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The use of Basalt Fibers to improve the Flexural Strength of Concrete Beam

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Abstract

In present era vast development occurred in the field of concrete technology. Many research scientists and research fallows have been developed numerous techniques to improve the strength & durability parameters of the concrete.

This present research work is mainly focused on one of such method in which Basalt fibers is used to improve the compressive and flexural strength of concrete. It gives the brief information regarding how exactly silica fume affects strength and durability parameters like compressive strength, flexural strength of concrete. Various samples of M30 grade concrete were taken with water cement ratio as 0.5 to show the effect of Basalt fibers additions as 0%, 0.5% and 4% of binder replacement. The results show significant increase in compressive and flexural strength of concrete up to certain percentage of Basalt fibers addition.

Index Terms—*Basalt fiber,compressive strength, flexural strength, durability, concrete.*

1. Introduction

Basalt is a natural material that is found in volcanic rocks. It is mainly used (as crushed rock) in construction, industrial and high way engineering. One can also melt basalt (1300-1700°C) and spin it into fine fibers. [1-3, 5-6, 8]

When used as (continuous) fibers, basalt can reinforce a new range of (plastic and concrete matrix) composites. It can also be used in combination with other reinforcements (e.g. basalt/carbon). [1,3]

Some possible applications of basalt fibers and basalt-based composites are: thermal and sound insulation/protection (e.g. basalt wool, engine insulation), pipes, bars, fittings, fabrics, structural plastics, automotive parts, concrete reinforcement (constructions), insulating plastics and frictional materials. [1-8]

This wide range of possible applications results from its wide range of good properties. Basalt has good thermal, electrical and sound insulating properties. It can replace asbestos in almost all its possible applications (insulation) since the former has three times the latter's heat insulating properties.

Furthermore, the fiber diameter (comparable with E-glass fibers, [5-6]) can be controlled in order to prevent uptake of Harmful ultra-fine fibers. Because of its good electrical insulating properties (10 times better than E-glass, [5]), basalt fibers are also incorporated into printed circuit boards, resulting in superior overall properties compared to conventional components made of fiberglass.

2.Materials and methodology

Basalt Fibers:

Basalt formations in the Ukraine are particularly well suited to fiber processing. Basalt Rock fibers have no toxic reaction with air or water, are non-combustible and explosion proof. When in contact with other chemicals they produce no chemical reactions that may damage health or the environment. It has good hardness and thermal properties, can have various application as construction materials. Basalt is a major replacement to the asbestos, which poses health hazards by damaging respiratory systems. Basalt base composites can replace steel (1 kg of basalt reinforces equals 9.6 kg of steel) as light weight concrete can be get from basalt fibe.

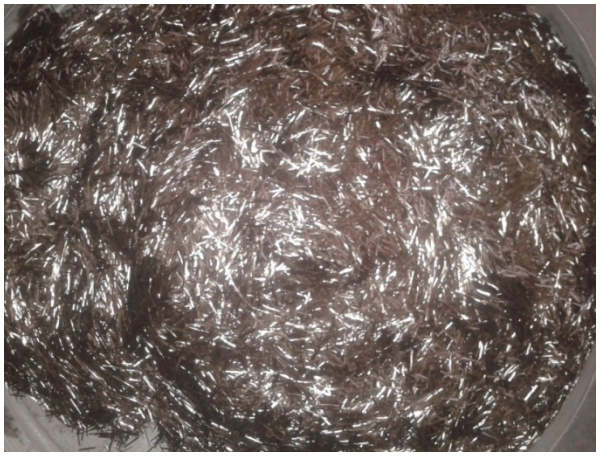

Fig. 1 Basalt Fiber

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2.1 Mechanical Properties of Basalt Fiber

Properties	Unit	Value
Thickness	μ	9-23
Density	gm/cm^3	2.7
Thermal conductivity	W/mk	0.031-0.038
E-modulus	Gpa	90-100
Moisture absorption	%	< 0.1%
Tensile Elongation	Mpa %	3800-4100 4

As it is made of basalt rock is really cheap and has strength, excellent sound and thermal insulator, non-flammable, biologically stable, etc.). It has been made label-free material in the US and Europe. Also, particles or fibrous fragments due to abrasion are too thick to be respir-able but care in handling is recommended.

