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A REVIEW OF THE BFRC CONCRETE WITH USING OYSTER SHELL ASH (OSA) AND GGBS

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Abstract:

The In recent years, there has been an increase in the use of basalt fibres to enhance the hardened properties of concrete. The inclusion of these fibres changes the hardened state of concrete. But these fibres also have an impact on the fresh properties of concrete that correspond to them, particularly its workability. Therefore, it is crucial to comprehend how the addition of basalt fibres affects the properties of fresh and hardened concrete. An overview of the mechanical and new properties of basalt-fibre reinforced concrete is given in this review (BFRC). The main focus of this review is on the effects of basalt fibre dosage and length on BFRC characteristics. A study was done to look into the potential applications for GGBS and OSA.

Keywords **— GGBS, basalt-fibre reinforced concrete (BFRC) , oyster shell ash (OSA) ,cement, sand and Crushed Stone**

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I. INTRODUCTION

Concrete is the most widely used building material and is primarily made of cement. Additionally, it is the most widely used building material. Significant amounts of CO2 are released into the atmosphere during cement production, which adds to environmental pollution. Cement should be replaced with GGBS and oyster shell ash as a workable solution (OSA). The fibres are used in concrete to fill a glaring gap. The most popular fibres are steel, basalt, glass, polypropylene, carbon fibres, and polyethylene. Workability improved as the proportion of mineral admixtures was increased in ternary mixes containing GGBS and Oyster Shell Ash (OSA), and it was superior to that of concrete made with close relatives.

Higher percentage substitutions of oyster shell ash (OSA) and ggbs had better and worse workability, respectively. by adding 3 kg/m3 of basalt fibre and substituting GGBS and oyster shell ash (OSA) for 40% of the cement. Oyster shell size and shape are affected by a number of factors, including temperature, the degree of calcium carbonate supersaturation, and the roughness of the sea waves, but more than 90% of an oyster shell is made of calcium carbonate, with magnesium carbonate and calcium sulphate making up the remainder.

Oyster shell is actually regarded as a safe and recyclable resource because it is devoid of any harmful elements. An oyster shell has a rough surface, is extremely porous, and has numerous voids. With a specific gravity of about 2.0, ground oyster shell has a similar apparent volume to sand and a higher level of permeability. There have been numerous attempts to make use of the physical and chemical properties of the oyster shell to create adsorbents for dangerous substances, water purifiers, soil remediation agents, fertilisers, and building materials.

Natural resources can be divided into two categories: renewable and non-renewable. We use resources that are continuously renewable and recyclable for our benefit. On the other hand, non-renewable resources are those that, once taken and used, are irreparably lost. The main challenge facing humanity today is how to use natural resources to meet human needs and maintain economic growth without depleting them and endangering the environmental foundations upon which life, economic prosperity, and our security depend. Regular sand is widely used all over the world as a result of the widespread use of cement. Particularly in developing nations, there is a high demand for regular sand due to the critical role that cement plays in the construction of infrastructure, buildings, and other structures.

II. LITERATURE REVIEW

Chao Hu a,, Daojun Zhong , Shilong Li (2023)

Using matrix asphalt as a base, this paper created oyster shell powder modified asphalt by adding oyster shell powder with a fineness of 40 mesh to matrix asphalt according to 3%, 6%, 9%, 12%, 15%, and 18% in order to investigate the effect of oyster shell powder on the mechanical properties of asphalt and the modification mechanism of oyster shell powder on asphalt. By creating a molecular model of oyster shell powder modified asphalt with various contents, the impact of oyster shell powder on the mechanical properties of asphalt was examined at the molecular level based on the theory of molecular dynamics. By using infrared spectroscopy, scanning electron microscopy, and atomic force microscopy, the modification mechanism of oyster shell powder modified asphalt was examined in detail from various scales.

