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REVIEW PAPER ON USE OF BAGASSE ASH AND STONE DUST IN CONCRETE

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ABTRACT

Nowadays, waste materials are used as advantageous replacement material industry. Sugarcane bagasse ash (SGBA) and stone dust (SD) used as partial replacement materials in the concrete mix. Sugarcane bagasse ash (SGBA) are used as pozzolanic materials for the development of blended cement. Few studies have been reported on the use of bagasse ash as pozzolanic material by partially replacing the cement and stone dust by partially replacing the sand in the concrete mix, and no detailed study for strength and durability properties of blended concrete mix containing both SGBA and SD have been reported so far. The main aim of the present investigation is to evaluate the efficiency of SGBA as supplementary cementitious material with reference to strength and durability properties in blended concrete and also to identify the optimal levels of replacement of ordinary Portland cement (OPC) with SGBA and replacement of sand by stone dust in blended concrete.

Keyword - stone dust, Sugarcane bagasse, river sand strength and durability

1. INTRODUCTION

The most commonly used building material in the world, concrete a heterogeneous composite material made up of easily accessible fundamental ingredients such as cement, -water, CA and fine aggregates, and, depending on the situation, admixtures, fibres, or other additives. When combined, these components create a fluid mass that is easily shaped into any desired shape. When the cement has adequately dried over time, it creates a firm matrix that holds the other materials together to create concrete, a long-lasting substance that resembles stone. Concrete is used extensively in the building industry Due to its strength, stiffness, durability, moldability, economy, and versatility. It is also dependable and sustainable.

Quarry Dust:

Quarry residue refers to the accumulation, leftover, or waste material that is left over from the extraction and processing of rocks in a quarry's pounding plant. It is also known as rock dust, quarry debris, or stone residue. When crushing and measuring rock in a quarry, the main goal has typically been to produce coarse-graded aggregates of different sizes and materials for roadway construction that adhere to standards for specific details

Sugar Cane Bagash

In tropical nations, sugarcane is farmed in large quantities. Around 1.84 billion tonnes of sugarcane were produced globally in 2017. Both sugar and alcohol mills employ it. However, after being used in those mills, roughly 30% of the pulpy fibrous residue is created, therefore it cannot be completely eaten by those mills.

2. LITERATURE REVIEW

R. Malathy et al. (2005) investigated the flow characteristics and mix design of SCC for grades varying from M20 to M60. Concrete's compressive strength is evaluated after 7, 28, 56, and 90 days of curing. Comparing SCC to regular concrete, the difference in compressive strength is limited to 2% to 6.3%. For high strength concrete, the fly ash replacement ranges from 5 to 20%. The tensile strength decreases from 2.8 to 8.3%. The amount of cement needed for SCC is roughly 5–20% less than that of regular concrete. The cost increase for SCC is relatively minimal.

In 1990, V. Kumar et al. conducted research on the partial substitution of ordinary Portland cement with fly ash that varied in percentages from 10% to 25% and a constant 7% silica fume. The effect of flyash and silica fume as a partial replacement of OPC on M20-grade concrete has been studied in relation to the static modulus of elasticity. The 56-day static modulus of elasticity for different mixes are 41.38 KN/mm2, 43.90 KN/mm2, 35.17 KN/mm2, 29.25 KN/mm2, and 23.33 KN/mm2, respectively, for flyash silica fume concrete, containing 0%,17%,22%,27%, and 32% of flyash and a constant 7% silica fume. These mix proportions have blast furnace slag instead of traditional stone

According to M. Sekar et al. (2007), OPC 53 grade was used for the specimen casting. The coefficient of permeability of modified Ferro cement decreases as the polymer cement ratio is increased up to 12.5% and the flyash replacement levels are increased up to 30%. The amount of time required for cracking depends on the percentage of polymer and flyash replacement levels. Ordinary Ferro cement specimens take less time to initiate a crack than specimens made of polymer and flyash.

