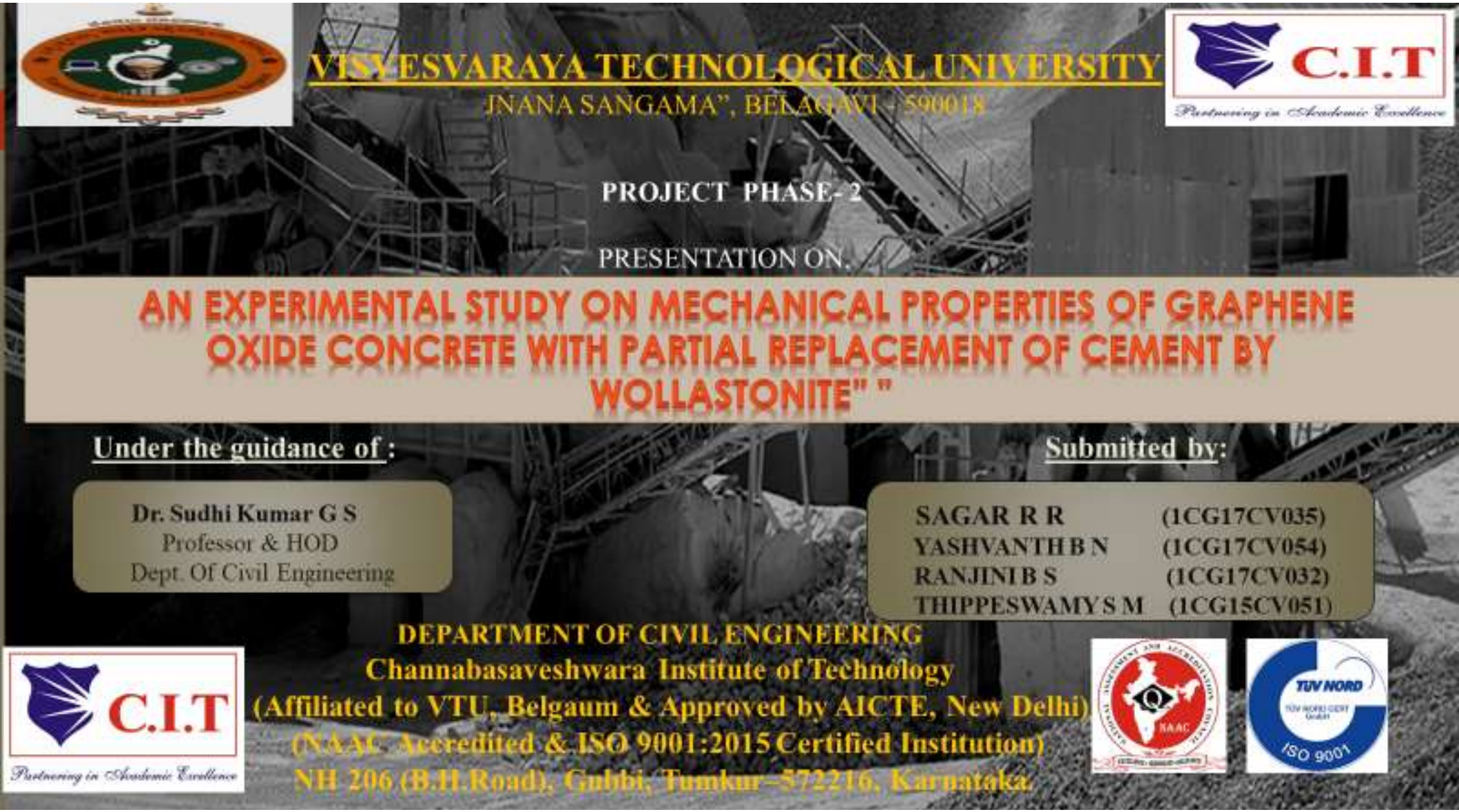

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

JNANA SANGAMA", BELAGAVI – 590018

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PROJECT PHASE- 2

PRESENTATION ON,

AN EXPERIMENTAL STUDY ON MECHANICAL PROPERTIES OF GRAPHENE OXIDE CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT BY WOLLASTONITE" "

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CONTENTS

INTRODUCTION

- Concrete is durable and efficient binding material which is used for construction. India is second largest producer of cement. About 1.5 tons of raw material is required for every single ton production of cement. In order to reduce the consumption of cement, supplementary cementitious materials are used in concrete production. Wollastonite is one such naturally occurring mineral formed due to interaction of limestone with silica in hot magmas which imparts additive strength to concrete. In the present work, cement is partially replaced by wollastonite at various percentage in concrete.
- Graphene Oxide is an extraordinary nano-material which is accessible in powder, sheets, flakes and oxide form. It is strong, elastic and light weight in nature and recently adopted in construction field. It is having great properties which are beneficiary in construction field. When graphene oxide is added to concrete composites, it increases the strength properties of the concrete. It also increases the rate of hydration and reduces permeability and also gives high bond strength to concrete structures.

OBJECTIVES

- To study the mechanical properties of graphene oxide concrete with partial replacement of cement by wollastonite.
- To facilitate the utilization of wollastonite as a new material in concrete with partial replacement of cement.
- To compare the mechanical strength parameters of conventional graphene oxide concrete with partial replacement of cement by wollastonite.
- To find out the optimum quantity of wollastonite required to achieve maximum compressive, tensile and flexural strength of graphene oxide concrete.