3. Result and Discussion:

In this present research work 3 (three) mix of concrete incorporating undensified basalt fiber are cast to perform experiments. We carried out twelve castings with varying % of basalt fiber from 0% (Plain concrete), 0.01, and 0.03 up to 1%. The specimens prepared with these varying percent were tested for Compressive Strength (Cubes), Flexural Strength (Beams & Cylinders) after 28 days of curing. The results obtained from these tests are tabulated below also the graphical representation is done.

Table 1: Test Results For 0% (Plain Concrete)

Beam(Size-150x150x700mm)			
Sr. no.	Applied Load KN	Flexural Strength N/mm^2	Avg. Flexural strength N/mm^2
1	16	3.31	3.30
2	17	3.51	
3	15	3.10	

Table 4: Test Results For 0.5% Basalt Fiber

Beam(Size-150x150x700mm)			
Sr. no.	Applied Load KN	Flexural Strength N/mm^2	Avg. Flexural strength N/mm^2
1	24	498	4.98
2	26	5.39	
3	22	4.56	

Table 5:Test Results For 1% Basalt Fiber

Beam(Size-150x150x700mm)			
Sr. no.	Applied Load KN	Flexural Strength N/mm^2	Avg. Flexural strength N/mm^2
1	28	5.80	5.88
2	30	6.23	
3	27	5.60	

Table 6: Test Results For 1.5% Basalt Fiber

Beam(Size-150x150x700mm)			
Sr. no.	Applied Load KN	Flexural Strength N/mm^2	Avg. Flexural strength N/mm^2
1	33	6.84	6.77
2	34	7.05	
3	31	6.43	

Table 7: Test Results For 2% Basalt Fiber

Beam(Size-150x150x700mm)			
Sr. no.	Applied Load KN	Flexural Strength N/mm^2	Avg. Flexural strength N/mm^2
1	36	7.47	7.46
2	35	7.26	
3	37	7.67	

Table 8: Test Results For 2.5% Basalt Fiber

Beam(Size-150x150x700mm)			
Sr. no.	Applied Load KN	Flexural Strength N/mm^2	Avg. Flexural strength N/mm^2
1	45	7.05	6.98
2	42	6.64	
3	39	7.26	

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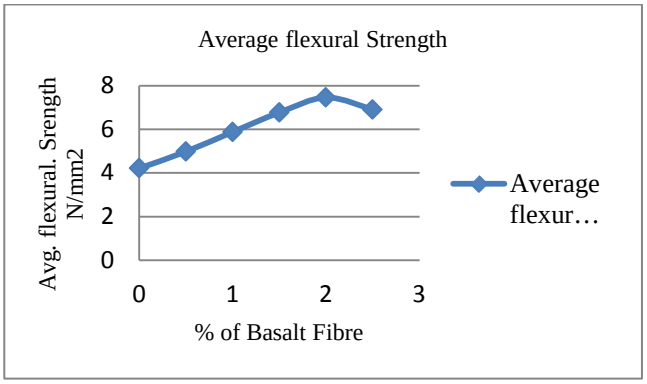

Figure 2: Average flexural strength vs. % of Basalt fiber

4.conclusion

A summary can be drawn from the test results that the workability of concrete significantly reduced as the fiber dosage rate increases. Results In flexural test showed that as the basalt percentage increases up to 0.07% flexural strength of Beams goes on increasing and after that from 0.07% again it goes on decreasing. The usages of fibers were fully utilized when it comes to post-cracking stage, as it increase on ductility and toughness of concrete.

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