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Review Article

Mechanical Properties of Waste Laterite Scrap as Fine Aggregate in Concrete: A Review

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Abstract *- Concrete has been a significant structural material for hundreds of years because of its strength, toughness, and flexibility. In India, natural sand is scarce mainly because of the widely growing construction sector, which leads to extensive sand mining. There is a detrimental effect on riverbanks, riverbeds, biodiversity, and the quality and availability of groundwater due to sand mining on a large scale. To address the problems, an investigation into potential substitutes for natural river sand as a fine aggregate in concrete has been conducted. Laterite is one such material widely available in large quantities in India. A popular building material found in tropical and subtropical areas, it has been used for masonry construction since the 19th century. This study examines the properties of concrete when lateritic sand is used as a substitute for river sand as an acceptable aggregate replacement. The replacement ranges from 0% to 100% with different grades of concrete, i.e., M15-M60 mixtures and the test results from the previous studies were discussed for 7 and 28 days. The new lateritic concrete made from the river and lateritic sand was analyzed to measure the fresh properties like slump cone, vee-bee consistometer, compaction factor, and flow table tests. Also, the characteristics of hardened concrete were examined through split tensile, flexural, and compressive strength tests.*

Keywords *- Green concrete, Laterite sand, Mechanical properties, River sand, Sustainability.*

1. Introduction

Concrete is widely utilised as a building material, ranking second in usage, following water [1]. Every construction activity involves concrete, which significantly impacts everyday life for all human beings. Concrete is a solid artificial rock that adds cement, sand, coarse aggregate, admixtures, and water in appropriate quantities. After mixing and placing, concrete does not harden by drying; instead, hydration, a chemical reaction between water and cement, causes the concrete to become solid [2]. Despite its advantages, concrete has certain limits and significant raw material consumption [3].

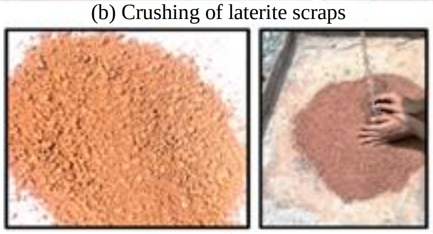
The rising demand for concrete in the building and industrial fields has resulted in a scarcity of natural fine aggregate supplies. This prompted the researchers to create more efficient and sustainable high-performance concrete [4]. The study involved researching multiple grades of concrete. The lateritic concentration varies at 0%, 20%, 40%, 60%, 80%, and 100% acceptable aggregate replacement in concrete. The new lateritic concrete made from the river and lateritic sand was analyzed to measure the initial properties like slump cone, vee-bee consistometer, compaction factor, and flow table tests. Also, the characteristics of hardened concrete were examined through the flexural strength, split-tensile, and compressive strength tests. Since the 19th century, masonry buildings in India have been made with laterite, a widely used construction material in tropical and subtropical areas [5]. Laterite (red soil) is clay rich in ferrous and alumina oxides [6]. Laterite is common in regions with high temperatures and considerable rainfall, such as Southeast Asia, Australia, India, and Africa [7]. Throughout the history of South India, monument structures have been constructed using locally accessible laterite, a type of soil rich in iron and aluminium.

These structures have gained recognition and are now included in the prestigious UNESCO World Heritage list. “There are an estimated 706 million tons of laterite in India; of this, 124 million tons are reserved, and 581 million tons are available for building purposes”. Most resources, approximately 74%, are concentrated in two states: Madhya Pradesh (55%) and Rajasthan (17%). Kerala, Gujarat, Karnataka, Andhra Pradesh, Maharashtra, and Jharkhand share 28 percent of resources [8]. The cement industry uses laterite as an ingredient. The extraction procedure of 400 cubic feet of laterite stone produces about 100 cubic feet of scrap [9]. This scrap must be removed for further excavation.

Most developing countries, including India, lack an adequate solid waste treatment system. As a result, instead of reusing and recycling, waste is directly dumped into the environment [10]. The waste laterite scarp can be used as a fine aggregate in construction, which causes less environmental damage and depletes natural resources. As a result, laterite sand is both economical and environmentally friendly. The extraction process of laterite sand is shown in Figure 1 [11].

(a) Collection of laterite scraps

(b) Crushing of laterite scraps



(c) Processing of Fe-Al rich sand

Fig. 1 The extraction process of laterite sand [11]

This literature review investigates the impact of different types of laterite on the mechanical characteristics of concrete when using laterite-sand fine aggregate. The study offers a detailed examination of the research carried out in this field, emphasizing the significance of comprehending the characteristics of laterite and their impact on the performance of concrete. A comprehensive analysis of the mechanical characteristics of concrete with a blend of M-sand, quarry dust, river sand, ceramic fine, and laterite sand has not been conducted. This research aims to analyze the properties of laterite sand and assess its appropriateness for use in different concrete grades by evaluating its strength performance.

