International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 05 | May 2019 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL INVESTIGATION ON THE PERFORMANCE OF CALCIUM CHLORIDE AND GEOGRID IN CONCRETE

SAFVANA T S[1], SHEHIN A S[2], SULTHANA SALIM[3], GEENA KURUVILLA[4]

[1,2,3]B.Tech Student, Department of Civil Engineering, ILM College of Engineering and Technology, Kerala, India
[4]M.Tech, Assistant Professor, ILM College of Engineering and Technology, Kerala, India

---

Abstract – *Concrete is a construction material composed of cement, fine aggregates and coarse aggregates mixed with water which hardens with time. Calcium chloride is an ionic compound of calcium and chlorine. Geosynthetic is defined as a planar product manufactured from a polymeric material. The work investigated the effects of calcium chloride as an admixture in Geosynthetic fibre (geogrid) concrete. Also studied the compressive strength and tensile strength of plain concrete and geogrid reinforced concrete by adding calcium chloride in various ratios (0.2, 0.5, and 0.8) and to determine the optimum value of calcium chloride. This study shows that geogrid reinforced concrete enhances the strength and ductility of concrete materials and in the presence of 0.50% $CaCl_2$ is the optimum ratio which has the higher compressive strength.*

Key Words: **Cement, Fine aggregate, Coarse aggregate, Calcium Chloride, Geogrid**

1. INTRODUCTION

Concrete is a construction material composed of cement, fine aggregates and coarse aggregates mixed with water which hardens with time. When aggregate is mixed together with dry portland cement and water, the mixture forms a fluid slurr. The cement reacts chemically with the water and other ingredients to form a hard matrix that binds the materials together into a durable stone like material that has many uses.

Structural Concrete, with some exceptions, allows calcium chloride as an accelerating admixture for cast-in-place concrete. Calcium chloride is the most efficient and least expensive accelerator used in concrete. Calcium chloride ($CaCl_2$) has the ability to accelerate cement hydration and reduce set time by as much as two thirds.

Geosynthetics are polymeric products used to solve civil engineering problems. The polymeric nature of the products makes them suitable for use in the ground where high levels of durability are required. These products have a wide range of applications and are currently used in many civil engineering fields.

1.1 Objectives

The objectives of the study are,

- To study the significance of Calcium Chloride and geogrid in the present scenario of construction works.
- To find out the optimum value of Calcium Chloride in plain concrete and geogrid reinforced concrete.
- To compare the strength of calcium chloride in plain cement concrete and geogrid reinforced concrete in various proportional ratios.

1.2 Need for the Study

- Addition of calcium chloride and geogrid in concrete increases the strength of container yards and pavements.
- They increases the durability of runway and taxiway of airport and warehouses.
- Using calcium chloride and geogrid in concrete reduces the maintenance of pavement structures like parking lots, container yards etc.
- It provides efficient and economical method of construction.

2. MATERIALS USED FOR THE STUDY

2.1 Cement

53 grade ordinary Portland cement is used for the entire study.

Table -1: Physical Properties of Cement

Sl. no	Properties	Results obtained	Specification as per IS Code
1	Specific gravity	3.13	3 -3.15
2	Normal consistency	30 %	30%
3	Fineness modulus	5.9 %	Less than 10

2.2 Fine Aggregate

Table -2: Physical Properties of M Sand

Sl. no	Properties	Results obtained	Specification as per IS code
1	Specific gravity	2.57	2.5 -2.7
2	Fineness modulus	3.85	2 -4

2.3 Coarse Aggregate

Table -3: Physical Properties of Coarse Aggregate

Sl. no	Properties	Results obtained	Specification as per IS code
1	Specific gravity	2.62	2.5 – 3.0
2	Fineness modulus	3.12	6.5 – 8.0

2.4 Geogrid

The geogrids are formed by means of intersecting grids. The polymeric materials like polyester, polypropylene and high-density polyethylene are the main composition of geogrids.

