4. Conclusions

The exploitation of *Acacia nilotica* ash in composites and its consequences were scrupulously planned. The preface exploration was completed for critical elements of standard composite and with diverse divisions of substitution of cement (0%, 2.5%, 7.5%, 10%, 12.5%, and 15%) exploiting *Acacia nilotica* ash. From the ingredient characteristics investigations, blend fractions tried for a standard composite of M_{35} grade with the blend fraction are 1: 1.649: 2.617: 0.40.

Compressive characteristics, split tensile characteristics, flexural characteristics, and shear strength experiments were instituted for standard specimens to corroborate the proportion of ingredients.

The mechanical potency characteristics soared for 10% substitution of cement when evaluating with 5% and 7.5% substitution. The mechanical potency characteristics diminished substantially with a rise in the proportion of substitution.

The optimum value of strength is obtained by blending 10% *Acacia nilotica* ash with cement and 5% salvage rubber with fine aggregate, and these ingredients can be exploited as construction materials. The ingredients, consisting of industrial waste, will diminish the consumption of natural resources being exploited and reduce the scarcity of natural resources.

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Formal analysis and investigation: Rajendran Selvapriya, Sampath Anand kumar, Muthukumar Soundar Rajan Writing: original draft preparation: Sampath Anand kumar,

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