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Effect of Basalt Fiber and RHA on Strength of Concrete-A Review

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Abstract: **- In recent years, both industrial and researcher world are giving their attention to the fiber reinforced concrete. There are two types of fiber natural and artificial. Basalt fiber is one of the natural fibers obtained from basalt rock which is easily available and also cheap. Basalt fiber offers various compromising characteristics which help to increase strength of concrete compared to other fibers. From past research it is found that basalt fiber increases strength of concrete effectively. RHA is byproduct of rice mill which act as supper pozzolanic material. This paper includes review on the strength of concrete using basalt fiber and RHA also different properties of it.**

Keyword :- Basalt Fiber, RHA (risk husk ash), Co0mpressive Tensile and Flexural Strength, Properties.

1 INTRODUCTION

1.1 Basalt Fiber

Basalt is naturally available rock obtained from frozen lava, with melting temperature varies from 1500˚C to 1700˚C[2,3]. Russia has huge amount of basalt reserves. In the United States,Washington, Oregon and Idaho have thousands of square miles covered with basalt lava. About 100,000 square miles of Columbia covered withbasalt [5]. The colour of basalt varies from brown to dull green as percentage of ferrous changes. Moscow Research Institute of Glass and Plastics developed the basalt fiber in 1953-1954.The manufacturing process of basalt fiber is same as glass fiber but it consume less energy than other fiber. Cost of basalt fiber is also cheap because it does not require any additives during its manufacturing process. [11].Concrete containing fiber in its composition is known as fiber reinforced concrete. FRC is use in pavement construction because fiber increases impact and fatigue resistances also enhance flexural strength, toughness, tensile strength, ductility and reduce creep and shrinkage. Nowadays BFRC is also use in construction of highway, airport runway etc[3]. It resists corrosion and alkali reaction on concrete, so it is very beneficial for construction industry. Basalt fiber does not show any reaction with air and water. Also there is no any hazard effect on human health [4]. The rapid increase in the use of fibers in concrete is recognizing to its positive result on the mechanical properties of the cementations composites. The addition of fibers to concrete shows considerable impact on improving the mechanical properties of hardened concrete as well as fresh concrete [10]**.**

From past research it was observed that basalt shows stability against chemical and thermal. Basalt shows good thermal insulating property which is three times more than asbestos, while electrical insulation property of basalt is 10 times more than glass fiber [5]. As above mentioned basalt shows resistant to acids and alkali so basalt composite pipes can be used to transport corrosive and gases[5].

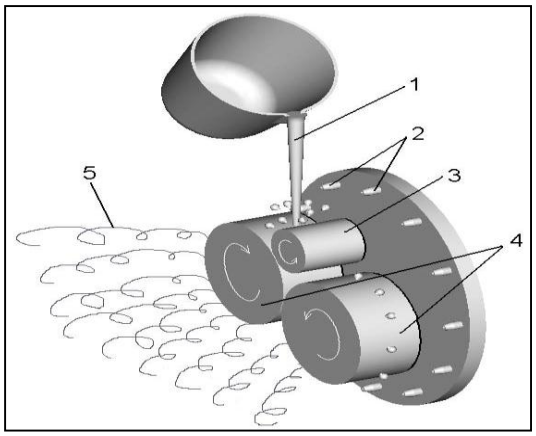

Fig 1 Process diagram of basalt fiber [11]

Junkers type basalt production (1-basalt lava, 2-blowing valves, 3-accelerating cylinder, 4-fabrication cylinder, 5-basalt fibers)

Fig 2: Basal Fiber

1.2 Rice Husk Ash

RHA is a great environmental hazard causing damage to the land and surrounding area which is deserted. Annually nearly about 20 millions of RHA is produced as byproduct from rice husk mills. Due to RHA land damage convert

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into desert where it is dumped. Husk is by-product generates from rice milling. RHA is obtained by proper burning and grinding of rice husk at controlled temperature. It is use as a pozzolanic material in cement and concrete. Its use reduces pollution and emission of carbon dioxide in environment it affects compressive strength, flexural strength, split tensile strength and durability of concrete [7].

