International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 02 | Feb 2020 www.irjet.net p-ISSN: 2395-0072

A STUDY ON STRENGTH PROPERTIES OF BASALT FIBRE REINFORCED CONCRETE WITH FILLER MATERIALS AND RECYCLED AGGREGATE – A REVIEW

V. Sindhu[1], Dr. K. Ramadevi[2] and S. Parkavi[3]

[1]P.G Scholar, M.E. Structural Engineering, Kumaraguru College of Technology, Coimbatore,
[2]Professor, Civil Engineering Department, Kumaraguru College of Technology, Coimbatore
[3]P.G Scholar, M.E. Structural Engineering, Kumaraguru College of Technology, Coimbatore.

Abstract - *In the construction industry world, use of alternative sources as construction materials is recent trend which can substitute the virgin materials in order to reduce environmental influence such as pollution, energy consumption, global warming, waste disposal etc. Thus, recycled concrete aggregate (RCA) from construction and demolition waste plays an important role to preserve natural resources is growing interest in the construction industry as it reduces the demand for virgin aggregate. The use of concrete deficiencies to certain extent like brittleness, poor tensile strength and poor resistance to impact strength, fatigue, low ductility and low durability is found common in concrete structures. To overcome this admixture and fibres like Basalt, carbon and glass fibres are introduced in concrete. This review paper presents a comprehensive review on the use of fibre reinforced concrete with filler materials such as Alccofine, fly ash and RCA in concrete based on the experimental data of research findings over the past few years regarding the material aspects. The most important physical, mechanical, and chemical properties are discussed in this paper.*

***Key Words*: Basalt fibre, Alccofine, Fly ash, Recycled concrete aggregate (RCA).**

1. INTRODUCTION

In this industrial world, huge quantities of construction and demolition wastes are generated every year in developing countries like India, China, Indonesia, Malaysia, Thailand, Gulf states, Russia, Brazil, Turkey. As per the data available it is 2.2 Billion tons every year throughout the world and in India it is 12 Million tons per annum. The disposal of this waste is a very serious problem because it requires huge space for its disposal, when it is dumped in open spaces within in layouts it spoils the health of the citizens and also punishable in some of the countries.

So, recycling construction material plays an important role to preserve natural resources. These studies seek to greener environment by replacing recycled concrete aggregate partially and totally in concrete from construction and demolition waste. Concrete is one of the most extensively used material in world and cement is major ingredient of it .One ton cement production cause emission of one ton of CO2 gas which is harmful to environment.so various materials are using as a replacement of cement such as Fly ash, Ground granulated blast furnace slag, Ground glass natural pozzolans, Silica fume, Alccofine, Quartz powder, Lime powder, etc. In this research work Alccofine and fly ash is used as the replacement of Cementous material. Fly ash is a pozzolan cementitious material, a substance containing aluminous and siliceous material that forms cement in the occurrence of water. When used in concrete blends, fly ash recovers the strength and segregation of the concrete. Alccofine is a new group Supplement Cementitious Material (SCM) with a built-in high-tech content which can be used as cement replacement. Alccofine is approved by Green Building Certification Agency-LEED. There are two types of Alccofine. Alccofine 1203 has good workability even up to 70% replacement level as per requirement of concrete performance and reduces water demand. It contains low calcium silicate. Alccofine 1101 is used as a micro finer cementitious grouting material for soil stabilization and rock anchoring it contains high calcium silicate.

But the use of concrete deficiencies to certain extent like brittleness, poor tensile strength and poor resistance to impact strength, fatigue, low ductility and low durability. Concrete is good in compression stresses and weak in withstanding tensile stresses, so to overcome this, fibres are introduced in concrete. Fibres also enhance strength and durability. In this work Basalt Fibres are usually used in concrete to control cracking due to plastic shrinkage and to drying shrinkage. Basalt fibre made from basalt rock melted at high temperature it is a high-performance non-metallic fibre. It offers more characteristics such as light weight, good fire resistance and strength and in upcoming generation it is very beneficial for construction industry.

Fig -1: Basalt fibre

2. LITERATURE REVIEW

A detailed review of literature has been done in order to assess and evaluate the earlier works done on the strength properties of basalt fibre reinforced concrete with filler materials and recycled aggregate. Literature based on the physical, mechanical, and chemical properties of concrete. From the detailed literature review, inference is studied.

1. R. Kamala et al. (2012) have studied the literature review on Reuse of Solid Waste from Building Demolition for the Replacement of Natural Aggregates. In this paper, the crushed tile aggregate has been used as partial replacement of convectional coarse aggregate in concrete making of cubes, cylinders, beams. Specimens were casted and tested for compressive strength, split tensile and flexural strength after a curing period of 7, 28, 56 days. But it is observed that the strength decreases from 50% replacement of coarse aggregate. The results show the effectiveness of crushed ceramic waste as partial replacement of conventional coarse aggregate up to 40 percent, without affecting the design strength.