2. Mechanical Properties of Lateritic Concrete

The mechanical characteristics of lateritic concrete, including its compressive, tensile, and flexural strengths from the previous studies, are analyzed and presented in Figures 2 – 5. Table 1 represents the mechanical properties of lateritic concrete with varying proportions of river sand by laterite aggregates. G. Sabarish et al. [12] investigated the strength performance of lateritic concrete. The concrete grade utilized was M30, with mix ratios of cement, sand, laterite, and granite of 1: 1.274: 3.126 and w/c 0.45. Flexural strength, Compressive, and the splitting tensile strengths of lateritic concrete were studied after 7, 28, 60, and 90 days of exposure to varied amounts of laterite content (0%, 10%, 20%, 30%, 40%, and 50%).

The new lateritic concrete made from the river and lateritic sand was analyzed to measure the initial properties like slump cone, vee-bee consistometer, compaction factor, and flow table tests. The results of this study, based on test outcomes, confirm that the compressive strength of lateritic concrete cured for 28, 60, and 90 days is 40.63, 51, and 61.64 N/mm^2, and the flexure strength for prisms is 9.63, 17.13, and 24.68 N/mm^2, and the splitting tensile strength for cylinders is 3.11, 4.43, and 5.87 N/mm^2 optimized at 20% laterite sand. Oluwatobi Aluko et al. [13] studied the effect of curing medium and combining the solution on the compressive strength of mixes for concrete, including lateritic sand and natural sand at different concentrations. In addition to water or bacteria solution, the concrete's laterite content was altered to 0%, 15%, and 30% fine aggregate.

After 7 and 28 days of curing in several settings, such as water, bacterial solution, nutritional broth, and a blend of the two, the compressive strength of the mixes was tested. After being cured in water for 7 and 28 days, the cube specimen's compressive strength was measured to be 14 and 19 N/mm^2, respectively. Similarly, when the cube specimen is exposed to a bacterial solution, the compressive strength is 10 and 14 N/mm^2. When the cube specimen is exposed to a nutrient broth, the compressive strength is measured to be 9 and 18 N/mm^2. Finally, when the cube specimen is exposed to a mixture of bacteria and nutrient broth, the compressive strength is 14 and 20 N/mm^2. L. O. Ettu et al. [14] investigate if laterite is suitable to replace sand as the only fine aggregate, especially if lateritic concrete would meet the low compressive strength for M-25 grade concrete necessary for reinforced concrete construction.

The bulk density test, Saturated Surface Dry (SSD), and compressive strength tests were performed. The compressive strength of the sole fine laterite aggregate after 28 days of curing is 30.66 N/mm^2, and the Saturated Surface Dry (SSD) bulk density is 2348 Kg/m^3, indicating that structural concrete may use laterite as the only fine aggregate. S N Basavana Gowda et al. [15] deal with concrete performance using laterite as sand at varying percentages of 25, 50, 75, and

100% river sand. The tests were carried out in two stages, first using laterite quarry waste (unfiltered laterite) in place of river sand and then with filtered laterite. The workability and compressive strength of concrete are examined. The test results show that filtered laterite contains a substantially higher workability than unfiltered laterite. After seven days, unfiltered laterite's compressive strength decreased by 14, 16, 29, and 36% for replacement rates of 25, 50, 75, and 100% for river sand, whereas filtered laterite reduced strength by 8, 11, and 16%. However, after seven days of curing, a 25% replacement will result in a 1% increase strength above control concrete. Unfiltered laterite had a compressive force of 6, 10, 23, and 34% lower after 28 days of curing.

At the same time, processed laterite was reduced by 2, 1, and 7 percent. But there will be a 2% strength increase for a 25% replacement compared to control concrete after 28 days of cure. However, the strength of lateritic concrete made with 100% processed laterite is only reduced by 7%. According to the test results of this study, processed laterite aggregates with similar physical properties to natural fine aggregates result in appropriate binding with cement matrix. According to Ebenezer Fanijo et al. [16], The study evaluated the efficacy of utilising Palm Kernel Shell (PKS) as a substitute for coarse aggregates in concrete, with laterite as a partial replacement for the fine aggregates. Considerations for replacement levels ranged from 10% to 30%. According to test results, concrete mixes that only partially replace PKS are more workable than control or laterite-containing mixtures. Following a curing period of 28 days, the compressive strengths of the mixtures containing 20P10L, 20P20L, and 20P30L were measured to be 33 MPa, 31.4 MPa, and 27.1 MPa, respectively.