Sasui Sasui, Gyuyong Kim, Jeongsoo Naa, Arievan Riessen ,Marijana Hadzima-Nyarko June 2021

This study replaces natural sand (NS) in GGBS(FA) and/or -(OYSTER SHELL ASH(OSA)) based alkali activated mortar with fine waste glass (GS) (AAm). The AAm was put through tests to ascertain its mechanical characteristics, water absorption, apparent porosity, and durability based on its resistance to concentrated solutions of Na2SO4 5% and H2SO4 2%. While AAm's microstructure and chemical makeup were examined by SEM-EDX in order to support the findings of the experimental tests. The study found that the ratio of binders used to create the mortar affects how GS behaves. For high FA/OYSTER SHELL ASH (OSA) mortar, increasing GS up to 50 wt% was found to increase strength and decrease porosity. Increasing GS for lower FA/OYSTER SHELL ASH(OSA) mortar

Anant Kumar, Nupoor Dewangan , Anurag WahaneInternational June 2021

The primary selection criteria for GGBS and Ground Granulated Burnt Slag (Oyster Shell Ash (OSA)) are their affordability and durability. Additionally, because there is a very low emission of harmful gases like carbon monoxide and carbon dioxide, environmental pollution can be reduced to some extent. In order to compare the strength properties of concrete to conventional concrete (CC) of M25 grade, a laboratory investigation on the ideal level of GGBS and OYSTER SHELL ASH (OSA) as a partial replacement of cement is presented in this paper. 10%, 20%, and 30% of Oyster Shell Ash, also known as GC1, GC2, and GC3, were substituted for Portland cement and 10%, 20%, and 30% of GGBS, also known as FC1, FC2, and FC3, respectively

K. Anupama Reddy, Venkata Ramesh Kode, Potharaju Malasani, Srikanth Satish Kumar Darapu October 2019

Due to its numerous benefits and environmental friendliness, multi-blend mix concrete has recently attracted attention. The mechanical characteristics of multi-blended concrete of M30 grade made with microsilica and basalt fibres have been investigated in this paper. The development of concrete involves replacing cement with admixtures like oyster shell ash (OSA) and fly ash in order to lessen the negative environmental effects of cement production. The mechanical properties of multi-blended concrete made with GGBS and oyster shell ash (OSA) were depleted. To make up for this shortcoming, basalt and microsilica fibres were additionally added to the mixture. Initially, GGBS 20% and oyster shell ash were combined to create four different series of multi-blended concrete mixes.

Akshay kumar Moogi, Swapnil Cholekar Aug 2018

In this experiment, oyster shell ash (OSA) and fly ash were substituted for 30% of the cement to study the impact of fibres and supplementary materials on the strength of concrete for M30 grade while maintaining a constant percentage of fibres. This experiment made use of basalt fibres. In this experiment, fly ash oyster shell ash (OSA) in varying percentages, including 0% FA-OYSTER SHELL ASH (OSA), 100% FA-OYSTER SHELL ASH (OSA), 25% FA-75% OYSTER SHELL ASH (OSA), 50% FA-50% OYSTER SHELL ASH (OSA), and 75% FA-25% OYSTER SHELL ASH (OSA), was used to fix 1.5% of the total dosage of fibre content. To test the compressive strength, cubes and beams are cast.

Poornima M Reddy Dr. Shreenivas Reddy Shahapue Maneeth P D Brijbhushan S August 2017

The effects of adding polypropylene fibres in various amounts on the characteristics of concrete are the subject of this essay. This experimental investigation's primary goals are to characterise the chosen mechanical properties of PPFRC and investigate the impact of volume fraction on (PPF). The current dissertation project is being completed with concrete of grade M30 and a w/c ratio of 0.363. 10% of oyster shell ash and 20% of GGBS are used in place of cement (OSA).

Polypropylene fibres are added in volume fractions of 0%, 0.50%, 1.00%, 1.50%, and 2.00%. Compressive, split tensile, flexural, and other tests are performed on all mixtures and are contrasted with results from conventional concrete.

