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UTILIZATION OF INSULATION FIBRE GLASS AS AN ADDITIVE IN CONCRETE

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Abstract: The current advancement in concrete technology aims to make concrete stronger and more durable while maintaining its sustainability and affordability. Concrete is fragile and has a low tension strength. The idea of incorporating fibers into building materials in order to enhance their performance is ancient. Mud bricks were reinforced with straw, plaster was strengthened with horse hair, and pottery was reinforced with asbestos. The random orientation of the fibres in concrete, which comes into play when the material fractures, increases its strength and ductility [1].

The purpose of this research is to describe the strength and longevity of concrete reinforced with insulating fibre glass. Fibrous glass, sometimes known as glass wool, is a kind of insulation made by melting recycled glass and natural sand together at a temperature of 1450 C. The strength and durability of concrete mixes created with various percentages of insulating fibre glass and water-cement ratio are assessed using compression strength, flexural tensile strength, pull off strength, water permeability DIN 1048, abrasion, static chloride diffusion, and carbonation tests.

When high flexural tensile strength is needed, as in the case of rigid pavement, the findings suggested using insulated fiber glass. It helps prevent the spread of microcracks in the concrete's structure and makes the pavement or building more resistant to collapse. Permeability and durability aspects also improved by the addition of fibre glass at certain percentage which also prevent the deterioration of pavement or structure.

Keywords: Insulating Fibre, compression strength, flexural tensile strength, rigid pavement, insulated fiber glass etc.

1. INTRODUCTION

Many decades have passed since the area of concrete technology first discovered the benefits of using fibre reinforcement. Because of its low tensile strain capacity and poor fracture toughness, concrete is often regarded as a brittle material. Adding randomly placed discrete fibers to the concrete matrix, as Prasaad et al. 2019 noted, may improve the ductility of the material. Fibres in concrete increase its strength, stiffness, and fatigue properties, which provides additional options for structural design.

The composite material known as fiber reinforced concrete (FRC) is made up of concrete and suitably sized, evenly scattered, discontinuous, and discrete fibers. In accordance with the work of Lilholt H et al., 2000, composites are defined as materials made up of two or more components that exhibit distinct physical properties. A material is considered to be a composite only if the components comprising each phase of the material exhibit significantly distinct physical characteristics. Composites are man-made materials in which a stronger load-carrying substance (called reinforcement) is embedded in a less dense material (known as matrix).

Strength and rigidity are provided through reinforcement, which aids in bearing the weight of the structure. The reinforcement's location and orientation are preserved by the matrix or binder (organic or inorganic). Importantly, the composites' components retain their unique physical and chemical properties while combining to form a new set of characteristics that neither component could generate on its own. The reinforcement, which may take the form of platelets, particles, or fibers, is often added to a matrix material in order to increase the matrix's mechanical qualities. The most effective load transmission occurs with long fibers that are aligned in the direction of loading. This is due to the fact that the area of the fiber-matrix interface where stress is transferred is very small, and because the effects of disturbance at the fiber ends may often be disregarded.

Which means that the length of the fiber that is not doing its job is rather short. Continuous filaments of glass, carbon, steel, polypropylene, and other natural and synthetic fibers are all accessible for use in high performance composites.

Objective of the Study

This study aims to investigate how strength and durability indicators are affected by insulating glass fibre in cement concrete. The approach includes the measurement of material properties, creation of concrete mixtures with various fibre glass to water cement ratios, casting, curing, and testing of specimens, analysis, and interpretation of results and conclusions.

