International Journal of Research Publication and Reviews

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

Review on Performance of Quarry Dust as Fine Aggregate in Concrete

Ranjan Kuamr[1], Pushpendra Kumar Kushwaha[2], Mithun Kumar Rana[3]

[1]Student, Department of Civil Engineering, RKDF College of Engineering Bhopal, India
[2,3]Assistant Professor, Department of Civil Engineering, RKDF College of Engineering Bhopal, India

ABTRACT

Recent developments in concrete technology have led to a cost-effective increase in the material's strength. The wise use of the resources that are readily available locally is essential to this economically driven development. Natural sand and filler material are important components of concrete, but they are both expensive and limited. Since the beginning of their studies on concrete, scientists and researchers have made an effort to use and incorporate different materials, such as agricultural or industrial wastes, into the material in a way that will not only effectively dispose of the wastes but also improve some of the concrete's inherent qualities. Researchers have often attempted to improve the characteristics of concrete by adding quarry dust to it. The current study employs a methodical methodology consisting of sequential steps to investigate the development of quarry dust concrete, whereby quarry dust is used in place of conventional sand. This study examines the qualities of concrete's fresh and compressive strength when stone dust is used in place of some of the natural sand.

Keywords: Concrete, sand, Quarry dust, compressive strength, Natural sand

I. INTRODUCTION

GENERAL

The primary component used in the construction of any structure is concrete. Portland cement is the primary ingredient used to make concrete. Conversely, the greatest threat facing humanity now is environmental pollution and global warming. Because of its pleasure, concrete is the most widely used building material worldwide, and ordinary elements cannot be substituted for concrete. However, it is now rare to be able to continue building for the long term in order to meet the demand for structures in the future using the energy-intensive materials and building processes or technologies that are currently accessible. As the public's concern about climate change is wisely addressed due to the growing impact of global warming and increasing sea level, the building industry contributes 22% of greenhouse gas emissions to the atmosphere. Concrete technologists are faced with the task of leading future growth in a manner that maintains environmental quality. Of fact, technological decisions that oppose the creation of ecologically friendly and sustainable concrete have a direct impact on the current environmental problems. Ordinary Portland cement (OPC) is the main binder used to make concrete. Its main disadvantages are the greenhouse gas emissions, which contribute to pollution, depletion, and global warming.

A byproduct of the quarrying, crushing, and sieving processes, quarry dust is typically referred to as crushed sand (CS), crushed rock powder (CRP), artificial sand (AS), quarry dust (QD), quarry waste (QW), quarry sand (QS), or rock powder dust (RPD) by various authors. It makes up approximately 10-15% of the non-valued waste produced in stone quarries. The burden of dumping dust on the planet that causes pollution is lessened when quarry dust is used.


Quarry Dust in Plant

1.1 Quarry Dust in Structural Concrete

More than 60 percent of the quarry rock dust produced is used in developed countries including Australia, France, Germany, and the United Kingdom. In Japan, raw crusher dust is typically thought to be appropriate for use in mixtures with natural sand only in cases where its quality and cost are sufficient to justify the substitution. Even though, quarry dust is a problem for the people residing nearby quarries by dumping of quarry dust and an environmental issue causing serious respiratory problems, the potential use as aggregate becomes a positive solution which is an added advantage.

Numerous investigators from various nations investigated the possible application of quarry dust in concrete. It is well known that adding quarry dust to concrete reduces its workability while increasing its strength when compared to concrete made with the same amount of river sand. Examining the aforementioned characteristics of quarry dust and fly ash, it is clear that when both are used together, the improvement in workability brought about by the addition of the one may partially offset the loss of workability due to the one, and the loss of early strength due to one may be mitigated by the gain in strength due to the other. The addition of ground fuel ash lessens the reduction in workability caused by the addition of quarry dust. There is a loss in slump when quarry dust is added, but this loss can be greatly mitigated by adding fly ash. By adding quarry dust, the early strength loss caused by the fly ash addition can be entirely offset. But the addition of fly ash up to a certain percentage has had no negative effect at all on the characteristic strength. River sand can be cheaply replaced with quarry dust, a byproduct of crushing stones (also known as blue metal) that is widely available at low cost from rock quarries in many regions. Quarry dust is the leftover material left over after rocks are extracted and processed into fine particles smaller than 4.75 mm. Due to disposal issues, quarry dust—which is typically regarded as a waste material—causes pollution in the environment. Since quarry dust is typically a waste product, using it extensively in the building industry will also lessen its negative effects on the environment. Therefore, using quarry dust as fine aggregate in concrete will lessen environmental issues as well as the need for natural sand.