ADVANTAGES OF GRAPHENE OXIDE

- High compressive and elasticity
- High tensile and flexural strength
- Corrosion protection
- High porosity
- More strong and durable
- Resistant to environmental deterioration

LITRATURE REVIEW

SL no.	Title of the paper	Author's name	Conclusion
1.	"INVESTIGATION ON STRENGTH PROPERTIES OF GRAPHENE OXIDE CONCRETE"	M. DEVASENA, J.KARTHIKEYAN	Addition of graphene oxide leads to an increase in compressive strength, tensile strength and flexural strength. 0.1% of graphene oxide is needed to improve flexural strength of a PPC matrix about 4% and compressive strength about 11%.
2.	"A FEASIBILITY STUDY ON MECHANICAL PROPERTIES OF CONCRETE WITH GRAPHENE OXIDE"	K R MOHAMMAD SHAREEF, SHAIK ABDUL RAWOOF, K SOWJANYA,	Nano particles graphene oxide improves the mechanical properties of the concrete, both compression and flexural strength, concrete samples were tested with Graphene Oxide (GO) in percentage of 1% to 2% by weight to obtain high strength, it is carried out for M25 grade of concrete.
3.	"PROPERTIES OF CONCRETE CONTAINING WOLLASTONITE"	SHUBHAM DAHIPALE, KABIR KHAN, KSHITIJ TIKHE	There was slight decrease in compressive strength at 5 % replacement but at 10%, 12.5% & 15% replacement there was rise in compressive strength. Optimum percentage of replacing cement with wollastonite selected is 15%.

SUMMARY OF THE LITERATURE

- The detailed literature review concluded that the optimum quantity of Graphene oxide (0.2%) can be used as an additive to the concrete which improves the mechanical properties of the concrete such as compression, flexural, tensile strength and also improves the degree of hydration of the cement paste and increases the density of the cement matrix, creating a more durable product.
- The wollastonite can be used as a partial replacement to cement up to 20%. Use of wollastonite as partial replacement reduces the cost and also saves the cement thereby reduces pollution and making the environmental green. With the presence of silica content in wollastonite which is responsible for imparting strength in concrete.

GRAPHENE OXIDE

WOLLASTONITE

MATERIALS USED

- Ordinary Portland Cement
- Graphene oxide
- Fine aggregate
- Coarse aggregate
- Wollastonite
- Portable water for mixing

CEMENT

Cement is a binder material used in the construction industry for production of concrete. Ordinary Portland cement (OPC) is the most common type of cement used in constructions.

SL.No	Particulars	Obtained results	Permissible limits as per IS 12269-1987
1.	Specific gravity	3.15	3.15
2.	Fineness (%)	8	10%
3.	Normal consistency	33	Minimum 23%
4.	Initial Setting time	35	30 minutes
5.	Final setting time	500	600 minutes

GRAPHENE OXIDE

Graphene Oxide is an extraordinary nano-material which is accessible in powder, sheets, flakes and oxide form. It is strong, elastic and light weight in nature and recently adopted in construction field. It is having great properties which are beneficiary in construction field. When graphene oxide is added to concrete composites, it increases the strength properties of the concrete.

SL.No	Element	%Composition
1.	Carbon	77.5
2.	Oxygen	16
3.	Sulphur	0.4
4.	Hydrogen	1.2
5.	Nitrogen	4.9

FINE AGGREGATES

The locally available river sand conforming to zone-II of IS 383-1970 has been used as fine aggregate. The fine aggregate are clean, inert and free from organic matter, silt and clay.

Sieve size (mm)	Percentage passing	ZoneII gradation	Remarks
10	100	100	Conforming to grading zone II of Table 4 of IS 383-1970
4.75	94.80	90-100	
2.36	91.80	75-100	
1.18	83.20	55-90	
0.6	57.40	35-59	
0.3	24.60	8-30	
0.15	3.90	0.1	

COARSE AGGREGATES

Locally available crushed blue granite stones conforming to graded aggregate of nominal size 12.5 mm as per IS: 383–1970. Coarse aggregates are naturally occurring inorganic materials of size retained on 4.75mm sieve.

Sieve size in mm	% Passing	IS 383-1970 specification		Remarks
		Graded	Single	
40	100	100	100	Conforming to 20mm size aggregates
20	90	95-100	85-100	
10	3	25-55	0-20	
4.75	0	0-10	0-5	
PAN	-	-	-	