This study finds that concrete mixes, including PKS and laterite at 20% or less, may produce concrete, offering an alternative to traditional concrete in sustainable buildings for waste recycling and reuse. Rajapriya Raja et al. [17] Examine the various amounts of lateritic sand in High-Strength Concrete (HSC). A 25 to 100% (by weight) substitution of laterite for M-sand was used to make concrete mixtures of the M60 grade. 10% micro silica and 10% Fly Ash (FA) were included in all mixtures to produce a high-strength mixture. After 7, 28, 56, and 90 days of curing, the laterite specimens showed a compressive strength about 12% greater than the control samples. On top of that, there was an 11.14% increase in split-tensile power and a 12.83% rise in flexural strength. Based on the results, it was determined that the optimal ratio for laterite substitution in High-Strength Concrete (HSC) is 25%. Awoyera et al. [18] this research aims to examine the relationship between the advancement of compressive strength, split tensile strength, porosity, phase change, and morphological alterations in ceramic-lateritic concrete. Various percentages of lateritic fine (0, 10, 20, and 30% replacement) and ceramic aggregates sorted from demolition waste were used to replace natural aggregates. The strength characteristics of the concrete specimens were evaluated 7, 14, 28, and 91 days after curing. According to the study, a lateritic concrete mix with 10% laterite and 90% ceramic fines as fine aggregate provided the highest strength among all the adjusted mixes. Although there was a 9% strength reduction relative to the reference sample, the observed decrease in power is within acceptable limits. It does not pose a risk to the structural integrity of concrete elements when using these alternative aggregates. K A Shahid et al. [19] investigated the compressive strength and workability of concrete that incorporates crushed palm oil clinker and lateritic sand instead of river sand to a certain extent. By substituting the river sand with lateritic sand and palm oil clinker, the compressive strength achieved is 23.87, 24.25, and 26.64 N/mm^2 at 7, 14, and 28 days of curing. The study's findings indicated that concrete strength was enhanced by thoroughly blending laterite and palm oil clinker in mix S1, specifically with a 25% laterite and 25% palm oil clinker composition.

R. Rajapriya et al. [20] investigated the usage of laterite from Malabar areas to replace river sand and M-sand. At intervals of 25%, laterite replacement in fine aggregate ranged from 0 to 100%. The mortar specimens (70.6mm x 70.6mm x 70.6mm) were cured in water, and the compressive strength after 28 days with 25% laterite content and river sand showed a 5.35% increase. With M-Sand replacement, mortar specimens showed a 12.93% increase compared to the reference mixes. M.A. Salau et al. [21] investigated the partial or complete substitution of laterite for river sand in concrete with varying coarse particle sizes (11.9 mm, 19.9 mm). By substituting 25% laterite for the sand, the compressive strength and workability of the concrete were significantly improved after 28 days of curing, compared to standard concrete, with coarse aggregate particles of 19.5mm and 12.5mm. Working with laterite concentrations ranging from 50% to 100% resulted in low workability and compressive strength figures. K. Siddharth et al. [22] discuss geopolymer mortar by combining fly ash, sand, and an alkaline solution. Laterite was employed as a supplementary material to substitute fine aggregates partially. As a result, both cement and sand in concrete are effectively replaced.

The fine aggregate in this study is being replaced with laterite at various percentages: 0%, 25%, 50%, and 75%. The behaviour of the material is then tested after each replacement. The test specimen was subjected to compression and split tensile tests. The results show that a 25% replacement increases strength, whereas a 50% replacement increases strength significantly. While a 75% replacement results in a sharp decline in power. Therefore, it is recommended to substitute geopolymer for about 50% of the crushed laterite rocks. Ambrose et al. [23], In this work, we replicate the river sand experiment with different ratios of quarry sand to lateritic sand to determine the resulting concrete's fresh and mechanical properties.