The study's goal is to find out whether the use of insulating fiber glass in concrete has any effect on the mix's properties i.e. Tensile and compressive strength, respectively, Permeability to water, Resistance to abrasion, Execute with vigour, Diffusion of chloride and carbon dioxide

2. LITERATURE REVIEW

The tension and character of plain concrete are weak and fragile. Drying shrinkage and other factors can contribute to the cracking that develops. It has been shown that adding fibres to plain concrete improves the object's tensile strength and lowers the risk of shrinkage cracking [2, 3]. Fibre reinforced concrete (FRC) has come a long way since its inception in the early 1960s [4]. By including fibers into the mix, concrete is transformed into a homogeneous, isotropic substance. Concrete's strength and ductility are enhanced by the random orientation of its fibers, which come into play when the material cracks. The two main reasons of failure in FRC are bond failure between the fibres and the matrix or material

Fibre Reinforced Concrete (FRC)

A composite material, it is described as a combination of cement, mortar, or concrete with appropriate, distinct fibers that are evenly spread throughout the substance. [5].

Types of Fibre

Fibers come in many sorts of textures, colors, and sizes. Common types of fibers include [6,7] :

Glass Fibre, Steel Fibre, Carbon Fibre, Synthetic fibre

Monofilament polyethylene fiber with wart-like surface deformations and alterations has been manufactured for use in concrete. Concrete reinforced with polyethylene fibres at concentrations between 2 and 4 percent by volume exhibits linear flexural load deflection behaviour up to the first fracture, after which there is a visible transfer of load to the fibres that permits an increase in load up until the fibres break.

Natural Organic and Mineral Fibres : Using local resources, such technology and labor, natural reinforcing materials may be acquired cheaply and with little energy expenditure. It is of particular relevance to less developed countries, where standard building materials are either not accessible or are prohibitively costly, to use natural fibers as a kind of concrete reinforcement. Such materials includes wood, asbestos, cotton, bamboo, and rockwool fiber.

Fibres in Concrete

Fibres, typically very thin and evenly distributed, are added to concrete for a number of purposes. [8] :

1. To enhance concrete's tensile strength, fatigue resistance, and plasticity.
2. in order to avoid cracking caused by drying shrinkage as well as plastic shrinkage.
3. In order to prevent water from leaking through the concrete.
4. To make concrete more resistant to wear and damage caused by impact.

Glass Fibres in Concrete

Fibre concrete has just recently started using glass fiber as an additive. Plastic shrinkage during the curing process often causes crazing and cracking in traditional concrete mixtures. Adding even a small amount of fibers may prevent this early-age plastic shrinkage breaking from becoming a major issue. It also eliminates the need for lightweight crack-control steel mesh, which may be awkward to work with and hard to place.

Insulation Fiber Glass

Fiber glass insulation has been made and sold commercially for over 60 years. It has evolved over the last century into one of the most advantageous and practical artificial substances in the world. Glass fiber insulation, often known as glass wool or glass fiber insulation, is a versatile material that is typically manufactured in the shape of wool-type fibers.

Effect of Fiber Glass on Various Concrete Properties

R.Gowri and M.AngelineMary, this study, the present trend in concrete technology is towards increasing the strength and durability of concrete to meet the demands of the modern construction world at lower cost. These factors can be achieved in concrete by adding natural or synthetic fiber. The strength parameters of concrete such as compressive strength and tensile strength were studied by varying the percentage of fiber from 0.025% to 0.075% of the weight of concrete.

C. Selin Ravikumar and T.S. Thandavamoorthy, The study there has been a significant increase in the use of fibers in concrete for improving its properties such as tensile strength and ductility. The fiber concrete is also used in retrofitting existing concrete structures. Among many different types of fibers available today, glass fiber is a recent introduction in the field of concrete technology.

Kavita S Kene has studied the Concrete is most widely used construction material in the world. Fiber reinforced concrete (FRC) is a concrete in which small and discontinuous fibers are dispersed uniformly. The fibers used in FRC may be of different materials like steel, G.I., carbon, glass, aramid, asbestos,polypropylene, jute etc.

3. METHODOLOGY

The cement, fine aggregate, and coarse aggregate that are used in creating concrete with insulation fiber glass added were analyzed in accordance with applicable IS standards, to determine the material's strength and durability criteria. Tests for free moisture content, flakiness, elongation at break, and elongation at break, as well as sieve analysis, crushing strength, impact value, and specific gravity were performed.

