EXPERIMENTAL INVESTIGATIONS ON EFFECT OF CONCRETE WITH BASALT FIBER AND BARYTE POWDER IN RIGID PAVEMENTS

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Abstract - *Concrete is a man-made stone formed by hardening of a carefully selected combination of cement, fine aggregate, coarse aggregate, & water. Sustainable development in the building sector entails the use of non-traditional novel materials to compensate for a lack of natural resources and to discover alternative methods of protecting environment. This project compares compressive, split tensile, and flexural strengths of M30 grade concrete with basalt fibre and baryte powder. The baryte powder is to be mixed into the concrete at a rate of 2.5 % to 7.5 % of the total weight of fine aggregate & basalt fibre with 1% , 2% and 3% of the total weight of cement in concrete. Where basalt is a fibre, it will be separated from volcanic rock. Basalt is mined, crushed, and cleaned before being melted at 1500o C. Basalt fibre has a higher operating temperature and is resistant to chemical assaults, impact stress, and fire. Barite is a mineral made up of barium sulphate. The specific gravity is 4.3-5. The term barium sulphate barite comes from the Greek word berries, which meaning substantial, and refers to its high specific gravity. Barite crystals are colourless, white, with mild blue, yellow, and grey tones. Reinforcing bars for concrete applications are usually made from glass, carbon, and polyamide fibres. Rapid innovations in fibre production technology enable the manufacture of basalt fibres, which are produced from basalt rock. This technology was developed mainly in USSR Basalt fibre has good thermal performance, high tensile strength, good electromagnetic characteristics, is inert, and is resistant to acid, radiation, UV light, vibration, and impact loading. The mechanical characteristics of concrete are discussed in this work. Basalt fibres are mostly produced in Eastern Europe, Russia, and the United States, but are also produced in Israel and China. Finally, it is concluded that this is a low-cost material that is also feasible to make in India due to the large amount of basalt rock. (nearly 5, 00,000 sq. km).*

Key Words: Basalt fibre, Barite Powder, Compression strength, Split tensile strength and Flexural strength.

1.INTRODUCTION

Industry always seeks to find new, better and cost-effective materials that are very helpful for the industry. A significant development in the preparation of composite products has been observed today. In this regard, energy conservation, corrosion, sustainability and environment risk are important for changing a product or for producing a new product.

Basalt fibre is a non-metallic fibre that has been molten at a high temperature and produced from basalt rock. Basalt crystal and chopped basalt fibre are all made from basalt rock, basalt fabrics, and continuous filament wire.

Basiular fibre is made from volcanic lava and volcanoes that solidify within the exterior at a lower place the earth' crust and is a particularly hot fluid or semi-fluid material. volcanic rock could be a term accustomed describe a sort of gray and black volcanic rock. The liquefied rock is then removed exploitation small balls, leading to continuous threads of basalt fibre. in a very single producing phase, the basaltic fibre doesn't need to any extent further additives, resulting in a value savings. volcanic rock rock fibres are non-combustible, explosion-proof, and don't react with air or water. they are doing not create any chemical reactions that might be dangerous to humans or the atmosphere once they get touch with different substances.

Barite is a mineral wide employed in heavy concrete as an aggregate. one amongst the applications is that the protection of radiation in hospitals and nuclear plants. This study explored the employment of barytes powder as a partial or full sand substitute in concrete. The study was conducted on 5 categories of concrete samples of densities from 2,31 to 2,48, corresponding to barite lots of 0 to 25 percent. as compared with traditional concrete, the impact of the barite ratio on physical and mechanical properties, together with compressive strength, stress strength, density, shrinkage, swelling and elastic modules was measured and compared. though the tensile strength was reduced by up to 50%, it absolutely was showed that a barytes-based concrete may be created with solely a small impact on the key mechanical parameters: the compressive strength at 28 days was only reduced by 10%, and also the elastic modulus at one year was reduced only by 20 percentage. The freshly developed mixture, that contains barite powder, can be accustomed create reinforced concrete.

2. LITERATURE REVIEW

2.1 General

This chapter deals with the review of literature related to strength properties of concrete made from Waste Foundry Sand as a replacement of fine aggregate on strength properties of concrete.

Washington Almeida Moura et al. (4th Brazilian MRS Meeting), 2007. The findings of a study on the usage of Copper Slag as a Puzzalonic Supplementary Cementing material for use in concrete are presented in this paper. The mineralogical and chemical properties of a Copper Slag were first established.

