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To Check Mechanical Property Of Concrete At Elevated Temperature By Using Chopped Basalt Fibre

Kartik Patel Assistant Professor, Faculty of Engineering, Gokul Global University, Sidhpur, Gujrat kapatelcivileng008@gmail.com

Abstract: Concrete is very strong in compression but very weak in tension. However it is reported that tensile and bending strength of concrete is 10 to 15% of the compressive strength respectively. The addition of chopped basalt fibres in concrete have significantly improves its compressive as well as tensile strength.
In present study the mechanical properties of smart concrete made of chopped basalt fibres were investigated,. The basalt fibre specimens were cast using length 18mm and varying dosae 0.25% ,0.50% and 1% are tested at elevated temperature 350^0C and 500^0C. The result show that with increase temperature, decrease compressive, flexure and split tensile strength upto 10% when temperature is nearest 500^0 c.
The result also show that up to 350^0 C concrete remain almost unaffected in appearance and strength but at temperature reach up to 500^0 C quality of concrete suffer slightly and strength to came down.

Keywords: chopped basalt fibre ,flexure strength, elevated temperature.

1.Introduction

Concrete has through the last hundred years established itself as one of the major building materials. The combination of excellent compressive strength, durability and readily available and affordable subcomponents has made concrete a highly demanded construction material and the backbone of our society's infrastructure. Concrete is the essential foundation and building block for strong, reliable and durable infrastructure.

Through the course of concrete history and development, the purpose has always been to improve the performance of concrete structures. It is known that Egyptians were using early forms of concrete in around 3000 BC to build pyramids . The ancient Romans made many developments in concrete technology, including the use of pozzolan (1). And since Joseph Aspdin invented the modern Portland cement in 1824 (2), the further development in concrete technology began to flourish, including the discovery of steel reinforced concrete and the use of admixtures and additives.

Since the 1950s, the overall development of concrete technology has improved a lot. New

techniques and methods in different aspects have contributed to develop concrete with better
performance and properties, and this has kept concrete a competitive material. Also the demands from our societies, such as more durable concrete, more environmental-friendly concrete and creating pleasing, artistic and creative structures, have played a major part in this development. And to further keep concrete a competitive material, research and further development of concrete are Important.

One of the goals of any building project is to minimize the construction costs. Löfgren found that roughly 40 % of total construction costs for a concrete building can be related to labor costs, and about 22 % of labor costs can be related to the reinforcement work. The current recession in economy in a lot of countries is an additional motivation to reduce the total costs and it is forcing the construction industry to find new ways to reach that goal. Through research done within concrete technology over the years, there are material technologies available that have the potential to significantly reduce the total operational costs. Examples of such materials are self-compacting concrete (SCC) and fiber-reinforced concrete (FRC). These materials will reduce some of the labor activities at the construction site, such as reinforcing and casting and finishing of concrete. FRC is the better performance and quality achieved in the concrete by the use of these materials. As an example, fibers in combination with self-compacting concrete has shown to achieve much higher load bearing capacity than corresponding construction elements in conventional vibrated concrete.

Fibers are added to enhance the ductility, increase the tensile and flexural strength of the material and to decrease crack widths and retard their propagation. Comprehensive research over the years on fibers has shown that fiber reinforcement has actually sufficient strength and ductility to be used as a complete replacement to conventional reinforcement in some types of concrete structures, such as foundations, walls and slabs on grades. In beams and suspended slabs, fibers are used in combination with conventional reinforcement which increase both the load bearing capacity and the stiffness of the structure. In both cases, from a structural viewpoint, fibers are incorporated to improve the fracture characteristics and structural behavior through the fibers' ability to bridge cracks.

In recent years, the technology has reached a level which makes it possible for fibers to completely replace conventional steel reinforcement in load carrying structures if the fibers are oriented and distributed as expected. However, for now, a more comprehensive study and research in this field is necessary to develop an all-round pure fiber-reinforced concrete which can be applied in load carrying structures. This will also help develop standardized guidelines for fiber-reinforced composites

2. Experimental Programme

An extensive experimental Programme involving the various processes of material testing, mix proportioning, mixing, casting and curing of test specimens were done. The forthcoming sections elaborate the various physical and chemical properties of each material separately.