II. LITERATURE REVIEW

2.1 Literature Review

Numerous studies have been conducted to investigate the advantages of utilising different waste materials, such as glass powder, granite dust, marble dust, and stone dust, in the production of concrete and to improve its qualities. The many authors' works are described here.

Baalbaki et al published the findings of the experiments carried out on high-strength concrete built with different types of crushed rocks, stressing the function played by coarse-aggregate through the elastic properties of the parent rock. The results provide a chance to review the current Ec to fc formulas that certain codes advocate. Studies on using quarry dust as fine aggregate to partially or completely replace traditional river sand have been started after a long hiatus.

A plan was created, according to Draft, to ensure that the Sydney Region would continue to receive construction sand supply for the next 20 years. Lake sand resource extraction is anticipated to be finished in the next five to ten years, necessitating the search for alternate supplies to keep up with Sydney's expanding construction industry need. The strategy will identify primary and secondary sources of construction material resources, provide frameworks for ongoing access to these resources in land use planning instruments, establish an assessment and approval regime for quarry proposals, develop best practice standards for quarry operation, and encourage the use of substitutes like manufactured sand and recycled material. It will also serve as the foundation for managing supply for the Sydney market both in the short and long term.

Using quarry dust as the primary filler ingredient, Karthikeyan and Ponni have successfully constructed flyash-based bricks with lime, gypsum, and sand.

The 28-day strength in compression, split tension, and modulus of rupture found increased for total replacement of sand with up to 20% replacement of coarse aggregate by ceramic scraps, according to Reddy and Reddy Rock, who had also tried replacing all of the sand in the concrete with the conventional coarse aggregate partially or fully replaced by ceramic scrap.

Additionally, Safiuddin et al. attempted to replace a portion of the sand in fly ash/silica fume-based concrete with quarry dust. The concrete had 20% of the sand replaced with quarry dust, 10% of the cement weight replaced with fly ash, and the same 10% of the cement weight replaced with silica fume by consideration. Without changing the concrete's unit weight or air content, it was discovered that using quarry dust as fine aggregate improved the slump and slump flow of the new concretes.

Shaviyani Atoll , has documented the state of sand mining in Maldives where construction is one of the key activities being carried out in the islands and sand mining has become a prevalent practice, increasing islands vulnerability. In some of the islands, a bigger obstacle to building new homes and developing new infrastructure is a lack of room. Following a field trip to the five islands (Milandhoo, Funadhoo, Komandhoo, Foakaidhoo, and Kandithem in the Maldives), an international team of experts revealed that the common denominator across all islands was land reclamation.

When used as fine aggregate in concrete, Waziri and Muazu investigated the characteristics of well-washed quarry sand from Gwoza, Borno State. The specific gravity, bulk density, porosity, water absorption, impact value, and aggregate crushing value of the cleaned and dried aggregates were all quite excellent, and they were graded in compliance with BS 812 part 1:1975. when the age rose, the compressive strength increased, but when the water cement ratio increased, it dropped. After seven days, every blend used in the study had reached more than 60% of its 28-day strength.

The strength and durability characteristics of concrete with quarry rock dust as fine aggregate were investigated by Langovan et al. (2008).

The viability of employing marble sludge powder and quarry dust as a complete replacement for sand was investigated by Shahul Hameed and Sekar. It is determined that because of their effective microfilling capacity and pozzolanic activity, the combined usage of quarry rock dust and marble sludge powder displayed good performance in strength and durability characteristics.

Radhikesh et al. conducted an experimental investigation to produce paving bricks using crusher dust. Investigations were conducted into the mechanical and physical characteristics of paving blocks that had different percentages of crusher dust substituted for fine aggregate (sand). The test findings demonstrated that while there was a 56% cost savings, replacing fine aggregate with crusher dust up to 50% by weight had no influence on the decrease of any physical or mechanical attributes. When producing paving blocks in large quantities, the saving percentage would be higher and much more advantageous.

The mechanical properties of HSC were studied by Raman et al. (2010) during a 28-day period at a strength of 60 MPa. Up to 40% of the sand was replaced with quarry dust, and 10% of the cement was replaced with RHA. According to reports, replacing sand in HSC with quarry dust may have some detrimental effects on mechanical qualities. However, these effects can be mitigated by using CRM, such as RHA, in conjunction with sound mix design.

