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The Effect of Lime Stone Powder as an Alternative Cement Replacement Material in Concrete after 28 days

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Abstract: ***This experimental study presents the variation in the strength of concrete when replacing cement by lime powder in the ratio 30%-35%. M-15 and M-20 grade concrete was used for which lime powder is replaced and an experimental program will be carried out and the effect on characteristics compressive strength will be analysed and the economic parameters are analysed with the optimum % of lime powder so that the overall cost of concrete can be minimized.. The cubes are to be tested after 7 days, 21 days and 28 days and the highest optimum percentage of Lime stone powder which can be preferably needed for highest strength after 28 days is to be examined. The basic aim of this project is to calculate the optimum percentage of lime powder in concrete.***

Keywords: Lime powder, concrete, strength.

I. INTRODUCTION

Lime is a calcium containing inorganic mineral composed primarily of oxides and hydroxides usually calcium oxide or calcium hydroxide. These materials are still used in large quantities as building and engineering materials (including limestone products, cement, concrete and mortar) used in many purpose. A concrete made from a mixture of lime, sand, and gravel is said to be as lime concrete. It was widely used before the lime was replaced by Portland cement.

Since long, Lime has been used to make things like plaster and mortar. Lime is usually made by burning of limestone. Chemically; lime itself is calcium oxide (CaO) and is made by roasting calcite (CaCO3) to remove carbon dioxide (CO2). Lime is also called calx or quicklime. Quick Lime is very caustic and can even dissolve human bodies.

When lime is mixed with water, lime slowly turns into the mineral portlandite (dense) in the reaction CaO + H2O = Ca (OH)2. Lime is mixed with an excess of water so it stays fluid, this is called slaking and the lime resulting is called slaked lime. Slaked lime continues to harden over a period of weeks. Lime has to be mixed with sand and other ingredients to take form of slaked lime cement, that can be used as mortar between stones or bricks in a wall or spread over the surface of a wall There, over the next several weeks or longer, it reacts with CO2 in the air to form calcite again(artificial limestone)

A. Manufacturing Of Lime

Lime is usually manufactured by burning limestone, in the process driving off carbon dioxide leaving the clinker of calcium oxide and quick lime. When quick lime is slaked with water, it disintegrates into fine grained powder depending on the volume of water added. The pure slaked lime formed in this way is said to be as fat lime. It can be used for construction of masonry but it hardens quickly in air. Masonry buildings that were built in the past by with fat lime are now demolished as there strength is very less than the strength when lime concrete was placed.

Hydraulic lime is one of the advanced form of fat lime. It is manufactured by addition of fat lime with surkhi (clay rich in silicates).Hydraulic lime can be made into satisfactorily mortar that achieves strength similar to that of cement mortar.

II. PROPOSED METHODOLOGY DURING THE TENURE OF RESEARCH WORK:

The raw materials used in this experimentation were locally available and these included most common binding agent as OPC, fine aggregates is sand procured locally and Lime stone powder a Tap water is used for mixing and curing as it is easily available. The material used for coarse aggregate will be having minimum particle size of 4.75mm. Do a thorough cleaning to remove clay particles.

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A. Selection Of Materials

1) Cement.
2) Partial replacing LPS(lime stone powder)
3) Fine aggregate
4) Coarse aggregate

Figure 3.1: Lime Stone Powder

The main objective of this project work is to study the mechanical properties of concrete containing the cement is replacement of limestone powder.

In this project M15 & M20 grade of concrete was used to evaluate mechanical properties of concrete. The cement is partial replaced by limestone powder. The cement replacement four test groups the percentages are 10%, 15%, 20% and 25% limestone powder in test series. Casting the concrete cubes, beams and cylinders and 7, 28 days were tested. The following tests were conducted.

a) Specific Gravity Test
b) Sieve Analysis Test
c) Soundness Test
d) Compressive strength test for cubes
e) Flexural strength for beams
f) Split tensile strength test for cylinders