2. Mohd Monish et al. (2013) have investigated on Demolished waste as coarse aggregate in concrete. The effect of partial replacement of coarse aggregate by demolished waste on workability and compressive strength of recycled concrete for the study at 7 and 28 days using experimental study. Three specimens each having 0%, 10%, 20%, and 30% demolished waste as coarse aggregate replacement for mix were cast and tested in order to have a comparative study. From this study, test results showed that the compressive strength of recycled concrete up to 30% replacement of coarse aggregate by demolished waste at the end of 28 days have been found to closer strength to the conventional concrete.

3. K. Ramadevi et al. (2017) have examined on Experimental study on strength properties of concrete with different aspect ratios of basalt fibre. In this paper, an attempt to predict the impact of basalt fibre in the design strength of M40 grade concrete. The concrete specimens are cast and tested for three different length of basalt fibre such as 16 mm, 19 mm and 24 mm are used for the fibre content of 1%, 2% and 3% to the volume of the concrete. From experimentally study, the variation of mechanical properties with the fibre length and optimum dosage of fibre content is found out. Finally result shows that using of higher fibre length increases in compressive strength, split tensile strength and flexural strength compared to plain concrete control specimen.

4. Patil Dinanjali et al. (2017) have investigated on Performance Evaluation of Basalt Fibre Concrete. The Experimental investigation on basalt concrete has been carried out to evaluate properties of basalt fibre concrete. The testing carried out on 24 concrete cubes for compressive strength, 12 numbers of cylinders was tested for split tensile test and 4 numbers of beams was teste for various percentage of fibre like 0, 0.25%, 0.50%, and 0.75%. Testing after 28 days average compressive, flexural, split tensile strength is maximum when 2% fibre is used. About 20% to 30% increase in strength is observed. From this study, it is concluded that use Basalt fibre in concrete is an effective technique to enhance performance of concrete.

5. Kiran Rayanagouda Police Patil et al.(2019) have evaluated on Experimental study on strength properties of concrete with partial replacement of cement by Alccofine & replace fine aggregate by m sand. From this study, strength properties of concrete by replacing cement by Alccofine partially. Different percentage of 5%, 10%, 15%. and 20% of Alccofine by volume of cement. The mechanical properties studied here are compressive strength on concrete cubes at 7 & 28 days of curing and flexural strength on beams at 7 & 28 days of water curing. It is observed from the result that the Alccofine material increases the strength to a large extent at 20% replacement level of cement and there is no reduction in mechanical strength properties by substituting river sand by m sand.

6. Swar Shah et al.(2018) have investigated on Strength and Durability study on Concrete with Alccofine as Cement Replacement. In this study, 20% cement replacement by Alccofine1203 Concrete of M30 Grade is prepared and compressive strength and flexural strength is measured. High Strength Concrete M60, M70, M80 is prepared with 5% cement replacement by Alccofine1203 addition to the M30 grade of concrete and compressive, flexural, split tensile strength is tested. From the experimental Work shows that Replacement of Cement by Alccofine is giving acceptable results. Hence the observed result shows that Alccofine is proper material which can use as partial replacement of cement.

7. Biseena M Kareem et al.(2019) have observed on Effect of Alccofine on Glass Fibre Reinforced Self Compacting Concrete. In this thesis discussed about the effect of Alccofine on the glass fibre reinforced self-compacting

concrete. Various percentages of cement are replaced by Alccofine in the glass fibre reinforced self-compacting concrete. Evaluated the fresh and strength properties and it is comparing with the normal glass fibre reinforced self-compacting concrete. Addition of Alccofine to the glass fibre reinforced self-compacting concrete enhances its strength properties. Thus, the percentage level of Alccofine is increased more than 10 %, it acts as a filler material only and the strength gradually decreases by increasing the percentage of Alccofine.

8. Malvika Gautam et al.(2017) have investigated on Effect of Alccofine on strength characteristics of Concrete of different grades-A Review. From the experimental study the result of Alccofine material increases the mechanical strength (both in compression and in flexure) to a large level at nearly 10% replacement level of cement have been observed. It is concluded that the 7 days compressive strength when compared between control mix and cement replaced by 10 % Alccofine an increase in strength is observed. Thus, the result shoes that percentage level of Alccofine is increased beyond that level it acts as a filler material and yields good workability to the concrete.