Table -4: Physical Properties of Geogrid

Sl. no	Properties	Specifications
1	Material	Polypropylene
2	Poisson's Ratio	0.3
3	Density	1440 kg/m^3
4	Strength	30 kN
5	Tensile Strength	100 kN/m
6	Aperture size	40 mm

2.5 Calcium Chloride

Calcium chloride is an ionic compound of calcium and chlorine. It is highly soluble in water and it is deliquescent. It has several common applications such as brine for refrigeration plants, ice and dust control on roads, and in cement.

2.6 Water

For concrete making water is an important ingredient. The water is reasonably free from such impurities as suspended solids, organic matter and dissolved salts, which may adversely affect the properties of the concrete, especially the setting, hardening, strength, durability etc. In general the potable water is considered satisfactory. The pH value of water used in making concrete should not be greater than 7.

3. EXPERIMENTAL RESULTS

3.1 Slump Test

Concrete slump test or slump cone test is to determine the workability or consistency of concrete mix prepared at the laboratory or the construction site during the progress of the work. The slump of the concrete is measured by measuring the distance from the top of the concrete to the level of the top of the slump cone. The slump value of fresh concrete is 90mm.

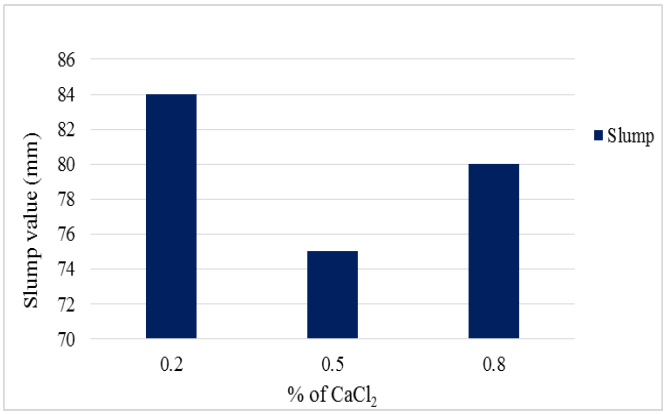

Chart -1: Slump Value obtained for various percentage of $CaCl_2$

The value of slump is decreasing with increasing percentage of calcium chloride added to the concrete. Addition of the calcium chloride ($CaCl_2$) causes drastic decrement in the slump. Workability of the concrete before adding $CaCl_2$ was found to be greater than the workability of the concrete after adding $CaCl_2$.

3.2 Compressive Strength Test

Compressive strength is one of the most significant and useful properties for the design of the structure. The compressive strength of any material is characterized as the resistance to failure down the activity of compressive forces. The test is carried out using 150×150×150 mm size concrete cubes on a compressive testing machine having a capacity of 1000 kN.

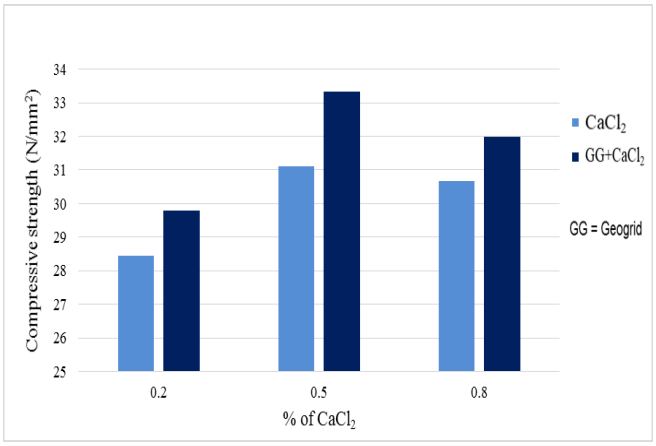

Chart -2: Comparison of Compressive Strength after 28 days

The result shows that compressive strength increases with increasing $CaCl_2$. The maximum strength obtained is 33.3N/mm² achieves at the ratio of 0.5% of calcium chloride in geogrid reinforced concrete and it is higher than 28.89N/mm² with 0% of calcium chloride in geogrid reinforced concrete.

3.3 Tensile Strength Test

The ability of the concrete to withstand tensile stress without broken is called Tensile Strength of concrete. The concrete is appropriate weak in tension due to its brittle nature and is not normal to resist the direct tension. The concrete establish cracks when subjected to tensile forces.

