International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 11 | Nov 2018 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL INVESTIGATION OF GLASS FIBER REINFORCED CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT BY DOLOMITE POWDER

Mr. R. Udhayasakthi[1], Mr. Sarath Kumar K P[2]

[1]Assistant Professor, Department of Civil Engineering, RVS Technical Campus, Coimbatore-641402, India,
[2]PG student, Department of Civil Engineering, RVS Technical Campus, Coimbatore-641402, India

---

Abstract - *Over the decades, there has been a significant increase in the use of fibers in concrete for improving its properties such as strength and ductility. Among many different types of fibers available today, glass fiber is a recent introduction in the field of concrete technology. The addition of these fibers into concrete mass dramatically increase the compressive strength , split tensile strength , flexural strength and impact strength of concrete. Based on the laboratory experiment on Fiber Reinforced Concrete cube, cylinder and beam specimens have been designed with Glass Fiber Reinforced Concrete containing glass fibers of 0.5% volume fraction. Replacement of cement with a more environment friendly will help to reduce the emission of carbon dioxide gas into the atmosphere. Dolomite is a rock forming mineral which is noted for its remarkable wettability and dispersibility. Dolomite has a good weathering resistance. Dolomite is preferred for construction material due to its higher surface hardness and density. This study aims to create a better concrete in low cost and is focused on the compressive strength of the concrete by partially replacing cement with dolomite powder at varying percentages and by the addition of glass fiber in a constant percentage into the concrete.*

***Key Words*: Dolomite powder, Glass Fiber Reinforced Concrete, Wettability, Dispersibility.**

1. INTRODUCTION

Concrete is a fundamental engineering material used in most of the civil engineering structures. It composed of three components: cement, water and aggregates. The cement plays an important role as it binds the aggregate and resists the atmospheric action. The most significant use of cement is the production of mortar and concrete. The bonding of natural and artificial aggregates will form a strong building material which is durable in the face of normal environmental effects.

Portland cement is a fundamental ingredient of concrete, mortar and most non specialty grout. The concrete production is the most common use of Portland cement..Cement is the most important constituent material, since. Cement is manufactured by calcining calcareous and argillaceous compounds at high temperature. However, manufacturing of cement emits about 0.8 tones of CO_2 in to atmosphere for every tones of cement manufactured. Dolomite is a carbonate material made up of calcium magnesium carbonate $CaMg(CO_3)_2$. Dolomite is a rock forming mineral which is noted for its exceptional wettability and dispersibility. Dolomite has a good weathering resistance. Dolomite is proposed for construction material due to its higher surface hardness and density. Asphalt and concrete applications prefer dolomite as a filler material due to its higher strength and hardness. By the effective utilization of dolomite powder, the objective of reduction of cost of construction can be met. An effort has been made to discuss the possibility of using dolomite as a replacement material for cement. . Concrete is the most widely used construction material that has several desirable properties like high compressive strength, stiffness and durability under usual environmental factors. At the same instant concrete is weak and brittle in tension. Plain concrete has two deficiencies and thy are: low tensile strength and a low strain at fracture. These deficiencies are normally overcome by reinforcing concrete. Usually reinforcement consists of continuous deformed steel bars or pre-stressing tendons. Fibre reinforced concrete (FRC) is a concrete mainly made of hydraulic cements, aggregates and discrete reinforcing fibres.. It is a composite material comprising of a matrix holding a random dispersed small fibres, either natural or man-made, having a high tensile strength. Because of the presence of these uniformly dispersed fibres, the cracking strength of concrete is increased and the fibres act as crack arresters. Fibres appropriate for reinforcing concrete have been produced from steel, glass and organic polymers. Glass fibre–reinforced concrete (GFRC) is a type of concrete which basically consists of a cementitious matrix composed of cement, sand, coarse aggregate, water and polymer, in which short length glass fibres are dispersed. In general, fibres are the primary load-carrying members, while the encomposed matrix keeps them in the desired locations and orientation, and act as a load transfer medium between the fibres and protects them from environmental damage. In fact, the fibres provide reinforcement for the matrix and other useful functions in fibre-reinforced composite materials. Glass fibres can be encompassed into a matrix either in continuous or discontinuous (chopped) lengths. Glass fibres have high tensile strength and elastic modulus but have brittle stress strain characteristics and low creep at room temperature. Glass fibres are usually round and straight with diameters from 0.005 mm to 0.015 mm. Numerous types of glass fibres are available in the market having different length, diameter and aspect ratio. This paper examines the possibility of using dolomite powder as a partial replacement material to cement in the mix containing 0.5 % of glass fibre as an additive.