Fig 3 Rice Husk Ash

2: PROPERTIES

2.1 Basalt Fiber

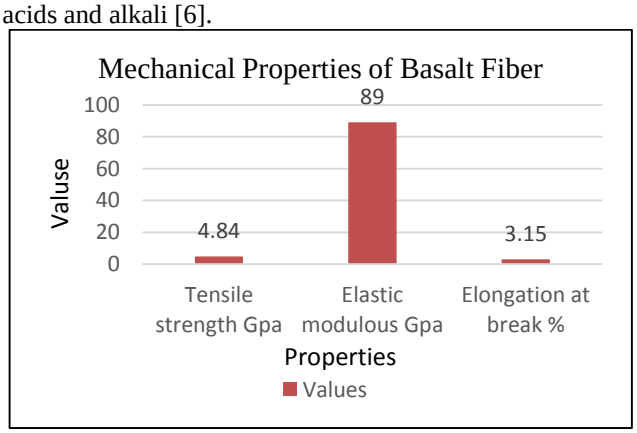
Table 1:Physical properties [6]

Sr No.	Particulars	Properties
1	Colour	Golden Brown
2	Diameter	Available in different diameter 5.8 micron
3	Length	6mm, 8mm,12mm etc
4	Density	2.75g/cm^3
5	Coefficient of friction	0.42-0.50

Table 2: Chemical properties[10]

Sr. No	Oxide	Basalt Fiber
1	SiO_2	69.51
2	Al_2O_3	14.18
3	Fe_2O_3	3.92
4	CaO	5.62
5	MgO	2.41
6	K_2O	1.01
7	Na_2O_3	2.74

In strong alkalis basalt fibers are more stable. Basalt has resistance to UV- Light and biologic and fungal pollution. Basalt fiber does not loss their weight in boiling water, acids and alkali [6].



The modulus of elasticity of basalt fiber is high as observe in fig4. Also basalt fibers are excellent thermal resistance.

According to Sim J et.al.,[12] The approximate value of tensile strength of basalt fiber is 1000 Mpawhich is 60% of strength of high strength of Glass fiber and 30% of the strength of Carbon fiber.

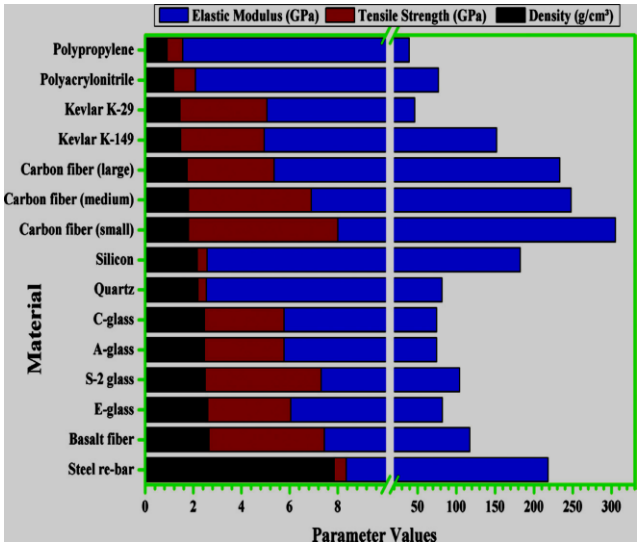


Fig 4 Typical mechanical properties of basalt fiber as compare to other fiber [10].

2.2 Rice Husk Ash

Table 3: Physical properties [9]

Sr. no.	Particulars	Properties
1	Colour	Gray
2	Shape Texture	Irregular
3	Mineralogy	Non crystalline
4	Particle size	<45 micron
5	Odour	Odourless
6	Specific gravity	2.3
7	Appearance	Very fine

Table 4: Chemical Properties [9]

Sr.No	Particulars	Proportion
1	Silicon dioxide	86.94%
2	Aluminum Oxide	0.2%
3	Iron Oxide	0.1%
4	Calcium Oxide	0.3-2.2%
5	Magnesium Oxide	0.2-0.6%
6	Sodium Oxide	0.1-0.8%
7	Potassium Oxide	2.15-2.30%
8	Ignition loss	3.15-4.4%

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Table 5: The strength of basalt fiber with different proportion is shown below as per researches' done.