9. K.Sathes Kumar et al. (2017) have examined on Strength and Analysis of Basalt Fibre in Concrete. In this study, mechanical strength such as compressive strength and flexural strength of M25 grade of concrete with basalt fibre and without basalt fibre are conducted to observe the strength .This paper provides data of fibre reinforced concrete containing fibres of 12mm length of various percentage such as 0.5%, 1%, 1.5%, 2% by weight of cement. Thus, strength increased for 0.5 and 1% and gradually decreased for the further percentages.

10. Fathima Irine I.A (2014) have studied on Strength Aspects of Basalt Fibre Reinforced Concrete. The aim of this paper is to investigate and compare the mechanical strength of basalt fibre reinforced concrete with plain M30 grade concrete. The cube, beam and cylindrical specimens have been casted with basalt fibre reinforced concrete containing 1kg/m3, 2kg/m3 and 4kg/m3 basalt fibre. The observed result shows that the failure pattern of the specimens and the formation of cracks is more in the case of concrete without fibres than the basalt fibre reinforced concrete. It is concluded that the presence of fibres in the concrete acts as the crack arrestors.

11. Abitha A. M et al.(2017) have evaluated on Properties of Concrete Incorporating Fly Ash and Basalt Fibre. In this study, performance of concrete with the addition of 0.1%, 0.15%, 0.3% and 0.45% chopped basalt fibre along with partial replacement of cement with 35% fly ash is consulted in the study. The experimental study specifies a lesser strength for fly ash concrete at the initial stage with an increasing trend at the future stage. The inclusion of basalt fibre accelerates the strength gain compensating the decrease in initial strength. In basalt fibre reinforced concrete, the failure pattern shows good bonding and crack resistance property of the fibre. Thus, the result concluded that combination of the two materials can create positive impacts in the construction industry.

12. Krishan Pareek (2019) have investigated on Effect of Recycled Aggregate on Mechanical and Durability Properties of Concrete . In this paper, an attempt is made to cumulate the various certainty and properties of cement with recycling waste. we observe that mechanical properties of concrete with recycled aggregate are slightly have lower strength to normal concrete. The mechanical properties like compressive strength, split tensile strength, flexural strength can be improved by using additives such as micro silica, GGBS & fly ash left subsequently burning coal and through appropriate surface treatment of RA and by using different mixing method such as dry mixing method. Finally, from the study it can be said that RA obtained from C & D waste must be considered as a sustainable material which is not only economic but environmentally friendly also.

13. Akshaykumar Moogi et al.(2018) have examined on an experimental investigation on strength and durability characteristics of basalt fibre reinforced concrete produced by partially replacing cement with fly ash and GGB. In this experiment effect of fibres and supplementary materials on the strength of concrete for M30 grade have been studied by keeping the constant percentage of basalt fibres and replacing 30% of the cement content by GGBS and fly ash in concrete. In this experiment 1.5% of total dosage of fibre content was fixed with Supplementary materials Fly ash GGBS in varying percentages i.e. 0%FA-GGBS, 100%FA-GGBS, 25%FA-75%GGBS, 50%FA-50%GGBS and 75%FA25%GGBS of total dosage (i.e.30%) by weight of cement. In this experiment it is also aimed to study the effect BFRC when subjected to sulphate attack. Results are taken after 90 days curing and 90 days of sulphate attack. The optimum supplementary material content while studying the strength parameters of all specimens is found 100%FA-0%GGBS." Hence 50%FA-50%GGBS is considered to be optimum for M30 mix.

14. Rooba Chakravarthy et al. (2016) have investigated on Mechanical Properties of High-Volume Fly Ash Concrete Reinforced with Hybrid Fibres, Previous research efforts seem to have utilized a single type of fibre or two types of fibres. In this research work, three types of fibres such as steel, polypropylene, and basalt of varying percentage 0%, 0.50%, 0.75%, and 1% by volume of concrete, were mixed in varying proportions with concrete specimens substituted with 50% flash. Thus, the test results show the significant improvement in strength properties could be attained by a particular hybrid fibre reinforcement combination. when the fibre combination exceeded 3% then workability of concrete was affected. Thus, a limiting value for adding fibres and the combination achieve maximum strengths have been identified in this research.

15. T. Parthiban et al. (2017) have studied on Durability of Concrete by Adding Basalt Fibre. Basalt fibres have no poisonous reaction with air or water and are non-combustible and explosion proof. In this study, concrete with basalt fibre of

varying percentage of 0%.1%,2% are conducted to show the difference in durability limits. Rapid Chloride penetration, Water permeability Test, Sorptivity test were led for the concrete mix. The test results show that concrete with basalt fibre have better durability limits then the nominal design strength concrete. Finally, we found that durability parameter holds good when 1% of basalt fibre is replaced with cement weight.