2. LITERATURE REVIEW

Aparajita Mallick & Indira M (2018) This research paper deals with the possibility of replacing the conventional ingredients of concrete like cement and fine aggregate by sustainable materials. In this work M20 grade of concrete is taken for study and the fine aggregate is partially replaced by dolomite silica a by-product of cement manufacturing plant by 50% weight of fine aggregate and then cement is replaced with Class C fly ash at 10%, 20%, 30%, 40% and 50% in weight of cement. The specimen is casted in favors of testing compressive, flexural, split tensile strength and water absorption. The workability result indicates that the replacement of fine aggregate by dolomite silica and cement by fly ash increases, but in the presence of super plasticizer. The results indicate that when the fine aggregate is replaced by dolomite silica by 50% and cement is replacement by fly ash by 30% the compressive strength increased by 21.35% than conventional concrete and split tensile strength results indicate that 24% increase in strength is achieved and flexural strength also improved 20.48% then conventional concrete. From the microscopic FESEM analysis it is evident that many ettringite crystals were formed.

Chandramouli K et.al., (2010) The present day world is witnessing the construction of very challenging and difficult civil engineering structures. Quite often, concrete being the most important and widely used material is called upon to possess very high strength and sufficient workability properties. Efforts are being made in the field of concrete technology to develop such concretes with special characteristics. Researchers all over the world are attempting to develop high performance concretes by using fibers and other admixtures in concrete up to certain proportions. In the view of the global sustainable developments, it is imperative that fibers like glass, carbon, polypropylene and aramid fibers provide improvements in tensile strength, fatigue characteristics, durability, shrinkage characteristics, impact, cavitation, erosion resistance and serviceability of concrete. Fibers impart energy absorption, toughness and impact resistance properties to fibre reinforced concrete material and these characteristics in turn improve the fracture and fatigue properties of fibre reinforced concrete research in glass fiber reinforced concrete resulted in the development of an alkali resistance fibers high dispersion that improved long term durability. This system was named alkali resistance glass fiber reinforced concrete. In the present experimental investigation the alkali resistance glass fibers has been used to study the effect on compressive, split tensile and flexural strength on M20, M30, M40 and M50 grades of concrete.

Deepthi C & Shindon Baby (2016) Cement and coarse aggregate are two important constituents of concrete. Several studies were conducted to find an effective replacement for these raw materials of concrete with different goals such as reduced cost and high strength. Replacement of cement with a more environment friendly will help to reduce the emission of carbon dioxide gas into the atmosphere and using a waste material in place of coarse aggregate will help to reduce the environment pollution. This study aims to create a better concrete in low cost and is focused on the compressive strength of the concrete by partially replacing cement with dolomite powder and coarse aggregates with crushed tiles. The obtained results are analyzed and the optimum mix with maximum strength is determined.

Harle S and Prof. R. Meghe (2013) Glass fiber reinforced concrete (GFRC) is a recent introduction in the field of civil engineering. So, it has been extensively used in many countries since its introduction two decades ago. This product has advantage of being light weight and thereby reducing the overall cost of construction, ultimately bringing economy in construction. Steel reinforcement corrosion and structural deterioration in reinforced concrete structures are common and prompted many researchers to seek alternative materials and rehabilitation techniques. So, researchers all over the world are attempting to develop high performance concrete using glass fibers and other admixtures in the concrete up to certain extent. In the view of global sustainable scenario, it is imperative that fibers like glass, carbon, aramid and poly-propylene provide very wide improvements in tensile strength, fatigue characteristics, durability, shrinkage characteristics, impact, cavitations, erosion resistance and serviceability of concrete. The present work is only an accumulation of information about GFRC and the research work which is already carried out by other researchers.

Hemalatha S & Dr.A.Leema Rose (2016) The Plain Concrete have brittle nature and low tensile strength. So placing of reinforcement bars to plain concrete to attain the tensile strength. Since Fibre Reinforced Concrete is most widely used construction materials. Fibre is easily available material. Due to the Glass Fibre Reinforced Concrete the Glass Fibre easily surrounded to the cementitious medium. The study work is focused on strength and durability characteristics of GFRC. As per IS 10262-2009 designed by M40 grade of Concrete and con plast as a super plasticizer and water cement ratio 0.40. The performance of Cement Concrete with varying percentage of Glass Fibre adding like 0.33%, 0.66%, 1%, 1.33%, 1.66%, 2%. The strength and durability properties of Glass Fiber Reinforced Concrete compared to Control Concrete.