S. Paulraj,Dr. N. Balasundaram,K. Sates Kumar,M. Dharshna Devi January 2017

Although more versatile than water, concrete is the second most common material used in construction. However, due to the massive applied load on a smaller area and the worsening environmental conditions, modern engineering structures require more demanding concrete. To improve the quality, strength, and durability of concrete, a variety of materials were investigated as impregnation agents. In order to achieve higher strength values along with good workability, we attempted to use basalt fibre as a strength enhancement agent in self-compacting concrete in this study. The self-compacting nature showed promising results when simple admixtures like VBA, workability agents, etc. were used. The concrete appeared to be highly workable, durable, and adaptable based on the rheological results. SCC slump values ranged from 620 to 620.

J. Guru Jawahar and G. Mounika 2016

Cement is the second-most popular product in the world. It is responsible for almost 7% of the world's carbon dioxide emissions. Ordinary Portland Cement (OPC) concrete is being replaced by Geopolymer Concrete (GPC), a unique type of greener concrete. This project mainly aims at the study of effect of class F GGBS(FA) and -(OYSTER SHELL ASH(OSA)) on the mechanical properties of geopolymer concrete (GPC) at different replacement levels (FA50-OYSTER SHELL ASH(OSA)50, FA25-OYSTER SHELL ASH(OSA)75, FA0-OYSTER SHELL ASH(OSA)100) using Sodium silicate (Na2SiO3) and sodium hydroxide (NaOH) solutions as alkaline activator. To determine the GPC's compressive, splitting tensile, and flexural strengths, specimens were cast and allowed to cure for various curing times at room temperature. According to test results, the replacement of OYSTER SHELL ASH (OSA) has increased.

Anil Ronad , V.B.Karikatti, S.S.Dyavanal july 2016

In the current study, different proportions of basalt fibres added to the geopolymer concrete were compared to the geopolymer concrete without basalt fibres in terms of compressive and split tensile strength of the various mixes.

The geopolymer concrete receives fibre additions in increments of 0.5% from 0.5% to 2.5%. Comparing the compressive and tensile strength of various mixes to a reference mix (0% fibre). The findings suggest that adding basalt fibres to geopolymer concrete at an ideal content can boost its tensile and compressive strength.

□□□□□□□A.H.L.Swaroop, K.Venkateswararao, Prof P Kodandaramarao Jul-Aug 2013

Concrete's durability is determined by its capacity to withstand processes that cause deterioration, such as abrasion, chemical attack, and weathering. It also covers the effects of sulphate and chloride attacks on the quality and usability of concrete. The primary selection criteria for GGBS and Ground Granulated Burnt Slag (Oyster Shell Ash (OSA)) are their affordability and durability. Additionally, because there is a very low emission of harmful gases like carbon monoxide and carbon dioxide, environmental pollution can be reduced to some extent. Our study is primarily limited to evaluating changes in compressive strength and weight reduction in five different mixes of M30 Grade, including conventional aggregate concrete (CAC), concrete made by replacing 20% of cement, and concrete made by replacing the remaining 80% of cement.

Jia, Aruhan and Yan 2012

This study examines the carbonation of concrete with various initial curing times made up of GGBS and -(OYSTER SHELL ASH(OSA)). Both are exposed for 720 days under accelerated conditions in a natural indoor environment. Analysis is done on the connection between compressive strength and carbonation depth. The orthogonal method is used to discuss the variables influencing the carbonation of high-volume mineral admixture concrete in both natural and accelerated conditions. The variables are the fly ash-slag ratio, water-binder ratio, mineral admixture content, and total amount of cementitious materials. It is also reported that different initial curing times at young ages have an impact on carbonation depth.The findings indicate that the relationship between the compressive strength and carbonation depth of high-volume mineral admixture concrete is not always linear. Early, adequate curing can significantly reduce the carbonation resistance of concrete. The initial stage before 56 days is the main stage of carbonation developing in a natural environment for inadequately cured concrete. After 180 days of exposure, there is a noticeable decrease in the depth of carbonation, which causes the carbonated area to once again turn red when phenolphthalein is sprayed on it. In addition to limiting the water-binder ratio and the amount of mineral admixtures, it is crucial to ensure the initial curing time of concrete in order to ensure its excellent anti-carbonation ability in field structures.