The main disadvantage of concrete made with quarry dust is that it is less workable than concrete made with sand. Super plasticizer should be used to improve the workability of concrete when the quarry dust fraction exceeds 40% of the sand replacement. Compaction by vibrations should always be considered when the quarry dust fraction exceeds 40% of the sand replacement. A. Krishnamoorthi et al. (2010) studied the mix design for M30 concrete and sand replacement by 0-100% with quarry dust was considered. This paper implies that there is no harm in replacing up to 40% of sand with quarry dust in making concrete.

According to J.K. Dattatreya et al. (2001), concrete strength at 7 days varies from 58-65% of the strength of the corresponding concrete mix at 28 days. The study also examined the effect of replacing cement with flyash at different percentages—15, 20, 25, and 30%. Flyash-based mixes show a 30–50% reduction in the co-efficient of absorption. We may deduce that adding flyash up to 25% in place of cement will make the concrete more corrosion-resistant and long-lasting.

Class C flyash with 70% cement replacement mixes were evaluated with respect to compressive strength, tensile strength, and modulus of elasticity. V. Revathi et al. (2004) studied the possibility of using Class C flyash as cement replacement up to 40% in reinforcement and 70% in plain concrete. The use of this type of cement may solve the issues of additional quality control and storage facilities related to the addition of flyash as a separate ingredient at the ready mixed concrete batching plants.

The five different percentages of replacing cement by 0,30,40,50, and 60% in normal mix M15 have been considered, according to K.K. Jain et al. (2004). The high volume flyash concrete exhibits poor quality of concrete at an early age because the ultrasonic pulse velocity is either below or slightly above 3000 m/sec. As the specimens age, a progressive increase in the ultrasonic pulse velocity for concrete up to 40% flyash replacement of cement indicates good quality flyash concrete. The maximum pulse velocity on a 30% flyash mix is 3536 m/sec.

In 2009, Shi-Cong and Chi-Sun looked into the effects of substituting crushed fine stone at replacement levels of 25%, 50%, 75%, and 100% for river sand. They found that the control mix had the greatest slump and that the workability of the concrete rapidly reduced as more crushed fine stone was added in place of natural sand. The measured lump size of concrete containing 100% river sand was 60 mm, whereas the lump size of concrete containing 100% crushed fine stone was 30 mm. They came to the conclusion that the angular shape of crushed fine stone, which increased the need for water, is what caused the loss in workability when it was added to concrete. As a result, more water was required to create concrete that was just as workable as the control concrete.

In a 2007 study by Dixon Chan et al., recycled aggregate was substituted for natural aggregate at weights of 0, 20, 50, and 100%. Flyash was substituted for cement at weights of 0%, 25%, and 35%. The use of flyash in place of cement increased the recycled aggregate concrete's resistance to chloride ion penetration and reduced drying shrinkage and creep. One of the practical ways to use a high percentage of recycled aggregate in structural concrete is by incorporating 25–35% of flyash as some of the drawbacks induced by use of recycled aggregate in concrete could be minimised. The compressive strength, tensile strength, and static modulus of elasticity values of concrete at all ages decreased as recycled aggregate and flyash contents increased.

According to Mark Reiner et al. (2006), at high volume percentage replacements from 40–70%, the study found that 50% and 60% cement replacement percentages were the best candidates for full-scale testing. The benefits of this approach are as follows: 25% less smog, less negative effects on human health, and less fossil fuel use than a 100% Portland cement mix; 15% less in capital costs and 20% less in life cycle costs; slump consistency maintained between 10-15 cm; mix temperature maintained between 15.6-26.7c.

Research on high performance concrete of grade M55 was conducted by S.K. Jeyaprakash et al. (2004). In this study on the use of flyash and chemical admixtures in RCC, nine RCC beams measuring 1400 mm by 100 mm by 200 mm were cast and tested under flexure. When compared to a normal concrete beam, the moment of resistance increases by 44% when flyash and super plasticizer replace 20% of the cement and by 25% when flyash and super plasticizer replace 25% of the cement. For the same section span and reinforcement, the flexural strength of flyash concrete beams is found to give strengths of 144% and 125% for 20% and 25% replacement of cement.