The components examined above were used to generate a concrete mix. Once the ratios of the different components were established, test batches of concrete were created to determine how much plasticizer was necessary to achieve the desired workability. Twelve different concrete mixes with various proportions of water and insulating fibre glass were created using a pan-style mixer. Each batch produced a total of twenty-four cubes and beams. Some of the mix qualities that were investigated were compression, flexibility, pull-off strength, abrasion, water permeability, carbonation resistance, and chloride migration.

The experimental plan was devised in such a manner that changes in properties like strength, permeability, and durability of concrete composites in response to changes in % of insulating fiber glass at water-cement ratios of 0.4 and 0.5 could be studied.

Materials Used

a) Cement - Regular Portland cement of grade 43, which is available at any nearby grocery shop, was the cement used in this research. Binani Cement used for this concrete.

b) Coarse aggregate - Machine Crushed angular aggregate in the 20 mm and 10 mm size range is sourced from a nearby facility. It didn't have any dirt, clay, or other nastiness mixed in.

c) Fine aggregate - In this study, fine aggregate is from Bannas river.

d) Water and Super plasticizer – The potable water along with Sulphonated Naphthalene Polymer based “Fosroc Conplast SP430 G8” Superplasticiser complies with IS:9103- 1999 was used in this study.

e) Fiber Glass – This research made use of loose glasswool, an E-type glass fibre that is alkali resistant.

Physical Properties of Materials

To determine the acceptability of coarse and fine aggregate in concrete mix, tests on sieve analysis, specific gravity, crushing strength, impact value, flakiness and elongation index, and free moisture content are conducted. These tests are done in accordance with the relevant IS codes.

Sieve Analysis Test

The particle size distribution in an aggregate sample is analyzed using a sieve analysis. Coarse aggregate and fine aggregate samples are evaluated for their grading patterns by being sieved through a series of progressively smaller sieves, with the biggest sieve at the top and the smallest sieve at the bottom.

Specific Gravity

The durability or quality of the material is substituted for by the specific gravity of the aggregate. By converting weight to solid volume using specific gravity, it is possible to calculate the theoretical yield of concrete per unit volume. Compaction factor and volumetric design calculations of concrete mixtures also rely on specific gravity. The aggregate's specific gravity was calculated using the following formula.

Aggregate Crushing Value Test

The "crushing value" of an aggregate is a comparative measure of resistance to crushing under a controlled compressive force. Aggregate that was both 12.5 mm and 10 mm in size was used in the test.

Aggregate Impact Value Test

The resistance to rapid shock or impact is quantified by its aggregate impact value. Aggregate that is 12.5 mm in size and yet retains some particles when passed through an IS sieve set at 10 mm is what makes up the test sample.

Flakiness Index and Elongation Index Test

The minimum and maximum dimensions are used in the aforementioned checks to determine whether or not an aggregate is suitable.

Free Surface Moisture Content

The quality of concrete may be impacted by the amount of free surface moisture present in the coarse and fine aggregate. In order to rectify the w/c ratio in weigh batching, the free surface moisture content of the aggregate must be determined. A layer of surface moisture builds loosely around each particle.

The aggregate moisture content must be directly measured in order to maintain control over the concrete's quality, especially in terms of its workability and strength. Aggregate moisture is determined by weighing it before and after drying in an oven and comparing the results.

Physical properties of materials.

Materials	Free Surface Moisture Content	Crushing Strength Value	Impact Value	Flakiness and Elongation Index
Coarse Aggregate (10 mm)	0.10%	24.67 %	23.32%	25.6%
Fine Aggregate	1.00%	-	-	-

Test Variables

Separate types of concrete were prepared using two different variables in the experimental program. These two factors have been used to provide a comparison of the mix properties.

a) Percentage of insulation fiber glass - 0%, 0.25%, 0.50%, 0.75%, 1.00% and 1.25% of total cement content (by weight).

b) Water Cement ratio - 0.4 and 0.5.

