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Experimental Study on Lime Stone Powder as a Binding Material in Concrete Mix

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ABSTRACT

Extensive research is in progress in the field of concrete technology in finding suitable replacement for cement. With the rapid growth in construction industry leading to increased consumption of concrete which further leads to increase in production of cement, resulting in global sustainability problems. An attempt has been made to study the effects on properties of both fresh and hardened concrete by using lime stone powder as an alternative binding material to cement at various percentages (5%, 10% and 15%).
Keywords : Lime Stone Powder, Slump, Compressive Strength

I. INTRODUCTION

With the revolution in construction industry, the demand for cement concrete has increased tremendously over a period of certain years. Extensive research has been under progress in the field of cement concrete to find suitable alternative materials in the place of conventional materials which is essential for global sustainability. cement has the largest footprints when it comes to both carbon dioxide release and energy consumption. Lime stone powder, is one of such material which possess cementitious properties and can be used as partial replacement for cement with the improved properties of concrete such as workability, bleeding control etc. Use of limestone also results in improved density of concrete.

Even though an increase in early strength was observed, loss of strength at later ages due to incorporation of limestone has also been reported.

Literature Review

Wendimu Gudissa etal. (2010) The investigation has revealed that, Replacement of ordinary Portland cement by fine limestone powder from 5% to 10% with Blain fineness value of 4000 to 4500 cm^2/gm satisfies the standard compressive strength requirement of high early strength cement as per the standard requirements. The results of grinding shows that, as the replacement of limestone increases by weight, increases in cement fineness and decrease in grinding time were observed compared to pure ordinary Portland cement. Since limestone is softer to grind than pure clinkers the energy required is also relatively less than required to grind pure clinker for Portland cement production. The test results indicated that, the compressive and flexural strengths of cement mortar decrease with the increase in the percentage addition of limestone content for same blain fineness and also increase with the increase of fineness

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Have concluded that, use of lime stone powder and silica lead to acceleration in hydration of cement and cement can be replaced by these filler up to 40%, with minimum impact on initial setting times and are helpful in applications where controlled setting is more important than development of high strengths. Also it is reported that, the rate of hydration with the use of lime stone is more than that of silica. Also improvement in rheological properties was observed due to reduction in yield stress and consistency factors.

Tarun R. Naik etal. This study gives the information about increase of effective w/c, accelerate early-age strength, dilution of cement paste and cement concrete mix effects the rate of hydration by using the limestone powder filler in cement. The addition of limestone powder filler to fine cement pastes and mortars reduces the diffusion coefficient of chloride ions. Using limestone powder in concrete proves economic and environmental advantages by reducing the usage of Portland cement in constructions and CO2 emission, as well as improving the early and the later age compressive strength. Limestone powder to cement changes the phase composition of pastes in comparison with pastes without addition. They also showed limestone powder prevents the transformation of ettringite to sulphoaluminates (monosulphate, hemisulphate and solid solutions), instead of which carboaluminate phases more resistant to sulphate attack (monocarbonate, hemicarbonate) are formed.

Materials and Methodology

The physical properties of materials per performed as per IS standards. The mix design is performed as per IS 10262-2009. Then the cubes and cylinders are casted by varying the percentage of lime stone powder as a binding material in concrete mix varies from 0, 5, 10 & 15%. Tests performed on fresh and hardened concrete. The specimens were weighed after curing of 7, 14 & 28 days to know the significance changes in density before testing compressive strength.concrete mix varies from 0, 5, 10 & 15%. Tests performed on fresh and hardened concrete. The specimens were weighed after curing of 7, 14 & 28 days to know the significance changes in density before testing compressive strength.

Table.1 Chemical Composition of lime stone powder

Component	Lime stone powder (%)
Sio_2	11.25
Al_2O_3	2.76
Fe_2O_3	1.15
CaO	43.77
SO_3	0.27
MgO	2.15
Na_2O	0.35

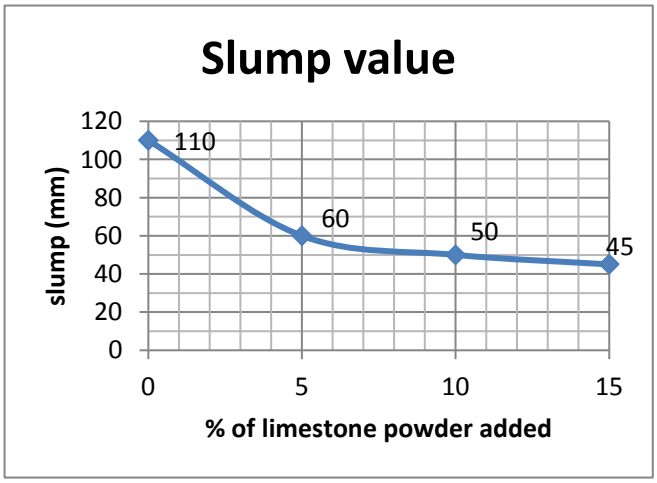
Table.2 Physical Properties of materials

