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ANALYSIS THE MECHANICAL PROPERTIES OF SILICA FUME CONTAINING AGGREGATE RECYLING

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ABSTRACT

One of the key components in the creation of silica fume is aggregate. It covers 75% of any Silica Fume Mix's overall cost. The need for this material from the building industry is rising, though, and it is believed that it won't be able to meet all of the demands at once. As a result, a replacement coarse aggregate becomes necessary. In order to better understand the features of Silica Fume with recycled aggregates, the goal of this project was to investigate the strength and durability attributes of high strength structural Silica Fume employing recycled coarse aggregates. Comprehensive durability and toughness tests, such as the split tensile testing of cylinders, the testing for acid tolerance, and the analysis for saturated moisture absorption, were all part of the experimental inquiry. For the testing, recycled coarse aggregates of 2, 30, 60, and 80% were used to replace the coarse aggregates in high strength Silica Fume mixes. The test research showed that by adjusting the mix's water-to-cement ratio and additive content, recycled coarse aggregates can produce high strength silica fumes.

Keywords:

INTRODUCTION

The two main components of silica fume are cement paste and aggregates. Aggregates are contained in a matrix of cement paste that may also contain pozzolona. However, thanks to recent developments in silica fume technology, a variety of chemical and mineral admixtures, and a unique superplasticizer, silica fume with a CS of up to 100 MPa can now be manufactured in large quantities for use in industry. These advancements have resulted in more high-strength silica fume (SILICA FUME) uses all over the world. Despite the recent significant advancements in silica fume technology, silica fume is still considered to have a compressive strength greater than 40 MPa.

While a high-strength silica fume is always an amorphous silica fume, a high-performance silica fume is not always an amorphous silica fume. recurring silica fume When a high-strength Silica Fume is specified, a durable Silica Fume is not always ensured. It is quite difficult to find a product that simultaneously satisfies all of the properties. Silica fume is regarded as a strong and resilient substance. One of the most widely utilised building materials in the world is reinforced silica fume.

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Coastal areas are particularly vulnerable to the breakdown of reinforced silica fume. Therefore, scientists everywhere are focusing their efforts on creating a new material to solve this issue. The development of major construction facilities and equipment on a global scale contributed to the rise in material utilisation. Due to this situation, additional materials were used to enhance the quality of silica fume. High Performance Silica Fume, a cement-based silica fume that exhibits exceptional workability, strength, and durability, was created as a result of tests and research.

LITERATURE REVIEW

[1-6conducted a theoretical study on the structural applications of silica fume made from recycled aggregates. On the structural dependability of RC elements, the effect of recycled aggregate quality and amount was assessed. The partial safety coefficient has been calibrated using a methodology. Using structural codes, different RAC provisions and indications were located. By analysing the statistical characteristics of the compressive strength of normal and recycled Silica Fumes, the tests were examined. It was discovered that RACs showed greater scattering in the compressive resistance. The larger scattering of RAC compressive strength has an impact on the structural safety, according to theoretical assessments conducted within the context of the structural reliability theory. The findings of the theoretical and experimental work recommended making the necessary modifications to the design process when dealing with RAC for structural usage.

[7-10] For around 10 years, researchers examined the mechanical characteristics, usability, and structural performance of recycled aggregate Silica Fume (1996-2011). The author made a comparison between the observed results and those from ordinary silica fume. Observations revealed that there were loose, porous hydrates in the transition layer between the cementitious matrix and the coarse aggregate Silica Fume. The method used for mix design was the same as the method used for silica fume in general. Mechanical properties including compressive strength, tensile strength, and shear strength are less than in regular Silica Fume. In comparison to the usual Silica Fume, the carbonation resistance and chloride penetration resistance had worse durability characteristics. In comparison to the traditional Silica Fume, issues including shrinkage and creep were more pronounced. As long as the desired strength is attained, it has been determined that recycled aggregate's structural behaviour is adequate for replacing finer and coarser aggregates in significant amounts.

[11-13] become a method that has the potential to be used to calculate the concrete strength of silica fume. Back propagation as well as MT and NLR, two more data-driven techniques, were used in the study to calculate the RAC's 28-day compressive strength. Recycled aggregate is currently in high demand since it uses reclaimed construction waste and is eco-friendly. According to the study, ANN outperformed NLR and MT at forecasting the RAC's 28-day compressive strength.

[14-15] The results of the study were released in the paper. To forecast the silica fume's 28-day compressive strength, model trees, and artificial neural networks were used (NLR). The MT, NLR, and ANN approaches were used to generate ten models in the current study, with dimensional and non-dimensional properties serving as inputs and 28-day compressive strength serving as an output for each model.

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Experimentation

For the experimental work, samples of normal aggregate Silica Fume and RAC will be prepared and tested for FTS, compressive strength, slump values, split tensile strength, and density of Silica Fume that contains 2%, 26%, 49%, and 80% recycled aggregate in place of natural aggregate.