Following the assault, SEM revealed thicker gel layers and deeper surface grooving, which were correlated with greater measured expansion. Following chloride intrusion, SEM analysis of mortar revealed that aluminates produced chloroaluminates, which explained the positive outcomes. According to Joana Sousa-Coutinho et al. (2013), waste granitic sludge that has been ground fine enough to provide a denser matrix may reduce expansion caused by ASR by up to 38% and enhance resistance to chlorides by almost 70% without sacrificing workability or strength. There is a marginal workability and strength loss for cement replacement levels up to 10%.

Raman and co. al. (2011) looked at how workability of high strength rice hush ash concrete was affected when natural sand was substituted with quarry dust. In order to reach target strengths of 60 MPa and 70 MPa, respectively, two series of concrete, C60 and C70, were created. 10%, 20%, 30%, and 40% of the natural sand in each series was substituted with quarry dust; for all combinations, 10% cement was swapped out for rice husk ash. Superplasticizer's inclusion allowed all of the concrete mixes in both series to display excellent workability and reach the desired minimum slump of 150mm.

The Vijayalakshmi et al. al. (2013) looked at the impact of adding granite powder instead of river sand to concrete at replacement levels ranging from 0% to 25%. They noticed that when the substitution rate increased, the concrete's workability decreased. In the concrete mixtures with 20% and 25% replacement rate, extremely poor workability was noted. They came to the conclusion that the differences in surface texture, particle shape, and size distribution between granite powder and river sand are what are causing this decrease in workability. Ninety percent of the particles in granite powder were finer than 50 microns, making it more fine than natural sand. This raised the specific surface area of the fine aggregate, which in turn increased the water consumption. Friction between aggregate particles and paste is increased by the angular geometry and rough surface roughness of granite powder particles. when a result, when more granite powder was substituted, the workability of the concrete decreased.

According to Krishna Sai M.L.N. et al. (2013), one way to investigate the strength property of concrete is to substitute some of the cement in the mixture with quarry dust. The experiment's goal is to determine the maximum amount of quarry dust that can be used to partially substitute cement in concrete. In concrete, quarry dust can be substituted for cement in the following percentages: 0%, 10%, 15%, 20%, 25%, 30%, 35%, and 40%. Concrete cubes of 150 x 150 x 150 mm were cast in the M20, M30, and M40 grades in order to perform a compressive strength test. According to experimental research, the characteristics of cured concrete were enhanced when 25% of the cement was replaced with quarry dust. According to the findings, there is a slight reduction in compressive strength up to 25% of cement replaced with quarry dust. A significant loss in compressive strength was noted starting at 25% of cement replaced with quarry dust. The compressive strength increases somewhat after 7 days when quarry dust is substituted for 20% to 25% of the cement.

In 2013, M. Raja and colleagues conducted research on the substitution of waste produced by the stone quarry industry for sand, which is utilised as fine aggregate in concrete. The goal of this study is to replace some of the sand in M35 grade concrete with quarry dust. Through testing, it was discovered that replacing 10% of the sand with quarry dust produced the best results. Consequently, our study suggests that if quarry dust is used to replace up to 10% of the sand in M35 grade concrete, efficient waste management can help protect the environment. Studies of a similar nature might be conducted using different percentages of concrete as well as cement mortar mixes used for tile installation and plastering walls and ceilings.

Singh and co. al. (2016) looked into the impact of using granite cutting waste in place of natural sand on the workability of concrete at replacement levels ranging from 0% to 40%. They noticed that when granite cutting waste is substituted for natural sand, the workability of concrete significantly decreases. They came to the conclusion that the increased friction between the concrete particles caused by granite cutting waste's comparatively more angular and rough surface roughness than river sand is the cause of the loss in workability of concrete.