Table 1. Mechanical characteristics of lateritic concrete

Author	Material Used	Grade of Concrete	% of Material	Compressive Strength		Split-Tensile Strength		Flexural Strength	
				7 Days	28 Days	7 Days	28 Days	7 Days	28 Days
G. Sabarish [12]	Laterite + River sand	M30	0%	35.16	40.67	2.12		-	10.27
			10%	35.14	40.65	2.12		-	10.24
			20%	35.12	40.63	2.12		-	9.63
			30%	35.11	40.62	2.11		-	6.33
			40%	24.53	36.93	1.42		-	4.08
			50%	20.53	31.56	0.71		-	2.68
Oluwatobi Aluko [13]	Laterite + River sand	M15	0%	16.1	20.6	-		-	-
			15%	15.5	17.8	-		-	-
			30%	13.1	16.9	-		-	-
L. O. Ettu [14]	Laterite	M25	100%	-	30.66	-		-	-
S N Basavana Gowda [15]	Laterite + River sand	M20	0%	26	36.2	-		-	-
			25%	26.2	36.8	-		-	-
			50%	24	36	-		-	-
			75%	23.1	35.5	-		-	-
			100%	22	34.6	-		-	-
Ebenezer Fanijo [16]	Laterite + River sand	M30	0%	35	41	-		-	-
			10%	28.9	33.5	-		-	-
			20%	27.5	31.6	-		-	-
			30%	23.8	27.4	-		-	-
Rajapriya Raja [17]	Laterite + M-sand	M60	0%	49.4	68.9	-		-	5.6
			25%	50.1	70.2	-		-	5.98
			50%	43.1	62.4	-		-	5.89
			75%	39.8	57.3	-		-	5.91
			100%	30.2	41.8	-		-	4.96
Awoyera [18]	Ceramic fine + Laterite	M20	0%	15.2	25.1	1.96		-	-
			10%	15.9	22.6	2.34		-	-
			20%	15. 4	20	1.78		-	-
			30%	14.8	18.7	1.56		-	-
K A Shahid [19]	Laterite + Palm oil clincker + River sand	M20	0%	19	22.42	-		-	-
			25%	23.87	26.64	-		-	-
			50%	19.98	20.98	-		-	-
			100%	17.24	24.61	-		-	-
R. Rajapriya [20]	Laterite + M-sand	1:3 (Mortar)	0%	47.74	56.4	-		-	-
			25%	60.24	69.86	-		-	-
			50%	49.26	58.84	-		-	-
			75%	45	52.71	-		-	-
			100%	23.62	30.01	-		-	-
M A Salau [21]	Laterite + River sand	M20	0%	16.24	25.04	-		-	-
			25%	15.82	23.96	-		-	-
			50%	14.64	20.8	-		-	-

K.Siddharth [22]	Laterite + River sand	1:2 (Mortar)	0%	-	37.24	-		-	-
			25%	-	33.6	-		-	-
			50%	-	45.8	-		-	-
			75%	-	22.5	-		-	-
E. E. Ambrose [23]	Laterite + Quarry dust	M20	0%	17.64	22.46	-		-	-
			10%	16.2	24.96	-		-	-
			20%	16.86	19.98	-		-	-
			30%	17.58	22.64	-		-	-
			40%	21.6	21.98	-		-	-
			50%	18.72	22.94	-		-	-
S. N. Basavana Gowda [24]	Laterite + River sand	1:3 (Mortar)	0%	37.92	49.24	-		-	-
			25%	36.98	50	-		-	-
			50%	35	47.86	-		-	-
			75%	34.98	44.32	-		-	-
			100%	37.5	41.26	-		-	-
J. Vengadesh Marshall Raman [25]	Laterite + River sand	M25	0%	21.77	31.11	1.72		-	-
			5%	20.14	26.62	1.34		-	-
			10%	20.22	28.14	1.43		-	-
			15%	21.59	30.37	1.6		-	-
			20%	19.2	28.88	1.48		-	-
R. Rajapriya [6]	Laterite + M-sand	M30	0%	26.2	39.96	-		-	-
			25%	28.4	43.45	-		-	-
			50%	26	38.72	-		-	-
			75%	23.64	27.2	-		-	-
			100%	14.98	22.54	-		-	-
R. Rajapriya [5]	Laterite + M-sand	M45	0%	34.94	53.64	-		-	-
			25%	36.84	58.76	-		-	-
			50%	32.56	51.98	-		-	-
			75%	28.7	45.76	-		-	-
			100%	19.32	29.67	-		-	-
Fakorede Ebenezer Oluwabusuyia [26]	Laterite + River sand	M15	0%	17.38	22.24	-		-	-
			15%	17.33	21,93	-		-	-
			30%	17.26	21.12	-		-	-
R. Rajapriya [27]	Laterite + M-sand	M30	0%	27.62	39.95	-	-	-	3.9
			25%	29.56	45.32	-	-	-	4.3
			50%	26.45	38.84	-	-	-	4
			75%	23.72	32,56	-	-	-	3.8
			100%	17.64	26.28	-	-	-	3.7
Abhilash D. T [28]	Laterite + River sand	M30	0%	27.83	38.04	2.45	-	-	-
			15%	29.86	40.92	2.53	-	-	-
			20%	29.71	37.62	2.41	-	-	-
			25%	23.14	36.28	2.37	-	-	-
			30%	18.52	34.25	2.29	-	-	-