The insulation fiber glass % has been changed by the aforementioned percentages for each of the water cement proportions. The impact of insulating fiber glass on concrete qualities was studied by analyzing the characteristics of a total of 12 different concrete mixtures. Properties of control mixes without any insulation fiber glass were than compared with composite mixes.

Mix Design

Concrete mix design of M30 in accordance with IS:10262-2009 standards was completed after validating the physical characteristics of the materials for their acceptance in concrete mixes and selecting the variables of the concrete mix design.

Preparation Of Concrete Mixes

All ingredients should be brought to room temperature, preferably 27° ± 3°C, before mixing. The cement will be thoroughly mixed dry when it is brought to the lab, either by hand or in an appropriate mixer, to ensure the optimum blending and uniformity while guarding against the entry of foreign components. The aggregates used in each batch of concrete must meet the required grading and air-drying conditions. To achieve the correct grading in the concrete, the aggregate was typically sieved into fine and coarse fractions before being recombined for each batch.

Workability – A compaction factor test (IS:1199-1959) using the configuration to evaluate the material's workability.

Concrete Testing

Immediately after the mixing and curing periods, to find out the properties of impact of insulating fiber glass on the strength, permeability, and durability qualities of concrete.

Strength Test

After the concrete used in the research was installed, its compressive strength, flexural strength, and pull-off strength were assessed 7, 14, and 28 days later. The average test result of an individual was calculated by averaging the outcomes of three different samples. After being removed from the curing tank and having any obvious moisture, grit, or sight projections removed, the specimens were immediately inspected and evaluated.

Compressive Strength Test

The compressive strength of concrete cubes after 7 days and 28 days of curing was determined using this test in accordance with IS 516 - 1959.

Procedure: The specimen's surfaces that will make contact with the compression platens must be clear of any loose sand or other debris, and the testing device's bearing surfaces must be well cleaned. Make sure the specimen's axis is parallel to the centre of thrust of the spherically seated platen. For both cubes, a loading pressure of around 140 kg/cm^2/min is advised.

Flexural Tensile Strength Test

This test, which is carried out in accordance with IS 516 - 1959, is used to assess the flexural strength of concrete beams after seven and thirty days of curing.

Procedure

Figure 3.8 shows the two-point loading setup that was used to evaluate the flexural strength of a beam with a span of 500 mm. The bearing surfaces of the supporting and loading rollers should also be cleansed of any sand or other debris before they come into touch with the specimen's bearing surfaces where they will make contact with the rollers. The specimen should be set up in the machine such that the tension is applied to the top surface of the cast-in mould along two lines that are 20.0 or 13.3 cm apart. Ensure that the specimen's axis and the loading device's axis are parallel.

Fig. Two-point load setup for flexural tensile strength test

Fig. Failure of specimen under flexural tensile load

Water Permeability Test (DIN 1048)

The water permeability of concrete samples was evaluated using a DIN 1048 test, which measures the material's resistance to the force of water entering a sample of concrete. Concrete samples were subjected to 0.5 N/mm2 of water pressure operating normally in the mold-filling direction for three days. This level of test pressure was sustained throughout. As soon as the pressure was released, the specimen was taken out and split lengthwise, with the side that had been buried in water facing downward. The greatest depth of penetration in the direction of the slab thickness was then measured to evaluate the degree of the water damage. The test result was calculated by averaging the three specimens' three maximum penetration depths.

Abrasion Resistance Test

In order to evaluate the abrasion resistance of the concrete, 10 cm x 10 cm square specimens were cast with a smooth finish. The evaluation was performed using an IS 1237-1980 compliant machine (Figure 3.12). Concrete specimen loading was raised from 300N to 600N so that abrasion resistance could be measured using the code's guidelines for tiling. The specimen is secured in the holder with the grounding face against the disc. The core of the sample was subjected to a load of 600N. A uniform coating of abrasive material was disseminated across the grinding path while the grinding disc revolved at a speed of 30 revolutions per minute. The disc was stopped, the abrasive powder was taken out, and fresh powder was inserted after every 22 spins. After every 22 clockwise rotations, the specimen was rotated by a 900 degree angle around the vertical axis. This was done 9 times. Therefore, 220 rotations were performed to each sample. Specimens were reweighed after abrasion to the closest 0.1 g. After being subjected to abrasion, the specimen's wear was quantified by comparing its starting and ending weights and calculating the percentage difference.