A. Materials Used

The material used in the preparation of concrete mixes includes cement, fine aggregates, coarse aggregates, basalt chopped fibres and admixtures. Each material was tested &its physical properties are described below.

1.Cement: Ordinary Portland cement of 43 grade were used, conforming to recommendations stated in IS 4031(1999). OPC manufactured from ultratech cement plant was used throughout the experimental work. The physical properties of OPC are tabulated in Table 1.

2.Fine Aggregate: Locally available Jhansi sand was used as fine aggregate. The test procedures as mentioned in IS-383(1970) were followed to determine the physical properties of fine aggregate.

3.Coarse Aggregate: Two single sized stone grit ranging from 20 mm to 4.75 mm and 40 mm to 4.75 mm (12.5mm and 20mm sizes) were used in respective proportions in concrete mixes. The aggregates were tested in accordance to IS-2386 (Part I, III & IV).

4.**Basalt Fibre:** Basalt chopped fibre golden brown color was used in the concrete mixes. The density of the fibre is 2.75 kg/m3 and is available in the length of 6 mm to 20mm. The specifications of these fibres are presented in Table 1.1 and Table 1.2

5. **Admixtures:** In order to make the concrete mixes workable Conplast SP 430 G admixture was used. The addition of fibres reduces the workability; therefore in order to make it use for practical purposes admixtures in appropriate quantity was added to the mix.

6. **Water:** As per recommendation of IS: 456 (2000), the water to be used for mixing and curing of concrete should be free from deleterious materials. Therefore potable water was used in the present study in all operations demanding control over water quality.

Table1.1 (physical property)

Property	Value
Tensile strength	3.84 Gpa
Elastic modulus	89 Gpa
Elongation at break	3.15 %
Density	2.7 g/cm3

Table 1.2(chemical property)

Oxide	value
Sio2	69.51
Al2O3	14.18
Fe2O3	3.92
CaO	5.62
MgO	2.14
K2O	1.04
NA2O3	2.74

3.Test Proggrame.

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, was shown in Figure 1. The test results are presented in Table 3 for different elevated temperature.

Fig.1

Fig.2

Fig.3

Figure 4

B. Flexural Strength:

The specimen was placed in the machine in such a manner that the load was applied to the Upper most surface as cast in the mould, along two lines spaced 13.33cm apart. The axis of the specimen was carefully aligned with the axis of the loading device. The load was applied through two 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 with out shock and increasing continuously at a rate of 180 kg/min until the specimen filed..The failure pattern has been presented in Figure 2. The test results are presented in Table 3 & 4 for different elevated temperature 350^0 C And 500^0C.

C.Splitting Tensile Strength:

The cylinder specimen was placed horizontally in the centering with packing skip (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 shock and increased continuously at a nominal rate with in the range 1.2 N/mm2/min 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 are shown in Figure 3.The test results are presented in Table 3 and 4 for different elevated temperature temperature 350^0 C And 500^0C.

Volume by %	Compressive strength (Mpa)			Split tensile strength (Mpa)	Flexural strength(MPA)
Mix	7 days	14 days	28 days	28 days	28 days

0%	29.5	32.34	38.7	3.66	4.28
0.25%	33.08	38.53	44.55	4.58	5.28
0.50%	34.17	41.25	51.11	5.67	5.39
1%	31.46	34.70	39.28	2.37	4.65

Table 3: Compressive, split tensile and flexural strength of M40 Grade of concrete with Temperature 350^0 C

Volume by %	Compressive strength (Mpa)			Split tensile strength (Mpa)	Flexural strength(MPA)
Mix	7 days	14 days	28 days	28 days	28 days
0%	26.25	28.45	33.67	3.49	4.37
0.25%	36.98	31.92	36.34	3.64	4.92
0.50%	34.3	40.42	50.08	5.21	5.13
1%	31.46	34.27	39.11	4.21	3.80