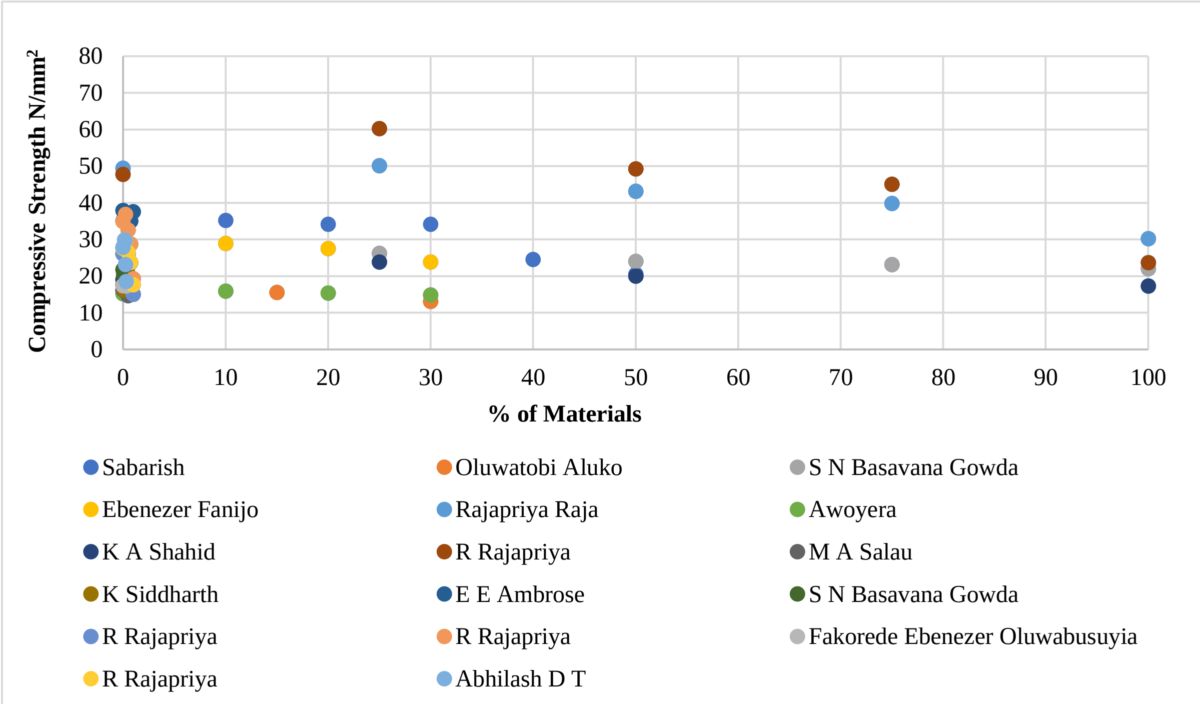


Fig. 2 Seven days compressive strength of the lateritic concrete

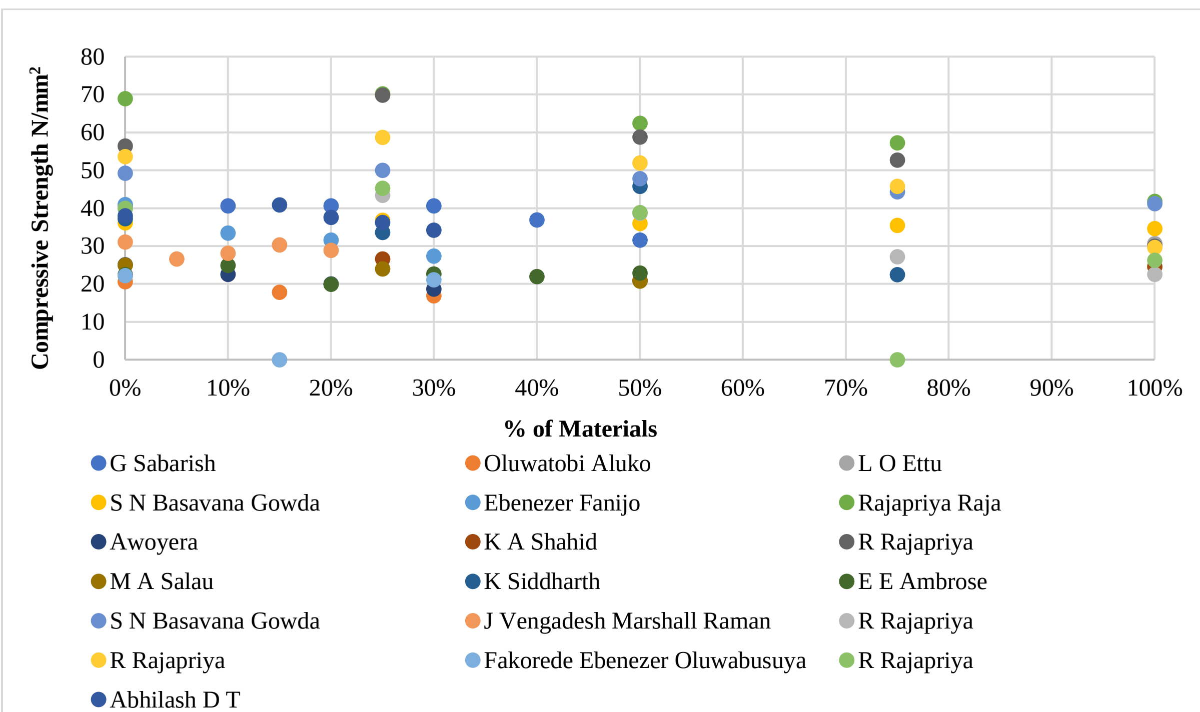


Fig. 3 28 days compressive strength of the lateritic concrete

The balance between lateritic sand and quarry dust was adjusted in increments of 10%, ranging from 0% to 50%. Concrete cubes were produced using three different water/cement ratios (0.5, 0.6, and 0.7) and two mix ratios (1:1.5:3 and 1:2:4). These cubes were subjected to curing and assessed for their compressive strength in a laboratory setting. Slump tests were performed for each blend as well. Control samples were prepared using river sand as the fine aggregate in each combination, along with different water-to-cement ratios. The manufactured concrete cubes fall within the acceptable range for standard-weight concrete. Despite the reduced workability of laterized quarry dust concrete, its compressive strength exceeds that of conventional concrete. Hence, it is recommended to employ lateralized quarry sand concrete for structural components in cases where the proportion of laterite does not exceed 50%. S. N. Basavana Gowda et al. [24] examine the effectiveness of cement mortars incorporating lateritic sand at percentage replacement of 0, 25, 50, 75, and 100% river sand.

The research was conducted in two phases, wherein the initial phase involved substituting river sand with unprocessed laterite obtained from a quarry waste source. In the subsequent stage, processed laterite was used as the replacement material. A detailed examination evaluates mortars' ability to flow and compressive strength qualities. The findings demonstrate that substituting river sand with unprocessed laterite reduces mortar compressive strength more than processed laterite.

However, compared to the control mortar, the strength of lateralized mortar made by 100% of processed laterite is only reduced by 13%. J. Vengadesh Marshall Raman et al. [25] deal with laterite soil from various sources to replace acceptable natural aggregate (river sand) in 5% to 20% replacement designed for M25 grade concrete. The compressive strength at 28 days of curing for 5%, 10%, 15%, and 20% is 26.62, 28.14, 30.37, and 28.88 N/mm2 and the split tensile strength is 1.88, 2.07, 2.24, and 2.17 N/mm2.28 days curing for 5%, 10%, 15%, 20% is 26.62, 28.14, 30.37,28.88 N/mm2 and split tensile strength is 1.88, 2.07, 2.24, 2.17 N/mm^2. R. Rajapriya et al. [5] evaluate the long-term effectiveness of laterite substitution for fine aggregate in concrete at 25% intervals from 0 to 100%. Workability and mechanical strength, two performance parameters of concrete mixtures, were the subjects of an inquiry.