SI no.	**Material**	**Results**
1.	Specific Gravity	3.15
2.	Compressive strength(N/mm^2)	54
3.	Specific gravity of fine aggregate	2.53
4.	Water absorption of Coarse agregate	0.5%
5.	Specific Gravity of Coarse aggregate	2.72
6	Specific Gravity of Lime stone Powder	2.48

Table.3 Slump value for different mix with water cement ratio of 0.4

Sl No.	**% of limestone powder added**	**Slump(mm)**
1.	0	110
2.	5	60
3.	10	50
4.	15	45

Figure.1 Slump value for different % of limestone powder



Tale.4 Density of concrete

% of limestone powder added	**Density (kg/m^3)**
0	2506.6
5	2488.8
10	2471.1
15	2444.4

Figure.2 Density of concrete mix v/s Percentage of limestone powder

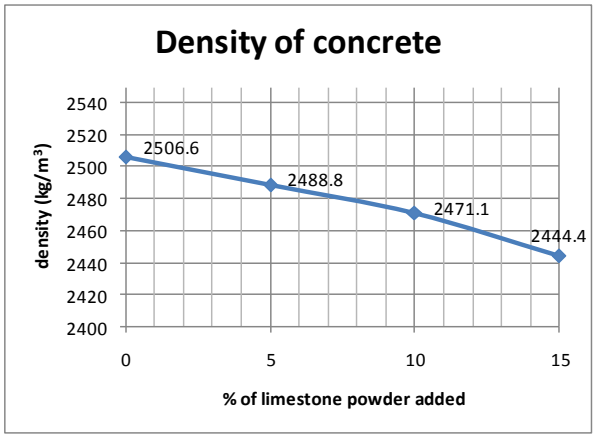


Table.5 Compressive strength

SL No.	**% of limestone powder**	**Average compressive strength (Mpa)**		
		7 days	**14 days**	**28 days**
1.	0	45.23	53.01	62.96
2.	5	46.6	50.7	60.8
3.	10	42.77	48.63	55.31
4.	15	31.2	35.4	39.5

Figure.3 Compressive strength v/s Percentage of limestone powder

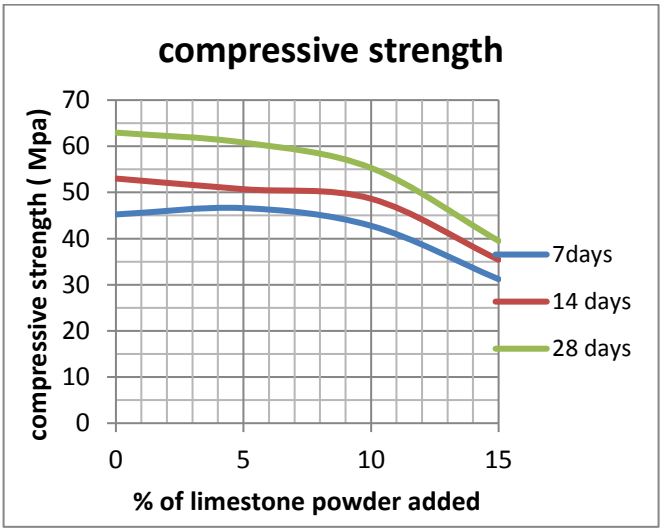
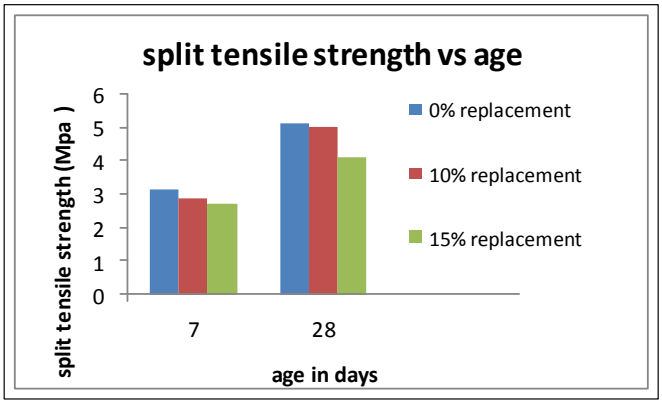


Table. 6 Tensile Strength

SL No.	% of limestone powder added	Tensile Strength(Mpa)	
		7days	28 days
1.	0	3.182	5.14
2.	10	2.9	5.04
3.	15	2.74	4.14

Figure. 4 Split Tensile v/s Percentage of limestone powder



IV. CONCLUSION

The following conclusions can be drawn from the obtained experimental data:

Maximum 10% of cement can be replaced by limestone powder without change in the strength of the concrete. Required split tensile strength can be achieved by 10% replacement of cement by limestone powder. The addition of limestone filler in to Portland cement results in increase in cement fineness and this fineness of the cement provide higher rate of hydration and hence faster development of the early strength. The use of limestone powder in cement and concrete provides economic and environmental advantages by reducing Portland cement production and CO2 emission. From the standard consistency results, it seems that limestone has no effect on water requirement compared to Portland cement. Moreover, the increase in level of fine particles caused requires much water.

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