Sr. No.	Author	Methodology	Basalt Fiber in %	Compressive strength(MPa) 28 days	Split Tensile Strength(MPa) 28 days	Elastic Modulus (GPa)
1	Tehmina Ayub [1]	Experimental	0%	71.87	5.26	40.76
			1%	73.52	5.40	42.01
			2%	74.16	5.524	41.88
			3%	65.08	6.00	42.54
2	Nayan Rathod [6]	Experimental		Comp. strength 28 days (MPa)	Comp. strength when concrete immersed in chemical(MPa)	Flexural strength (MPa)28 days
			1%	42.44	Na2SO4=42.04	3.5
			2%	45.99	HCl=42.24	5.90
				48.14	NaOH=43.25	
3	Gore Ketan [2]	Experimental		Comp. strength(MPa) 14 days	Split Tensile Strength(MPa) 7days	Flexural strength (MPa)7 days
			0%	35.34	2.49	4.56
			1%	34.69	1.36	3.80
4	Gorde Pravin Jaysing [4]	Experimental		Compressive strength in MPa after 28th days	Split tensile Strength in MPa after 28th days	Flexural strength in MPa after 28th days
			0%	49.98	4.565	4.3
			0.25%	63.51	5.700	6.3
			0.5%	56.64	5.640	5.8
			0.75%	47.93	5.205	5.16

5	Arivalagan.S [13]	Experimental	Days Of Curing	M 20 Grade Concrete		M 30 Grade Concrete	
				Normal Concrete (Mpa)	Basalt Concrete (Mpa)	Normal Concrete (Mpa)	Basalt Concrete (Mpa)
			7^{th}	16.02	19.273	22.013	27.35
			14^{th}	18.75	22.335	25.257	35.730
			28^{th}	21.33	27.53	32.875	40.357

TABLE 6: RICE HUSK ASH

SR No.	Author	% RHA	%increase Compressive Strength 7-28 days (MPa)	Flexural Strength 28 days(MPa)
1	Padma Rao [9]	0%	47.23	4.21
		5%	63.21	3.62
		7.5%	57.36	3.84
		10%	58.22	2.75
		12.5%	62.22	2.24
		15%	54.13	2.08
2	M.R. Karim [7]	RHA:OPC W/c=0.53	Comp. strength14 days (MPa)	Comp. strength 28days (MPa)
		00:100	32.3	37.1
		05:90	34.2	40.0
		15:85	36	4108
		20:80	39.3	42.5
		25:75	36.1	38.8
		30:70	33.5	37.6
		35:65	31.1	35.1
3	Makarand Suresh Kulkarni [8]	%RHA	Compressive strength after 7 days	Compressive Strength after 28 days
		0	27.2	37
		10	27.8	42.8
		20	28.3	39.8
		30	27.4	37

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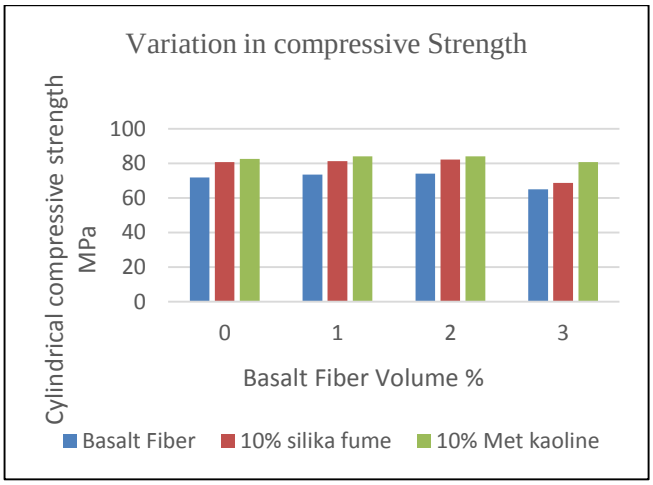
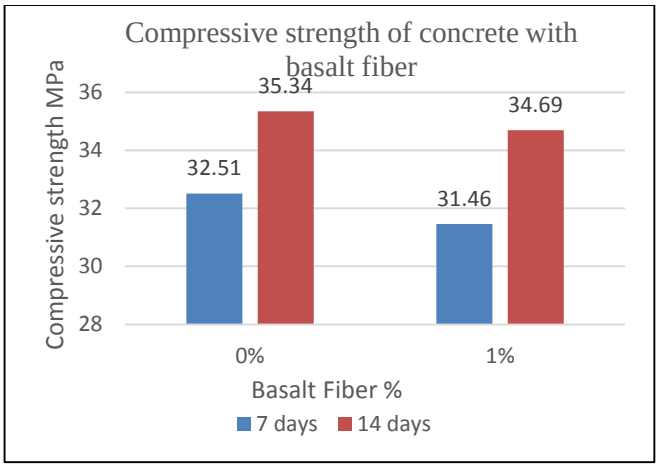
4. RESULTS AND DISCUSSION:

4.1 Compression Strength

The compressive strength of concrete varies with change in % of basalt fiber. Tehmina et.al.,[1] showed that increase in compressive strength observed up to 2% addition of basalt fiber. While addition of 3% of basalt fiber decreases the compressive strength of concrete. She make three series of concrete using different admixtures like silica fume and met kaolin with 1% ,2% , 3% addition of basalt fiber. More effective result found at 2% addition of Basalt fiber with 10% met kaolin as partial replacement of cement.



