STUDY THE PROPERTIES OF HIGH STRENGTH CONCRETE WITH ADDITION AND ALTERING THE LIMESTONES DUST AND MARBLE DUST

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Abstract

Because of constantly expanding amount of waste materials and developing ecological mindfulness, solid waste management is the prime concern in the world. Scarcity of resources and daily increase in demand, the world is surprisingly turning to investigate properties of waste material and finding its valuable properties so that it may use as a replacement of these natural resources.

The experimental investigation was performed to evaluate the strength and durability etc. properties of high strength concrete M40 and M60 grades of concrete mixes, in which natural sand was partially replaced with Marble dust, Limestone dust and mix of Marble dust & limestone dust (LIMA), with five percentage (0%,25%,50%,75%,100%). Slump test, compression test and flexural strength test were carried out to evaluate the strength of concrete.

The Test results were clearly showing that there is increase in compressive strength and flexural strength for both grades of concrete mixes (M40 and M60) with inclusion of Marbledust, Limestone dust and mix's of Marble dust & limestone dust (LIMA) up to 50% replacement.Percentages increase of strength is higher in marble dust for both grades of concrete with any percentage replacement

Key words: High Strength Concrete, Marble Dust, Lime Stone Dust, Fine aggregate, coarse aggregate, Compressive Strength, Flexural strength, Workability

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I. INTRODUCTION

Concrete is that the most generally used construction material within the world, and is second solely to water because the most utilised substance on the world .It is formed by mixing cementing material, water and aggregates and sometime admixture in required proportion. The mixture which is formed by mixing is then placed in forms and allowed to cure, hardens to cure into rock like mass known as concrete. The hardening of the concrete is caused by chemical reaction between water and cement and it continues for a long time, and consequently concrete grows stronger with age. The hardened concrete which is formed can be considered as an artificial stone in which the voids of larger particles are filled by the smaller particles and voids of smaller particles are filled by cement. The strength, durability and other characteristics of concrete depend upon the ingredients, on the proportion of mix, the method of compaction and other controls during placing, compaction and curing.[22] The advances in concrete technology have passed the way to make the best use of locally available material by judicious mix and proper workmanship, so as to produce concrete satisfying performance requirements.

Due to decreasing natural resources, increasing demand there is danger arises for future generation of these natural resources therefore to make the concrete industry sustainable, in place of natural resources the use waste material s the only solution. In limitless quantity of these raw material are found which are used for making cement and aggregates are essential for the concrete.[12] To overcome the above problem, studies have been initiated in the use of non conventional materials for partial replacement of cement by fly ash in concrete, recycled and waste product such as quarry dust, marble dust and limestone dust in concrete. Due to rapid industrialization have contributed to the accumulation of industrial waste and by- product which pose disposal and environmental problem and causing health hazards, therefore new concept arises green concrete

Benefits of Lime Stone Dust in Concrete:

• When it adds in the concrete it decreases the in initial and final setting time of the concrete.
• It has greater surface area, smooth textured and spherical shape therefore satisfy the properties of natural sand
• Limestone powder increases the plasticizer dosage in order to keep the target slump
• Addition of limestone increases the compressive strength of concrete, decreases cost and make it economical
• With the increase in limestone dust viscosity of the concrete increases
• Addition of limestone also increases the chloride penetration resistance of the concrete

Benefits of Marble Dust in Concrete
• Marble dust retard the setting time of cement
• On the partial replacement of cement with marble powder it affect on workability of concrete .
• Marble dust can be used as a aggregate as well as binder in concrete .
• Marble dust increases the flexural strength and compressive strength as compared to the conventional concrete
• Homogeneous mix of the concrete is created and reduces the segregation and bleeding
• It is used as a filler in paint and is also used to make plasters such as marmoreal and venetian plaster

II. OBJECTIVE OF THE WORK

Replacement of natural sand by waste material in concrete the following aims are to be performed:
• To find out the optimum percentage of replacement of natural sand in concrete by waste product such as limestone dust and marble dust
• The replacement is done in high strength concrete M40 and M60
• Mix design of high strength concrete is created and various proportion of replacement 0%, 25%,50%,75%and 100% are taken
• The workability, compressive strength and flexural strength test are performed in the concrete by making cubes and beams.