Equation below was used to evaluate wear

$\% w = (W_i - W_f / W_f) \times 100$

Where,

%w is percentage wear,

W_i is initial weight of specimen and W_f is final weight of specimen

Concrete Carbonation Test

This test was performed as per CPC-18 RILEM. For each mix, cubes were casted for carbonation test. The samples were removed from the curing tank and put away properly after 28 days. The cubes were then cut into twelve pieces, each measuring 50 mm by 100 mm; the mixtures were baked at 60 to 70 degrees Celsius for two weeks. After the samples had finished drying in the oven, each longitudinal side was painted with two layers of epoxy paint.The samples were carbonated in a controlled environment with a relative humidity of 50–65%, a carbon dioxide concentration of 50.2%, and a temperature of 20–22 0C after they had been coated, dried, and labeled. Three samples from each batch were monitored throughout the course of 14 days, 21 days, and 28 days.

4. EXPERIMENTAL PROGRAMME

Experimental programme and observation of different tests as a part of methodology for the present investigation are presented here.

Workability

The efficacy of twelve various cast mixes was evaluated using a compaction factor test, the results of which are shown in the table below

Table 4.1: Workability of concrete mixes at different percentage of Insulation Fibre Glass

S. No.	Specimen Identification	% Insulation fibreglass used (by wt.of cement)	% Superplasticizer used (by wt. of cement)	w/c Ratio	Compaction Factor
1.	P00	0	Not Used	0.4	0.92
2.	P0	0.25	0.2	0.4	0.91
3.	P1	0.50	0.3	0.4	0.89
4.	P10	0.75	0.4	0.4	0.87
5.	P2	1.00	0.6	0.4	0.83
6.	P3	1.25	0.9	0.4	0.81
7.	M0	0	Not Used	0.5	0.95
8.	M1	0.25	0.2	0.5	0.93
9.	M2	0.50	0.25	0.5	0.91
10.	M3	0.75	0.3	0.5	0.89
11.	M4	1.00	0.4	0.5	0.86
12.	M5	1.25	0.5	0.5	0.82

Compressive Strength

Compressive strength tests on concrete mixtures incorporating insulating fibre glass are conducted after 7 and 28 days. The results of a compressive strength test are shown here.

7 days Compressive Strength

The compressive strength at 7 days for concrete mixtures using various proportions of insulating fibre glass as an addition is shown in Table

Table 4.2 : 7 Days Compressive Strength

Grade	Water Cement Ratio	% Fibre Glass Used	Sample	Compressive Strength (N/mm^2)
M-30	0.4	0	P00	22.4
		0.25	P0	23.1
		0.5	P1	24.8
		0.75	P10	26.9
		1	P2	28.2
		1.25	P3	28.6
	0.5	0	M0	20.6
		0.25	M1	21.5
		0.5	M2	22.5
		0.75	M3	24.2
		1	M4	26.9
		1.25	M5	27.8

4.2.2 28 days compressive strength

The compressive strength of concrete after 28 days when combined with various quantities of insulating glass fibre is compared in Table

Table 4.3: 28 Days Compressive Strength

Grade	Water Cement Ratio	% Fibre Glass Used	Sample	Compressive Strength (N/mm^2)
M-30	0.4	0	P00	33.6
		0.25	P0	34.6
		0.5	P1	36.2
		0.75	P10	40.3
		1	P2	42.3
		1.25	P3	42.9
	0.5	0	M0	30.9
		0.25	M1	32.2
		0.5	M2	33.7
		0.75	M3	36.8
		1	M4	40.6
		1.25	M5	41.7

With increasing volumes of insulating fibre glass added to concrete with water/cement ratios of 0.4 and 0.5, respectively, at 7 and 28 days, the concrete's compressive strength rises

Flexural Tensile Strength

Concrete containing insulation fibre glass as an additive is tested for its flexural strength at 28 days. Results from a test measuring flexural tensile strength are provided.

