GREEN CONCRETE WITH BASALT FIBER AND COPPER SLAG: A REVIEW

Suman S. Patel[1], Dr. Jayeshkumar R. Pitroda[2], Prof. Amit D. Raval[3]

[1]Final year M. Tech. Student, Construction Engineering &Management, Civil Engineering Department, BVM Engineering College Vallabh Vidyanagar, Gujarat

[2]Associate Professor, PG Coordinator Construction Engineering and Management, Civil Engineering Department, BVM Engineering College, Vallabh Vidyanagar, Gujarat

[3]Assistant Professor, Department of Civil Engineering, B & B Institute of Technology, Vallabh Vidyanagar, Gujarat

Abstract : In the current field, infrastructure development holds the key for the growth of every nation. Concrete is one of the most utilized material by the construction industry which is a uniform material prepared of varied materials like sand ,Cement, &aggregate. Though rapid urbanization have created a vast insist for natural sand hence made it even more costly. This lead researchers to find other materials which could be use as a alternate of sand whose main chemical composition is Silica Researchers found that materials like Copper Slag, Coal Fly Ash , Carbonate & Sand Stone dust etc. having silica composition could be used as a replacement of fine aggregate. In recent years, the concrete construction industry has seen a growing interest in the advantages offered by fiber reinforcement. Different types of fibers available, basalt fiber is measured as a new material equipped for use It has an extremely good personality and high resistance to the thermal resistance of an alkaline environment and is a low price product, which makes it an excellent material for reinforced concrete Considering the implications of basalt fibers for concrete and because different lengths and volumes of basalt fibers have a result in the mechanical properties of concrete, it is proposed to review the effect of using different basalt fiber lengths The mechanical properties of the revised concrete are the tensile strength, compressive strength, flexural strength, workability, mass, permeability unit. This paper reviewed on utilization of Basalt Fiber and Copper Slag in Green Concrete.

Keywords: Green Concrete, Basalt Fiber, Copper Slag, Environment

I. INTRODUCTION

In this modern world, civil engineering constructions include their own structural and durability requirements. For meet this requirement of structural integrity for every structure, modification in the traditional cement concrete has become mandatory. Plain concrete (PC) is a brittle material with low tensile strength. Consequently, Plain Concrete is susceptible to cracking under tensile stress. It has been establish that addition of different kind of fibers in concrete with precise percentage improves the chemical and mechanical properties, durability & serviceability criteria of the structure.Concrete is a composite material which composed of cement,sand and aggregate is essential needs. Sand is a keymatteruse for preparation of concrete and mortar &highly affected for the preparation of mix design. Use of natural sand has high, due to the large use ofmortarand concrete. So, the demand of natural sand is very far above the ground in rising countries to assure the rapid infrastructure growth. Some other materials have already been used as aalternate of natural sand such as quarry dust, fly ash and siliceous foundry sand, stone powder, limestone, filtered sandand copper slagin mixtures of concrete and mortar as partial or complete replacement of natural sand.

Chemical properties of Basalt Fiber and Copper Slag are shown in table 1 and 2.

Table 1: Chemical Propertiesof Basalt Fiber

Chemical Properties (%)	Author		
	Dr.Daulatrao et al.	KunalSingha et al.	Gore Ketan et al.
Sio_2	52.8	52.8	69.51
Fe_2O_3	10.3	10.3	3.92
Al_2O_3	17.5	17.5	14.18
Cao	8.59	8.59	5.62
Mgo	4.63	4.63	2.41
SO_3	-	-	-
K_2O	1.46	1.46	1.01
Na_2O	3.34	-	-
Zro_2	-	-	-
P_2O_5	0.28	0.28	5.26
Sro_2	-	-	-
Cl	-	-	-

Table 2: Chemical Propertiesof Copper Slag

Chemical Properties (%)	Author					
	M. V. Patil Et Al.	Mavroulidou M. et al.	MeenakshiSudarvizhi. S et al.	K Rajasekhar et al.	M. C. Nataraja et al.	PranshuSaxena et al.
Sio_2	97.01	33-38	27	25.84	31.92	25.85
Fe_2O_3	1.05	-	355	68.29	59.11	68.29
Al_2O_3	0.095	3-7	3	0.22	1.25	0.22
Cao	1.064	1-4	1-3.5	0.15	1.65	0.15
Mgo	0118	1-2	-	-	6.41	-
So_3	0.008	-	-	0.11	-	-
K_2o	0.028	-	-	0.23	0.81	0.23
Na_2O	0.118	-	-	-	1.40	0.58
Zro_2	-	-	-	-	-	-
P_2o_5	-	-	-	-	-	-
Sro_2	-	-	-	-	-	-
Cl	0.350	-	-	0.0118	-	-
Loss of Ignition	0.190	-	-	-	-	-