According to Norazila and Kamarulzaman's study, adding up to 30% of quarry dust to replace sand in foam concrete improved its qualities. The foam concrete with quarry dust had about 40% greater compressive and flexural strength than the foam concrete used as a control.

Quarry dust has been found to have other uses in different fields by Mir and Shubhada. The geotechnical characteristics of expansive soil have been found to be improved by adding flyash to quarry dust in an equal amount (20–30% weight of soil).

According to Sivakumar and Prakash, concrete with a fine to coarse aggregate ratio of 0.6 that has 100% of its sand replaced with quarry dust has a higher elastic modulus and compressive strength. High fineness quarry dust reduced the amount of water needed in regular concrete, hence its use was restricted.

In the Indian state of Maharashtra, Shaikh and Daimi compared the strength and durability performance of concrete built with natural sand and artificial sand with dust using microstructure-related parameters. It was discovered that the sharp edges of the particles gave a better bond with the cement than the rounded portion of the natural sand, and that there was a consistently higher strength. Both concretes had the same amount of water absorption, chloride permeability, and weight loss during immersion for up to ninety days.

Kyung and Hun presented the current initiatives in Korea to make use of the mineral waste materials from the metals sector. The Korea Institute of Geology, Mining, and Materials has developed the manufacturing technologies of artificial stone plate as a building material with firing method and hydrothermal synthesis to utilise waste stone and stone powder sludge generated from domestic quarry and cutting process of stone plates. It was demonstrated that the artificial stone plate's manufacturing cost was only 18,000 won/m2, half that of real stone plate, and that its use in the building stone business might be feasible.

For a design mix of M20 grade concrete, Lohani et al. investigated the effects of replacing sand with quarry dust in portions at0%,20%,30%,40%, and 50%. It was found to be highly useful in ensuring very good cohesion of concrete because of its high fines of quarry dust. Comprehensive interaction with the concrete admixture, enhanced pozzolanic reaction with quarry dust, micro aggregate filling, and durability of the concrete. In order to sufficiently wet the particle surfaces and retain a particular workability, aggregates with larger surface areas need more water in the mixture. It goes without saying that adding more water to the mixture will lower the concrete's quality. It was found that as the percentage of sand replaced by quarry dust grows, so does the slump value.

The geotechnical properties of stone dust were investigated by Naman Agarwal and Ajit Kumar using the same laboratory tests as before. The third process involves calculating the pavement thickness for both unstabilized and stabilised soil that has been stabilised by adding the ideal amount of stone dust according to the CBR test.

According to compressive quality, B. H. Shindel et al. established the viability of using both treated and untreated ocean sand in bond and geopolymer concrete.

An experimental investigation on M20 grade concrete by partially replacing cement with stone dust and fine aggregate with crushed fine aggregate was conducted by Dr. B. Madhusudana Reddy and B. Bharathi. experimental research Stone dust (stone dust that has passed through a 90 micron screen) can be used in different percentages—10%, 20%, and 30%—to partially replace cement by weight. Crushed fine aggregate replaces the fine aggregate to increasing degrees, 25%, 50%, 75%, and 100%, in that order. Investigated are the effects of crushed fine aggregate and stone dust on the flexural, split tensile, and compressive strengths of concrete of the M20 grade. T

Research on Geo Polymer Concrete with Quarry Stone Dust Used to Replace Part of the Sand, Shaik Farooq Ahamed et al. In this work, alkaline liquids for polymerization are solutions of sodium hydroxide (NaOH) and sodium silicate (Na_2SiO_3). The alkaline solution's molarity is assumed to be 12 in this work. In India, cement is often made with fine aggregate, or regular stream sand. Nevertheless, research into the use of an optional resource for fine aggregates in the development industry is being spurred by the emergence of inherent constraints on the misuse of sand from riverbeds. The use of quarry stone dust as a fine aggregate is examined in this research.

Abhishek Kumar and Vikram Singh investigate how steel fibre and stone dust affect the strength characteristics of concrete.The research The replacements consist of adding steel fibre at 1% by the weight of cement and replacing fine aggregate at0%,30%,1%,40%,1%, and 50%, 1%. On concrete with an M30 grade, the design mix is prepared. The outcome shown that strength and durability first rose at small percentages and that production costs were also lower at a fixed W/C ratio of 0.40.