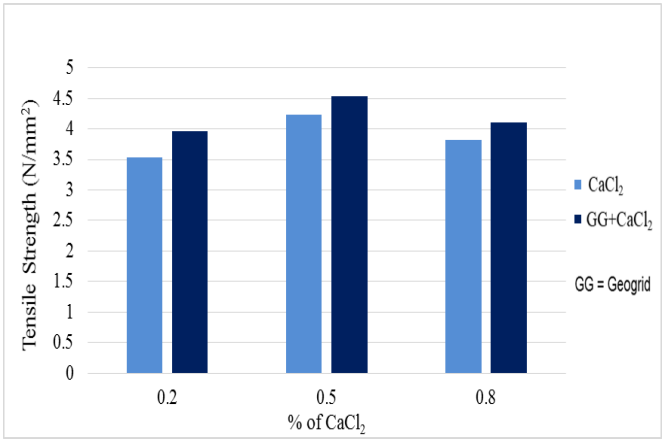

Chart -3: Comparison of Tensile Strength after 28 days

The result shows that tensile strength increases with increasing $CaCl_2$. The maximum strength obtained is 4.53N/mm² achieves at the ratio of 0.5% of calcium chloride in geogrid reinforced concrete and it is higher than 3.68N/mm² with 0% of calcium chloride in geogrid reinforced concrete.

3.4 Comparison of Test Results

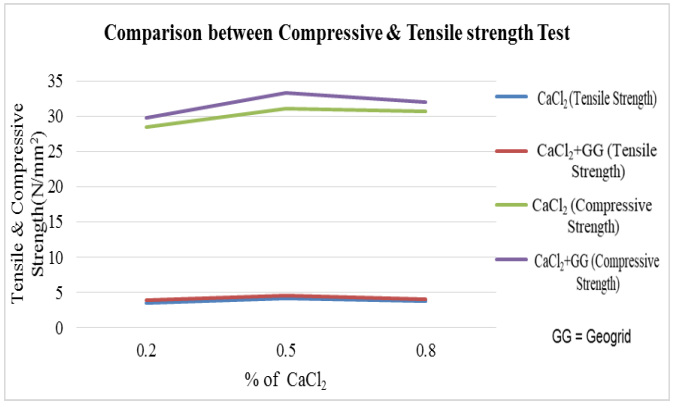

Chart -4: Comparison between Compressive & Tensile strength Test

The addition of calcium chloride in concrete increases the compressive and tensile strength of concrete with and without the addition of geogrid. Both calcium chloride and geogrid added concrete shows high compressive and tensile strength. But the compressive strength increases compared to tensile strength in calcium chloride added to the geogrid reinforced concrete.

4. CONCLUSIONS

The addition of calcium chloride caused decrease in the slump. It shows as the percentage of calcium chloride increases the water absorption decreases gradually. Hence the strength of compressive strength and tensile strength of concrete increased with increasing percentage of calcium chloride.

Because of the advantages of geogrid, these are used for structural repair and strengthening, and finally geogrid has became popular. The compressive and tensile strength of concrete specimens increases, when the geogrid is used in concrete as a fibre.

The addition of calcium chloride in concrete increases the compressive and tensile strength of concrete with and without the addition of geogrid. The result shows the strength of concrete has been improved by varying the percentage of calcium chloride upto 0.5%. It indicates that 0.5% of $CaCl_2$ can be considered as the optimum value for getting highest compressive strength and tensile strength of concrete. This study concludes that the use of calcium chloride and geogrid in concrete can improves the compressive and tensile strengths.

REFERENCES

[1] S. O. Odeyemi et.al, (2015), "Effect of Calcium Chloride on the Compressive Strength of Concrete Produced from Three Brands of Nigerian Cement", American Journal of Civil Engineering, pp.1-5.

[2] Hong Huang, Xiao-dong Shen, (2011), "Statistical Study of Cement Additives With and Without Chloride on Performance Modification of Portland Cement", Science Direct, pp.246-253.