3. CONCLUSIONS

From the detailed literature review, the points inferred are as under,

- Increase in fibre length gain more strength than the normal concrete.
- The properties of concrete got increased, while adding more than 10 % of Alccofine and the strength gradually decreases by increasing the percentage of Alccofine.
- The strength of concrete increased for 0.5 and 1% addition of basalt fibre and gradually decreased for the further percentages.
- Recycled aggregate obtained from C & D waste must be considered as a sustainable material which is not only economic but environmentally friendly also.
- The presence of fibers in the concrete acts as the crack arrestors.

REFERENCES

[1] R. Kamala and B. Krishna Rao," Reuse of Solid Waste from Building Demolition for the Replacement of Natural Aggregates", International Journal of Engineering and Advanced Technology (IJEAT), ISSN: 2249 – 8958, Volume-2, Issue-1, October 2012, pp 74-76.

[2] Mohd Monish and Vikas Srivastava et al.," Demolished waste as coarse aggregate in concrete", J. Acad. Indus. Research (JAIR), ISSN: 2278-5213, Vol. 1(9), February 2013, pp 540-542.

[3] K. Ramadevi and Dr. R. Chithra et al.," Experimental study on strength properties of concrete with different aspect ratios of basalt fibre", International Journal of Civil Engineering and Technology (IJCIET), ISSN Print: 0976-6308, ISSN Online: 0976-6316, Volume 8, Issue 9, September 2017, pp. 629–637.

[4] Patil Dinanjali and Ogale Ramesh," , Performance Evaluation of Basalt Fiber Concrete", International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395-0056, p-ISSN: 2395-0072, Volume: 04 ,Issue: 11, November 2017, pp 1105- 1107.

[5] Kiran Rayanagouda Police Patil and Dr. Anila Kumar C P," Experimental study on strength properties of concrete with partial replacement of cement by Alccofine & replace fine aggregate by m sand", International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395-0056, p-ISSN: 2395-0072 , Volume: 06 Issue: 07, July 2019, pp 1171-1175.

[6] Swar Shah and Alka Tomar," Strength and Durability study on Concrete with Alccofine as Cement Replacement", International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET),Print ISSN: 2395-1990, Online ISSN : 2394-4099 Volume 4 ,Issue 4 , March 2018, pp 1437-1441, April 2018.

[7] Biseena M Kareem and Shaji M Jamal," Effect of Alccofine on Glass Fiber Reinforced Self Compacting Concrete", International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395-0056, p-ISSN: 2395-0072, Volume: 06 , Issue: 05 , May 2019, pp 5691-5693.

[8] Malvika Gautam and Dr. Hemant Sood," Effect of Alccofine on strength characteristics of Concrete of different grades-A Review", International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395 -0056 , p-ISSN: 2395-0072 , Volume: 04 , Issue: 05 , May 2017, pp 2854-2857.

[9] K.Sathes Kumar and K.Tamilarasan et al.," Strength and Analysis of Basalt Fibre in Concrete", International Journal of Chem Tech Research, ISSN: 0974-4290, ISSN(Online):2455-9555, Vol. 10, No.8, pp 376-381, 2017.

[10] Fathima Irine I .A," Strength Aspects of Basalt Fiber Reinforced Concrete", International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163 ,Volume 1, Issue 8, pp 192-198, September 2014.

[11] Abitha A. M and Liji Anna Mathew," Properties of Concrete Incorporating Fly Ash and Basalt Fibre", International Journal of Science Technology & Engineering (IJSTE), ISSN (online): 2349-784X ,Volume 3 , Issue 12 , pp 115-120, June 2017 .

[12] Krishan Pareek," Effect of Recycled Aggregate on Mechanical and Durability Properties of Concrete", International Journal of Structural and Civil Engineering Research ,Vol. 8, No. 2, pp 119-125, May 2019.

[13] Akshaykumar Moogi and Swapnil Cholekar,"An Experimental Investigation on Strength And Durability Characteristics of Basalt Fiber Reinforced Concrete Produced By Partially Replacing Cement With Fly Ash And GGBS", International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395-0056, Volume: 05 ,Issue: 08 , Aug 2018, pp 94-98.

[14] RoobanChakravarthy and SrikanthVenkatesan,"Mechanical Properties of High Volume Fly Ash Concrete Reinforced with Hybrid Fibers", Hindawi Publishing Corporation Volume 2016, Article ID 1638419 , 7 pages, November 2016.

[15] T. Parthiban and G. Pavithra et al.," DURABILITY OF CONCRETE BY ADDING BASALT FIBRE", International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395 -0056, p-ISSN: 2395-0072, Volume: 0, Issue: 09, September 2017, pp 1491-21494.