WOLLASTONITE

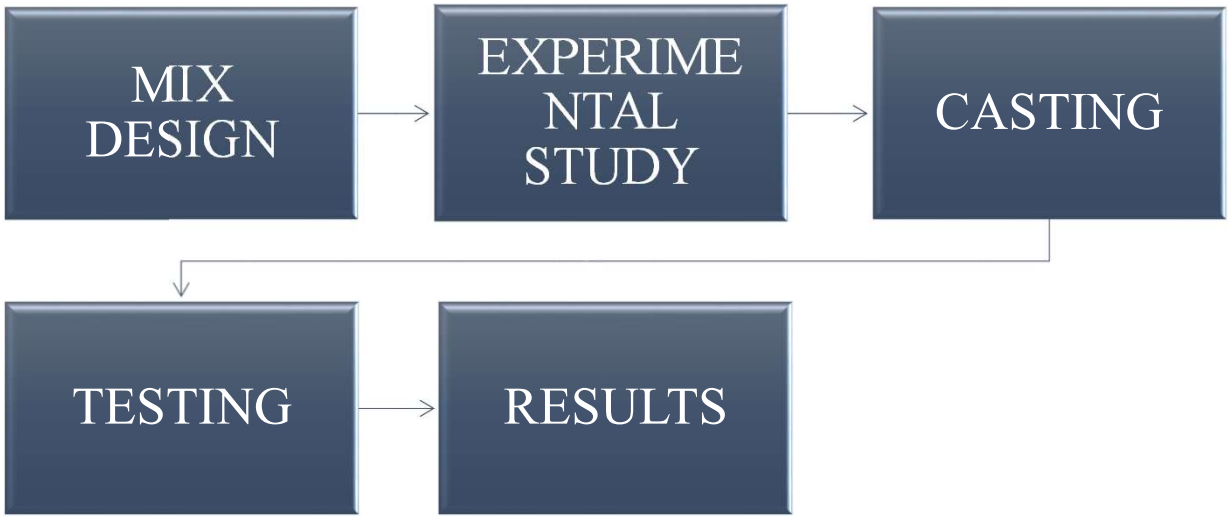
Wollastonite is a calcium metasilicate mineral ($CaSio_3$) that may include little amounts of iron, magnesium and manganese substituting for calcium. Wollastonite powder are minerals comprised chemically of calcium, silicon and oxygen. The wollastonite powder contain 86-89% of calcium metasilicate.

SL.No	Element	% Composition
1.	SiO_2	50.80
2.	CaO	40.88
3.	Fe_2O_3	0.11
4.	TiO_2	0.04
5.	Al_2O_3	0.27
6.	MgO	3.05
7.	LOI	4.85

POTABLE WATER

- Ordinary potable water which is free from all the impurities such as organic content, turbidity was used for mixing and curing of the specimen. The water is added into the concrete in the form of water/cement ratio.

METHEDOLOGY



Stage1 : Graphene oxide concrete

Materials used	: Cement, Graphene oxide, Fine aggregate, Coarse aggregate, Water.
Number of castings	: 3no. of cubes, 3no. of cylinders and 3 no. of beams
Curing period	: 7 days, 14days, 28days
Tests to be conducted	: Compressive strength test, Tensile strength test, Flexural strength test.

Stage2 : Graphene oxide concrete with replacement of cement Wollastonite

Materials used : Cement, Graphene oxide, Fine aggregate, Coarse aggregate, Wollastonite, Water.

Percentage replacement : 5%, 10%, 15%, 20%.

Number of castings : 12no. of cubes, 12no. of cylinders and 12no. of beams

Curing period : 7 days, 14days, 28days

Tests to be conducted : Compressive strength test, Tensile strength test, Flexural strength test.

MIX DESIGN

Stipulations for Proportioning

Grade selection	: M25
Type of cement	: OPC 43 grade conforming to IS 12269-1987
Maximum nominal size of aggregates	: 20mm.
Minimum cement content	: 300 kg/m^3
Minimum W/C ratio	: 0.50
Workability	: 50-100mm
Exposure condition	: Severe
Type of aggregate	: Crushed angular aggregate
Maximum cement content	: 450 kg/m^3

Test Data of Materials

Cement used	: OPC 43 grade cement
Specific gravity of cement	: 3.15
Specific gravity of coarse aggregate	: 2.64
Specific gravity of fine aggregate	: 2.65
Specific gravity of wollastonite	: 2.90
Water absorption of coarse aggregate	: 0.5%
Water absorption of fine aggregate	: 0.9%
Zone of fine aggregate	: Confirming to grading zone II of Table 4 IS 383

MIX PROPORTION

Mix proportions as per 10262:2009

Sl. No	Particulars	For 1 m^3 concrete	Mix proportions
1	Cement	394 kg	1.00
2	Fine aggregates	790.55 kg	2.00
3	Coarse aggregates	1002.35 kg	2.54
4	Water	197.00 litres	0.50