III. NEED FOR THE PROPOSED WORK

Due to decreasing natural resources increasing cost the concrete construction industry tried alternate which is economical and easy available and has realized that the waste material are costless and widely available waste product that can be used as a partial replacement of natural sand . It offers a best solution to the problem of increasing demand for concrete and make it economical. By this study we can decrease the pollution of the environment that are more important to economic development. The need of the study also offer the technology of limestone dust and marble dust concrete, which are needed for infrastructure and housing in accost effective and ecological manner . The use of waste material like marble dust and limestone dust will help to enhance the sustainability of the concrete industry and also preserve the environment.

IV. LITERATURE REVIEW

Lime Stone dust and Marble dust (LIMA) is used as substitute to sand. The Lime Stone dust and Marble dust (LIMA) otherwise a waste material and directly can cause environmental problem, if used properly it will conserve valuable sand deposit. The Lime Stone dust and Marble dust (LIMA) has advantages of better performance, durability and optimal production cost, better strength, beside being eco-friendly. A brief review of the work carried out by researchers on use of Lime Stone dust and Marble dust (LIMA) in concrete is presented below.
• Burak (2007) investigated by the experiment use of quarry dust limestone powder in self compacting concrete. He found from his experiment that quarry waste limestone powder can be successfully used as a ingredients in self compacting concrete it increases strength and decreases the plasticizer dosage up to a certain limit of mixing. If we further increases the amount of quarry dust limestone powder it decreases the strength.
• Ilangovna et al (2008) present with the help of experiment of quarry rock dust can replace 100% of natural river sand in concrete. They use various mix design method India, ACI, USBR, RN. No 4 and British to proof this. He prepared three grades of concrete M20, M30, M40 by the experiment concluded that quarry rock dust can replace 100% natural river sand and give 10-12% higher strength as compared to conventional concrete. Drying shrinkage, durability under sulphate and acid action in quarry rock dust prepared concrete is higher natural sand prepared concrete and also shows that permeability of quarry dust concrete is less as comparison to conventional concrete.
• Hammed & Sekar (2009) investigate the green concrete which is made up of industrial waste to save most valuable our natural resources for sustainable development. In research he replaces the fine aggregate with 50%

marble powder and 50% quarry dust in concrete. They concluded that concrete made of marble powder and quarry dust gives good workability and also shown self compacting behavior of concrete without affecting the strength. They also concluded that if we increase the marble powder, slump flow increases and most important compressive strength of concrete increase by 14% by marble powder and quarry dust as compared to natural sand.

- Shi-Cong & Chi-Sun (2009) investigate by the experiment the use of crushed fine sand in concrete by replacing natural river sand. from this concluded that the slump of concrete of crushed fine sand decreases with increase of crushed fine sand and says this occur due to angularity between the crushed fine sand as compared to natural sand.
- Baboo et al (2011) investigate the partial replacement of cement and sand in mortar and optimum percentage of replacement of sand by marble dust in concrete. He prepared mortar mix of 0 to 20% replacement of cement by waste marble powder and another 0 to 20% replacement of sand by waste marble granules and concrete mix he replaces sand 0 to 20% by waste marble granules. From this he observe that in mortar mix if marble powder replaces cement than strength is reduced with increase in marble powder and when sand is replaced by waste marble granules than increased strength is achieved as compared to control sample. For concrete he observe that marble powder does not affect the slump and by the addition of waste marble granules the compressive and flexural strength increases and higher than a conventional concrete
- Hebhoub et al (2011) investigate the use of marble waste as a aggregate in concrete. In this experiment he can replace fine aggregate, coarse aggregate and coarse and fine both with recycled sand and gravel with proportion of 25, 50,75,100%. By this experiment he concluded that by the addition of marble aggregate the compressive and tensile strength of concrete increases and workability of concrete increases by the addition recycled gravel and recycled sand as compared to natural sand in concrete.
- Malpani et al (2014) investigate the fine sand replacement by marble powder and quarry dust. He mixes marble powder and quarry dust and replaces fine sand by this mix in concrete. By the experiment he concluded that by adding mixture of marble powder and quarry dust in concrete slump value decreases as compared to natural sand. He conclude that 80% of natural sand can be replaced by mix of marble powder and quarry dust which give higher compressive and tensile strength as compared to normal concrete and make concrete economical.