III. MATERIALS USED

3.1 Ordinary Portland Cement (IS: 269)

The relative proportions of the four compounds and the degree of grinding of the cement clinker cause the properties of various types of Portland cement to vary. The most common type of Portland cement, also known as setting cement, is produced in greater quantities than any other type. In general concrete construction, where there is no exposure to sulphates in the soil or in ground water, it is admirably suited for use.

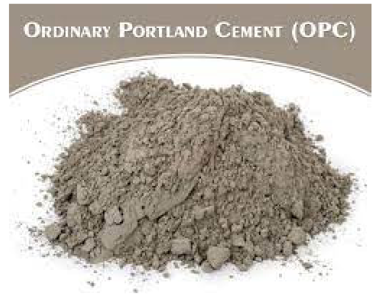

Figure 01 Ordinary Portland Cement (IS: 269)

3.2 Basalt fiber

There is no environmental waste produced during the production of basalt fibre. When used, basalt fibre is non-toxic. With a high tensile strength, good thermal endurance, and stability in all hostile environments, it is a unique building material. Basalt fibre is an inorganic substance made from the basalt volcanic rock. Because it is more affordable, lighter, greener, and doesn't cause the corrosion- and reinforcement-bar-related damages that cause concrete structures to corrode, basalt fibre reinforced concrete (BFRC) will modernise the construction industry. Bundled fibres and filaments are the two different varieties of chopped basalt fibres.

Figure 02 Basalt fibers

3.3 Oyster Shell Ash

Because oyster shell dust contains CaO, it can be used in place of cement in some situations. Therefore, research into oyster shell ash as a fine aggregate and cement substitute in the production of concrete is necessary. An electric boiler was used to calcine crushed oyster shell for three hours at 1000 °C. The electric boiler was used to slowly cool the calcined oyster shell to room temperature before pulverising it to pass through a 150-m sieve. calcination of used oyster shell to produce calcium oxide powder. The oyster shell primarily consists of 90% calcite and 10% aragonite. The chemical composition of limestone and oyster shell waste is remarkably similar, and calcite and aragonite are both present in large quantities. Because oyster shell powder is a good source of calcium, it is used to make cement.

Figure03 Oyster Shell Ash

3.4 Ground-granulated blast-furnace slag (GGBS)

When making ground-granulated blast-furnace slag (GGBS or GGBFS), molten iron slag from a blast boiler is frequently quenched in water or steam to create a glassy, granular by-product that is then dried and ground into a fine powder. Blast boiler slag that has been ground into small granules is rich in calcium silicate hydrates (CSH), a compound that increases the concrete's strength, durability, and aesthetic appeal. When compared to the production of OPC, the consumption of GGBS as a mineral admixture requires only grinding, which significantly reduces energy consumption. Due to its engineering profit, GGBS is now concentrating more and more due to a decline in negative environmental effects.

Figure04 Ground-Granulated Blast-Furnace Slag (GGBS)

When compared to the production of OPC, GGBS uses less energy and emits fewer greenhouse gases into the atmosphere. GGBS is a by-product of the pig iron industry; it has a higher alumina and silica content than OPC and less lime content. Blast boiler slag's primary constituents are CaO (30–50%), SiO2 (28–38%), Al2O3 (8–24%), and MgO (1–18%) Slag basicity rises and compressive strength rises generally as the CaO content of the slag increases. Up to respective values of 10-12% and 14%, the MgO and Al2O3 content exhibit the same trend, and after those values no further advancement is possible.