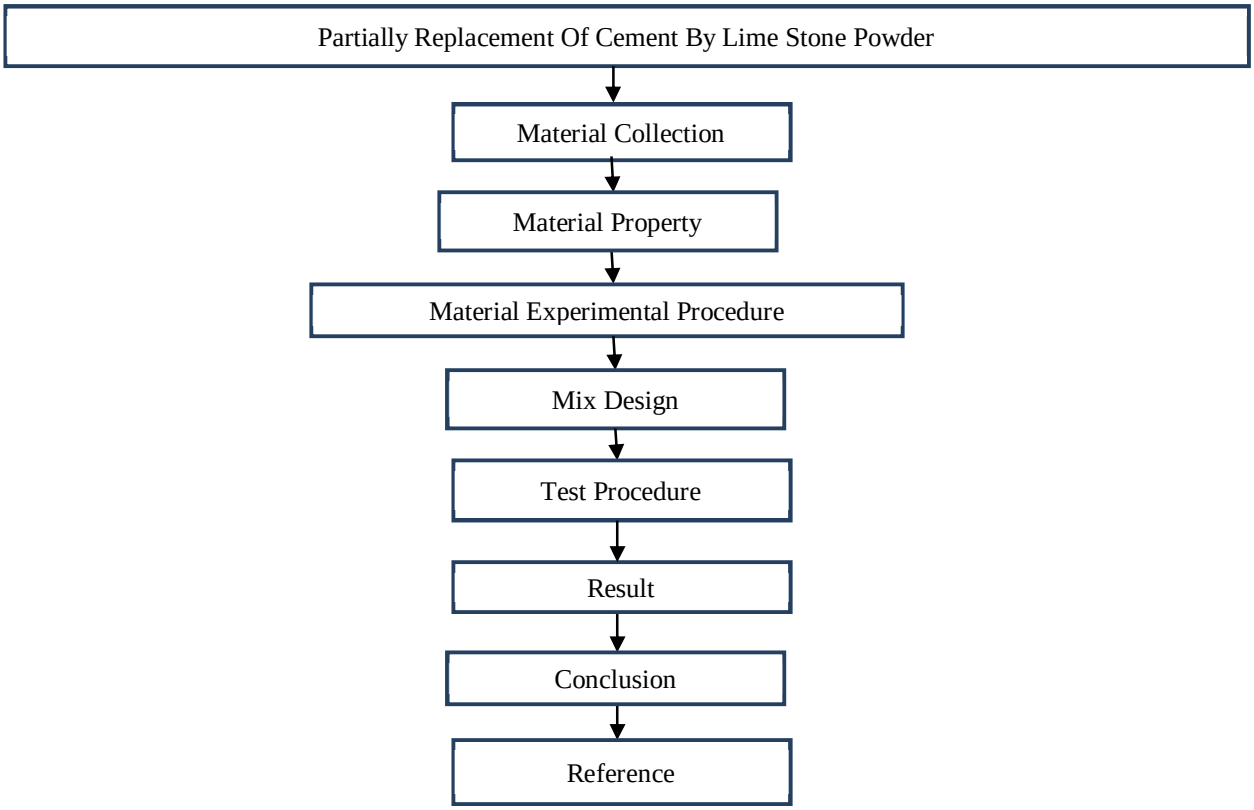

Figure 3.2: Flow chart of the Methodology adopted

B. Tests On Materials

Table 3.1: Tests on materials

S. No	Material	Test	Apparatus
1.	Cement	Specific Gravity	Le-Chatelier flask
		Standard Consistency	Vicat's apparatus
		Initial and Final Setting Time	Vicat's apparatus
		Compression Test of Cement	Mechanical vibrating machine
		Water Absorption Test	
2	Fine aggregate	Sieve Analysis of fine aggregate	Sieve shaker
		Specific gravity of fine aggregate	Pycnometer
3	Coarse Aggregate	Aggregate crushing value	Compression testing machine
		Aggregate impact test	Impact testing machine
		Specific gravity	Wire Basket

C. Material and Mix Proportions

The materials used in the investigation and their properties are explain below.

1) *Cement:* Ordinary Portland cement of 53 grades from Sri Bhavya cement brand conforming to IS: 8112-1989 and IS: 12269-1987 is used in this experimental work

2) *Limestone Powder:* The Limestone powder is used for the replacement of cement is brought from Guntur, Andhra Pradesh, India. The performance of concrete mass with limestone powder is replacement for cement. The percentages of limestone powder are 10% ,20% and 30%.

3) *Fine Aggregate:* Fine aggregates generally consist of natural sand or crushed stone with most particles passing through 9.5 mm sieve. Fine aggregate fine sand were purchased from a nearby crusher in Guntur area, typically the same material used in normal concrete mixture.

4) *Coarse Aggregate:* The coarse aggregate are stones retained 4.75mm sieve. Nearly all natural aggregate originate from bed rock. Coarse aggregate are different shapes like rounded, irregular or partly rounded, angular, flaky etc. rounded particles full irregular and sometimes shaped on coarse aggregate.

