International Journal of Research Publication and Reviews, Vol 5, no 11, pp 1988-1990 November 2024

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Review Paper on Concrete using Laterite Sand by Replacing Natural Sand

Swatantra Dangi[1], Pushpendra Kumar Kushwaha[2], Mithun Kumar Rana[3]

[1]M. Tech. Research Scholar, Civil Department, RKDF College of Engineering, Bhopal (M. P.),402026 India
[2]Assistant Professor, Civil Department, RKDF College of Engineering, Bhopal (M. P.), 402026 India
[3]Assistant Professor, Civil Department, RKDF College of Engineering, Bhopal (M. P.), 402026 India

ABTRACT

Manufactured sand is a term used for aggregate materials less than 4.75mm and which are processed from crushed rock or gravel. Due to booming of construction activities in our country, natural sand resources are increasingly depleted and its cost is becoming increasingly high. This research was, therefore, conducted to study the influence that manufactured sand have in compressive strength of concrete, to compare the cost of different mix compositions

Based on the findings, laterite sand can be used as a fine aggregate replacement in concrete to the extent of 30%.

1. Introduction

Sand that is mostly made up of worn laterite rock is known as laterite sand. Rich in iron and aluminum, laterite is a type of soil and rock that forms in hot, humid tropical climates. Laterite deposits are created as a result of the parent rock, which is typically basalt or another type of volcanic rock, weathering. Because laterite sand contains a large amount of iron, it usually has a characteristic red or brown appearance.

This kind of sand is frequently employed in building and construction-related operations, especially in areas with a high concentration of laterite formations. Because of its solidity and longevity, it can be used in a variety of civil engineering applications, including the building of buildings, roads, and other structures. The particular characteristics of laterite sand may differ according to the environmental and geological circumstances in the area of origin.

2. Literature Review

Shukla (2000) observed that the replacement of river sand by stone dust decreases the concrete workability, while on the contrary compressive and split tensile strength of the hardened concrete increases up to 40% replacement by stone dust.

Osunade (2002) studied the consequences of replacement of lateritic soils with granite fines on the compressive and tensile strengths of laterized concrete. Slump tests on fresh concrete showed that increasing laterite content affected the workability negatively and reduced the cohesion of the mix. The study suggested that laterized concrete with 10% granite fines can be used for huge foundations without compaction, and laterite utilizing 20% to 40% granite fine can be employed in flat slab requiring manual compaction.

Salau (2003) monitored laterized short columns for 90 days and established long-term deformations. A similar shrinkage-time relation pattern for both standard and laterized concrete specimens, regardless of sealed or unsealed conditions, was obtained. Shrinkage value increases 60% more for unsealed laterized specimens. Higher creep deformation was observed in laterized concrete. Temperature and humidity variations influence the extended period of deformation. Laterite addition did not affect the compressive strength and durability of short columns.

Udoeyo et al. (2006) conducted tests on laterized mix of ratio 1:2:4, with laterite replaced in steps of 20% up to 100%. The results asserted the relation that the workability increases with the addition of laterite in concrete. Compaction factor increases with laterite percentage, and it may be attributed to the larger size laterite fines in the mix

Safiuddin (2007) studied and asserted that quarry waste fine could be used in concrete as a substitute for river sand. Quarry waste fine aggregate is substituted up to 20% in concrete and as another variation, silica fume and fly ash were substituted for 10% of cement. Results show that the workability of the concrete increases and compressive strength decreases, with increasing quarry waste substitution. However, when silica fume is substituted for cement in quarry waste concrete, compressive strength yielded the highest strength due to increased pozzolanic activity of silica fume and micro filing ability. Studies on the durability of concrete concerning water absorption showed decreased resistance to water penetration.

Olusola (2014) examined the performance of laterized concrete exposed to alternate drying and wetting cycles of sulfate solution. The study implemented an accelerated aging method to explore the sulfate environment on laterized concrete subjected to the wetting and drying cycle. When exposed to the repeated sulfate exposure, the compressive strength of laterized concrete initially improved; however, the values decreased between 6 and 8 weeks. This might be owing to the fact that the sulfate interaction time was short and did not have any significant impact on the concrete. It is reported that loss in compressive strength of laterized concrete after sulfate exposure is more remarkable than normal concrete.