28 days Flexural Tensile Strength

Table displays the flexural tensile strength at 28 days for concrete mixtures with varied percentages of insulating fiber glass as an addition.

Table 4.4: 28 Days Flexural Tensile Strength

Grade	Water Cement Ratio	% Fibre Glass Used	Sample	Flexural tensile Strength (N/mm^2)
M-30		0	P00	4.62
		0.25	P0	4.8
		0.5	P1	5.02
		0.75	P10	5.51
		1	P2	5.76
		1.25	P3	5.8
		0	M0	4.48
		0.25	M1	4.55
		0.5	M2	4.8
		0.75	M3	5.1
		1	M4	5.54
		1.25	M5	5.6

Flexural tensile strength increases at 28 days for both the 0.4 and 0.5 water/cement ratios when insulation fiber glass is added to the concrete mix.

Abrasion Resistance Test

Table 4.6 displays the results of an abrasion resistance test on concrete mixtures that include varied amounts of insulating fiber glass.

Table 4.6: Result of abrasion resistance test

w/c	% of fibreadded	Weight beforeabrasion	Weight afterabrasion	Weight decreased	Abrasion loss(in %)
0.40	0	2381	2342	39	1.665243
	0.25	2394	2358	36	1.526718
	0.50	2369	2335	34	1.456103
	0.75	2403	2370	33	1.392405
	1.0	2412	2381	31	1.301974
	1.25	2383	2354	29	1.231946
0.50	0	2402	2361	41	1.736552
	0.25	2299	2260	39	1.725664
	0.50	2429	2393	36	1.504388
	0.75	2309	2275	34	1.494505
	1.0	2347	2316	31	1.338515
	1.25	2353	2323	30	1.291433

Fibre glass insulation, when added to concrete, reduces abrasion loss at both the 0.4 and 0.5 water-to-cement ratios.

5. ANALYSIS OF RESULTS

The results of various tests performed as part of the methodology for the current investigation are evaluated and presented.

5.1. Workability

In Fig. 5.1, we can see the variation in the workability of concrete mixtures with insulating fiber glass injected at a w/c ratio of 0.4 and 0.5.

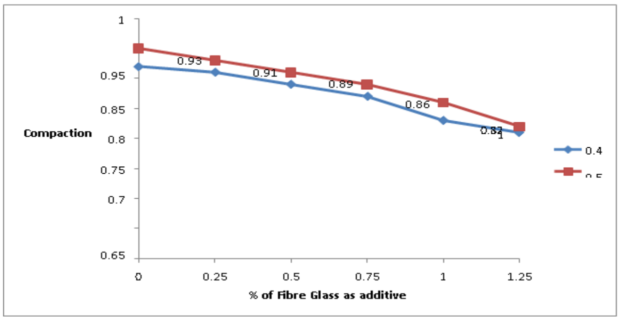

Fig 5.1: Variation of workability with addition of insulation fibre glass

The compaction factor results showed that the concrete mixes containing insulation fiber glass decreased in workability. The insulating properties of fiber glass rise from zero to seventy-five points of a percent, making it very easy to deal with. Beyond 0.75% addition, degrees of workability become very low.

The fibers can be thought of as a highly irregular aggregate, in contrast to the more typical smooth rounded aggregate. When the fibers knot up around the aggregate particles, it greatly hinders the object's workability. [3]

Compressive Strength

7 days compressive strength

Variation of 7-day compressive strength of concrete mixes with different percentage of insulating fibre glass as an addition at w/c ratio of 0.4 and 0.5 is shown in Fig. 5.2.