5) *Water:* The water helps from the strength giving cement and required workability to the concrete. Portable water is used the concrete mix. The quality and quantity of water is used the concrete mix to check carefully.

a) *Mix Design:* In this process selecting suitable material of concrete and determine relative amount to produce the concrete to required strength, durability and workability economically possible it is concrete mix design.

b) *Mix Proportion:* The M15,M20 & M25 grade of concrete was prepared the mix design IS: 10262-2009 recommendations are taken. The mix proportions are cement :sand : aggregate with water-cement ratio is desirable according to IS: 10262-2009 recommendations.

c) *Mixing:* The individual mix ingredients are weighed with their proportions and then the material is place the tray. The materials are mixed thoroughly mixed in dry conditions before added all ingredient. The prepared mix was immediately used for testing fresh mix for workability. In the properties of fresh concrete and tensile strength of hardened concrete were examined.

i) Conventional concrete.

ii) Cement replacement by lime powder by 10%, 20% & 25% and sand replacement respectively.

iii) The lime powder each percentage constant and above samples was test for compressive strength, split tensile strength, flexural strength test.

6) *Comparison:* Comparison of 7days and 28days cube crushing strength of M15 , M20 & M25 grade concrete using locally available cement and Limestone Powder as binding Material.

III. RESULT

Replacement	Mix Grade	&7 Days			28 Days		
		Trial1	Trial 2	Mean	Trial1	Trial 2	Mean
0%	M15	9.87	9.93	9.9	14.91	15.02	14.97
10%	M15	10.02	10.08	10.05	15.05	15.21	15.13
20%	M15	9.91	9.96	9.93	14.93	14.98	14.96
30%	M15	9.71	9.82	9.77	14.76	14.81	14.79
0%	M20	13.21	13.36	13.27	20.09	20.16	20.13
10%	M20	13.38	13.45	13.42	20.00	20.21	20.10
20%	M20	13.25	13.35	13.30	19.97	20.02	20.0
30%	M20	13.18	13.29	13.23	19.85	19.89	19.87
0%	M25	16.91	17.02	16.97	24.86	24.98	24.92
10%	M25	17.09	17.26	17.18	24.87	25.01	24.94
20%	M25	17.02	17.18	17.10	24.82	24.87	24.85
30%	M25	16.59	16.63	16.61	24.71	24.79	24.75

Table 6.1 Summarized compressive strength

The compressive strength for the concrete mix gradually increased with the increase in % of Lime added up to10- 20% of cement replaced by Lime

As the table shows the concrete mix prepared by replacing the 30% of cement by the Lime is having the more compressive strength upto 10-20% replacement but slightly decreses with extra additional % of replacement upto 20%. If there is a need of concrete with high compressive strengths in same grade of concrete the mix with 30- 35% Lime can be adopted.

High compressive strength can be seen in the concretes with 35% of Lime replaced in the place of cement.

Replacement of natural cement by 30% artificial Lime gives the maximum compressive strength upto 10-20% replacement.

The concrete mix is more workable when 10-20% of cement is replaced by Lime as the slump values and compacting factor values are high when compared to conventional mix. Finally the concrete mix with 10% of cement replaced by Lime gives the best mix with high compressive strength with high workability.

Considering, the acute shortage of river sand, huge short coming on cement, high cost, greater impact on damages and environmental effects, The Construction Industry shall start using the Lime to full extent as alternative, reduce the impacts on environment by not using the cement.

IV. CONCLUSION

A. It was found that as we increase the percentage of lime stone powder the percentage of strength decreases with a kink at 20%

B. This 7 days strength for shows a gradual decrease in strength however a sudden change is noted at 30%.

C. The value at 20% for 7 days compressive strength was found to be respectively 9.93 MPa, 13.30 MPa, 17.10 MPa. Of respective mix grade of M15, M20 & M25.

D. This 28 days strength for shows a gradual decrease in strength however a sudden change is noted at 30%.

E. The value at 20% for 28 days compressive strength was found to be respectively 14.96 MPa, 20.00 MPa, 24.85 MPa. Of respective mix grade of M15, M20 & M25.

F. It can be concluded that the replacement of Lime stone Powder can be replaced upto 20% to be used in members having high load bearing requirement

V. FUTURE SCOPE

There is a vast scope of research in the recycled aggregate usage in concrete. The possible research investigations that can be done are mentioned below:

A. The test can be carried out for different grades of concrete.

B. The use of admixtures in the test can be performed to get improved strength.

C. The durability of such a concrete has to be tested for beams and columns with varying proportions of crushed coconut shell of different ages.