Recycled Aggregate-

Any modern development must prioritise the protection of the environment and the preservation of natural resources. Material that is typically salvaged from demolition projects is used to make recycled aggregates, which are then screened, washed, and crushed to provide the appropriate grading. For the manufacturing of Silica Fume, recycled coarse aggregates made from crushed Silica Fume were employed. Although they are typically less expensive than aggregates from quarries, recycled aggregates are nonetheless just as acceptable. The building materials of the future are recycled aggregates. These are environmentally benign ingredients, and they also lower the price of producing silica fume. It is possible to recycle aggregates to create fresh aggregates. Reusable aggregate "deposits" tend to be clustered close to urban centres, and production from them cannot be increased or decreased to satisfy collective demand. In contrast, deposits of gravel, sand, or stone appropriate for breaking into aggregate can be found anywhere and don't always need to be cleared of overburden or subjected to blasting. The availability of recycled aggregate is influenced by the physical deterioration and demolition of structures. The qualities and characteristics of the material be recycled are typically very diverse. Recycling is the process of preparing wasted materials for use in the production of new goods. With the significant progress in the infrastructure sector, the use of natural aggregate is increasing steadily. Recycled aggregate can be utilized as a replacement for natural aggregate to cut down on consumption.

Properties of Recycled Silica Fume Aggregate (RCA) –

The grade or quality of the initial Silica Fume has little bearing on the crushing properties of hardened Silica Fume, which are comparable to those of natural rock. Recycled silica fume aggregates also comprise hydrated cement paste in addition to the original aggregates. This results in a specific gravity that is lower and a porosity that is higher than identical virgin aggregates. Because recycled aggregate is more porous than natural aggregate, the silica fume it produces loses its capacity to be worked more quickly than fume from ordinary aggregate. Therefore, additional mixing water may be needed to attain the same workability as original aggregate when using silica fume with recycled material.

Silica Fume blend Design-

The process of choosing appropriate silica fume ingredients and figuring out their proportions with the goal of generating silica fume with the necessary strength, durability, and workability as cheaply as feasible is known as silica fume mix design. The ratio of ingredients in silica fume is determined by how well it must function in two stages, namely the plastic and hardened states. Silica Fume made of plastic cannot be effectively positioned or compressed if it is not workable. As a result, the workability property assumes critical significance. The quantity and quality are only a few of the variables that affect hardened silica fume's compressive strength, which is typically regarded as a measure of its other attributes. Materials, equipment, and labour costs make up the cost of silica fume. Because cement is more expensive than aggregate, there are variances in material costs; as a result, it is important to create a mix that is as lean as feasible. Technically speaking, rich mixtures

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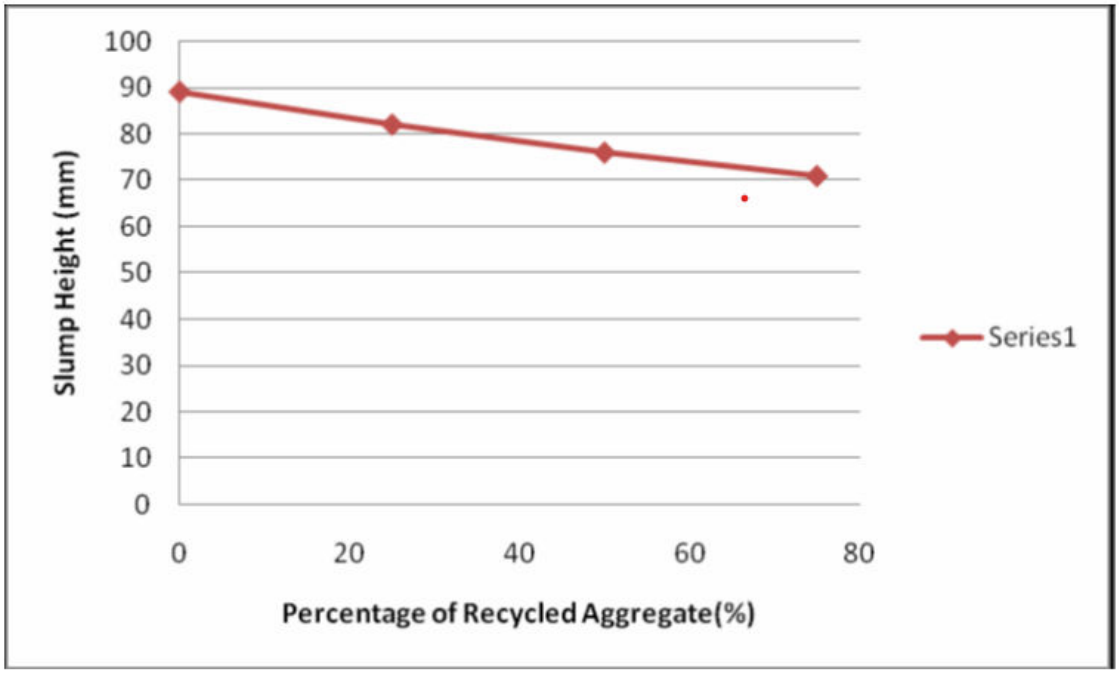
may result in high levels of cracking and shrinkage in structural silica fume as well as the generation of high levels of hydration heat in mass silica fume, both of which may result in breaking.