3.5 Fine Aggregate

All particles that will pass through a 10-mm IS sieve are considered sand or fine aggregate. Natural sand is by far the most widely used fine aggregate, but when sand is not economically feasible, fine stone and gravel crushing may be used instead. According to its fineness modulus (FM), sand can also be further divided into fine, medium, and coarse categories as shown below:

1. Fine sand, FM 2.20 to 2.60
2. Medium sand, FM 2.60 to 2.90
3. Coarse sand, FM 2.90 to 3.20.

Grading – Particle size of fine combination is split in to four ones.

1. ZoneI
2. ZoneII
3. ZoneIII
4. ZoneIV

Figure 05 fine aggregate or sand

Obtain or construct a straightforward trough measuring 2.5 to 3 metres in length as shown. Place the sand in the trough and, using a hose or a tap, gently stir the material as water is poured through it. The clean sand will stay behind as the water overflows at the lower end, carrying the dirt particles away.

There are also modern sand washing machines that are more automated and effective. Fine total is defined as total that passes through a 4.75 mm strainer. Utilized is nearby stream sand that has been cleaned of any natural impurities. In this study, sand that has been held on a 150 micron IS strainer and passed through a 4.75mm sifter is used.

3.6 Coarse Aggregates

Coarse aggregates are defined as all material that is retained on an IS sieve with a 10-mm mesh size or greater and a maximum size of 80-mm. Natural picked gravel, crushed gravel, crushed stone, and other materials are examples of coarse aggregate. Additionally, coarse aggregates must be graded from 10-mm up to the largest size typically used on the job, 63-mm. The desired mix determines the aggregate grading. According to IS:383-1970, used coarse aggregate should adhere as closely as possible to the grading limits indicated for its nominal size.

The sieve size on which a percentage or more of the particles are retained is traditionally used to determine the maximum aggregate size. In general, the surface area per unit volume that must be covered by the cement paste of a given water-cement ratio will be smaller the larger the maximum aggregate size. Therefore, if the coarse, strength, workability, and durability properties are met, it might be economical to use the largest size of maximum aggregate.

If coarse aggregates have "origin" material in them, they should be washed in the same way as fine aggregates, or they can be washed by dumping baskets full of the material into a big tank. When using this method, it is necessary to frequently change the water and to dip and drain each basket. By dipping in a number of tanks, you can get better results.

Figure 06 Coarse Aggregates 10 mm

Figure 07 Coarse Aggregates 20mm

3.7 Water

The purpose of water in concrete is three fold. Water distributes the cement evenly so that every particle of the aggregate is coated with it and brought into intimate contact with other ingredients. It reacts chemically with the ingredients of cement, the reaction called hydration of cement, and brings about the setting and hardening of cement. Water also lubricates the mix and gives it the workability required to place and compact it propcrly. Cement requires about 25 to 50 percent of water for hydration. Additional water is required for the workability of concrete

IV. CONCLUSIONS

Thefollowingconclusionsaremadefromthestudy:

1. The most important problems faced in reinforced concrete construction are the decay of reinforcing steel, which considerably affects the durability and life of concrete structures.
2. Normal concrete gives a very low tensile strength, restricted ductility and small amount of resistance to cracking. Internal small cracks lead to brittle failure of concrete. In this new generation civil engineering constructions have their own structural and durability requirements.
3. In this thesis has attempted to examine mechanical properties of M30 grade of concrete of made with basalt fibers. To reduce the deleterious effects of the production of cement on the environment, concrete is being developed by substituting admixtures like OYSTER SHELL ASH(OSA) and GGBSin place of cement.
4. Multi blended concrete developed with GGBS and OYSTER SHELL ASH(OSA) showed depletion in the mechanical properties. Basalt fibers were added to this mix additionally to overcome this deficiency.

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