The mix design ratio is found to be **1 : 2.00 : 2.54**

CASTING

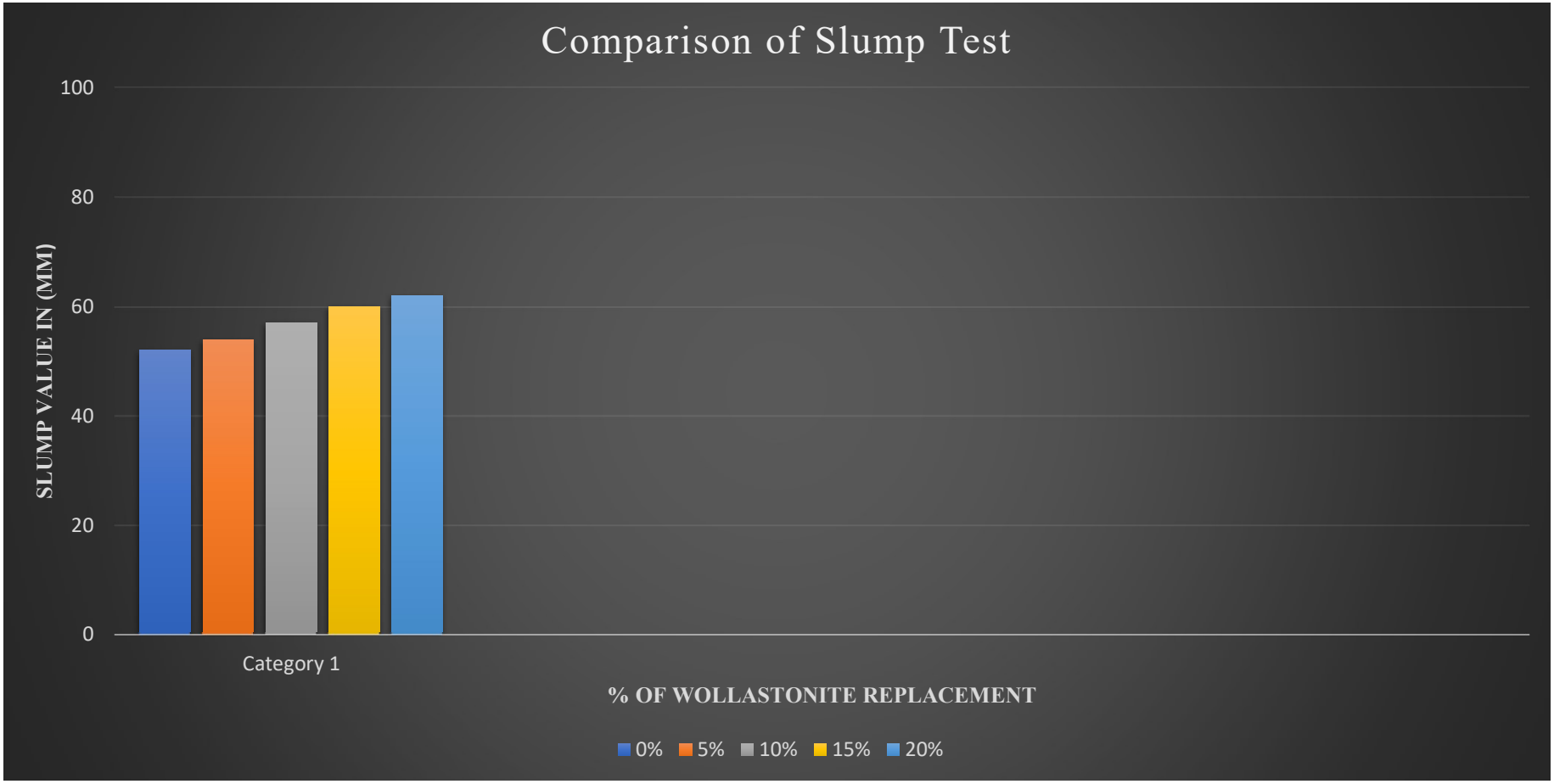
After the mix design of the M25 grade concrete mix proportions were arriving and tabulated in table. Initially the dry materials, Cement, Aggregates & Sand are mixed. Further, graphene oxide and Wollastonite were added into the dry mixture for another 1 minute. The fluid part of the mixture was then added to the dry materials and the mixing continued for further about 4 minutes. The total mixing time was 5 minutes. Compaction of concrete in three layers with 25 strokes of 16 mm rod was carried out for each layer is done. The concrete was left in the mold and allowed to set for 24 hrs before the cubes were de-molded and placed in the curing tank until the day of testing.

TESTS ON CONCRETE

- Slump Test
- Compaction Factor Test
- Compression Strength Test
- Split Tensile Strength Test
- Flexural Strength Test