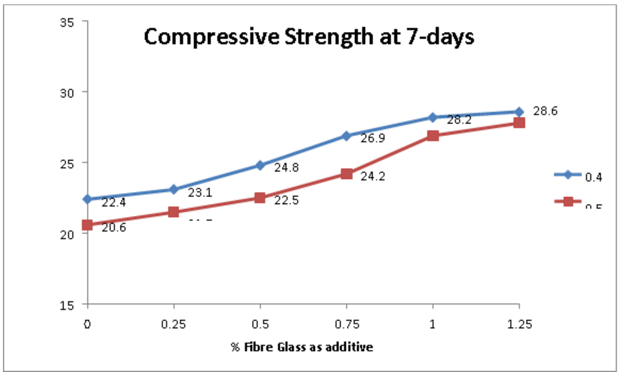

Fig 5.2: Variation of Compressive Strength (7 days) with addition of Insulation FibreGlass

The compressive strength at 7 days rises with increase in % of insulating fibre glass. For water cement ratio 0.4, the strength at addition of 1 % of insulation fibre glass improves upto 25.89 % and at addition of 1.25 % of insulation fibre glass it increases upto 27.67 % with regard to control mix. Similarly for water cement ratio 0.5, the strength with addition of 1 % and 1.25 % of insulating fibre glass improves upto 30.58 % and 34.95 % correspondingly with regard to control mix.

28 days compressive strength

Variation of 28-day compressive strength of concrete mixes with different percentage of insulating fibre glass as an addition at w/c ratio of 0.4 and 0.5 is illustrated in Fig. 5.3.

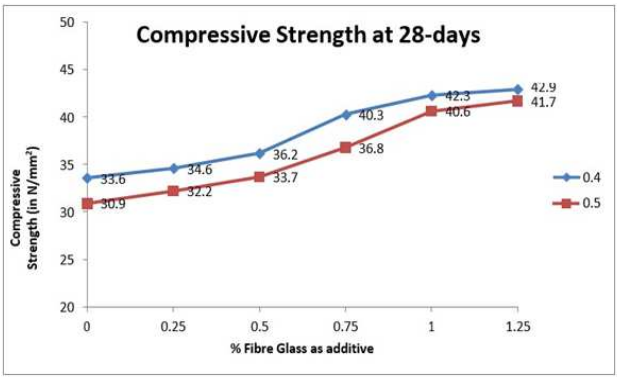

Fig 5.3: Variation of Compressive Strength (28days) with addition of Ins. Fibre Glass

As the proportion of insulating fiber glass rises, so does the compressive strength at 28 days. Adding 1% and 1.25% insulating fiber glass to a water/cement ratio of 0.4 improves the mix's strength by 25.89% and 27.67%, respectively, compared to the control mix. In the same way, adding 1% and 1.25% of insulating fiber glass to a mix with a water-cement ratio of 0.5 boosts its strength by 31.39% and 34.95%, respectively, compared to the control mix

28 days Flexural tensile strength

Figure 5.4 displays the variation in flexural tensile strength after 28 days for concrete mixes including increasing percentages of insulating fiber glass as an addition at a water-to-cement ratio of 0.4 and 0.5.

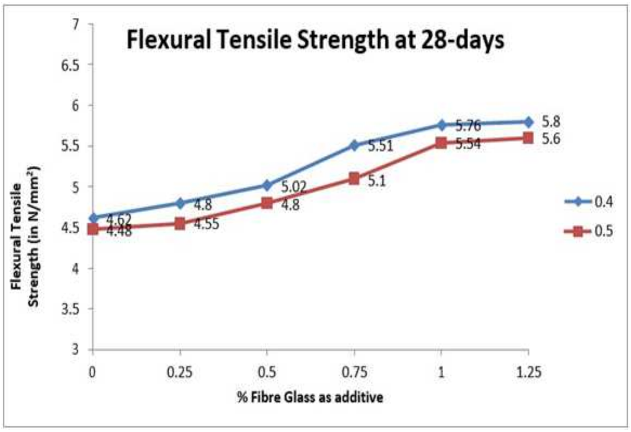

Fig 5.4 : variation in flexural tensile strength after 28 days with % of insulation fibre glass

The flexural tensile strength at 28 days increases together with the percentage of insulating fibre glass. In comparison to the control mix for water cement ratio 0.4, the strength increases by

24.67 percent and 25.54 percent, respectively, with additions of 1 percent and 1.25 percent of insulating fibre glass. With a water/cement ratio of 0.5, adding 1 percent and 1.25 percent of insulating fibre glass increases the mix's strength by 23.66 and 25 percent, respectively over the control mix.