D. A study to deem the correct proportion of lime stone dust with their particle size for special effective concrete.

E. Durability studies on lime stone dust powder concrete should be carried out to assess its behavior in aggressive environments.

F. The behavior of limestone powder in cement matrix can also be an area requiring future research.
G. Sustainability of lime replaced cement in high rise buildings.
H. To design a prototype product 'Development material of the concrete mix by using lime stone powder' as partial replacing material as the binding material of the product.

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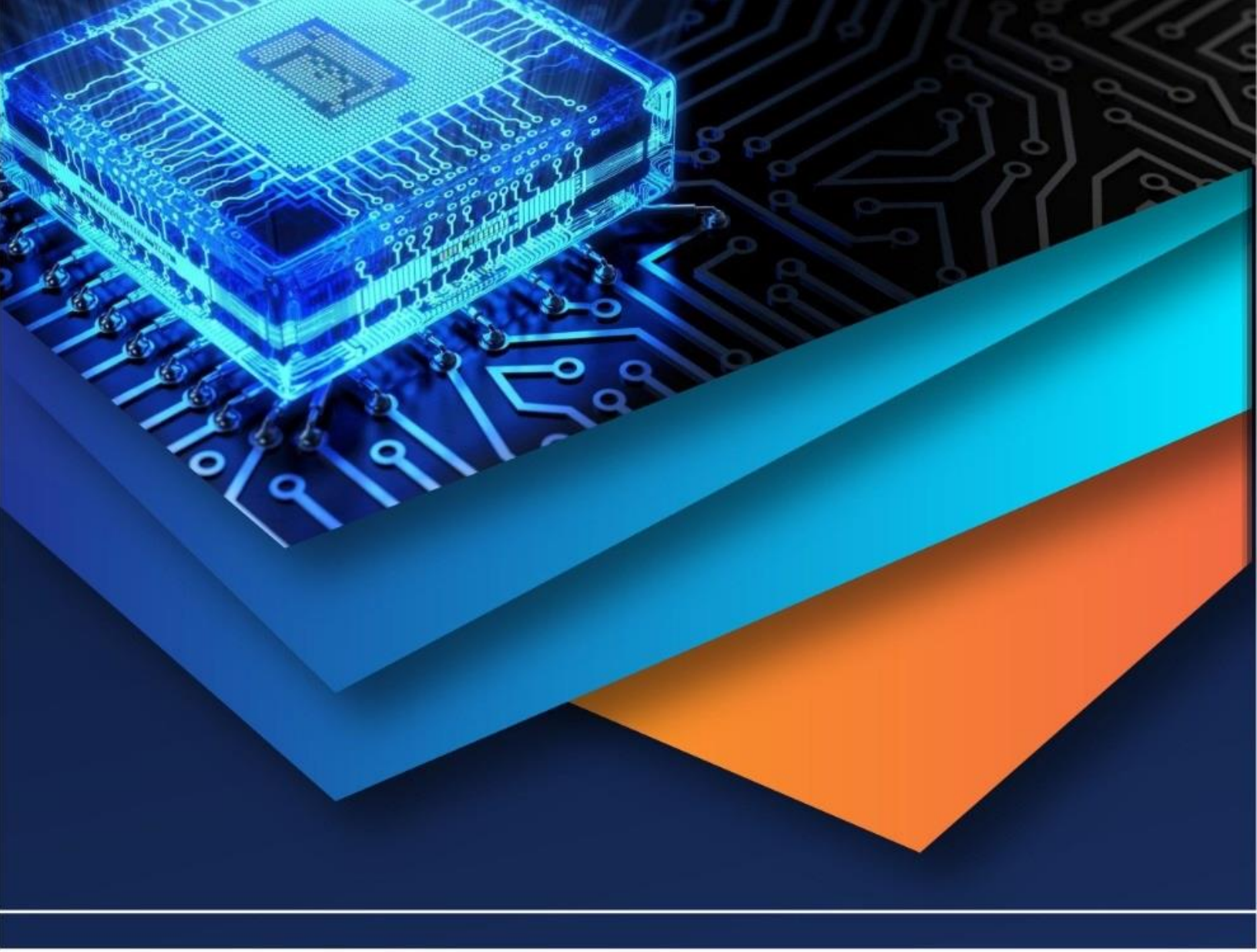

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