L.Ranjith Kumar et.al., (2017) The purpose of this work is to describe the effect of fine ground dolomite on important physical and mechanical properties of concrete. Dolomite powder has some similar characteristics of cement. The replacement percentages tried were 0%, 5%, 10%, 15% and 20% by weight of cement. The compressive, split tensile and flexural strengths of concrete with dolomite powder were compared with those of the reference specimens. The results indicate that replacement of cement with dolomite powder increases the compressive, split tensile and flexural strengths of concrete.

Md. Abid Alam et.al., (2015) Concrete being brittle is weak in tension. The inclusion of fibres in concrete have significantly improves its compressive as well as tensile strength. The use of different types of fibres & their orientation in the matrix have shown positive responses among the researchers. In the present study alkali resistant glass fibres were used in the concrete mixes. A total of 8 mixes were prepared by varying the percentages of glass fibres and grade of concrete mixes. Based on the laboratory results the compressive and tensile strength was reported to increase up to 26.19% and 25.4%. However the workability of concrete mixes is not much affected by the addition of fibres. The tensile strength of concrete is improved which shows the use of glass fibres in concrete mixes may reduce its shortcoming of low tensile strength without affecting its workability and compressive strength.

Olesia Mikhailova et.al., (2013) The purpose of this work is to describe the effect of fine ground dolomite limestone on important physic and mechanical properties of concrete. The present examinations indicate that the use of dolomite limestone as component instead of limestone is a viable solution for producing Portland dolomite limestone cement, especially for quarries with dolomitic inclusions or overburden.

Preethi & Prince Arulraj (2015) Cement is one of the most important constituents of concrete. Most of the properties of concrete depend on cement. Cement is manufactured by calcining argillaceous and calcareous materials at a high temperature. During this process, large amount of CO2 is released in to the atmosphere. India is the second largest producer of cement in the world. It is estimated that the production of one ton of cement results in the emission of 0.8 ton of CO2. The reduction in the consumption of cement will not only reduce the cost of concrete but also the emission of CO2. Dolomite powder obtained by powderising the sedimentary rock forming mineral dolostone can be used as a replacement material for cement in concrete up to certain percentage. Dolomite powder has some similar characteristics of cement. Using dolomite powder in concrete can reduce the cost of concrete and may increase the strength to some extent. This paper examines the possibility of using dolomite powder as a partial replacement material to cement. The replacement percentages tried were 0%, 5%, 10%, 15%, 20% and 25% by weight of cement. The compressive, split tensile and flexural strengths of concrete with dolomite powder were compared with those of the reference specimens. The results indicate that replacement of cement with dolomite powder increases the compressive, split tensile and flexural strengths of concrete.

Salim Barbhuiya (2011) This research deals with the utilisation of an alternative material, dolomite powder, instead of limestone powder, for the production of SCC. Test results indicated that it is possible to manufacture SCC using fly ash and dolomite powder. The mix containing fly ash and dolomite powder in the ratio 3:1 was found to satisfy the requirements suggested by the European Federation of Producers and Contractors of Specialist Products for Structures (EFNARC) guide for making SCC.

3. PROPERTIES AND MATERIAL USED

3.1 Cement

Table 3.1-Physical properties of cement

Physical Properties	Values
Specific Gravity	3.15
Initial setting time	30 minutes
Final setting time	10 hours
Soundness , expansion	10 mm

Table 3.2-Chemical properties of cement

Chemical Properties	Values
Loss on ignition	4%
Insoluble residue	2%
MgO	6%
SO_3	2.5%
CaO	63%

3.2 Fine aggregate

Table 3.3- Properties of fine aggregate

Properties	Values
Specific Gravity	2.6
Specific Weight	2.57g/cm^3
Loose unit weight	1.69Kg/cm^3
H_2O absorption	1.83%

3.3 Coarse aggregate

Table 3.4- Properties of coarse aggregate

Properties	Values
Specific gravity	2.74
Specific weight	2.7057g/cm^3
Loose unit weight	1.345Kg/m^3
H_2O absorption	1.15%
Compaction unit weight	1.547 Kg/m^3