When 25% of lateritic sand is substituted, an increase in laterite content and grades leads to a decrease in the workability of concrete. However, it also improves the mechanical properties of concrete. When M-sand was substituted with 25% more laterite than the control mix, the strength of M30 & M45 grade concretes increased by 11.85% and 8.15%, respectively. After 25% replacement, compressive strength decreases.

Fakorede Ebenezer Oluwabusuyia et al. [26], The main objective of this research is to determine how various curing agents affect the compressive strength of lateritic concrete that has been microbiologically treated. Three distinct concentrations of laterite were employed: 0%, 15%, and 30%. The specimens underwent curing in four separate curing media over 28 days. The samples provided include distilled water containing bacteria, water-retaining nutrient broth, and water containing both bacteria and nutrient broth. The results of the investigations indicated that the concrete curing process in a nutrient-rich broth using Bacillus sp. CT-5 medium resulted in higher compressive strength than the control and other media test samples. Rajapriya Raja et al. [27], In this study, laterite sand was used to assess the concrete's performance instead of M-sand, made by crushing hard granite stones.

Intervals of 25% were used for the replacement, which might range from 0% to 100%. The primary goal was to find out how laterite sand performed as a substitute for traditional fine aggregate in concrete. Initial research aimed to identify the properties of lateritic sand and M-sand that meet the criteria for natural aggregates. Curing times of 7 and 28 days were applied to the specimens. respectively, once the casting of M30-grade concrete mixtures.

As a result of the 25% substitution of laterite sand, compressive, split-tensile, and flexural strengths increased by about 12%, 11%, and 13%, respectively. The results revealed that concrete with a greater laterite content was less workable. According to the SEM examination, the best mix had a more compact microstructure. The existence of numerous hydration products was confirmed by EDS analysis, and XRD examination revealed that the tobermorite and xonotlite showed extra peaks in the L25 samples. Abhilash D. T et al. [28] highlight the usage of lateritic concrete, which involves incorporating laterite soil instead of conventional sand for Normal Strength Concrete (NSC).