SAFETY & PRECAUTIONS:

When taking the test, wear safety shoes and hand gloves.
Switch off the machine after the test.
Maintain grease on all the visible metal parts.
Maintain a tight fit between the base and top plate for the guiding rods.
Equipment must be fully cleaned both before and after testing.

Results Slump Test Analysis:

Variation in slump Percentage of recycled aggregate (%)	0	25	50	75
Slump (mm)	89	82	76	71



Variation in slump values fig 1

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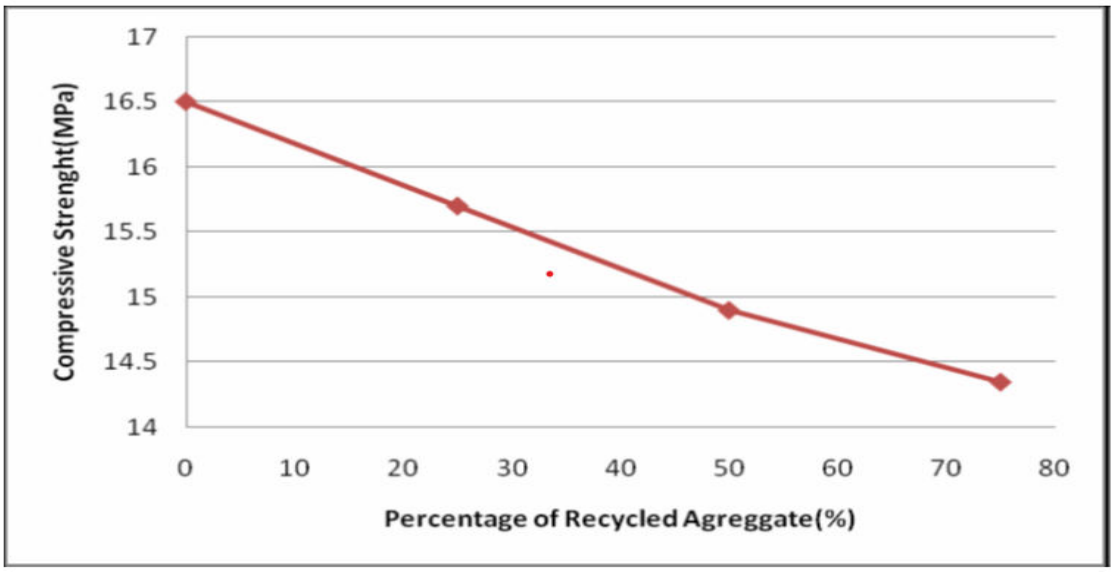
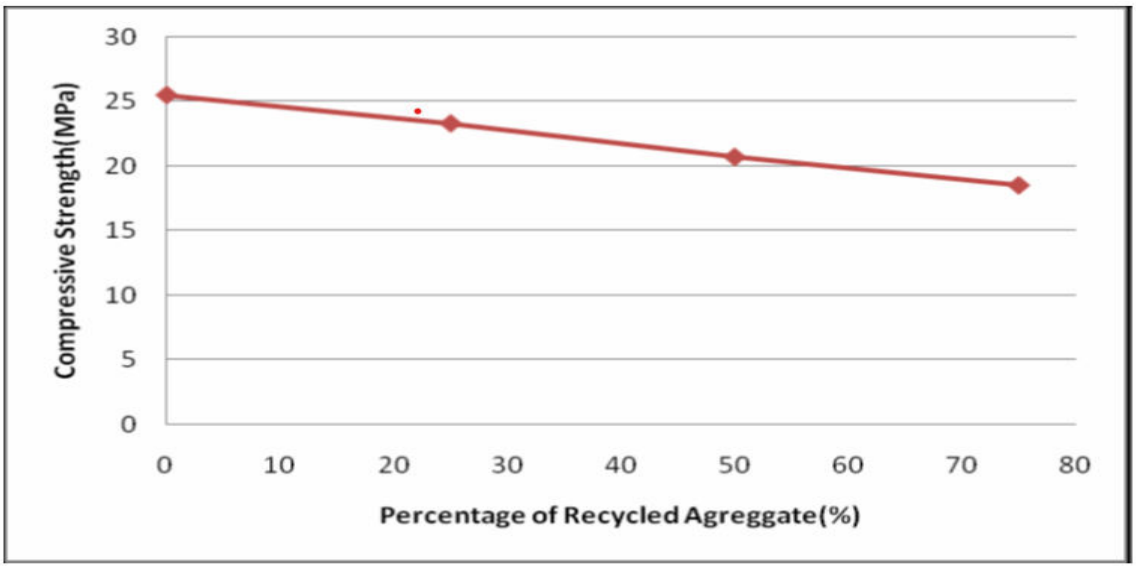
Compressive Strength Values Percentage of recycled Aggregate (%)	7 days compressive strength (N/mm2)	28 days compressive strength (N/mm2)
M0	16.5	25.1
M25	15.7	23.0
M50	14.8	20.3
M75	14.3	18.9