Cordeiro and others. al. (2016) looked into the impact on concrete workability of replacing natural sand with crushed granite aggregate at replacement levels of 10%, 30%, and 50%. A concrete with a goal strength of 50 MPa and a slump range of 15–200 mm–220 mm was created. They noticed that when the amount of natural sand replaced with crushed granite aggregate grew, so did the dosage of superplasticizer. For concrete with replacement levels of 10%, 30%, and 50%, the superplasticizer dosage was increased to 0.17%, 0.19%, and 0.23%, respectively, from 0.16% for the control concrete. They came to the conclusion that the higher superplasticizer dosage suggested that the water need of concrete rose as the amount of crushed granite aggregate increased.

Jeyaprabha and co. al. (2016) looked at how adding granite dust to mortar instead of natural sand affected the mortar's compressive strength. They looked into what happened when 15% of the natural sand was replaced with granite dust after 3, 7, 14, and 28 days of curing. They found that adding granite dust to mortar in place of natural sand at all ages significantly increased the mortar's compressive strength. For curing periods of 3, 7, 14, and 28 days, the improvement in compressive strength of granite dust mortar over river sand mortar is 48%, 57%, 61%, and 43%, respectively. They came to the conclusion that the filling effect of granite dust, which has a higher fineness than natural sand, may be the reason for the mortar's increased compressive strength when it is added in place of natural sand.

Rai and co. al. (2014) looked tested the compressive strength of mortar that had natural sand replaced with quarry dust at substitution rates of 20%, 50%, and 100% during the course of three, seven, twenty, and fifty days of curing. At the early ages of 3 and 7 days, they came to the conclusion that the compressive strength of mortar improves with an increase in quarry dust content from 0% to 100%. At 28 and 50 days of age, the rate of development in compressive strength reduces dramatically when natural sand is replaced with 50% and 100% quarry dust, respectively. When quarry dust is used in place of natural sand entirely, there is a noticeable decrease—roughly 13% and 4% at 28 and 50 days, respectively. When compared to control mortar, the compressive strength of the mortar increased by 6% at the replacement level of 20% and by around 4% at the replacement level of 50% at the ages of 28 and 50 days. Thus, it may be inferred that a 20% substitution of quarry dust for natural sand results in the best reaction and filling capacity. In cement mortar, this means that a 20% substitution of quarry dust for natural sand will result in the highest compressive strength.

Jeyaprabha and co. al. (2016) looked into how adding granite dust to mortar instead of natural sand affected the mortar's flexural strength. After 28 days of curing, they looked at the impact of 15% granite dust replacement in place of natural sand on the flexural strength of mortar. When compared to control concrete, they found that the addition of granite dust increased the flexural strength of mortar. This outcome was consistent with other mechanical characteristics since, when compared to the control mix, granite dust concrete had superior compressive and splitting tensile strengths.

Ghannam & Co. al. (2016) looked into how adding granite powder instead of river sand affected the concrete's compressive strength at replacement points, ranging from 0% to 20% after seven and twenty-eight days of curing. When granite powder was added in place of sand, they saw that the compressive strength significantly increased and reached its maximum when 10% of the original material was replaced. When compared to control concrete, there was an improvement of roughly 31%, 37%, 20%, and 8% at replacement levels of 5%, 10%, 15%, and 20%, respectively, after 28 days. At seven days, a comparable improvement in compressive strength was also noted. In order to obtain the highest compressive strength, it was determined that 10% substitution of natural sand with granite powder was ideal.

Ghannam & Co. al. (2016) looked into how adding granite powder instead of river sand affected the concrete's splitting tensile strength at replacement, which ranged from 0% to 20% after 7 and 28 days of curing. When granite powder was added in place of sand, they saw that the splitting tensile much improved. for 28 days, there was a 22 improvement over control concrete of roughly 4%, 15%, and 29% for replacement amounts of 5%, 10%, and 15%, respectively. At seven days, a comparable improvement in compressive strength was also noted. At a 20% replacement level, the concrete's splitting tensile strength did, however, fall. Therefore, 15% is the ideal amount of granite dust to replace sand with in order to get the highest splitting tensile strength. It should be highlighted that this ideal composition differs from the 10% compressive strength requirement. Furthermore, splitting tensile strength increased at a slower rate than compressive strength.