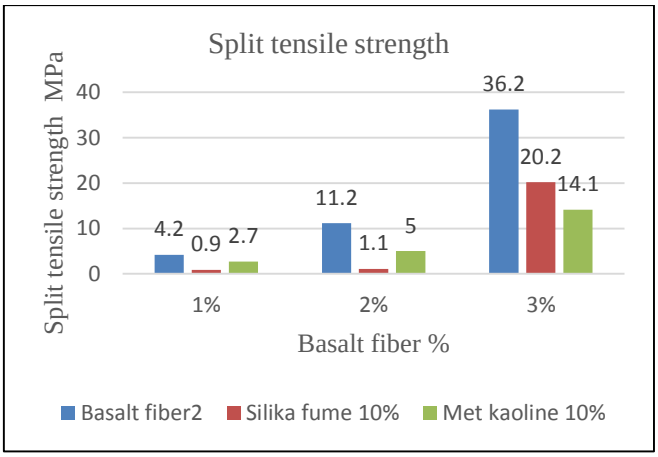
The result shows that Addition of minerals in less amount can increases strength of concrete effectively. Gore et al.,[2] Basalt fiber concrete gains strength after 28 days curing while 7 days and 14 days strength of concrete is less than plain concrete strength. As compare to design strength 83% to 92% increase in compressive strength of basalt fiber concrete mix is observed according to Nayan et al.,[6].



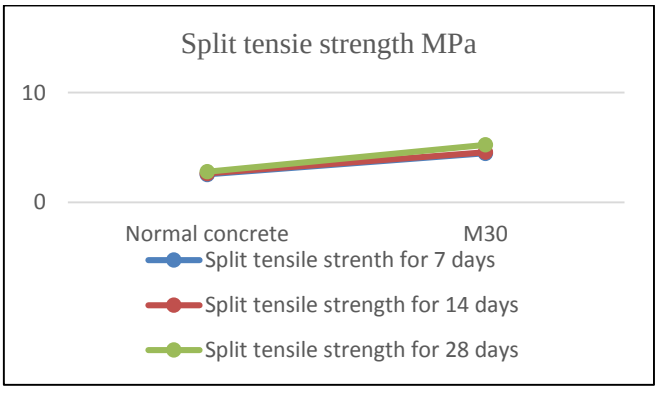
Addition of Rice husk ash in concrete increases compressive strength with high rate during 7 days to 28 days of curing while strength increases gradually after 28 days to 56 days of curing. According to Padma et al.,[9] 5.0% addition of RHA gives effective increase in compressive strength during 7 days to 28 days of curing. According to study of Makrand et al.,[8] 10% addition of RHA in concrete increases compressive strength by 16%, 20% addition of RHA again increases strength by 8% While strength reduces on addition of 30% of RHA.

4.2 Split Tensile Strength:

According to research done byTehmina et al.,[1] addition of 1%, 2% and 3% of basalt fiber increases split tensile strength of concrete.



By Arivalagan et al.,[13] In 7 days of curing Basalt fiber concrete acquire 25% split tensile strength 39% to 45% in 14 days while 47% in 28 days of curing as compare to plain concrete.



The research of Gorde et al.,[4] shows that 0.25% addition of basalt fiber gives highest split tensile strength.