In brief

In many parts of the world, there are diminishing amounts of viable natural sand resources. This can be attributed to a number of factors, including river sterilisation or extinction, the expense of extraction and transportation, the scarcity of water in some locations for processing, or environmental concerns.

Following a thorough assessment of the literature, the following elements are a summary of the current state of the concrete industries facing the shortage of fine aggregate and the use of quarry dust as an alternative:

excessive sand mining from rivers that has almost completely depleted the resource and makes additional mining impractical. Thus, it is crucial to rapidly find alternatives and halt additional river sand extraction. Studies on concrete have shown that near-shore marine sand, dune sand, land-based sand, offshore sand, manufactured sand from quarry dust, and bottom ash can all be used as fine aggregate in place of river sand. However, more research on the viability and feasibility of quarry dust is advised. The results of the laboratory tests indicate that quarry dust can be utilised to replace sand entirely or in part. Hazardous materials include particles less than 75 µm. Because quarry dust causes uneven grading, increased surface area to absorb water, and less strength and durability, it is thought to be detrimental to concrete.

III. CONCLUSION

In many parts of the world, there are diminishing amounts of viable natural sand resources. This can be attributed to a number of factors, including river sterilisation or extinction, the expense of extraction and transportation, the scarcity of water in some locations for processing, or environmental concerns. Following a thorough assessment of the literature, the following elements are a summary of the current state of the concrete industries facing the shortage of fine aggregate and the use of quarry dust as an alternative: excessive sand mining from rivers that has almost completely depleted the resource and makes additional mining impractical. Thus, it is crucial to rapidly find alternatives and halt additional river sand extraction. Studies on concrete have shown that near-shore marine sand, dune sand, land-based sand, offshore sand, manufactured sand from quarry dust, and bottom ash can all be used as fine aggregate in place of river sand. However, more research on the viability and feasibility of quarry dust is advised. The results of the laboratory tests indicate that quarry dust can be utilised to replace sand entirely or in part. Hazardous materials include particles less than 75 µm. Quarry dust is said to be detrimental to concrete because it causes uneven grading, increased surface area to absorb water, and a decrease in the material's strength and longevity.

REFERENCE

[1]]Baalbaki, W., Benmokrane, B., Chaallal, O and Aitcin, P.C (1991). Influence of coarse aggregate on Elastic properties of High performance concrete, ACI Materials Journal, 88(5):499-503.

[2] Ho, D.W.S., Sheinn, A.M.M., Ng, C.C and Tam C.T (2002). The use of quarry dust for SCC applications, Cement and Concrete Research 32 (2002) 505– 511.

[3] Raman, S. N., Zain, M.F.M., Mahmud, H. B and Tan, K. S (2004). Suitability of quarry dust as partial replacement material for sand in concrete,

[4] Venkatarama Reddy, B. V (2004). Sustainable building technologies: Application of Science &Technology to Rural Areas (ASTRA), Special Section, Current Science, 87(7): 899-907

[5] Draft (2005). Sydney Construction Materials Strategy Newnes Plateau - Draft Issues Paper

[6] Reddy, M.V and Reddy, C.N.V.S (2007). An Experimental Study on use of Rock Flour and Insulator Ceramic Scrap in Concrete, IE (I) Journal – CV, 88: 47-50.

[4] Safiuddin.Md., Raman, S.N and Zain, M.F.N (2007). Utilization of Quarry waste fine aggregate in concrete mixtures, Journal of applied Science Research, 3(3):202-208

[8] Shaviyani Atoll (2007). Building resilience to Tsunamis in the Indian Ocean, Baseline study Report, MALDIVES, pp. 30.

[9] Prachoom Khamput, E (2008). A study of compressive strength of concrete using quarry dust as fine aggregate and mixing with admixture type E, Rajamangla University of Technology, Thanyaburi, Pathumthani, Thailand.

[10] Jayawardena, U.DE. S and Dissanayake, D.M.S (2008). Identification of the most suitable rock types for manufacture of quarry dust in Sri Lanka, Journal of the National Science Foundation of Sri Lanka, 36 (3):215-218.

[11]Kamalanathan, G and Sivakumar, A (2008). Study of self compacting properties of quarry dust cement mortar using marsh cone flow studies, Proceedings, International Conference on Advances in Concrete and Construction, ICACC-2008, 7-9 February 2008, Hyderabad, India, pp. 72-78.