R. R. Chavan & D.B. Kulkarni (2013) performed experimental studies to evaluates effect of utilization copper slag as fine aggregate design on strength properties and concluded that maximum compressive strength enhanced by 55% at 40% replacement of fine aggregate by copper slag or even flexural strength enhanced by 14% at 40% replacement.

Khalifa et al, revealed about using copper slag as a sand supplement enhances the strength and durability properties of high strength concrete while retaining workability and generates concrete that satisfies the design criteria for strength and durability.

Mostafa et al observed that there is stronger bonding between Copper slag aggregates and cement paste matrix in Cement Concrete and this leads to higher strengths in Concrete. According to Li and Zong, concrete employing copper slag as fine aggregate has equivalent mechanical characteristics to concrete including conventional sand & coarse particles. According to Shoya M et al., the freezing-thawing resistance of concrete contains copper slag aggregates is less than control samples. According to B.Mobasher et al, copper slag has high potential for usage as a Pozzalonic material.

Brindha et al investigated that strength behaviour of concrete in which sand was partially replaced with Copper Slag during the process of manufacturing. The strength was found to increase until 40 percent of the sand was replaced with copper slag, at which point it began to decrease. Brindha and Nagan evaluated the durability characteristics of copper slag admixed concrete and discovered that the copper slag concrete have far less resistance to H2So4 solution than control concrete.

Saveria Monosi et al. studied impact of Foundry Sand in Mortars and Concrete and found structural mortar & concrete can be manufactured with UFS as partial replacement of natural sand. A suitable recycling of discarded foundry sand as building construction material was suggested.

Ishimaru utilised class II fly ash and copper slag as fine aggregates aggregates in concrete and observed that adopting copper slag or class II fly ash up to 20% (in volume) as fine aggregates resulted in highest compressive strength results.

Chandana Sukesh et al studied influence of utilising quarry dust as a partial replacement for sand in concrete and discovered that it increased the compressive strength of the concrete.

Sreekrishnaperumal Thanga Ramesh discovered that welding slag and furnace slag performed better than sand in terms of compressive strength. According to the experimental results, 10% Furnace Slag and 5% Welding Slag were used as sand replacement. very effective.

2.2 Summary of Literature: -

Replacement of fine aggregate with copper slag showed increase in the compressive strength of concrete up to 90% and then there was a marginal decrease in the strength.

1. Copper slag can be effectively used as fine aggregate in place of conventional river sand ,in concrete.
2. Maximum compressive strength was achieved with 40% replacement of fine aggregate with Baryte

The addition of fiber tends to decrease the cracks that are going to be formed and increase the strength properties and further there is decrease in strength when ever addition of fiber exceeds the optimum % and it can be obtained from test results

3. Materials

A. Cement

Cement is a binder, a substance that sets and hardens and can bind the other materials together. It plays an vital role in construction field. In this research the OPC of 53 grades is used.

B. Aggregate

Aggregation is a component used with cement, bitumen, lime, gypsum or another adhesive to make concrete or morter in construction and construction materials. The compound gives the end product with longitudinal stability, wear resistance and corrosion, and other physical features. Sand, broken or crushed stone, gravel, broken slag, boiler ash (clinker), burnt shale and burnt clay are the most often utilised aggregates. Usually the fine aggregate consists of sand, broken stone or slag.The ground aggregate is made of cauldron, shattered stone fragments, slag and other ground material. The fine aggregate are utilised for producing thin concrete layers or other smooth-surface structural elements. For bigger limbs and when smooth surface is required, the Fine Aggregate is employed. For bigger members, coarse aggregates are employed. Based on aggregate scale, aggregate is separated in to two types.

- Coarse aggregate
- Fine aggregate

C. BASALT FIBER

Basalt fibres contain a minerals plagioclase, pyroxene, & olivine, which are produced from very fine basalt fibres. It is comparable to fibergals, however it is far less expensive than carbon fibre and has better physicomechanical characteristics than fibergals. It is used as an air-resistant cloth and as a compound in an aerospace and automotive industries to make things like as camera tripods.