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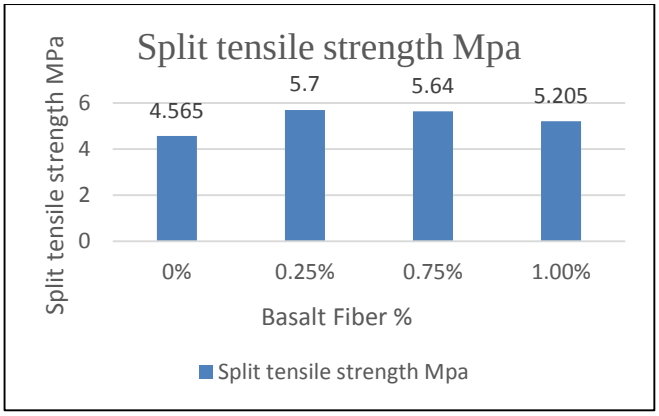
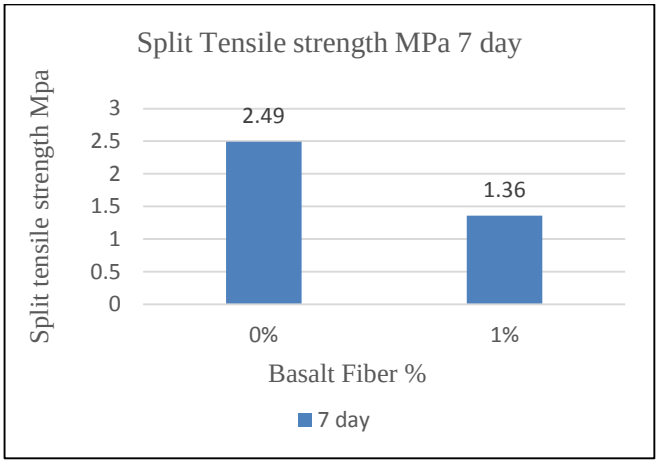


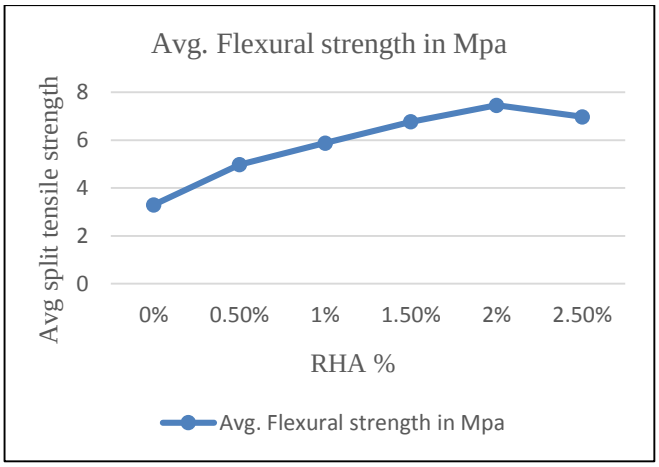
According to Gore et al.,[2] strength of basalt fiber concrete decreases from 7 days to 14 days and then increases. While strength increases after 14 days to 56 days of curing.



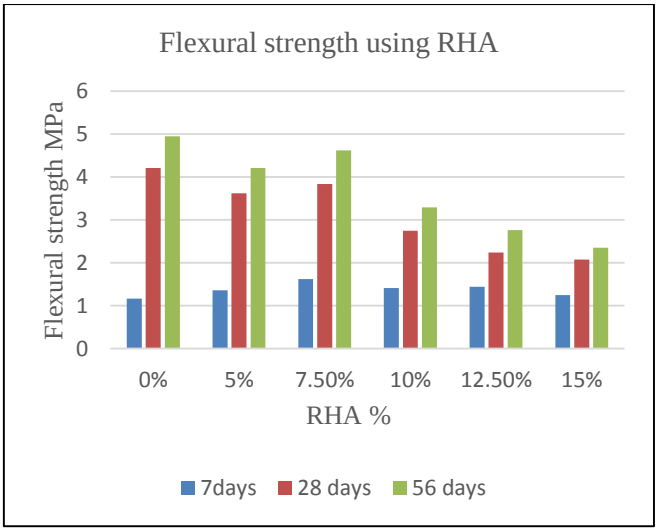
Addition of Rice husk ash shows improvement in split tensile strength up to 20% replacement of cement.

4.3 Flexural Strength:

Joshi et al.,[14] shows that maximum flexural strength obtained at 2% addition of basalt fiber. More than 2% addition of basalt fiber reduces the flexural strength. Following graph shows increment in flexural strength.



Rice husk ash not show effective increase in flexural strength in concrete. Results analyzed by Padma et al.,[9]



5 CONCLUSION

Based on above review conclusion is made as follow:

Basalt fibers is cost effective, environment friendly, non-harmful and natural admixture. It can use in construction of high raise structure, highway and runways, because of its effective mechanical properties and good strength. It shows resistance against acids and alkalis and helps to increase the life of harmful liquid transporting piper. it is anticorrosive so can use in construction of underwater structure.

Optimum compressive strength and flexural strength obtained at 2% addition of Basalt fiber while split tensile reduces. RHA is a pozzolanic material which helps to increase the strength of concrete its use in concrete will helps to reduce the pollution in some amount.

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