For the experiment, M30-grade concrete was selected. The replacement percentages are 15%, 20%, 25%, and 30% by weight of laterite soil, respectively. Compressive strength and split tensile strength tests were performed on all acceptable aggregate substitution levels of concrete after three, seven, and twenty-eight days of curing. The experimental investigation demonstrated that laterite soil increases compression strength at later phases. Furthermore, the experimental work revealed that 15% replacement is optimal for NSC, i.e., M30 grade.

Odubela Christiana Adebola et al. [29] examined the substitution of a fraction of Ordinary Portland Cement (OPC) in concrete with Sawdust Ash (SDA), a byproduct generated from the wood milling sector. Laterite was used in concrete instead of river sand to save costs and prevent harmful environmental consequences. Research was done on the characteristics of both fresh and hardened concrete.

This study demonstrated the possibility of using laterite soil instead of the natural fine aggregate and SDA as a partial replacement for OPC. The utilization of a 10% (SDA) and a 45% laterite as partial substitutes for Ordinary Portland Cement (OPC) and river sand, respectively, can result in an acceptable slump and compressive strength.

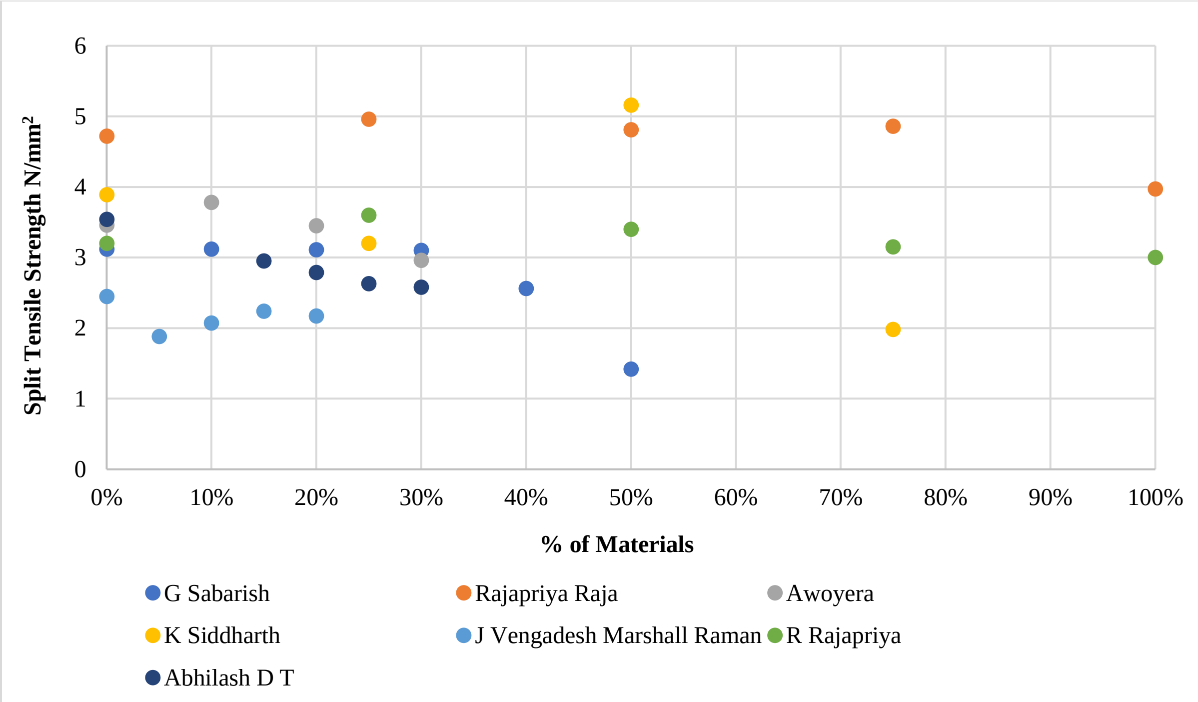


Fig. 4 28 days split tensile strength of the lateritic concrete

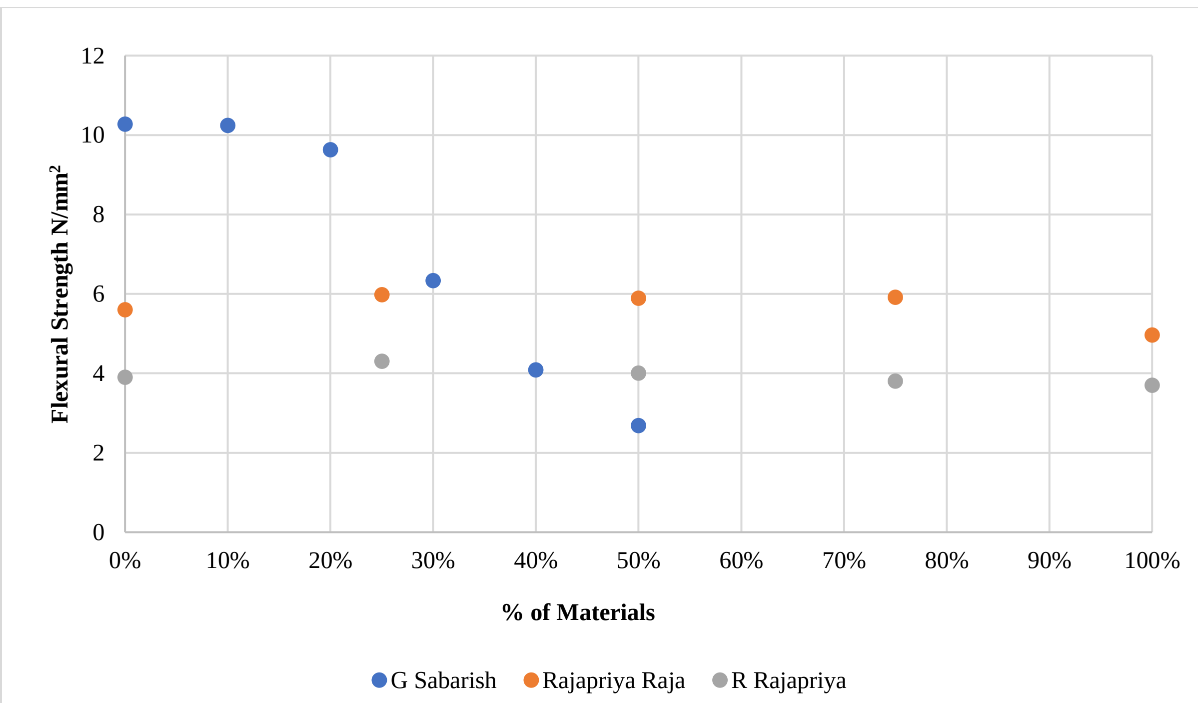


Fig. 5 28 days flexural strength of the lateritic concrete

3. Physical and Mineralogical Properties of Waste Laterite Scrap

A concrete's strength and performance are greatly affected by the chosen aggregates. Even though river sand and other conventional fine aggregates are widely used, laterite and other non-traditional materials have recently been spotlighted. The soil-like laterite, common in the tropics and subtropics, is rich in iron and aluminium oxides. Sustainable building practices, lower costs, and less environmental impact may be possible by using laterite as a fine aggregate in concrete [30]. To optimize concrete mix designs and assure structural integrity, it is vital to comprehend the effects of laterite type on concrete strength. The mineral content, physical characteristics, and hydration behaviour of various laterite forms might differ. Therefore, it is essential to investigate the impact of laterite type on concrete strength to develop durable and high-performing concrete formulations.