Fig -1: Basalt fiber

D. BARITE POWDER:

Basalt Continuous Fiber (BCF) processing technology is a one-phase process: melting, basalt homogenisation and fiber extraction. Just once is Basalt heated. In the form of cold technologies with low energy cost, the BCF is further processed.
Basalt fibres constitute of one distinct properties from chosen quarry and crushed basalt sources. Basalt with high acidity and low iron concentrations are regarded as excellent for fibre production. In essence, in contrast to other composites like Galsfibres, ingredients are involved during manufacture. The basalt is melted and purified.

Fig -1: Barite powder

4. EXPERIMENTAL RESULTS

4.1 INTRODUCTION:

This chapter explains the strength qualities of basalt fibres and barite powder. The compressive strength, divided tensile strength, tensile strengths and fracture toughness of classical curing concrete and associated subjects will be explored.

4.2 Compressive strength of concrete

The compressive strength of concrete is the most essential and unique mechanical parameter as it offers an overall view of the quality of the material. The compressive strength of M30 grade concrete mixes is enhanced by replacing OPC with Barite powder and Basalt fibres in the cement. The compressive strength of these concrete mixtures at 7 days, 14 days, 28 and 90days, as well as a graphical representation of compressive strength vs concrete curing age, are provided below.

Table -1: compressive strength of cubes (N/mm2)

Compressive Strength (N/mm²)						
S.No	Materials		Curing			
	Barite powder	Basalt fibres	7 days	14 days	28 days	90 days
1	2.5%	0%	18.45	21.43	26.24	30.21
2	2.5%	1%	21.32	23.12	29.43	32.45
3	2.5%	2%	22.84	25.56	31.56	35.42
4	2.5%	3%	22.45	23.01	28.74	32.21
1	5.0%	0%	23.8	25.757	32.872	37.23
2	5.0%	1%	24.6	26.96	35.73	38.82
3	5.0%	2%	25.43	30.03	38.43	41.62
4	5.0%	3%	25.12	28.2	33.53	35.87
1	7.5%	0%	19.35	22.23	27.74	31.01
2	7.5%	1%	22.12	23.12	30.43	34.75
3	7.5%	2%	22.65	24.76	32.73	36.12
4	7.5%	3%	22.4	24.11	31.84	35.01

The compressive strength of these concrete mixtures was verified at 7 days, 14 days, 28 and 90days, and a graphical representation of the compressive strength versus curing age of concrete is shown below:

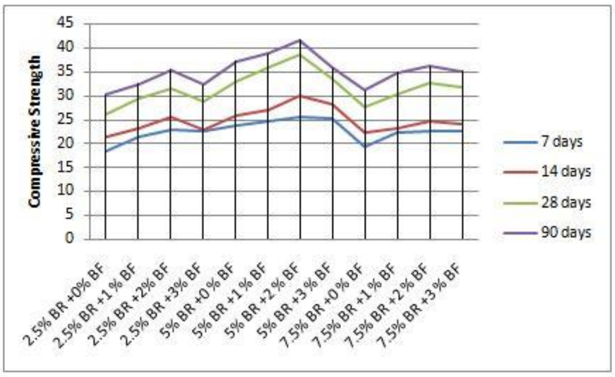

Chart -1: Compressive Strength Cubes

4.3 Split tensile strength of concrete:

By replacing OPC with basalt fibre and barite powder with cement weight, the split tensile strength of M30 grade concrete mix is investigated. Below are the split strength findings for various concrete mixtures recorded at 7 days, 14 days, 28 and 90days, as well as a graphical representation of compressive strength versus concrete curing age.

Table -2: split tensile strength of cylinders(N/mm²)

Split Tensile Strength (N/mm²)						
S.No	Materials		curing			
	Barite powder	Basalt fibres	7 days	14 days	28 days	90 days
1	2.5%	0	1.69	2.01	2.59	2.83
2	2.5%	1%	2.22	2.68	3.36	3.65
3	2.5%	2%	2.47	3.15	3.98	4.1
4	2.5%	3%	2.15	2.88	3.44	3.98
1	5.0%	0	1.87	2.54	2.87	3.02
2	5.0%	1%	2.65	3.1	3.63	3.8
3	5.0%	2%	2.72	3.5	4.25	4.36
4	5.0%	3%	2.25	3.12	3.92	4.14
1	7.5%	0	1.55	2.12	2.72	2.92
2	7.5%	1%	2.22	2.74	3.42	3.74
3	7.5%	2%	2.42	3.21	4.01	4.15
4	7.5%	3%	2.01	2.86	3.74	3.99

