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Review Paper on behavior of Concrete Made of Partial Replacement of White Crystal Stone with Fine Aggregate

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ABTRACT

Concrete is becoming an essential element and a highly sought-after commodity in the global construction industry in the modern world. The demand for everyday items, like concrete, is growing in a logarithmic manner. There are currently difficulties in meeting current needs due to the deficiency of natural resources in our environment. In addition, the ongoing exploitation of raw materials for the manufacturing of concrete raises a number of social and environmental issues. The planet and its inhabitants face major ecological and environmental challenges due to the production of cement and the depletion of river sand. It's critical to produce or identify a material that can replace the main ingredients in concrete.

Keywords: -,- Quartz crystal stones, aggregate, environmental, coarse aggregate, split tension

1. Introduction

Cement is the most popular material in the concrete industry in the world. The need for cement in the The concrete and construction industries are experiencing significant growth on a daily basis. The manufacturing process involved in producing a significant quantity of cement results in the release of around 80% of this quantity as carbon dioxide (CO_2), a prominent greenhouse gas, into the Earth's atmosphere. The energy required for the manufacturing of 1 tonne of geopolymer cement is 3.5 times lower compared to that of Portland cement. The combustion of carbon results in the emission of around 0.184 to 0.218 tonnes of carbon dioxide (CO_2), whereas the production of Portland cement yields 1 tonne of CO_2.

2. Literature survey & background

The original concrete, which had a compressive strength of 24 MPa, was crushed, according to Hasaba et al. (1981), to produce a 25 mm aggregate with an average of 35.5% old mortar attached to a natural gravel particle. Similarly, mortar contents were found to be 36.7 and 38.4% for concretes with 41 MPa and 51 MPa, respectively.

Recycled aggregate made up 25–35% of the mortar's volume for size fractions of 16–32 mm, 40% for size fractions of 8–16 mm, and 60% for size fractions of 4–8 mm, according to Hansen and Narud et al. (1983).

To find the CS trend loss, Soshiroda (1988) added more recycled sand to the concrete. 50% of the CS of recycled concrete is lost when all of the natural sand is replaced with recycled sand. Additionally, strength loss increased when recycled sand had a particle size of less than 2 mm. Furthermore, there was a potential that the recycled sand would become less resistant to freezing. It was not recommended to use any recycled aggregate smaller than 2 mm.

Tokuhashi et al. carried out a study in 2001 on the possible substitution of various metal industry slags for FA in self-compacting concrete (SCC). Lime stone powder was utilised as a viscosity-modifying agent to produce SCC. The author concluded that as the water demand of SCC decreased, the volume proportion of ferronickel slag fine aggregates increased. On the other hand, copper slag concrete and blast furnace slag concrete had more water when the water volume fraction of slag sand was raised.

Sahu et al. (2003) examined the utility of using ballast dust as an FA for concrete. Using CPV, two building mixtures were selected with a substitution percentage of 0, 20, and 40% for natural sand to create concrete with an M20 and M30 grade. In the corresponding blends, natural sand was either completely or partially replaced by stone dust. The results show that the addition of rock dust significantly enhances the material's strength characteristics and rupture module. It was found that substituting ballast dust for 40% of the sand in concrete results in significant cost and natural sand savings.

The main factors that determine mix design are surface texture, shape, and gradation, according to Gerry Huber and Bob McGennis (2008). When utilising M-Sand and RS in a mix design, the M-Sand percentage can be increased to improve the surface texture. By increasing the amount of FA, combining the aggregates, and lowering the dust content in the mixture, the voids in the mineral aggregate will grow. When washed M-Sand is used in place of 20% RS, there will be a 2% increase in voids in mineral aggregate.

Revathi et al. (2009) looked at the efficiency of quarry waste in the flow of FA—gypsum slurry. FA, gypsum, and quarry debris were among the industrial waste materials used in the creation of the slurry flow. They argued that using more quarry waste increases the need for water and that quarry waste can be efficiently used in FA, or gypsum slurry.

Elavenil & Vijaya documented M-Sand's palpable effectiveness in 2013. The addition of M-Sand obviously affects the properties of concrete when it is still fresh, whereas gradation has no effect on the properties of hardened concrete, such as MOR and CS. Because microfines were used to plug the pores, he came to the conclusion that high fines concrete typically had higher mechanical characteristics than concrete formed from RS.

Pradeepkumar et al. submitted a paper discussing the use of M-Sand rather than river sand to increase GPC strength (2017). The results showed that for 5M and 10M, respectively, CS increased by 9.51% and 4.08%, and that M-Sand replacement reduced hydration. It was demonstrated that for 5M and 10M, respectively, the STS increased by 2% and 9%.

2.1 Strength and Durability Properties

Fernandez-Jimenez et al. (2000) published the results of experimental studies on the strength characteristics of alkali-activated FA concrete and OPC concrete. Each GPC specimen was cured at 850C for 20 hours. The results demonstrate that GPC made with a mixed alkaline solution produced stronger results than GPC made with a single alkaline solution.

