Experimental Investigation on Mechanical properties of Concrete by Partial Replacement of Cement with Dolomite Powder

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Abstract

Concrete is the most extremely used construction material within the world, which always uses natural resources like lime, aggregates and water. The production of cement in world has increased greatly, due to this cement production emission of CO2 gas has been increased tremendously, ultimately environmental pollution increased to very large extent. This affect to environment has been reduced by cement has been replaced by some supplementary materials like Dolamite Powder or Fly ash or GGBS & so on. Dolamite. Powder was conducted detailed study and lots of research work has been made on other waste materials and it is found there is a great future scope for research on Dolamite Powder as a replacement to cement, sand or both. Now in our case, cement has been replaced partially with in varying proportions likewise from 0% to 20% and its effect has been analysed on the standard consistency, soundness, setting times of cement and compressive strength of cement mortar mixes. The cubes and cylinders of concrete were casted for variable content of dolomite powder Concrete is the most extremely used construction material within the world, n which always uses natural resources like lime, aggregates and water. By the effective utilization of dolomite powder as a construction material, the objective in reduction of construction cost can be acheived. An attempt was attained to explore the possibility of using dolomite as a replacement material for cement M25 grade concrete and its specimens were made by replacing 0, 2.5%, 5% & 7.5% of cement by dolomite powder. The Compressive, Split tensile and Flexural strength of the specimens were found on the 28th days. Optimal replacement percentage of dolomite was determined. The cement should be replaced with 5% of dolomite powder to get the optimal results for concrete. At the time of testing cubes, cylinders and beams we have got good results at 5% replacement only. The production of cement in world has increased greatly, due to this cement production emission of CO2 gas has been increased tremendously, ultimately environmental pollution increased to very large extent

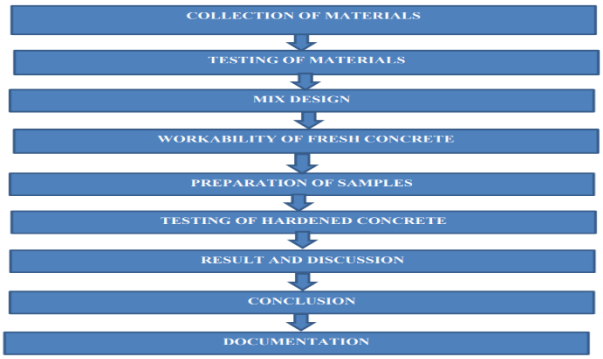
INTRODUCTION

The reduction of cement content in concrete is one of the persistent global sustainability concerns of the 21st century. Of all the ingredients in concrete (the primary ones being cement, supplementary cementitious materials, water, and coarse and fine aggregates), cement has the largest footprints when it comes to both carbon dioxide release and energy consumption. While the feasibility of achieving higher levels (greater than 50 %) of cement replacement using fly ash, a residual product from coal combustion, has been demonstrated in the laboratory and in practice, questions remain about the stability of the supply of quality fly ash and local shortages have indeed been encountered in parts of the U.S. in recent years. Similarly, high replacement mixtures using slag have demonstrated good performance, but the worldwide slag supply is quite limited when compared to the annual demand for concrete for new construction and repair. Cement manufacturing produce a large amount of undesirable products, mostly CO2, which result in greenhouse effect that leads to the earth temperature increase. In addition, cement production process is energy intensive as well as raw materials demanding. Technical development to lower the environmental impact of cement production achieved by the reduction of cement demand (blended cement). Therefore, many studies have considerable attention on mineral additions such as slag, natural pozzolana, fly ash and Dolomite in order to reduce energy consumption and CO2 emission. Nowadays Dolomite has been widely used to add or replace a part of Portland cement to produce Portland Dolomite cement and Portland composite cement. Consequently, all available materials options must be investigated in earnest in the quest to reduce cement content in concrete. One material that has been used in concrete in some parts of the world for many years, but is receiving renewed interest globally, is Dolomite powder, typically available in the form of the calcite polymorph of calcium carbonate and with varying percentages of magnesium (carbonate). Because Dolomite is the major source of calcium for cement production, as well as being one of the most commonly employed aggregates, its presence is ubiquitous within the concrete industry.

METHODOLOGY:

Assessing the physical & chemical properties of materials. 2) Mix design for concrete are made using the properties constituents of concrete. Grade of concrete is taken as M25 and the mix design are done as per IS: 10262-2009 and IS: 456-2000 for different dolomite powder percentage replacing of cement, using M sand as fine aggregate. All mixtures are

prepared for room temperature. 3) Mix design of M-25 grade concrete by partially replacement of cement with dolomite powder 2.5%, 5% and 7.5% by weight of cement. 4) Test on fresh concrete using slump test. 5) Test on hardened concrete using cube test, flexural test & split tensile test



Flow chart showing different activities

MATERIALS USED:

Cement: A cement is a binder, a chemical substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel (aggregate) together. Cement mixed with fine aggregate produces mortar for masonry, or with sand and gravel, produces concrete. Concrete is the most widely used material in existence and is behind only water as the planet's mostconsumed resource. Ordinary Portland cement (OPC) of 53 grade was used throughout the course of the investigation. The physical properties of the cement as determined from various tests conforming to Indian Standard IS: 1489:1991. Aggregates: are those chemically inert materials which when bonded by cement paste form concrete. Aggregates constitute the bulk of the total volume of concrete and hence they influence the strength of concrete to great extent. The properties of concrete are directly related to those of its constituents and as such aggregate used in a concrete mix should be hard, strong, dense, durable, and free from lumps of clays, loam, vegetable and other such foreign matter. The presence of all such debris prevents adhesion of cement on the surface of aggregates and hence reduces the strength of concrete. Fine Aggregate: The material which passed through I.S. Sieve No. 480 (4.75mm) is termed as fine aggregates. Function of fine aggregates is to make concrete dense, by filling voids of coarse aggregates, reduces the shrinkage of cement and makes an economical mix. Natural sand or crushed stone dust is used as a fine aggregate in concrete mix. Sand may be obtained from sea, river, lake or pit, but when used in a concrete mix, it should be properly washed and tested to ascertain that total percentage of clay, silt, salts and other organic matter does not exceed specified limit. Sand as obtained from the above sources may be round or angular in grains. Angular grained sand has good interlocking property which results in a strong mix while rounded

grained sand does not afford sufficient interlock in the matrix. But for our project m-sand is used. 3.2.2.2 Coarse Aggregate: The material whose particles size such that they are retained on I.S. Sieve No. 480 (4.75mm) is termed as coarse aggregates. Coarse aggregates, like fine aggregates, must consist of sound durable inert particles to make the concrete strong and weather resistant. It should be free chemicals or coating or clay or other fine material that may affect bonding of cement paste. The size of the coarse aggregates used depends upon the nature of work. Crushed hard stone and gravel are the common materials used as coarse aggregates for structural concrete. Coarse aggregates are usually obtained by crushing granite, gneiss, crystalline Dolomite stone and good variety of sand stone etc. As far as possible flaky and elongated pieces of stone should be avoided. 3.2.3 Dolomite Powder: Waste DOLOMITE powder was collected by crushing the DOLOMITE which is collected from DOLOMITE quarry. It was sieved by IS-90 micron sieve before mixing in concrete. The sample was collected from Shahabad Taluk, Gulbarga district, Karnataka. The area is rich in DOLOMITE content

Pictures during casting of moulds

Fig 3.7.1 Hand Mixing

Fig 3.7.2 Cleaning of Moulds

Fig 3.7.3 Vibrating the moulds

Fig 3.7.4 Finished Moulds

RESULTS AND DISCUSSIONS

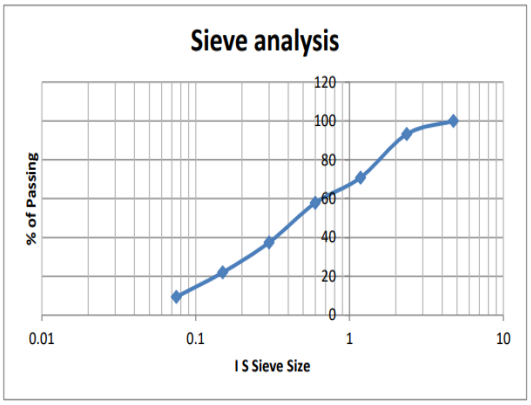
Physical properties of cement			
SI no.	**Physical Properties Of OPC 53 Grade Cement**	**Results**	**Requirement as per IS: 8112-1989**
1.	Specific Gravity	3.15	3.10-3.15
2.	Standard Consistency (%) including different % of DOLOMITE powder	27	25-35
3.	Initial Setting Time(Minutes)	32	30 minutes minimum
4.	Final Setting Time(Minutes)	300	600 minutes maximum
5.	Compressive strength(N/mm^2)	54	53 N/mm^2

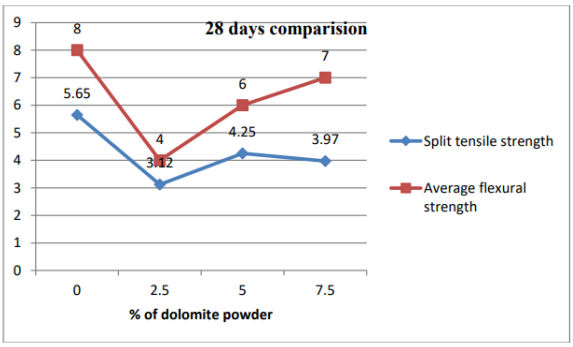
Specific Gravity of fine aggregate by pycnometer

Tabular column for Specific Gravity of fine aggregate	
Empty Weight of Pycnometer (W_1)	0.62kg
Weight of Pycnometer + 1/3rd F.A (W_2)	1.22kg
Weight of Pycnometer + 1/3rd F.A + Water (W_3)	1.87kg
Weight of Pycnometer + Water(W_4)	1.51kg

Specific gravity = 2.53

Graph 1 Sieve analysis of fine aggregate





CONCLUSION

This study reports the effect of the amount of Dolomite powder on concrete properties. The following conclusions can be drawn from the obtained experimental data: • Maximum 5% of cement can be replaced by Dolomite powder without change in the strength of the concrete. • Required flexural strength can be achieved by 5% replacement of cement by Dolomite powder. • The addition of Dolomite 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 Dolomite 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 Dolomite 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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