Ilangovan (2008) studied the possibility of complete substitution of quarry rock dust as fine aggregate in concrete and reported that such concrete performed 10% better in compressive and flexural strength. Fresh concrete properties, namely workability, were studied, and it was noted that the workability of rock dust concrete is lower than conventional concrete. When subjected to sulfate and acid action, quarry dust concrete performed poorly than the conventional concrete. The study suggests that quarry dust can be used as a replacement for fine aggregate

Zhou (2008) investigated the properties of high strength concrete using stone dust (SD), natural sand, and manufactured sand (M-sand). When the percentage of stone dust was increased, properties of workability improved, and the compressive strength of high strength concrete increased. The combined use of SD and M-sand in high strength concrete showed initial high values of dry shrinkage up to 7%; however, the value remained similar to natural sand concrete when stone dust was more than 7%.

Shahul (2009) investigated the properties of green concrete prepared using quarry rock dust and marble sludge powder as fine aggregate. The authors asserted that the compressive strength, split tensile strength and durability properties of quarry rock dust concrete are 14% more than the control concrete

Udoeyo et al. (2006) conducted tests on laterized mix of ratio 1:2:4, with laterite replaced in steps of 20% up to 100%. The results asserted the relation that the workability increases with the addition of laterite in concrete. Compaction factor increases with laterite percentage, and it may be attributed to the larger size laterite fines in the mix

Alawode et al. (2011) compared the effects of water-cement ratios on compressive strength and workability of laterized and normal concrete. The mix proportion employed in the study was 1:2:4, and slump tests were also recorded. Laterized concrete achieved a true slump for all values of water-cement ratio, and the study inferred that the addition of laterite reduces the workability and consequently affects the strength of concrete

Ukpata et al. (2012) investigated the compressive strength of concrete using several combinations of lateritic sand and quarry dust as full substitution for normal river sand. The concrete mix of 25% laterite to 75% quarry dust yielded greater values of compressive strength, and the compressive strength of laterized concrete was found to increase with age. The results established an increase in compressive strength with the decrease in laterite content at 0.5 water/cement fraction. This might be owing to the greater water absorption quality of laterite, which left inadequate water in the mixture for thorough cement hydration

Norul (2013) studied the effect of curing on compressive strength of laterized concrete. Laterites were replaced up to 60% for coarse aggregates. Cubes of grade M30 with a water-cement ratio of 0.45 were tested for strength. When subjected to air curing, laterized concrete yielded less compressive strength. However, water curing the specimens yielded comparable results up to 30% replacement of coarse aggregates

Jared (2014) investigated the effect of completely replacing sand with natural sand in concrete. Fresh and hardened properties of concrete were investigated, and the results show that to achieve the same strength as conventional concrete, glasscretes need a lower water-cement ratio. Glasscrete exhibits greater elastic modulus, less chloride penetration, lower sorptivity for the same water-cement ratio as standard concrete. Because of the smooth surface of the glass, workability of glasscrete requires a reduced quantity of superplasticizer

Benny (2014) investigated the particle size distribution of fine aggregate by sieve analysis. The study compared the grading pattern of the laterite replaced fine aggregates up to 20% in steps of 5% and observed that there was no change in the zone after the fine aggregate replacement by laterite. Specific gravities of fine aggregates with different replacement levels of laterite were in the range 2.77 - 2.72 and 2.6 - 2.54 for manufactured sand and river sand, respectively

Siddique (2015) compared the effect of foundry sand as fine aggregate for two different grades of concrete. Two grades (M20 and M30) were investigated with increasing percentages of utilized foundry sand up to 20% in steps of 5%. Mechanical and durability properties were studied for up to the age of 365 days.

uthusamy (2015) observed that the workability reduces with the addition of lateritic coarse aggregates. It is owing to the enhanced water absorption of lateritic coarse aggregates having high porosity. Awoyera et al. (2016) observed the workability of laterized concrete containing ceramic wastes as coarse aggregate. Slump values obtained range between 50 and 90 mm, and laterized concrete was less workable than normal concrete.

Shettima et al. (2016) observed the influence of using iron ore tailings (IOT) as a replacement for fine aggregate and reported the results. Concrete with IOT as fine aggregate was investigated for the workability of the mix, mechanical properties, and durability characteristics.

Patra & Mukharjee (2017) studied the effect of granulated blast furnace slag (GBFS) addition as fine aggregate replacement in concrete. Two water-cement ratios 0.45 and 0.5 were employed in combination with increasing GBFS percentages from 20% to 60% in increments of 20%.