Table 4: Compressive, split tensile and flexural strength of M40 Grade of concrete with Temperature 500^0 C

Effect of percentage of fibers on compressive strength of concrete

The result shows that the compressive strength of concrete mixes increases with the addition of fibers. Inclusion of 0.25% of basalt fibres to concrete mix increases the strength to 4.78% & 7.69% for 7 & 28 days. Similarly a higher increase in strength was observed for 1%addition of fibers by weight of cement i.e 46% increase in strength was obtained for 7 & 28 days respectively. This shows that as we go for higher increases in percentage of fibers the strength increases rapidly. Fig. 5 and 6 clearly shows the increase in strength for different percentage of basalt fibres in concrete.

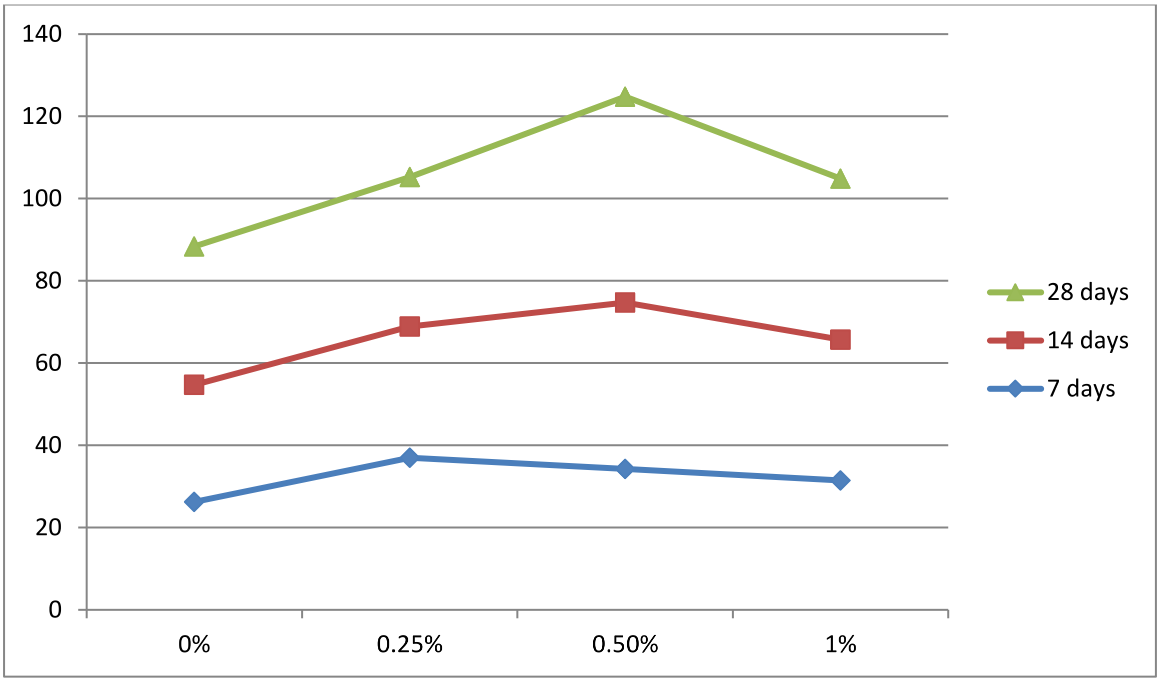

Figure 5 compressive strength upto 500º C Temperature.