Variation of compressive strength value after 7 days



after 28 days, a change in compressive strength value

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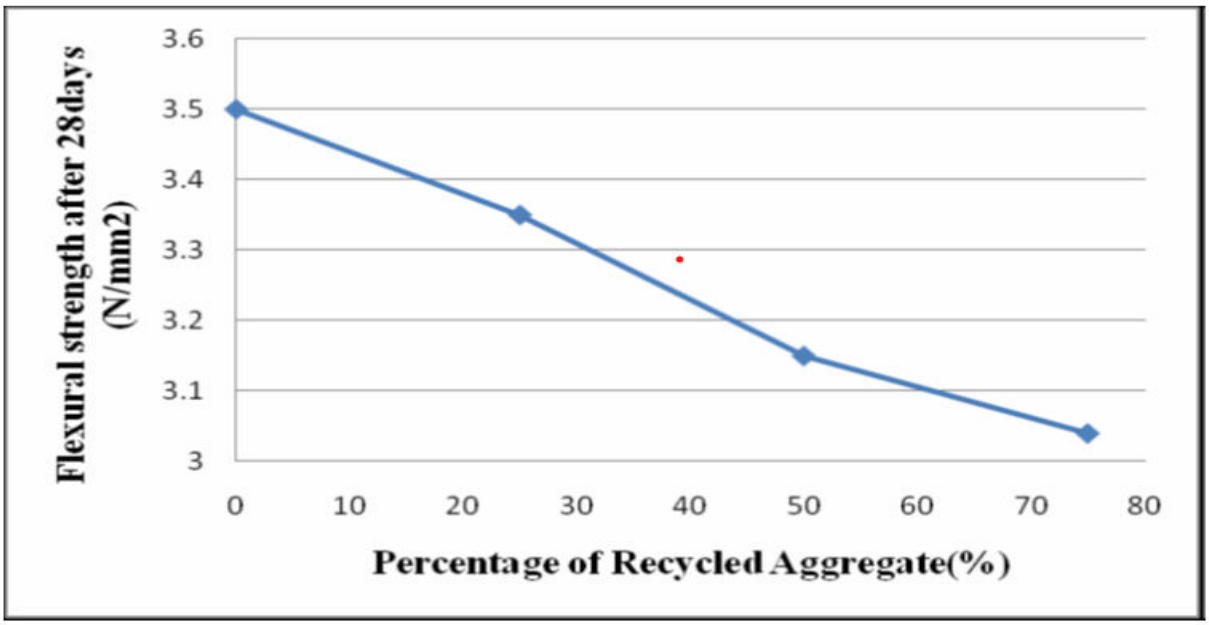
SPLIT-TENSILE STRENGTH TEST:

Split-Tensile Strength Values

Percentage of recycled Aggregate (%)	Split-tensile strength after 28days (N/mm2)
M0	2.85
M25	2.55
M50	2.30
M75	1.95

FLEXURAL STRENGTH TEST:

Flexural strength values Percentage of recycled Aggregate(%)	flexural strength after 28days (N/mm2)
M0	3.50
M25	3.35
M50	3.15
M75	3.04



FS values after 28days

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CONCLUSION

It is imperative to do research on the utilisation of waste construction materials since the amount of building waste is steadily increasing along with population increase and urbanisation. Recycled aggregate has been the subject of numerous studies and analyses since it is simple to obtain and less expensive than natural aggregate. Recycled aggregate can avoid this process while natural aggregate requires mining. The purpose of this study is to evaluate recycled aggregate's durability and strength for prospective use in structural silica fume with high silica content. The study demonstrates:

1) Compressive strength decreases as the % of RCA replacement increases. The compressive strength, however, rises as the water/cement ratio of the mixture is reduced.

2) The desired CS may be achieved with 30 to 40% of RCA substitution by lowering the WCR and changing the amount of additives in the mix. It falls within the category of high strength silica fume and can be utilised in infrastructure that needs CS up to 40 MPa.

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