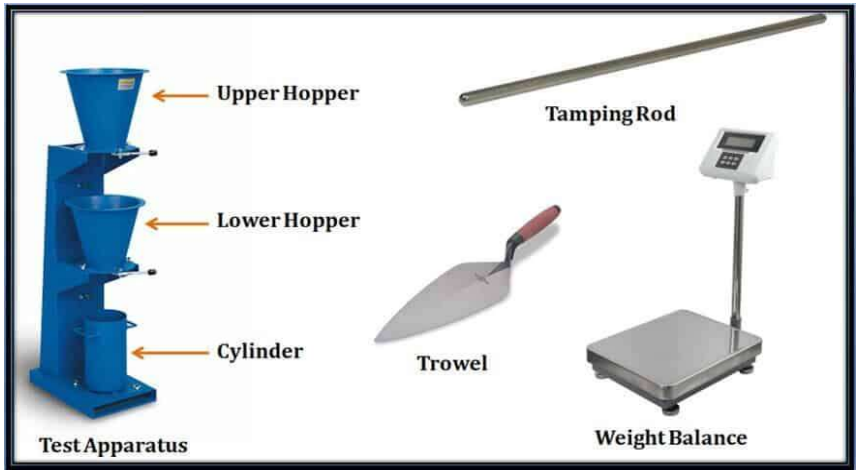
Slump test

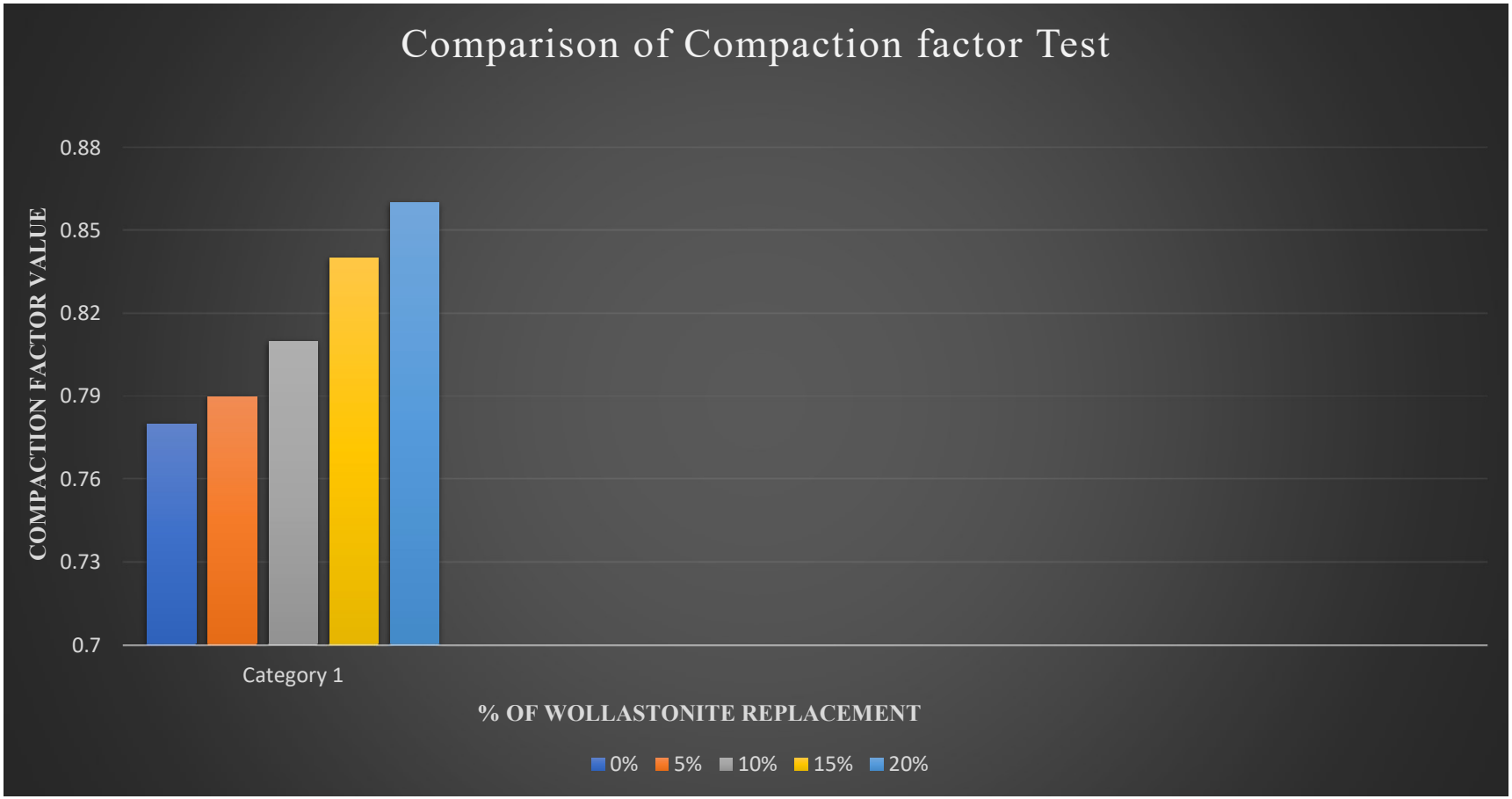
Workability is a term associated with freshly prepared concrete. This can be defined as the ease with which concrete can mixed, placed, compacted and finished. Slump test is the most commonly used method of measuring ‘workability’ of concrete in a laboratory or at site of work. It is used conveniently as a control test and gives an indication of uniformity of concrete from batch to batch. Vertical settlement of a standard cone of freshly prepared concrete is called ‘slump’.


Comparison of Slump Test
100
80
60
40
20
0
SLUMP VALUE IN (MM)
Category 1
% OF WOLLASTONITE REPLACEMENT
0%
5%
10%
15%
20%