V. DESCRIPTION OF MATERIAL

Properties of Cement

Sr.No	Characteristics	Values Obtained Experimentally	Values Specified By IS 8112:1989
1	Specific gravity	3.15	3.15
2	Standard Consistency percent	27	24
3	Initial Setting Time (minutes)	45	30 (minimum)
4	Final Setting Time (minutes)	360	600 (maximum)
5	Compressive Strength 3 Days 7 Days 28 Days	 24.5 N/mm^2 35.2 N/mm^2 44.6 N/mm^2	 23 N/mm^2 (minimum) 33 N/mm^2 (minimum) 43 N/mm^2 (minimum)

To produce high strength concrete, the first step is to select the materials. In this study, the aggregate used is coarse aggregate which has nominal size of 20 mm is used. This use is based on the previous research which conclude that use of small coarse aggregate increases the concrete strength as compared to the larger aggregate so smaller is stronger than the larger ones. The concrete using larger aggregate is low strength is caused by larger size of aggregate makes the transition zone become larger and more vary.

Sieve Analysis of Coarse Aggregate

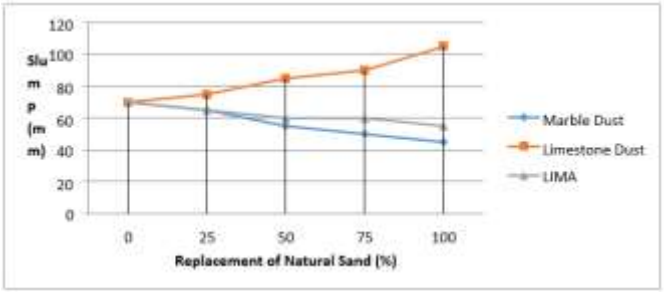
Weight of sample taken=3000gm					
Sr. No	**IS-Sieve (mm)**	**Wt. Retained (gm)**	**%age retained**	**%age passing**	**Cumulative % retained**
1	80	0.00	0.00	100.00	0.00
2	40	0.00	0.00	100.00	0.00
3	20	68.5	2.28	97.72	2.28
4	10	2776.5	92.55	5.17	94.83
5	4.75	113.5	3.78	1.38	98.62
6	Pan	0.00	0.00	0.00	
Total		3000.00	**SUM**		195.73+500
Fineness modulus 6.95					

Physical Properties of Natural Sand

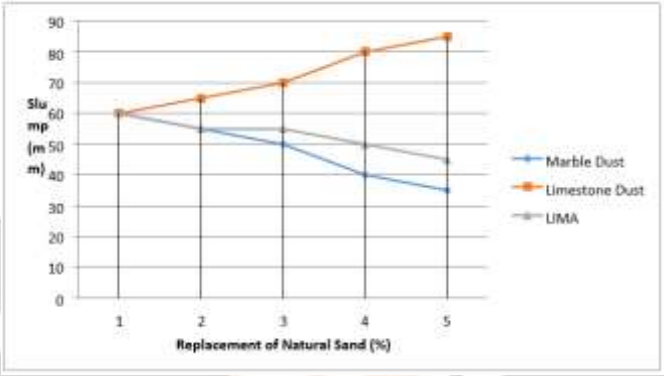
Property	Natural Sand
Specific gravity	2.62
Absorption (%)	3.38
Moisture content (%)	NIL
Sieve analysis	Zone-II

VI. ESULT

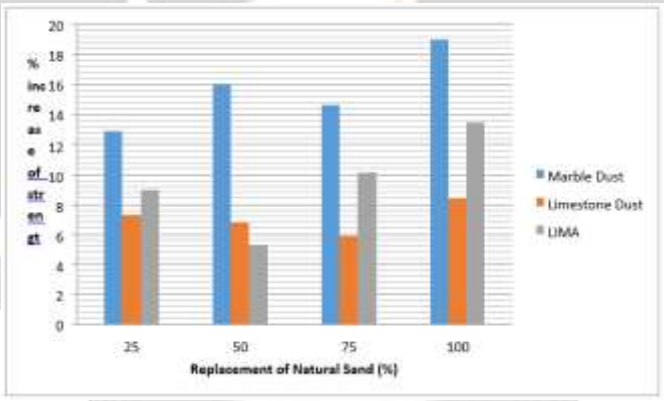
Workability of concrete is checked by Slump cone test was conducted for each mix design
1Comparison of Slump at Varying Percentage of Replacement (M40)



