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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 This affect to environment has been reduced by cement has been replaced by some supplementary materials like Dolamite Powder or Fly ash or GGBS & so on.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

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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. 7 Dolomite powder can also physically improve the denseness of hardened Portland cement paste due to its filling effect. The optimum use of Dolomite powder as a supplementary material to Portland cement has therefore technical benefits, such as improved workability, bleeding control, lower sensibility to the lack of curing, and a little bit increased early strengths. On the other hand, loss of strength at later ages due to incorporation of Dolomite has also been reported. Dolomite and cement have characteristics which make them ideal for specific applications. However, significant problems can arise when cement is introduced to buildings originally constructed and previously maintained using Dolomite mortars. The aim of this study is to know the effect of partial replacement of cement with Dolomite powder on compressive strength and split tensile strength of harden concrete. The concrete is one of two largest producers of carbon dioxide (CO2), creating up to 5% of worldwide man-made emissions of this gas, of which 50% is from the chemical process and 40% from burning fuel. The carbon dioxide CO2 produced for the manufacture of one tonne of structural concrete (using ~14% cement) is estimated at 410 kg/m3 (~180 kg/tonne @ density of 2.3 g/cm3) (reduced to 290 kg/m3 with 30% fly ash replacement of cement). The CO2 emission from the concrete production is directly proportional to the cement content used in the concrete mix; 900 kg of CO2 are emitted for the fabrication of every ton of cement, accounting for 88% of the emissions

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associated with the average concrete mix. Cement manufacture contributes greenhouse gases both directly through the production of carbon dioxide when calcium carbonate is thermally decomposed, producing lime and carbon dioxide, and also through the use of energy, particularly from the combustion of fossil fuels. One area of the concrete life cycle worth noting is the fact that concrete has a very low embodied energy relative to the quantity that is used. This is primarily the result of the fact that the materials used in concrete construction, such as aggregates, pozzolans, and water, are relatively plentiful and can often be drawn from local sources. This means that transportation only accounts for 7% of the embodied energy of concrete, while the cement production accounts for 70%. With a total embodied energy of 1.69 8 GJ/tonne concrete is lower than any other building material besides wood. It is worth noting that this value is based on mix proportions for concrete of no more than 20% fly ash. It is estimated that one percent replacement of cement with fly ash represents a .7% reduction in energy consumption. With some proposed mixes containing as much as 80% fly ash, this would represent a considerable energy savings. One reason why the carbon emissions are so high is because cement has to be heated to very high temperatures in order for clinker to form. A major culprit of this is alite (Ca_3SiO_5), a mineral in concrete that cures within hours of pouring and is therefore responsible for much of its initial strength. However, alite also has to be heated to 1,500 °C in the clinker-forming process. Some research suggests that alite can be replaced by a different mineral, such It has a roasting

Fig.1 Dolomite Powder

OBJECTIVES:

- To achieve the economy by utilizing the quarry waste materials in construction works.
- The use of a quarry waste as an alternative material to partial replacement of cement by Dolomite stone dust.
- To minimize the cost.
- Reducing Portland cement production and CO_2 emission at production level by using Dolomite dust as alternative of it.
- The primary objectives of this study are to improve the strength properties of partial replacement of cement with Dolomite Powder in concrete so as to make it suitable for construction of any civil engineering structures.
- To study the workability of concrete using Dolomite Powder.
- The study of mechanical properties of concrete like compressive strength, split tensile strength, flexural strength by replacing dolomite powder

METHODOLOGY:

1) 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

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powder percentage replacing of cement, using Msand 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:

1) Assessing the physical & chemical properties of materials.

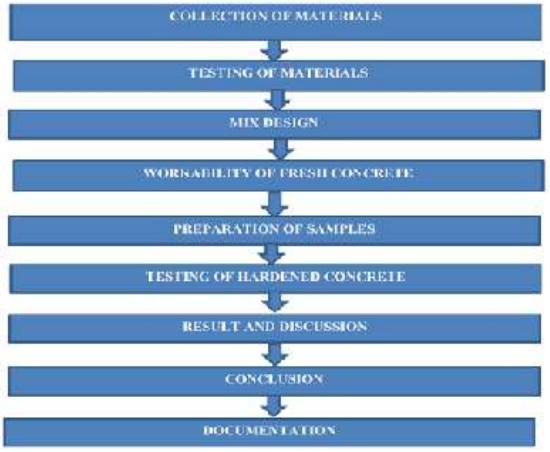
2) Mix design for concrete are made using the properties constituents of concrete. Grade of concrete is taken as M25 and the mix design are done as per IS: 10262-2009 and IS: 456- 2000 for different dolomite powder percentage replacing of cement, using Msand as fine aggregate. All mixtures are prepared 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. 23

3.1.1 Flow Chart:



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,

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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

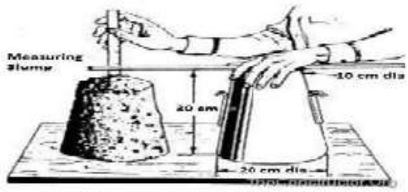


Fig.3.5.1 Measuring Slump of Concrete

Fig.3.5.2 Types of Concrete Slump Test Results

FIG:-2

RESULTS:

Graph 1 Sieve analysis of fine aggregate

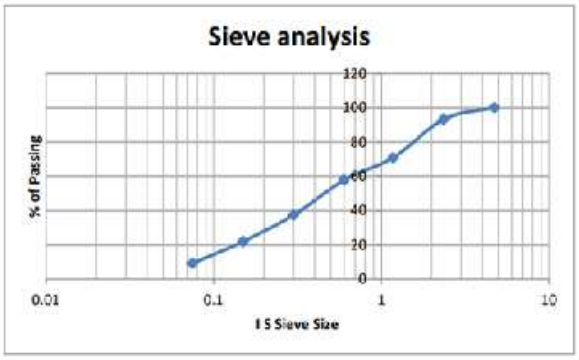


Table 1Physical properties of fine aggregate

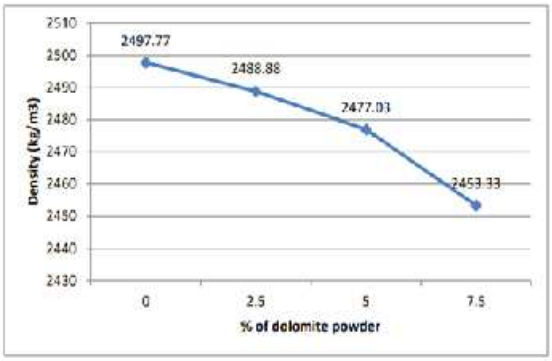
Physical properties of fine aggregate		
Sl no	Description	Value
1	Specific gravity	2.53
2	Water absorption	4.8%
3	Finess Modulus	3.09
4	Bulk density	1628kg/m^3

Density of Concrete:

Table 2 Density of concrete

% of dolomite powder	Mass of cube (kg)	Volume of cube (m^3)	Density (kg/m^3)
0	8.43	0.003375	2497.77
2.5	8.4	0.003375	2488.88
5	8.36	0.003375	2477.03
7.5	8.28	0.003375	2453.33

Graph 2 Density of concrete:



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.

FUTURE SCOPE:

In the present study on mechanical properties concrete by partial replacement of cement with 0, 2.5%, 5.0% and 7.5% Dolomite powder has been done. Due to the limitation of time the study wasrestricted to few parameters, the exhaustive list of future scope of study as follows

1. The effect of partial replacement of cement with Dolomite powder in cement-Dolomite paste can be studied.
2. The mechanical properties of concrete by using admixtures with partial replacementof cement with Dolomite powder can be studied.
3. The properties of concrete can be studied by using Dolomite as aggregate.
4. Compressive strength of self compacting concrete blended with Dolomite powder canbe studied.

REFERENCES

1. Mahesh Yelbhar, Shelke Megha, "Experimental Study of Performance of Concrete with Partial Replacement of Cement by Dolomite". Vol. 6 No.(2020).
2. Raphael Varela, "Effects of Replacing Sand in Concrete by Ceramic tile Powder and Dolomite Powder". Vol.7, No 4 (2020).
3. Pramod Dhamne and Nagarnaik P. B.,"Experimental Investigation on Replacement of Cement in Concrete Partially by using Dolamite Powder". Vol-3, No. 3, 2019.
4. Akhila S, Riyana M S, "Experimental Study on Strength of SCC with Partial Replacement of Cement by Dolomite and Addition of Para Aramid Fibers". Volume-06, Issue- 04 (2019).
5. Shaikh Mohtasim M.A, Sanap S.T, "Replacement of Cement with Dolomite Powder: An Experimental Analysis". Vol. 5 No. 10 (2018).
6. Athulya Sugathan, "Experimental Investigation on partial Replacement of Cement with dolomite powder" IJIRSET, Vol. 6, No. 7, July 2017.
7. L. Ranjith Kumar, et al. "Properties of Concrete Incorporating Dolomite Powder". IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE). Vol. 14, No 2 Ver. II.
8. Muthukumaran A (2017), et al. "Experimental study on partial replacement of sand with Msand and cement with dolomite powder in cement concrete", International Journal of Civil Engineering and Technology, Vol. 8, No. 1, 2021
9. Sathish Kumar K., Effect of glass powder on performance of concrete subjected to sulphate attack, International Journal of Applied Engineering Research, v-9, i-22, pp-5636- 5659, 2014.
10. Marija Jelčić Rukavina, Ivan Gabrijel, Dubravka Bjegović, "Modifications Of DolomiteBased Self-Compacting Concrete Properties Using Mineral Additives" ISSN 1848- 6339,(2015).
11 Chandramouli, B., Vijayaprabhu, A., Arun Prasad, D., Kathiravan, K., Udhayaraj, N., Vijayasanthi, M., 2022, Design of single switch-boosted voltage current suppressor converter for uninterrupted power supply using green resources integration, Electrical Engineering and Electromechanics, 10.20998/2074-272X.2022.5.05

12 Wang, J., Wei, K., Ansari, M.D., Al. Ansari, M.S., Verma, A., 2022, Photovoltaic Power Generation Systems and Applications Using Particle Swarm optimization Algorithms, Electrica, 10.5152/electrica.2022.22086

13 Prasanna Moorthy, V., Siva Subramanian, S., Tamilselvan, V., Muthubalaji, S., Rajesh, P., Shajin, F.H., 2022, A hybrid technique based energy management in hybrid electric vehicle system, International Journal of Energy Research, 10.1002/er.8248

14 Nayak, S.C., 2022, Bitcoin closing price movement prediction with optimal functional link neural networks, Evolutionary Intelligence, 10.1007/s12065-021-00592-z

15 Rajashekhar, K., Vinod, G., Mahesh Kumar, K., Naik, J.L., 2022, Impact of erbium (Er) doping on the structural and magnetic properties of Ni-Cu (Ni0.1Cu0.9Fe2O4) nanoferrites, Journal of Magnetism and Magnetic Materials, 10.1016/j.jmmm.2022.169323