Torgal (2008) looked into the 1940 invention of activated alkaline cement, also known as binder. The researcher used GGBFS as an aluminosilicate material and NaOH as an alkaline agent. Since then, alkali activation research has been conducted in several countries, though it really gained traction in the 1990s.

The effects of alkali activator molarity on the carbonation, sorption capacity, and strength of GPC based on FA and activated alkaline slag were investigated by Adam A. A. et al. (2010) in their study. 30%, 50%, and 70% OPC concrete are swapped out for concrete with GGBS and control. As per their report, the alkaline modulus had a noteworthy influence on the sorption capacity of both AAS and geopolymer. The phenolphthalein indicator was unable to discern between non-carbonate and carbonated areas in the GPC samples, and the sorption capacity of the mixed concrete decreased as replacement quantity increased.

Abdullah et al. (2011) looked into the process by which FA dissolves Al and Si by reacting with an alkaline solution. As the alkalis attack the particle's surface, the molecules come together to form a gel. The larger hole causes them to expand, which permits the smaller hollow particles that contain a lot of tiny ash to travel backward.

Using pieces of plastic bag, RaghatateAtul M. (2012) examined the behaviour of a concrete mixture to determine its mechanical parameters. OPC RS, FA, and CA gravel, as well as a variable quantity of used plastic bags (between 0.2% and 1%), make up the concrete mix. This study concluded that adding plastic bag fragments to concrete may increase its tensile strength.

Gritsada Sua-iam and associates (2013) looked into the effects of using recovered alumina in place of RS in SCC. The results of the experiment showed that more super plasticizer was required to maintain the workability properties of SCC in the presence of alumina waste. All percentage replacement of alumina waste performed better in the slump flow tests for SCC; however, in the flow time test, the performance increased to 75% of the alumina waste replacement before declining. The addition of alumina waste also resulted in a 75% increase in compressive strength. Therefore, the authors concluded that when the alumina waste was added in the appropriate amount, its pozzolanic reactions and filling effects would improve the concrete's early and long-term strength.

Madheswaran et al. (2013) looked into how the strength of various GPC types was affected by changing the molarities of NaOH. Various mixtures are made with varying NaOH molarities and allowed to cure at room temperature. GPC mix compositions with compressive strengths ranging from 15 to 52 MPa have been developed. The results show that the compressive strength of GPC increased together with the molarity of NaOH.

Suganthy et al. (2013) investigated high density polyethylene, or finely crushed plastic, as a possible partial replacement for FA. In concrete, RS was substituted with pulverised plastic sand at percentages of 0%, 75%, and 100%, respectively. With an increase in RS substitution, the w/c ratio rises. The data showed that when concrete FA was replaced, there was a progressive 25% decline in concrete strength; when more plastic FA was replaced, there was a sharp decline in concrete strength.

Gameiro et al. (2014) evaluated the durability properties of cement by replacing fly debris (FA) with waste from the marble quarry industry. The testing results showed that adding stone powder, basalt powder, and RS to concrete as a fractional replacement for regular RS improved, maintained consistency, and individually decreased the substance's solidity properties. Marble powder in concrete showed remarkable durability qualities when used in place of RS. Nevertheless, the notable rise in marble residue adversely affected its unique characteristics. As a result, these totals can frequently be used to create cement under normal conditions.

et al., Aravindan S. (2015): In contrast to CC, the author discussed the long-term strength and durability of fly ash and alkali-based GPC. The alkaline activators are obtained by mixing a solution of NaOH and Na2SiO3 at a ratio of 2.5. A total of nine mixes with concentrations of 12M and 16M NaOH were created. External curing and dry curing were the two distinct curing regime approaches that were employed. Their experimental research led them to the conclusion that the strength attributes increased the molarity of the NaOH solution. The externally cured samples became stronger in comparison to the dry cured samples. Nevertheless, it was found that the unsatisfactory sorptivity and RCIP test results were caused by surface cracks. Fly ash GPC had higher RCPT and sorptivity with the nominal mix than CC.

Shah et al. (2015) investigated the effects of alkaline solution changes on GPC's mechanical properties. Samples measuring eight and sixteen millimetres (M20, M40, and M60) were made using different grades for alkaline solution ratios of two and three. The characteristics of the GPC have been observed to be influenced by the ratios of alkaline fluid to fly ash, the water-to-solid ratio of the geopolymer, the concentration of NaOH, and the ratio of NaOH to Na2SiO3.

3. Conclusion

Based on the strength and durability properties, it is observed that the concrete mixes made with varying percentages of QS gives better results with consideration of strength and economy. 60% replacement of RS by QS shows improved results on strength properties of concrete and reduction in environmental issues related to RS. From the extensive investigation done on concrete with QS, it is concluded that 60% replacement of QS was considered as optimum percentage and further increase in replacement percentage of QS will reduce the strength and durability characteristics of concrete drastically

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