II. CRITICAL LITERATURE REVIEW

The following are the previous research review based on Copper Slag and Basalt Fiber which can be used in concrete:

FathimaIrine et al (2005) used fiber in concrete is 1kg/m^3, 2 kg/m^3 and 3 kg/m^3 for each mix. The percentage raise of compressive strength basalt fiber concrete compare with 28 days compressive strength of conventional Concrete is observe that 13%. The bending strength of basalt fiber concrete is also found with an increase of over 53% to 4 kg / m3 of fiber content. The percentage increase in the split tensile strength of the basalt fiber concrete mix compared to the 28-day compressive strength of conventional concrete was observed at 63%. It was concluded that the formation of cracks in basalt fiber concrete is less than plain concrete. The ductility had improved and failure is gradual in fiber concrete.**(10)**

Cory High et al (2015)analyzed that use of chopped basalt fibers as an additive to improve the mechanical properties of concrete The use of crushed basalt fibers had little effect on the compressive strength of the concrete; However, it significantly improved its flexural modulus. In addition, the early compressive strength of concrete containing fly ash and additives can increase considerably due to the use of basalt fibers. The use of basalt fibers slightly increased the compressive strength for 28 days of the concrete containing fly ash and low water mixtures cement ratio.**(6)**

AngadalaSowjanya et al. tested with an addition of 1% lengthening of steel fiber shaving 61 and replacement of copper slag of 0%, 10%, with an increase of 10% equal to where the best resistance is obtained. The most favorable resistance for M30 and M40 grade concrete is observed at 50% and 40% of copper slag substitution with sand. The maximum percentage of increase in compression strength for conventional concrete is 28.4%, while for reinforced concrete with steel fiber it is 33.29% for M30 and 23% for M40. Because of the low-absorption natural copper slag, there is an increase in the machinability of simple concrete compared to steel-reinforced concrete due to the addition of steel fibers. Steel reinforced concrete has an increase in compressive strength of 7%, tensile strength is 67%, flexural strength is 50% compared to simple concrete.**(3)**

N.Sathish et al (2017)indicated that fine aggregate is to some extent replaced with foundry sand (20,30, 40%), and basalt fiber used to improve the both compression and tensile strength of concrete (2,2.5,3%).Decided to did all the preliminary tests for concrete materials including foundry sand and studied that density and strength characteristics of concrete produced by volume replacement of20%,30% and 40%, replacement of foundry with Basalt fiber were investigated and we found the compression strength of the concrete and split tensile strength is increased than its original strength. When the fiber is increased more than the 2.5% of weight of cement both compression and tensile strength is decreased. Durability studies on foundry sand and basalt fiber in concrete should be carried out to assess its behavior in aggressive environments.At the same time the workability of concrete has reduced while using foundry sand and basalt fiber.**(16)**

ObiliMaheshwar Reddy et al stated that to find the aptness of copper slag as an option material for the river sand.he examined that M30 grade of concrete is the effective substitution of copper slag with sand by replacement levels of 0%, 20%, 40% and 60%. Basalt Fibers used in the concrete taken in 0%, 1% and 2% by weight of cement**.**High High resistance to copper slag attributes to improve compressive strength.. Most of the percentage increase in compressive strength is 20.41%. The maximum percentage increase in flexural strength is 21.86%. The maximum percentage increase in the divided tensile strength is 31.52%. The maximum percentage increase of the modulus of elasticity is 33.59%. The concrete samples mixed with copper slag show a lower comparison to the acid attack due to its greater resistance and greater mass to the attack of chloride, sulfate and carbonation attack.**(17)**

Arivalagan et al (2012)invested made use of every grade of concrete as simple concrete and basalt (M20 and M30). Compressive strength of basalt fiber concrete containing 40% basalt fiber acceptable for most structural applications, since the compressive strength is more than 21 MPa at 28 days. 28-day strength basalt fiber concrete achieves compressive strength of 121% and 122% and achieves tensile strength in the range of 122-124% at 28 days of 28-day flexural strength. **(4)**

Mustapha Abdulhadi et al.polypropylene fibers used were 0%, 0.3%, 0.6%, 0.9% and 1.1% by weight volume of cement. Basalt fiber 0%, 0.3%, 0.6%, 0.9% and 1.1% by weight volume of cement and concluded that the. the addition of 0.3%, 0.6%, 0.9% and 1.1% resulted in a decrease in compressive strength in relation to simple concrete of 8%, 18%, 1% and 17% respectively . Similarly, the addition of 0.3%, 0.6%, 0.9% and 1.1% polypropylene resulted in a decrease in resistance to concrete control of 8%, 6%, 16% and 23% in this order. The addition of 0.3% and 0.6% of the amount of basalt fiber increases the resistance to breakage of the concrete respectively by 2.6% and 22.5%; while for a volume of 9% and 1.1%, the concrete

breaking strength decreased by 12.7% and 19.9% in that order. The inclusion of fibers in the concrete matrix considerably increases the tensile strength.**(15)**