Compaction Factor Test

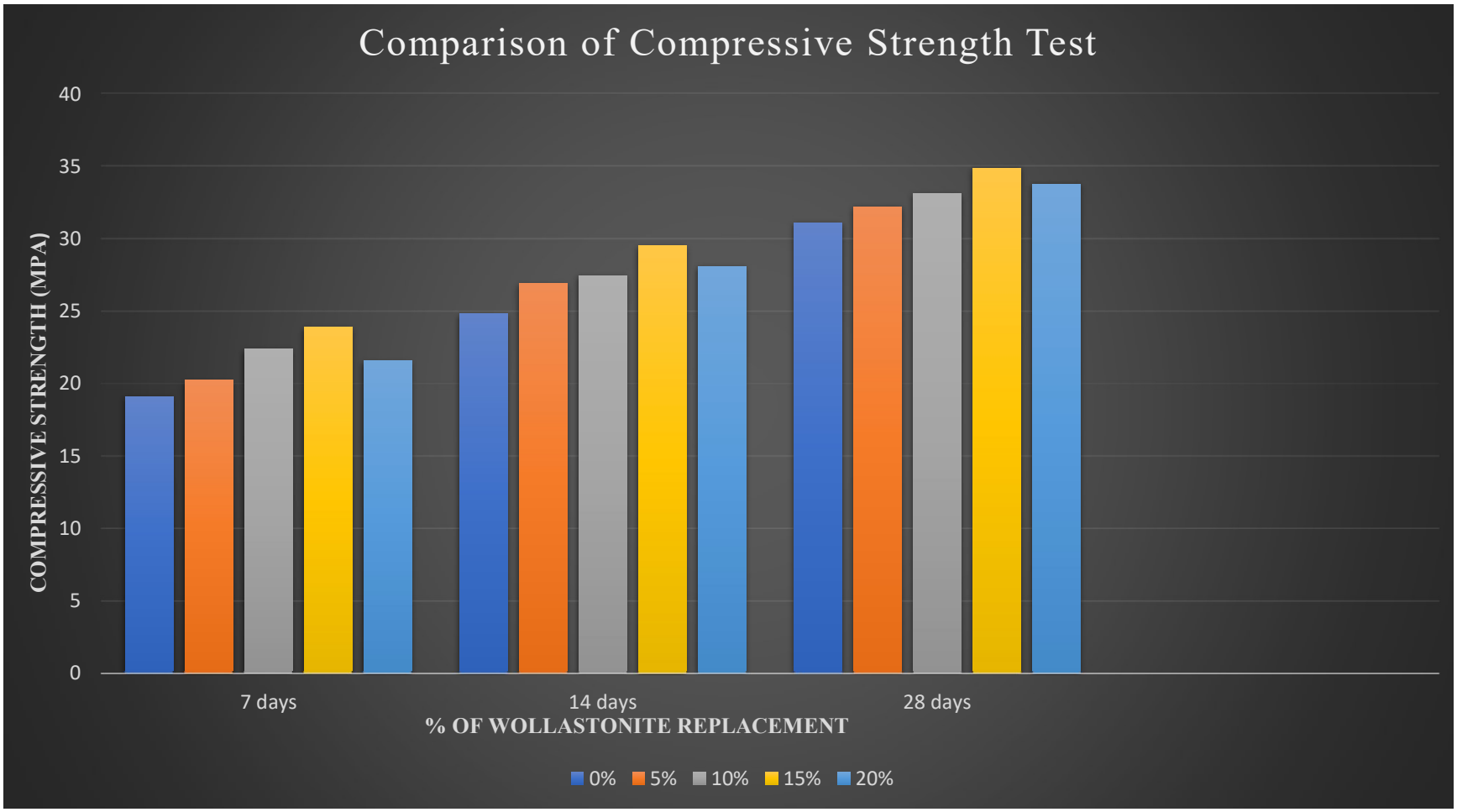
Compaction Factor is used to indicate workability of concrete where nominal size of aggregate does not exceed 40mm. It is a measure of density of concrete to which a fresh concrete mix can be compacted for a standard energy input relative to the theoretical maximum density corresponding to zero air content. This theoretical maximum density can be estimated in the laboratory as that obtained by full compaction under mechanical vibration.




Comparison of Compaction factor Test
0.88
0.85
0.82
0.79
0.76
0.73
0.7
COMPACTION FACTOR VALUE
Category 1
% OF WOLLASTONITE REPLACEMENT
0%
5%
10%
15%
20%