[3] P.Maheswar Reddy, J.Ravi Kumar, (2018),"Study of Geo-Grid Confined Reinforced Concrete Beams", International Journal of Science, Engineering and Technology Research (IJSETR), Volume 7, Issue 4, pp.278-286.

[4] Sudheer S. Prabhu et.al, (2018), "Evaluation of Resilient Modulus of geosynthetic Reinforced Layers Using Repeated load Triaxial Tests", Indian Journal of Geosynthetics and Ground Improvement, pp.9-16.

[5] Srujan Gaddam, Suresh Barmavath, (2017), "Performance of Glass Powder and Geosynthetics in Concrete", International Research Journal of Engineering and Technology (IRJET), Volume: 04, Issue: 10, pp.1602-1609.

[6] Rakendu K, Anagha Manoharan, (2017),"Flexural Behaviour of Concrete Beams Reinforced with Biaxial Geogrid", International Journal of Engineering Research and General Science, Volume 5, Issue 4, pp.72-83.

[7] Jorge G. Zornberg, (2017),"Functions and Applications of Geosynthetics in Roadways", Science Direct, pp.298-306.

[8] Brian O. Oyegbile, Benjamin A. Oyegbile, (2017), "Applications of Geosynthetic Membranes in Soil Stabilization and Coastal Defence Structure", International Journal of Sustainable Built Environment, pp.636-662.

[9] Mohammad Mehdi Shokouhi et.al, (2017), "The Effect of Calcium Chloride on Push-Out Bond Strength of Calcium-Enriched Mixture Cement and Mineral Trioxide Aggregate", Iranian Endodontic Journal, pp.334-337.

[10] Venkateswararao J et.al, (2016), "Effect of Accelerators on the Compressive Strength Development of Geopolymer Concrete Composites", International Journal of Research in Engineering and Technology, pp.74-77.

[11] Saranyadevi M et.al, (2016), "Strengthening of Concrete Beam by Reinforcing with Geosynthetic Materials", International Journal of Advanced Research in Education & Technology, Vol. 3, Issue 2, pp.245-251.

[12] Aanand Jain, (2016), "Tomorrow with Geosynthetics: A Cost Effective Building Construction Material", International Journal of Research in Engineering and Technology, pp.228-238.

[13] Ramesh Rao B, Dr N Bhavanishankar Rao, (2016), "Experimental Study on Effect of Geosynthetic Fibres on Compressive and Tensile Strength of Cement Concrete", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 5, Special Issue 9, pp.113-118.

[14] Dhanalakshmi R et.al, (2018), "Strengthening of Concrete Beam by Reinforcing with Geosynthetic Materials", International Journal of Advance Engineering and Research Development, Volume 5, Issue 03, pp.762-772.

[15] Mohamed A. Al rawashdeh, Omar Asad Ahmad, (2013), "The Environmental Impacts of Calcium Chloride Addition to Cement on Reinforcing Steel Corrosion", International Journal of Science, Engineering and Technology Research, Vol.3, No.9, pp.148-161.

[16] Essam A. Kishar et.al, (2013), "Effect of Calcium Chloride on the Hydration Characteristics of Ground Clay Bricks Cement Pastes", Science Direct, pp.20-30.

[17] Dr. S. Geetha et.al, (2018), "Geogrid Reinforcement in Aerated Concrete", International Journal of Innovative Research in Science, Engineering and Technology, Volume 7, Special Issue 5, pp.66-71.

[18] K.Rajeshkumar et.al, (2010), "Experimental Studies on Viability of Using Geosyntheticsas Fibers in Concrete",International Journal of Applied Engineering Research, Dindigul, Volume 1, No1, pp.15-28.

[19] A.Khodaii, Sh. Fallah, (2009), "Effects of Geosynthetic Reinforcement on the Propagation of Reflection Cracking in Asphalt Overlays", International Journal of Civil Engineerng, Vol. 7, No. 2, pp.131-140.

[20] E. Guler, C. Ocbe, (2003), "Centrifuge and Full Scale Models of Geotextile Reinforced Walls and Several Case Studies of Segmental Retaining Walls in Turkey", Emirates Journal for Engineering Research, pp.15-23.