Dr. U. R. Awari et al (2017) studied that addition of basalt fibers, up to (0 - 2.5%) by volume, different quantities of fibers compared to existing fibers. Different W/C ratioscan be added without causing any segregation. Theperformance of basalt fiber reinforced concrete is superior that different fiber reinforced concrete currently being usedin the market. The results shall be compared with the control specimens; there will be considerable increase in themechanical properties and performance of concrete is expected. The most important involvement due to the addition of basalt fibers is the change of form of breakdown from a brittle to ductile, while subjected to solidity, bending, tensionand impact with improvement in properties of concrete specified in the list provided by the dealer.**(8)**

Deepika K P et al (2016)focuses on the study of the effect of the use of copper slag as a substitute for sand. M25 grade concrete was used and tests were carried out for a variety of substitute volume of copper slag with a fine aggregate of 40%, 80% and 100% in concrete. In the first case, together with the substitution of the copper slag with the fine aggregate, an effort is made to exchange the cement with 50% fly ash, as well as the second case for 30% and the third case without the replacement of cement. from flying ash. The result obtained was compared to the presumed concrete and a compression test was performed on the basis of experimental results 80% of copper slag substituted by fine aggregates giving a satisfactory end value. For a split tensile strength, it can be rolled up until 80% of the copper slag concrete in a 50% fly ash mix provides a satisfactory value.**(7)**

M. V. Patil et al. (2015) stated that M30 grade of concrete be used and the tests be conducted for a variety ofvolume of copper slag replacement with fine aggregateof0% to100 % in concrete. Obtain results be compared with plain concrete made with cement & sand and accomplished that as the percentage of copper slag increases workability increases and maximum Compressive strength of concrete increased by 33 % at 20% replacement of fine aggregate, 80% replacement concrete increase more strength than plain concrete strength and establish that to 30% replacement of natural sand by copper slag, the flexural strength of concrete is amplified by 13%. And all percentage replacement of sand by copper slag the flexural strength of concrete is more than plain mix. Mass is increased by 6% due to replacement of sand at 100 %.**(12)**

R Rchavan et al. studied the result of copper waste was as a substitute for sand in resistance properties. M25 grade concrete must be used and tests are conducted for a variety of copper slag substitution rates with aggregates of 0 to 100% in concrete. The obtained results have been compared with the smooth concrete made with sand and cement and the maximum resistance to compression has been obtained increased by 54% and 40% of sand replacement with copper slag and up to 75% of substitute, the concrete increases the strength of more than smooth concrete. For the 100% replacement of sand with copper slag, the bending strength is more than just a mixture and has improved by 12%. The compressive strength and flexural strength increase due to the high resistance of copper waste.**(18)**

Kharadeet al.(2013)investigated the copper slag does not haspropensity of fascinating the water in large proportion &therefore the percentage of copper slag in mix increase the workability of concrete. He revealed that when sand was replaced by 20% copper slag compressive strength increased by 28% at 28 days. When replacement of copper slag was 80% the strength increases. But when substitution of copper slag was up to 80% the strength increases 80% and then strength directly decrease. The strength at 100% replacement was reduced by 8% at 28 days. It is observed that the compressive strengthas well as flexural was greater than before due to hardiness property of copper slag.**(2)**

HonnakkalavarAbhishka,et al.(2018) proved that the quality of the concrete M25 took to the design of the concrete mixture. For the concrete mix, the properties and characteristics of the materials were calculated for fine aggregates, coarse aggregates, cement and copper slag. The compression, flexural strength and tensile strength of the concrete were deliberated for various sand substitutions by the use of 0%, 20%, 40%, 60% and 80% copper slag. At 40% substitution of fine aggregates, the concrete achieves a greater resistance to compression, at 7 and 28 days. Maximum tensile strength and flexural strength were also obtained at 40% of the 28 day replacement level. The results of the split tensile strength, the compressive strength and the flexural strength of the concrete showed a value of more than 40% of the added amino substitute using copper slag. The use of copper slag as a substitute for fine aggregates in concrete to increase the thickness of the concrete. Therefore, the substitution of 40% of copper waste is the best proportion for the substitution of fine aggregates.**(1)**