Abrasion Resistance Test

Figure 5.6 displays the results of an abrasion resistance test on concrete samples with different amounts of insulation fiber glass (w/c ratio = 0.4 and 0.5).

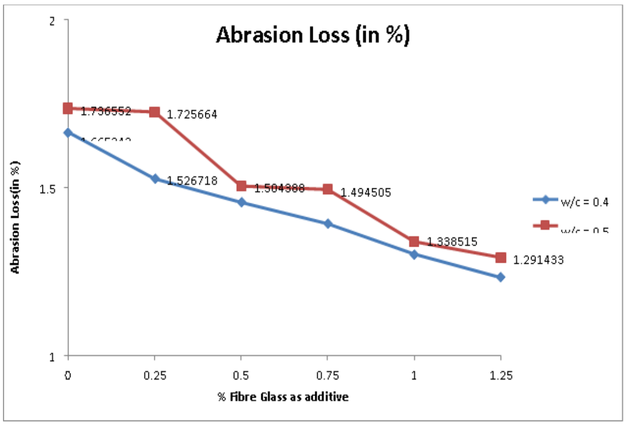

Fig 5.6: Abrasion loss (in %) with addition of insulation fibre glass

With the increase in insulation fibre glass, mixes were found more resistant towards abrasion. The results showed that abrasion loss was minimized by 1.25 percent when insulating fiber glass was added at a w/c ratio of 0.4. The use of insulating fiber glass decreased the abrasion of the concrete mix by as much as 33 percent. The similar pattern holds true for a w/c ratio of 0.5; abrasion loss is lowest when using insulating fiber glass at 1.25 percent.

6. CONCLUSIONS AND FUTURE SCOPE

The mechanical characteristics of concrete have been modified by the use of insulating fiber glass. These changes include an increase in compressive and flexural tensile strength, pull off strength, resistance to abrasion, and a drop in permeability below a specific percentage. The results of the laboratory experiments lead to the following conclusions.:

- Adding insulating fiber glass may improve the compressive strengths of concrete, including its compressive strength and flexural tensile strength.
- When insulating fiber glass is added to cement with a water-to-cement ratio of 0.4, the mix's compressive strength may increase by up to 27.67% compared to the control. The strength of a mixture with a water-to-cement ratio of 0.5 is increased to 34.95 percent when 1.25 percent insulating fiber glass is added to it.
- For a water cement ratio of 0.4, adding 1.25 percent insulating fiber glass increases flexural strength by up to 25.54 percent as compared to the control mix. A mix with a water-cement ratio of 0.5 gains up to 25 percent more strength than the control mix when 1.25 percent insulating fiber glass is added.
- Concrete loses permeability when insulating fiber glass content is increased; combinations with a water-to-cement ratio between 0.4 and 0.5 are the least permeable.
- Concrete's inherent resistance to abrasion has been proven to be enhanced by the inclusion of insulating glass fiber. The abrasion resistance rating shows how much less concrete surface wear there is when additional insulating fiber glass is added.
- The weight increase caused by the insulating glass fiber reduces durability. Older buildings and/or those with larger percentages of fiber glass insulation have been shown to have more widespread carbonation.
- The insulation glass fibre is a potential environment polluter. Thus its use in concrete as additive can solve the problem of its disposal.

7. FUTURE SCOPE

- High-strength concrete with insulation fiber glass needs further study.
- Long-term strength parameter change with changing water content has to be assessed.

- The long term durability effect of concrete with insulation fibre glass at varying water content should be evaluated.
- Durability study including sulphate attack, alkali aggregate reaction and freezing thawing resistance on the mixes containing insulation fibre glass should be done.

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