Quest Journals
Journal of Architecture and Civil Engineering
Volume 7 ~ Issue 10 (2022) pp: 54-56
ISSN(Online) : 2321-8193
www.questjournals.org

Research Paper

A Review on Alernatives for Sand and Utilization in Concrete

Inti Jagan[1], Kumarapu Bharathi[2] and Korukonda Bhanu Prakash[3]
[1,2,3] UG Student, GMR Institute of Technology, Rajam, 532127, India,

ABSTRACT:*Sand is a vital component of our daily life and the second most utilised raw material in the world after water. Nowadays, sand supply has recently become quite restricted due to erosion, forest decline, and other environmental challenges. Because of the fast rise of the building sector, demand for sand has skyrocketed, resulting in a scarcity of river sand in most regions of the world. Furthermore, the mining of river sand has an impact on the ecological equilibrium. Natural sand is in short supply worldwide. Some replacement sands are needed to improve the mechanical and durability properties of concrete more than natural sand, as well as be more cost-effective than natural sand and help reduce the dumping of waste in landfills. The choice of fine aggregate is critical to the performance and cost of concrete. This study reviews the various replacements for sand such as such as degraded marine, walnut shells, waste foundry sand, etc., in the production of concrete and also the use of alternative sand for a cleaner and sustainable environment.*

KEYWORDS: *Fine aggregate, Sand, Concrete, Compressive strength, Flexure strength, Replacement*

R*eceived 13 Oct., 2022;* ***R****evised 26 Oct., 2022;* ***A****ccepted 28 Oct., 2022 © The author(s) 2022.*
P*ublished with open access at* ***www.questjurnals.org***

I. INTRODUCTION

Sand is a key component in many building materials, including cement-mortar, concrete, tile, brick, glass, bituminous concrete adhesives, and ceramics. An environmental emergency is occurring as a result of the rising use of sand that is being removed from riverbeds and beaches. River sand has been overexploited in some areas, threatening the stability of riverbanks and causing environmental concerns. Alternative sustainable materials should be used to create resource-efficient concrete and those alternatives are bagasse ash with marble waste, walnut shells, waste foundry sand, crumb rubber, waste glass with zeolite, quarry waste,a mixture of brick dust, stone dust, recycled fine aggregate,etc., A significant amount of bagasse ash (44,200 t/day) is thrown away as waste as India overtakes other countries as the world's largest producer of sugar. Sugar factories produce bagasse ash (BA) as a byproduct. It can be used as a pozzolanic material in concrete and contains reactive silica. In sugar mills, bagasse—the fibrous residue left over after sugarcane juice is extracted—is used to produce steam and power. Similarly, marble slurry dust is disposed of in marble processing facilities. As a result, marble waste and sugarcane bagasse ash (used as pozzolan) are employed (as a fine aggregate replacement for crusher sand). It was discovered that 20% for bagasse ash and 25% for marble mining powder were the ideal replacement amounts [1]. Walnut shells are one of the agricultural wastes. Walnut shells are a type of agricultural waste that have a significant specific area, strong mechanical properties, and reasonable chemical stability. By grinding the walnut shell, the agro-industry produces large quantities of the walnut shell. It often ranges in hue from light brown to dark brown. As a result, little research has been done on the usage of walnut shells in concrete mixtures. Halabja is renowned for its walnut trees, therefore the use of walnut shell, the agro-waste produced as a partial replacement of fine aggregate Every year, it yields a harvest of more than 10 million walnuts. The Aweisar region, which is three kilometers to the east of Taweila Village in the Hawraman district, is where the walnut shells were found.Up to 30% of fine aggregate can be replaced with walnut shell when the water to cement ratio is 0.38[2]. As a fine aggregate, waste foundry sand is utilized [2]. WFS (waste foundry sand) is an industrial solid waste. There are numerous opportunities in the cement industry to employ waste materials in concrete, where trash can be used as a replacement for aggregate or cement in concrete. The amount of rubbish collected worldwide each year can reach up to 2500 million tons. WFS with a replacement ratio of up to 30% can be utilized successfully in concrete without affecting its durability and strength [3]. The crumb rubber is used as fine aggregate. The crumb rubber is recycled rubber produced from automotive and truck scrap tires during the recycling process. Steel, tire cords are removed. Every year, around

*Corresponding Author: Inti Jagan
Department of Civil engineering, GMR Institute of Technology, Rajam, 532127, India