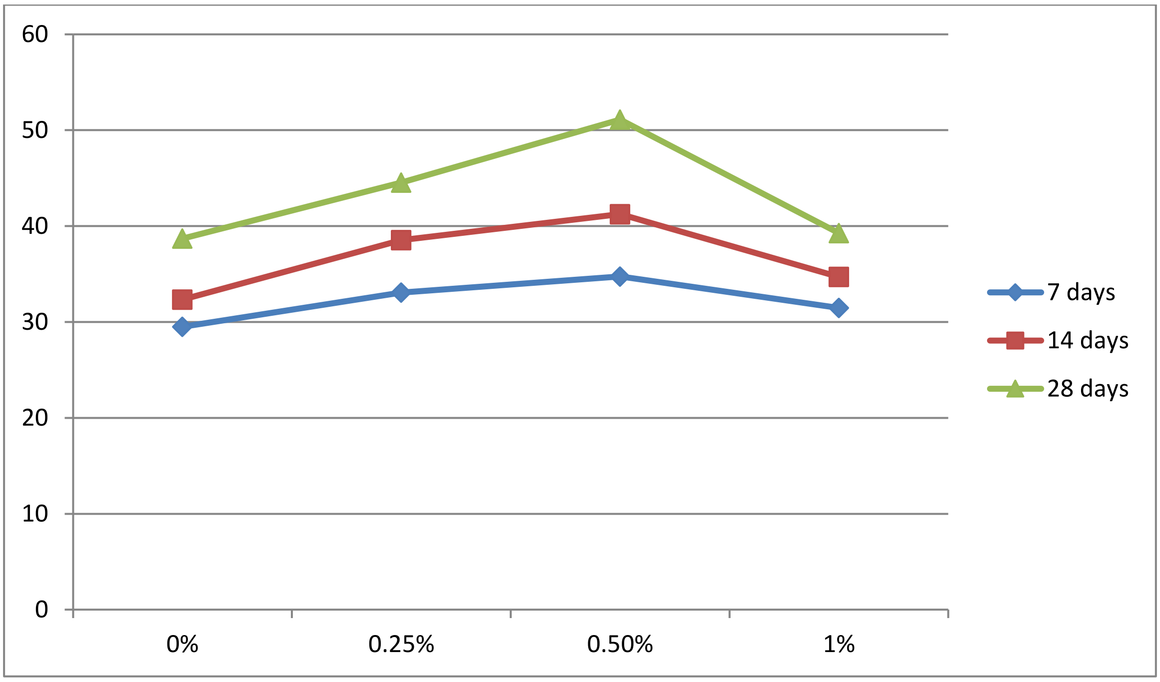

Figure 6 compressive strength upto 350º C

C. Effect of percentage of fibers on flexural strength of concrete A remarkable increase in flexural strength was obtained on addition of basalt fibres to the concrete mixes. Addition of 0.25% basalt fiber increases the flexural strength to 29.2% for 7 days and 36.70% for 28 days. Further addition of 1.0% of fibers, the average increase in strength is reported as 74.8% for 7 days & 63.9% for 28 days respectively.

Conclusion

- Based on this research it was found 0ut that use 0f certain amount basalt fibre in concrete result in increase compressive strength , increase in splitting tensile strength also increase flexural strength.
- Workability is reduced when higher amount 0f fibre is used.
- Effect of elevated temperature also studied up to 350 c concrete remain almost unaffected in appearance and strength Effect. But when temperature reach upt0 500 C Quality 0f Concrete Suffer Slightly and strength t0 Come down
- At temperature upto 500^{o} C compressive strength decrease upto 11% but when higher amount of fibre are used this effect is reduced.

References

[1] Y. Zhou, Z. Fan, J. Du, L. Sui, F. Xing, Bond behavior of FRP-to-concrete interface under sulfate attack: an experimental study and modeling of bond degradation, Constr. Build. Mater. 85 (2015) 9–21.
[2] R.A. Hawileh, A. Abu-Obeidah, J.A. Abdalla, A. Al-Tamimi, Temperature effect on the mechanical properties of carbon, glass and carbon–glass FRP laminates, Constr. Build. Mater. 75 (2015) 342–348.
[3] R. Realfonzo, E. Martinelli, A. Napoli, B. Nunziata, Experimental investigation of the mechanical connection between FRP laminates and concrete, Compos. B Eng. 45 (1) (2013) 341–355.
[4] P. Wong, Y. Wang, An experimental study of pultruded glass fibre reinforced plastics channel columns at elevated temperatures, Compos. Struct. 81