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EXPERIMENTAL INVESTIGATION OF BASALT FIBRE IN CONCRETE

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ABSTRACT

From the past few decades, the concrete industry and construction field is been observed a growing interest in the advantages that fibre reinforcement must be used in construction industry. Since the different types of fibres available in market, basalt fibre is considered as a promising new material to be used. Basalt fibre is extremely good in strength characteristics and thermal resistance too, high resistance to an alkaline environment, and is cheap product, making it an excellent material to be reinforced in concrete. In view of the consiquence of basalt fibres for concrete, and because of different lengths, dimensions and proportions of basalt fibres have an cause on the mechanical characteristics of concrete, it is suggested to review the effect of using different dimensions of basalt fibre and content on the mechanical properties of concrete. The mechanical properties of concrete examined are high compressive strength, high tensile strength, high flexural strength, permeability, workability, and the unit weight. This paper has been reviewed for the first time and the current literature related to the effect of using basalt fibres in different proportions on the mechanical properties of concrete, provided future researchers with the all their data and facts needed to compare their work, and identified the best basalt fibre dimensions and content combination that describes an improvement in the mechanical properties of concrete. From reviewing the literatures of various authors, it was found that most authors agreed that the mechanical properties of concrete was improved significantly when basalt fibre of length between 12mm and 24mm, and content between 0.1% - 0.5% by total volume was used in concrete. In this context, the length and content of basalt fibres in concrete becomes an important factor for the mechanical properties of concrete.

***Keywords**: Basalt Fibres, Compressive Strength, Elastic Modulus ,Flexural Strength, Tensile Strength, ,Workability.*

I. INTRODUCTION

Industry is always trying to find new, better and economical material to manufacture new product, which is very beneficial to the industry. Today a significant growth is observed in the manufacture of mixed or composite material. With this in mind energy conservation, corrosion risk, the sustainability and environment are important when a product is changed or new product is manufactured. Basalt fiber is a high performance non-metallic fiber made from basalt rock melted at high temperature at 1450ºC. Basalt rock can make chopped basalt fiber, basalt fabrics and continous basalt thin filament wire. Basalt fiber originates from volcanic magama and volcanoes in earths crust, a very hot fluid or semi fluid material under the earth's crust, solidified when comes in contact with open air. Basalt is a common term used for a variety of volcanic rock, which are gray dark in colour. The molten rock is then emitted through small nozzles to produce continuous filaments of basalt fiber. The basalt fibers do not contain any other additives in a single producing process, which makes additional advantage in cost. Basalt rock fibers have no hazardous reaction with air or water, and are non combustible and explosion proof. When it gets in contact with other chemicals they produce no chemical reaction that may damage health or the surrounding environment. Basalt fiber has good hardness and thermal properties. Basalt fibers have been successfully used for load bearing profiles,cavity wall ties, foundation, slabs on ground concrete.

II. LITERATURE REVIEW

Basalt is mainly defined by its mineral content and texture, and physical descriptions without mineralogical condition may be unreliable in some circumstances. Basalt Fibre is usually grey to black in colour, but rapidly weathers to brown or rust-red due to oxidation of its iron-rich minerals into rust. Although it is usually characterized as "dark", basaltic rocks displays a wide range of shading due to regional geochemical processes in its origin. Due to weathering or high concentrations of plagioclase, some basalt rocks are quite light coloured, superficially resembling rhyolite to untrained eyes. Basalt has a fine-grained mineral texture due to the molten rock cooling too quickly for large mineral crystals to grow, although it is often porphyritic, containing the larger crystals formed prior to the extrusion that brought the magma to the surface, enclosed in a finer-grained matrix.

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Fig No.01 Basalt Fibre Filaments

III. PROPERTIES OF BASALT FIBRE

A. Physical Properties

Color:- It is available in golden brown in color. Diameter:- It is available in different diameter like 5.8 micron. Length:- Available in 6mm,8mm,10mm,12mm etc. Density:- density of basalt fibre is 2.75 g/cm^3. Coefficient of friction:- The coefficient of friction may be between 0.42 to 0.50.

B. Chemical Properties

Basalt fibres are more stable in strong alkalis. Weight loss in boiling water, Alkali and acid is also significantly lower. It owns resistance to UV- Light & biologic and fungal contamination. Are compatible with phenolic resins. Soaking up humidity comes to less.

C. Thermal Properties

With a thermal range of –260 ◦C to 982 ◦C and melt point of 1450◦C as well as low thermal conductivity 0.031 – 0.038w/mk, the basalt fibers are beneficial for fire protection and insulation applications. Basalt fibers are most cost effective than the other high-temperature Materials including E-glass, silica, ceramics, stainless steel preventing rapid overheating and improving brake life. Offer three times the thermal efficiency of asbestos with no Mental and heat hazards. Basalt fiber is the best solution for asbestos replacement. Basalt fiber is incombustible and explosion proof. After exposition less than 400 ◦C the basalt fibers loss on their initial strength, while the E-glass loss more 50%.

D. Mechanical Properties

The specific tenacity (rupture stress to density ratio) of basalt fibers exceeds that of steel, many times. Basalt fibers are non-capillary and non-absorbent (hygroscopic), giving good moisture resistance. Basalt fibres has shot content generally less than 3%.

IV. OBJECTIVES

1. Study the design aspects of the BFRC.
2. Understand the various application involving BFRC.
3. Perform laboratory test that are related to compressive, tensile and flexure by use of basalt fiber in the concrete.

V. TESTING PROGRAMME

A. Compressive Strength

The cube specimen was placed in the machine, of 2000kN capacity. The load was applied at a rate of approximately 140 kg/sq.cm/min until the resistance of the specimen to the increasing load can be sustained.

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Fig No.02 Compressive Testing Machine

B. Flexural Strength

The specimen was placed in the machine in such a manner that the load was applied to the upper layer as cast in the mould, along two lines spaced 13.33cm aside. The axis of the specimen was carefully aligned with the axis of the loading device. The load was applied through two likely similar steel rollers, 38mm in diameter, mounted at the third points of the supporting span that is spaced at 13.33cm centre to centre. The load was applied without shock and increasing continuously at a rate of 180 kg/min until the specimen filed.

C. Splitting Tensile Strength

The cylinder specimen was placed horizontally in the centering with packing skip with wooden strip/or loading pieces carefully positioned along the top and bottom of the plane of loading of the specimen. The load was applied without impact and increased continuously at a nominal rate with in the range 1.2 to 2.4 N/mm2/min until failure the specimen. The maximum load applied was recorded at failure. Appearance of concrete and unused features in the type of failure was also observed.

Fig No.03 Universal Testing Machine

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VI. CONCLUSION

Based on the studies conducted, it would be probably concluded that that the basalt fiber inclusion enhanced the split tensile and flexural strength of concrete. The benefit of using fiber is that it is non-corrosive. Through the SEM analysis, it is confirmed that the rod like structure of basalt fibre observed at the interface of cementitious and aggregate matrix could probably be the reason for the increased split tensile and flexural strength of concrete, as it bridges or connects the weak and strong matrix upon loading. However, the quantitative nature of this benefit is difficult to determine, as it is required to conduct further studies to prove, which is also our future scope of work, as well.

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