Cordeiro and others. al. (2016) looked into the impact on concrete's compressive strength at seven and twenty-eight days after curing when natural sand was substituted with crushed granite aggregate at replacement levels of 10%, 30%, and 50%. They found that at replacement levels of 10% and 30% after 7 days and 28 days, the addition of crushed granite aggregate had no detrimental effects on the concrete's compressive strength. In contrast to control concrete, the compressive strength at 50% replacement was much higher, reaching 48.3 and 58.0 MPa after 7 and 28 days of curing, respectively. Singh and co. al. (2016) investigated the behaviour of concrete produced by adding granite dust to river sand when exposed to unfavourable conditions. They investigated the impact of substituting granite dust for river sand at replacement levels of 10%, 25%, 40%, 55%, and 70% on chloride-ion penetration at ages of 28 days, 56 days, and 90 days, respectively, at two distinct w/c ratios of 0.3 and 0.4 each, in addition to a number of other parameters.

3. CONCLUSION

Several future investigative directions have been proposed based on the identified research gaps. These include producing concrete using optimal stone dust contents to validate their performance, investigating optimal packing methods to reduce the influence of voids, studying the effect of stone dust pre-wetting on workability and strength over time, and quantifying the real environmental impact of stone dust through the measurement of embodied energy and carbon dioxide emissions.

Ultimately, this comprehensive literature review provided valuable insights into the properties and application of stone dust in concrete. It identified optimal contents, discussed environmental impacts, and proposed future directions for further research in this field. It is hoped that this study will encourage research on SD applications for achieving a sustainable concrete industry. This study’s future direction is to explore this alternative based on the conclusions of the proposed literature review and apply it to real projects.

4. REFERENCE

[1] Kumar Mehta P, Monterio JM Paulo, “Concrete-Microstructure, Properties and Materials”, Indian Edition, Reprint 2005, pp18,36-46,52.

[2] Neville A M, “Proerties of Concrete”, Third Edition, Longman Singapore Publishers, 1995, pp32-33, 36-41, 84, 142, 204, 434-438.

[3] R. Malathy and T.Govindaswamy:”Strength development of various grades of self compacting concrete with flyash”;(2005).

[4] V. Kumar and M.M.Prasad:”Effect of flyash and silica fume on the static modulus of elasticity of a concrete mix”; National Institute of Technology;(1990).

[5] K. K. Kapoor and S.C. Patodiya:”High strength concrete with large quantities of flyash”;(1993)

[6] S. Gopalakrishnan, N. P. Rajamane, M. Neelamegam, J.A. Peter,J.K.Dattareya:”Effect of partial replacement of cement with flyash on the strength and durability of HPC;(2001).

[7] Virendra Kumar, M. M. Prasad and K. K. Jain:”Strength assessment of high volume flyash concrete”;(2004).

[8] Shi Cong kou, Chi Sun poon and Dixon Chan:”Influence of flyash as cement replacement on the properties of recycled aggregate concrete”;(2007)12.Mark Reiner and Kevin Rens:”High volume flyashconcrete:Analysis and Application”;(2006)

[9] C. Prabu, P. Perumal, S. K. Jeyaprakash:”Effect of using flyash and chemical admixtures in plain and reinforced concrete members”;(2004)

[10] Lohani T.K, Padhi M, Dash K.P, Jena.S:” Optimum utilization of Quarry dust as partial replacement of sand in Concrete”; (2012) 22.http://www.silicafume.org/general-silicafume.html

[11] Dr. P.B. Sakthivel, C. Ramya, M. Raja:” An Innovative Method of Replacing River Sand byQuarry Dust Waste in Concrete for Sustainability”; (2013)

[12] Chandana Sukesh, Katakam Bala Krishna, P.Sri Lakshmi SaiTeja, S.KanakambaraRao:” Partial Replacement of Sand with Quarry Dust in Concrete”;(2013).