1.5 billion tyres are discarded worldwide, which may increase to 5 billion tires by 2030. 4% crumb rubber is used as a partial replacement [4]. The high volume of waste glass by zeolite as used fine aggregate in self-compacting concrete (SCC).Batch preparation, melting, refining, forming, and post-forming are the primary operations in the production of glass, and they all use a lot of energy and produce a lot of pollution. In 2013, the United States produced around 11.54 million tons of waste glass, but only 27% of it was recycled. The other 73% was dumped in landfills. Researchers are becoming more interested in using leftover glass in concrete by effectively using it as aggregate or powder [5]. Since used glass is not biodegradable and resembles natural sand in terms of physical characteristics. Some researchers make an effort to utilize this waste material as aggregate in concrete. Quarry dust, a byproduct of the crushing process, is a concentrated material that can be used as aggregates, particularly as fine aggregates, in concrete. The rock is crushed into different sizes during quarrying activities; the dust produced during the process is considered to as quarry dust and it is released as waste [6].Large amounts of nonbiodegradable trash are generated by the brick, stone, and construction industries, and when these wastes are mixed with concrete, the result is construction that is both green and sustainable. To investigate how the characteristics of natural aggregate concrete (NAC) and recycled aggregate concrete are affected when brick dust (BD), stone dust (SD), and recycled fine aggregate (RFA) are partially substituted for fine aggregate (RAC). In the current study, two types of mixtures were taken into consideration: Group B, which contains 50% recycled coarse aggregate and 50% natural coarse aggregate (NCA), and Group A, which is 100% NCA. Each group received 30% BD, 30% SD, and 30% RFA individually to replace some of the natural fine aggregate [7].Geopolymers, a novel class of inorganic polymers, are new promising binders produced by thermally activating a solid-state alumina-silicate with a very alkaline activating solution. Geopolymer binders have recently been discovered to be the greatest alternative to cement binders due to their environmental sustainability. Fly ash and powdered granulated blast furnace slag shall be used to make geopolymer concrete (GGBS). Fly ash is a byproduct of thermal power plants, whereas GGBS is a byproduct of steel mills. Under ambient curing conditions, alternative fine aggregates such as dredging marine sand (DMS) and manufactured sand (M-Sand) were used in place of the usual rare fine aggregate (river sand) [8].

Fig.1a. Marine sand

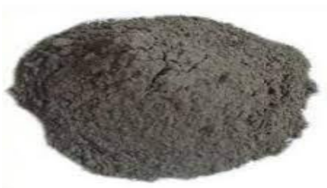

Fig.1b. Waste foundry sand

Fig.1c. Walnut shells

Fig.1. Replacement of fine aggregates.

II. LITERATURE REVIEW

Compressive strength:

The optimum replacement level of crusher sand with marble slurry dust, which is utilised as fine aggregate, has been determined to be 25%. In comparison to control concrete, 20% bagasse ash substitution is the best level to achieve without reducing compressive strength [1]. If we use 40% or 50% of waste foundry sand (WFS) as fine aggregate, the compressive strengths are considered reduced because of the fineness and porosity of WFS. The concrete mix with the addition of 30%of WFS displayed 5.4% less compressive strength at the age of 28 days [3].The compressive strength of rubberized concrete is lowered due to crumb rubber adhering to the surrounding cement paste. When compared to rubberized concrete that had not been treated, the compressive strength of the treated version was 7.05 percent higher. The presence of more rubber reduces compressive strength [4].In comparison to control concrete, which is concrete that contains 100% NFA, the compressive strength is improved when concrete is combined with brick dust, stone dust, and RFA at rates of 24.57%, 36.89%, and 18.04%, respectively, at 28 days. In comparison to NAC, which has a compressive strength of 27.11 MPa, RAC with 100% NFA has a compressive strength of 25.18 MPa [7].The compressive strength of self-compacted concrete (SCC) mixtures at 7 and 28 days is marginally reduced when the fine glass aggregate (FGA) percentage increases. When compared to combinations without FGA, those that do exhibit better compressive strength after 90 days [5].When compared to control mortar, the percent losses in compressive strength by utilizing 15% walnut shells for 7 days were 48.5, 21, and 41.3% for untreated, 1/2 hr, and 1-hour treated walnut shells, respectively. For 28 days, the proportional decreases are 34, 17, and 29.4% [2].In terms of compressive strength, D100 has a maximum stress that is 9.33% higher than the goal strength but only 6.63% lower than the control concrete (river sand as fine aggregate) [8].