Comparison of Slump at Varying Percentage of Lima (M60)

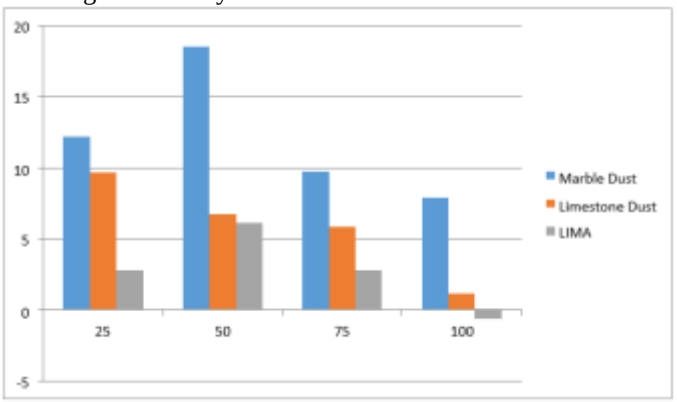


Effect of mix of marble and limestone dust (LIMA): The result of compressive strength of high strength concrete with mix of marble dust and limestone dust with different addition percentage are given in Table 4.4. using mix of marble and limestone dust as a replacement of natural sand in concrete results that compressive strength increased about 8.98, 5.33,10.11,13.48 and 2.78,6.1,2.78,-0.678 in 7 and 28 days for 25%,50%,75%,100% replacement respectively



Comparison in Increase of Strength in 7 Days

Comparison in Increase of Strength in 28 Days



VII. CONCLUSION

Based on the results which are presented above, the following conclusions can be drawn:

1. The compressive and flexural strength is greater in marble dust replacement as compared to limestone dust replacement and combination of both marble dust & limestone dust mix replacements
2. Initial strength and final strength of concrete (M40 & M60) with marble dust or combination of both marble dust & limestone dust is always increases with any percentage replacement of natural sand as compared to regulate concrete of same grade.
3. By increasing the grade of concrete, the flexural strength of limestone dust concrete and marble dust concrete increases suddenly.
4. Slump value of marble dust concrete decreases with increase in marble dust percentage and slump value of limestone dust concrete increases with increases in limestone dust percentage
5. Natural sand can be fully replaced by marble dust or combination of both marble dust & limestone dust
6. For maximum increment in strength of concrete, the optimum replacement of natural sand by marble dust or a combination of both marble dust & limestone dust is about 50%.
7. Limestone dust cannot be fully replaced by the natural sand in concrete because decrement of strength occurs above 50% replacement as compared to control concrete. So 50% is the maximum replacement of sand with limestone dust, we can do.
8. Limestone dust and marble dust are the waste materials and its use in civil construction besides reducing environmental polluter factors, will bring several improvements to concrete characteristics. respect to adjacent floors. Thus the building frame behaves in the flexible manner causing distribution of horizontal shear across floors. In presence of infill wall (panel), the relative drift between adjacent floors is restricted causing mass of the upper floors to act together as a single mass. In such case, the total inertia of the all upper floors causes a significant increase in horizontal shear force at base or in ground floor columns. Similarly, increases the bending moment in the ground floor columns.

VIII SCOPE FOR FUTURE WORK

1. Other levels of replacement with waste materials can be researched.

2. Some tests relating to durability aspects such as water permeability, resistance to penetration of chloride ions, corrosion of steel reinforcement, resistance to sulphate attack durability in marine environment etc.

3. The study may further be extended to know the behavior of concrete whether it is suitable for pumping purpose or not as present day technology is involved in RMC where pumping of concrete is being done to massive heights.

4. For use of Rice husk ash (RHA), Wheat Straw Ash (WSA), Fly Ash, (FA), Glass powder(GP)and other waste material concrete as a structural material, it is necessary to investigate the behaviour of reinforced Rice husk ash concrete under flexure, torsion, shear and compression.

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