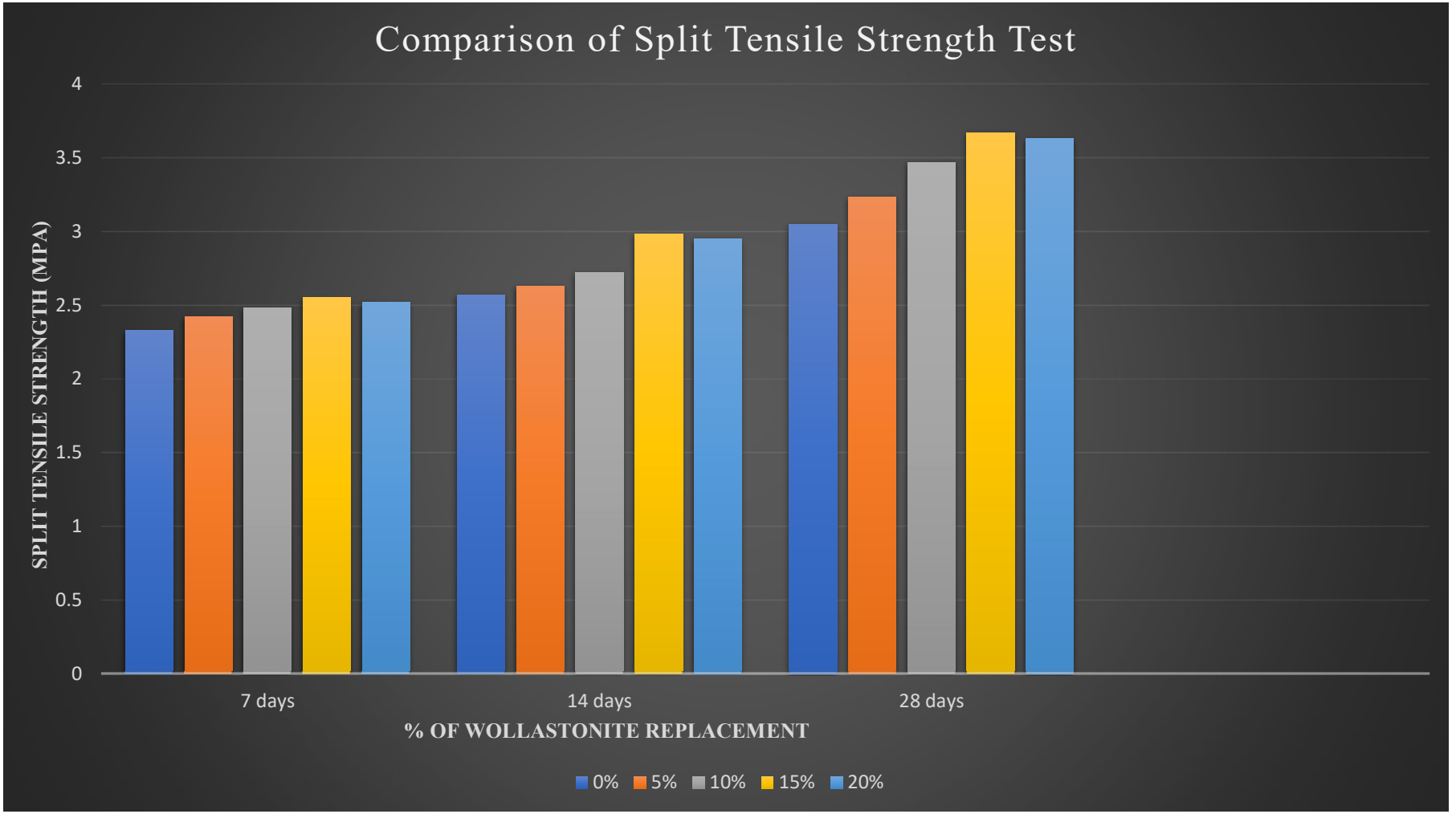
Compression Strength Test

Testing hardened concrete plays an important role in controlling and conforming the quality of cement concrete work. The main factor in favor of the use of concrete in structures is its compressive strength. One of the important properties of the hardened concrete is its strength which represents its ability to resist forces. The compressive strength of the concrete is considered to be the most important and is often taken as an index of the overall quality of concrete. The compressive strength of concrete is defined as the load which causes the failure of specimen per unit cross section on compression under given rate of loading.


Comparison of Compressive Strength Test
40
35
30
25
20
15
10
5
0
COMPRESSIVE STRENGTH (MPA)
7 days
14 days
28 days
% OF WOLLASTONITE REPLACEMENT
0%
5%
10%
15%
20%