Flexure strength:

The percent losses in flexural strength by utilizing 15% walnut shells for 7 days were 50, 20, and 32.1% for untreated, 1/2 hr, and 1-hour treated walnut shells, respectively, compared to control mortar. For 28 days, the equivalent decreases were 49.3%, 25.3%, and 43%. Soaking walnut shells in boiling water reduces the toxic soluble hydrolysable tannins in walnut shells while increasing the binding strength between cement and walnut shell [2].There was no improvement in strength with the addition of WFS to concrete; the concrete flexure strength of the mix up to 30% incorporation of Waste Foundry Sand was roughly the same as the strength of the control mix (WFS0 percent), When compared to the Control mix, the concrete mix containing 30% WFS had a 9.1% reduced flexure strength at 28 days [3].Amazingly, the flexural strength of silica fume containing rubberized concrete is raised by 1.41% when compared to the mix 0CR0SF. This increase is 8.52% when compared to the mix 5TCR0SF. The first crack appears at 11.77 kN for the control concrete specimen, however it is reduced to 7.85 and 8.83 kN for the mixes 5TCR0SF and 5TCR15SF, respectively [4].

III. CONCLUSION

From the above literature, it is concluded that

Under ambient curing conditions, degraded marine sand shall be suggested as an alternate fine aggregate to the conventional scarce fine aggregate (river sand) in geopolymer concrete.In place of 50% of the normal concrete, dredged marine sand is used.The bonding ability of the fine aggregates determines the compressive strength of geopolymer concrete. D100 attained the necessary compressive and flexural strengths.

When compared to untreated walnut shells, processed walnut shells considerably influenced the compressive and flexural strengths of mortar but soaking walnut shells in boiling water reduces the toxic soluble hydrolysable tannins in walnut shells while increasing the binding strength between cement and walnut shell.As well as after 28 days of moist curing, the compressive and flexural strengths of mortar were reduced by 17 and 25%, respectively, in contrast to the control mortar. Up to 15% walnut shells used as fine aggregate.

Without adversely affecting the mechanical performance characteristics of concrete, it is advised that WFS can be successfully employed in concrete production up to a 30% substitution rate.Due to the fineness and porosity of WFS, the strength was significantly decreased at 40% and 50% substitution rates.

REFERENCES

[1]. Thangavel Murugesan, Ramamurthy Vidjeapriya and Abdulsalam Bahurudeen, "Sustainable use of sugarcane bagasse ash and marble slurry dust in crusher sand based concrete", Structural Concrete, (2020) https://doi.org/10.1002/suco.202000215 .

[2]. Mohanad Yaseen Abdulwahid and Sarmad Fadhil Abdullah, "The utilization of walnut shells as a partial replacement of sand in mortar mixes", Structural Concrete, (2020) https://doi.org/10.1002/suco.202000108 .

[3]. Jawad Ahmad, Fahid Aslam, Osama Zaid, Rayed Alyousef and Hisham Alabduljabbar "Mechanical and durability characteristics of sustainable concrete modified with partial substitution of waste foundry sand", Structural Concrete, (2020) https://doi.org/10.1002/suco.202000830 .

[4]. Chellakavitha Nagarajan and PrabavathyShanmugasundaram, "Effect of modified clay treated crumb rubber and silica fume on the properties of concrete", Structural Concrete, (2021) https://doi.org/10.1002/suco.202100085 .

[5]. Saeed Khalooee, Babak Ahmadi, AzadehAskarinejad and Masoud Nekooei, "Tackling the issues of self-compacting concrete containing high volume of waste glass aggregate by zeolite", Structural Concrete, (2020) https://doi.org/10.1002/suco.202000252 .

[6]. Furong Gao, Yongsheng Ji, Qi Xue, Zhishan Xu and Yangmei Zhou, "Gradation effect of cleaned quarry waste to improve size distributions of concrete constituents" Structural Concrete, (2019) https://doi.org/10.1002/suco.201900457 .

[7]. MeesalaChakradhara Rao "Influence of brick dust, stone dust, and recycled fine aggregate on properties of natural and recycled aggregate concrete", Structural Concrete, (2020)https://doi.org/10.1002/suco.202000103 .

[8]. Indhumathi Anbarasan and NaganSoundarapandian, "Investigation of mechanical and micro structural properties of geopolymer concrete blended by dredged marine sand and manufactured sand under ambient curing conditions", Structural Concrete, (2019) https://doi.org/10.1002/suco.201900343 .