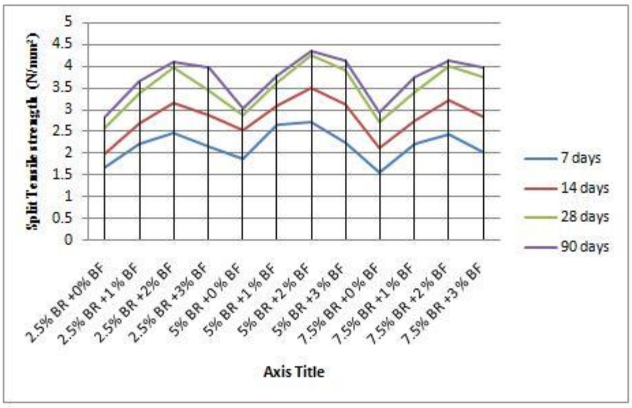

Chart -2: Split Tensile Test Cylinders

4.4 Flexural strength of concrete

The flexural strength of M30 grade concrete mixes is investigated by substituting the cement mix OPF with basalt fibre and the barite powder concrete mixes with 1,2, 3 percentages of basalt fibre and barite powder replaced by the weight of cement. The compressive strength of various concrete mixtures at 7 days, 14 days, 28 and 90days, as well as a graphical representation of compressive strength vs concrete curing age, are provided in the table below.

Table-3: Flexural Strength of slabs tested results (N/mm²)

Flexural strength						
S.No	Materials		curing			
	Barite powder	Basalt fibres	7 days	14 days	28 days	90 days
1	2.5%	0	3.24	3.65	4.02	4.06
2	2.5%	1%	4.05	4.24	4.81	4.84
3	2.5%	2%	4.16	4.99	5.21	5.79
4	2.5%	3%	4.03	4.58	4.93	5.11
1	5.0%	0	4.14	4.65	4.72	4.96
2	5.0%	1%	4.35	4.94	5.11	5.24
3	5.0%	2%	4.46	5.39	5.97	6.09
4	5.0%	3%	4.23	4.73	5.38	5.41
1	7.5%	0	3.82	4.15	4.49	4.66
2	7.5%	1%	4.12	4.54	4.98	5.09
3	7.5%	2%	4.28	5.12	5.52	5.92
4	7.5%	3%	4.07	4.72	5.24	5.59

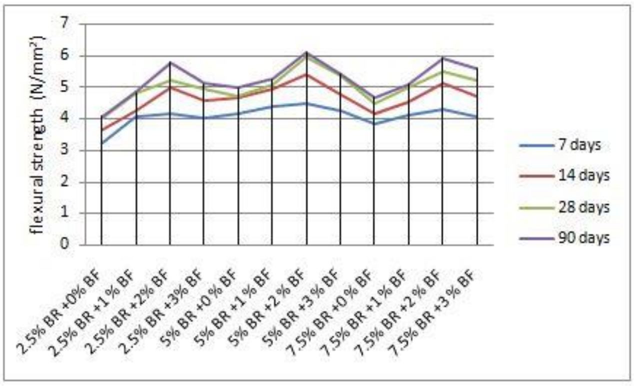

Chart -3: Flexural Strength of Beams

5. CONCLUSIONS

1. In the current investigation, 0% 1 %, 2%, & 3%, Basalt fiber are used to partially replacement. 2.5%, 5%, 7.5% of barite powder are also included.
2. The influence on compressing, breaking tensile and bending strength of concrete M30 is investigated by combining barite powder and basalt fibers.
3. The testing of concrete samples and the combined application for material characteristics of Barite powder and Basalt fibres.
4. Curing was performed at ages 7, 14, 28 and 90 days, with compression, break tensile, and flexure tensile measures performed at 90 days.
5. The mix proportion of concrete using 1 percent basalt fibre improves mechanical properties of the concrete, whereas using 2 percent basalt fibre increases mechanical properties of the concrete, i.e., compressive strength, split-tensile strength, and flexural strength. The overall partial replacement of fibers with cement material is 2%. More than 2% of

fibers used in mix construction it gets reduce the mechanical properties of the concrete.

6. So the concrete with 5% of barite powder and 2% Basalt fiber gives better results in properties of concrete.

In the current study, incorporating barite powder and basalt fiber into concrete improves its mechanical properties.

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