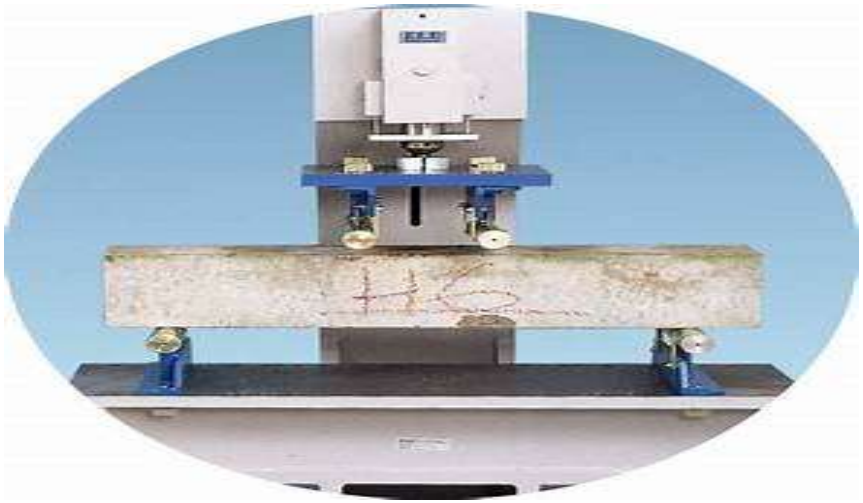
Split Tensile Strength Test

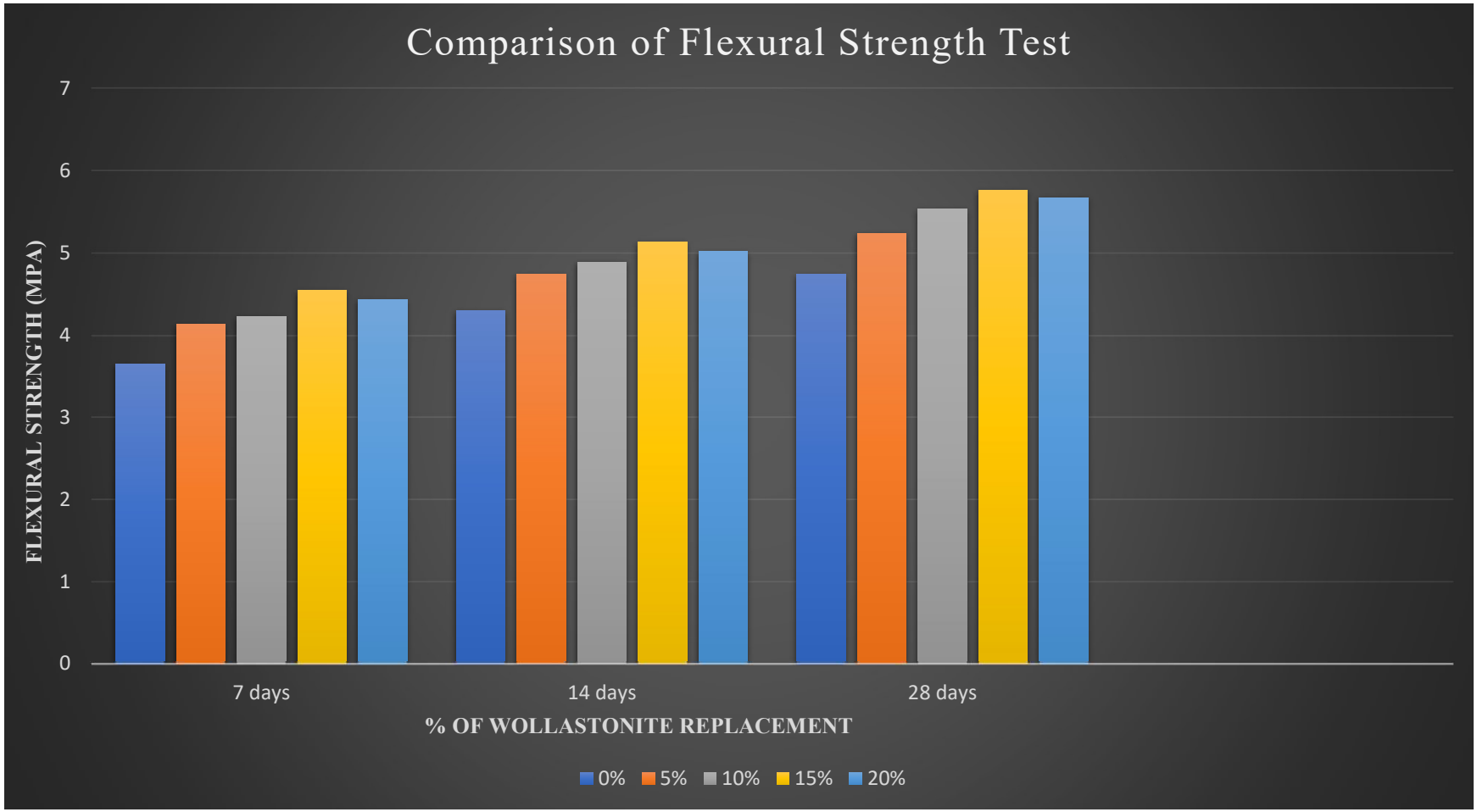
Concrete is not usually expected to resist the direct tension because of its low tensile strength and brittle nature. However the determination of tensile strength is necessary to determine the load at which the concrete members may crack. The cracking is a form of tensile failure.


Comparison of Split Tensile Strength Test
SPLIT TENSILE STRENGTH (MPA)
4
3.5
3
2.5
2
1.5
1
0.5
0
7 days
14 days
28 days
% OF WOLLASTONITE REPLACEMENT
0%
5%
10%
15%
20%

Flexural Strength Test

Concrete is relatively strong in compression and weak in tension. In RCC concrete members, little dependence is placed on tensile strength of concrete since steel reinforcing bars are provided to resist all tensile forces. However, tensile stresses are likely to develop in concrete due to drying shrinkage, rusting of steel reinforcement, temperature gradient and many other reasons. Therefore, the knowledge of tensile strength of concrete is of importance.




Comparison of Flexural Strength Test
FLEXURAL STRENGTH (MPA)
7
6
5
4
3
2
1
0
7 days
14 days
28 days
% OF WOLLASTONITE REPLACEMENT
0%
5%
10%
15%
20%

CONCLUSION

- The slump value and compacting factor value of graphene oxide concrete will be increases with the increase in the wollastonite content for M25 grade concrete and the workability reaches its maximum at 20% replacement.
- There is a rise in compressive strength at 5%, 10% and 15% Wollastonite replacement of cement in graphene oxide concrete and at 20% replacement, compressive strength decreases slightly. Maximum compressive strength is observed at 15% Wollastonite replacement of cement in graphene oxide concrete.
- There is also rise in flexural and split tensile strength at 5%, 10% and 15% Wollastonite replacement of cement in graphene oxide concrete and at 15% replacement, flexural strength and also split tensile strength decreases slightly. Maximum flexural and split tensile strength is observed at 15% Wollastonite replacement.

- Hence from above results we can conclude that by adding 15% of wollastonite by replacing cement, strength of the graphene oxide concrete is increased.
- Test results indicated that wollastonite can efficiently substitute cement without affecting mechanical parameters of concrete. Replacing 15% cement even enhance the longevity of concrete structures. The gainful utilization of wollastonite as building material will contribute to sustainable development of country by reducing greenhouse emissions and depletion of natural resources.

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THANK YOU