Al-Jabri et al. (2011) testedthat the result of the use of copper slag as sand in the properties of mortars and cement. The consequences obtained for the concrete indicate a slight increase in mass of around 6% with the increase in copper residues. The machinability has increased considerably with the percentage increase of the copper slag compared to the base mix. A substitution of the copper slag up to 40-50% since the replacement of the sand provides a resistance comparable to that of the base mix. Therefore, the addition of additional copper waste results in a decrease in the strength due to the improvement of the free water content. Therefore, it has been recommended that up to 30-40% of the copper waste can be used as a substitute for fine aggregates to obtain a concrete with good strength and durability.**(4)**

BinayakPatnaik et al.(2015) Studied the slag as a partial replacement of the fine aggregate. Use two different types of concrete (M20 and M30). Replacement of copper slag (from 0 to 40%) in the concrete. The strength and durability properties such as cracking resistance, compressive strength and flexural strength, acid attack and sulfate attack were evaluated for both mixtures. The results show that the concrete's strength properties increase with copper slag as a partial replacement of the sand by up to 40%, the durability of the concrete that is in low opposition to acid attack and more resistant to sulfate attack.**(5)**

V. Sushma et al. (2015)concluded for the concrete to increase the power with the real price more without depletion in the usual property. Through this project, the cost of added fine of 50% was reduced compared to normal concrete, in this way the cement will give maximum resistance. When replacing the sand with 50% of the copper waste, a saving of 20% was found. In the compression resistance characteristic, he found an incremental alteration that is 1.45 times more than the control mixture. The resistance to dividing the traction has turned out to be an incremental alteration that is 1.75 times greater than the control mixture.**(20)**

The following table 3 shows the literature review papers based on cement and fine aggregate replacement by waste and it's Comparison.

No.	Year	Utilization Area	Material Used	Addition/ Replacement	Test	Increase/ Decrease
1	FathimaIrine et al (2005)	Cement	Basalt Fiber	Replacement	Compressive and flexural Strength	Increase
2	Cory High et al (2015)	Cement	Basalt Fiber	Replacement	Compressive Strength,	Increase
3	AngadalaSowjanya et al	Fine Aggregate	Copper Slag	Replacement	Compressive Strength	Increase Increase
4	N.Sathish et al (2017)	Cement Fine Aggregate	Basalt Fiber and Foundry Sand	Replacement	Compressive and Tensile Strength	Increase
5	ObiliMaheshwar Reddy et al	Fine Aggregate	Copper Slag	Replacement	Compressive and flexural Strength	Increase
6	Arivalagan. S et al (2012)	Cement	Basalt Fiber	Replacement	Compressive and tensile Strength	Increase
7	Mustapha Abdulhadi et al.	Cement	Basalt Fiber and Polyproplyn Fiber	Replacement	Compressive and tensile Strength	Increase
8	Dr. U. R. Awari et al (2017)	Cement	Fibers	Replacement Replacement	Compressive and tensile Strength	Increase Increase
9	Deepika K P et al (2016)	Fine Aggregate	Copper Slag	Replacement	Compressive Strength	Increase
10	M. V. Patil et al(2015)	Fine Aggregate	Copper Slag	Replacement	Compressive Strength	Increase
11	R Rchavan et al.	Fine Aggregate	Copper Slag	Replacement	Compressive Strength and Tensile Strength	Increase
12	Kharade et al.(2013)	Fine Aggregate	Copper Slag	Replacement	Compressive Strength	Increase
13	BinayakPatnaik et al. (2015)	Fine Aggregate	Copper Slag	Replacement	Compressive Strength	Increase
14	V. Sushma et al. (2015)	Fine Aggregate	Copper Slag	Replacement Replacement	Compressive Strength	Increase

III. CONCLUSION

Based on the critical literature review the following conclusions are made:

1) Basalt fiber can significantly improve the internal pores and crack propagation in concrete.
2) Based on the compressive tests on basalt fiber reinforced concrete with an addition of basalt fiber the compressive strength of concrete blocks increase.
3) Substitution of fine aggregate by copper slag further than 30-50% leadto reducestrong point of concrete mix.
4) The substitution of fine aggregate by copper slag in concrete increase the split tensile strength by 30-36 %and compressive strength by 30-40%.
5) Basalt can replace almost all applications of asbestos and has three times its heat insulating properties.
6) The increase in compressive strength is a propos 8.5% for an addition of 0.5% basalt fibers. For 1%, 1.5% and 2% of basalt fibers, there is an enhance in compressive strength of 14%, 27% and 38% respectively. From the test results.
7) The percentage of fiber increases the compressive strength alsoincrease. As the percentage of copper slag in the concrete increases, the viability of the concrete increases

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