3.4 Dolomite Powder

Table 3.5 – Physical properties of dolomite powder

Properties	Value
Specific gravity	2.85
Fineness modulus	6%
Initial setting time	5 minutes
Consistency	28%

Table 3.6-General properties of dolomite powder

Category	Carbonate minerals
Formula	$CaMg(CO_3)_2$
Crystal system	Trigonal
Crystal class	Rhombohedral (3)
Streak	White
Luster	Vitreous ,pearly
Color	White , pink

3.5 Glass fiber

Table 3.7- Properties of Glass fiber

Properties	Value
Specific gravity	2.68
Elastic modulus	72 Gpa
Tensile strength	1700 Mpa
Length(mm)	12 mm

4. MIX DESIGN

4.1 Mix Proportion

Cement = 594.3 Kg
Fine aggregate = 736.87 Kg
Coarse aggregate = 875.67 Kg
Water cement ratio = 0.35
Mix proportion in M_{30} = 1:1.2:1.5

5. CONCLUSION

Different aspects of various authors on glass fiber reinforced concrete and partial replacement by dolomite powder have been discussed. This gives the theoretical knowledge about the utilization of dolomite powder and glass fibers into the conventional concrete. From the literatures it is understood that the partial replacement of cement by dolomite powder shows good mechanical properties. Replacing cement by dolomite powder can improve the strength of concrete Usage of dolomite powder decreases the cost of concrete. As the cost of dolomite is less than that of cement. Dolomite powder can improve the compressive strength, the split tensile strength and the flexural strength of concrete up to certain replacement percentage By the addition of glass fiber the flexural strength, tensile strength and durability increases. The durability increases gradually based on the addition of glass fiber. Therefore based on the literature study, the major conclusion is that dolomite powder can be used in partial replacement of cement in glass fiber reinforced concrete.

REFERENCES

[1] Aparajita Mallick & Indira M (2018), 'Experimental Investigation of Partial Replacement of Cement and Fine Aggregate by Pozzolana and Dolomite Silica in Concrete', International Journal of Civil Engineering and Technology (IJCIET), Volume 9, Issue 4, pp. 1696–1703.

[2] Chandramouli K., Srinivasa Rao P, Pannirselvam N., Seshadri Sekhar T. and Sravana P(2010), 'Strength Properties of Glass Fibre Concrete', ARPN Journal of Engineering and Applied Sciences, Vol. 5, No. 4.

[3] Deepthi C & Shindon Baby (2016) 'Study on Compressive Strength of Concrete with Dolomite Powder and Crushed Tiles' IJIRSET Vol. 5 issue 9.

[4] Harle S & Prof. R. Meghe (2013), 'Glass Fiber Reinforced Concrete & Its Properties', International Journal of Engineering and computer science,Volume-2, Issue-12, PP-3544-3547.

[5] Hemalatha S & Dr.A.Leema Rose (2016),'An Experimental Study On Glass Fibre Reinforced Concrete' International Research Journal of Engineering and Technology IRJET Vol.3, issue 4.

[6] L.Ranjith Kumar, J. Kiran & P. Rangarajan (2017), 'Properties of Concrete Incorporating Dolomite Powder', IOSR Journal of Mechanical and Civil Engineering, Volume 14, Issue 2 Ver. II, pp. 78-80.

[7] Md.Abid Alam, Imran Ahmad & Fazlur Rehman (2015), 'Experimental Study on Properties of Glass Fibre Reinforced Concrete', International Journal of Engineering Trends and Technology (IJETT),Volume 24, Number 6.

[8] Olesia Mikhailovaa, Grigory Yakovlev, Irina Maeva & Sergey Senkov (2013), 'Effect of Dolomite Limestone Powder on the Compressive Strength of Concrete', International Conference on Modern Building Materials, Structures and Techniques, Vol.57, pp.775-780.

[9] Preethi G & Prince Arulraj (2015), 'Effect of Replacement of Cement with Dolomite Powder on the Mechanical Properties of Concrete', InternationalJournal of Innovative Science, Engineering & Technology, Vol.2, pp.1083-1088.

[10] Salim Barbhuiya (2011), 'Effects of Fly Ash and Dolomite powder on the properties of Self-Compacting Concrete', Construction and Building Materials, Volume 25, Issue 8.