4. Influence of Laterite Sand on Concrete

Regarding concrete, aggregate qualities are only one of several aspects that affect its strength. Important aggregate characteristics that influence the strength of concrete are:

- Particle size distribution: Aggregates that are well-graded and consist of a diverse range of particle sizes have been found to enhance the packing efficiency of concrete, leading to higher concrete strength.
- Shape and texture: Aggregates with an angular or rough surface type improve mechanical interlock and interlocking, increasing strength.
- Surface characteristics: Aggregates that are clean, well-graded, and contain few contaminants are better able to form bonds.
- Mineralogy and composition: Aggregate mineralogy affects hydration and strength development, especially laterite. Laterite contains minerals rich in iron and aluminium oxides, which may react differently with cementitious ingredients, affecting concrete strength [31].

By comprehending the properties of these aggregates and how they impact the strength of concrete, it becomes feasible to optimize the proportioning and selection of aggregates in the formulation of concrete mixes, thereby resulting in enhanced overall performance.

5. Conclusion

The literature analysis compared river sand-based concrete with lateritic concrete for seven days & 28 days. The mechanical performance of compressive, flexural, & split tensile strengths is increased.

At all fineness levels & optimum replacement levels, lateritic concretes have obtained greater power than control concretes (Zone I to Zone IV). The addition of laterite to the mixture results in a reduction in workability.

Clay particles and high water absorption can reduce the mixture's workability. In lateritic concrete, replacing M-sand with 25% laterite led to enhanced development of the C-S-H gel, which increased compressive strength by 12%, split-tensile & flexural strength by 11.14% and 12.83% relative to control concrete. Further increases have a negative effect on the strength characteristics. Laterite may make concrete a partial substitute for river sand in sustainable buildings for waste recycling and reuse.

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