Awoyera et al. (2018) studied ceramic-laterized concrete where ceramic coarse aggregates were used. Low workability is observed in laterized samples due to the presence of kaolinite and illite minerals, and additional water was needed to aid plasticity

Awoyera et al. (2018) investigated the porosity of laterized concrete using Mercury Intrusion Porosimeter (MIP) test. The test results showed that the standard concrete possessed 26.04% porosity and laterized concrete 35.29% porosity. The obtained results indicate more macropores and fewer micropores in the laterized and standard concrete, respectively.

Vardhan et al. (2019) investigated the use of waste marble as a fine aggregate replacement for natural river sand in concrete. While replacing partially, the influence of marble waste aggregates was determined for different parameters such as workability, compressive strength, and shrinkage. The microstructural changes were also observed for waste marble concrete. The optimum level of replacement for marble waste as fine aggregate was found to be 40%.

Steyn et al. (2020) studied the fresh, hard, and durability properties of concrete utilizing waste plastic, rubber, and glass in concrete. In this study, 15% and 30% of sand were replaced with the above materials separately, and properties of concrete were studied with 100 ×100 × 100 mm cubes and 100 × 200 mm cylinders. The results revealed that plastic, rubber, and glass reduced concrete workability, and as air content increases, glass enhances the mechanical and durability properties

Yaragal et al. (2020) investigated the effect of using processed lateritic fine aggregates on the performance of cement mortars and concretes. As per Indian standards, lateritic FA is replaced at the levels of 0, 25%, 50%, 75%, and 100% weight to river sand at all fineness levels from Zone I to Zone IV and concluded that that all replacement levels, there is ±3% compressive strength results of control concrete is achieved.

Arulmoly et al. (2021) investigated the performance of cement mortars containing manufactured sand and offshore sand as alternatives to river sand. In this study, 0, 25%, 50%, and 75% of the manufactured sand was replaced with offshore sand. The blended sand at 25% replacement of manufactured sand with offshore sand was a viable solution for completely replacing river sand in fresh and hardened test results.

3. Conclusion

Most of the researchers listed above considered alternative material such that stone dust and construction waste for fine aggregate and coarse aggregate replacement in the production of concrete for other purpose

REFERENCES

[1] Muthusamy, K 2015, 'Durability Performance of Concrete Containing Laterite Aggregates' KSCE Journal of Civil Engineering, vol. 19, no. 7, pp. 2217-2224.

[2] Norul, W 2013, 'Effect of curing regime on compressive strength of concrete containing malaysian laterite aggregate', Advanced Materials Research, vol. 626, pp. 839-843.

[3] Raychaudhuri, SP 1980, 'The occurrence, distribution,classification and management of laterite and lateritic soils', Journee Georges Aubert, vol. 18, no. 3-4, pp. 249-252

[4] Raychaudhuri, SP 1980, 'The occurrence, distribution,classification and management of laterite and lateritic soils', Journee Georges Aubert, vol. 18, no. 3-4, pp. 249-252

[5] Salau, MA 1999, 'Shrinkage deformations of laterized concrete', Building and environment, vol. 34, no. 2, pp. 165-173

[6] Shahul, H 2009, 'Properties of green concrete containing quarry rock dust and marble sludge powder as fine aggregate', ARPN Journal of Engineering and Applied Sciences, vol. 4, no. 4, pp. 83-89.

[7] Shahul, H 2009, 'Properties of green concrete containing quarry rock dust and marble sludge powder as fine aggregate', ARPN Journal of Engineering and Applied Sciences, vol. 4, no. 4, pp. 83-89.

[8]Wright, JR Cartwright, C Fura, D Rajabipour, F 2014, 'Fresh and Hardened Properties of Concrete incorporating Recycled Glass as 100% Sand Replacement', Journal of Materials in Civil Engineering, vol. 26, no. 10, 04014073.

[9] Yaragal, SC Gowda, SNB & Rajasekaran, C 2019, 'Characterization and performance of processed lateritic fine aggregates in cement mortars and concretes', Construction and Building Materials, vol. 200, pp. 10-25.

[10] Zhou, M 2008, 'Effects of manufactured-sand on dry shrinkage and creep of high-strength concrete', Journal of Wuhan University of Technology Matererial Science Edition, vol. 23, pp. 249-253