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EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF CEMENT WITH DOLOMITE POWDER

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ABSTRACT :- In a growing country like India a huge amount of industrial waste are polluting the environmental. With a view to the above, this study aims at utilization of such industrial by product for value added application. In addition the waste can improve the properties of construction materials. The dolomite has been used in the form of powder. The dolomite powder was tested with concrete and mortar. Cement was replaced by the dolomite powder in the proportion of 0%, 10%, 20%, 30%, 40% and 50%. The compressive strength, split tensile strength, consistency and flexural strength were conducted for the above replacements. The result showed dolomite powder improves the mechanical properties. The advantages of this project are that the replacement of dolomite powder is economically cheap as well as a superior concrete can be made.

Keywords: Experimental Study, Concrete, Using Cement, Dolomite Powder

I INTRODUCTION

Concrete is one of the world's most used construction material due to its versatility, durability and economy. India uses about 7.3 million cubic meters of ready-mixed concrete each year. It finds application in highways, streets, bridges, high-rise buildings, dams etc. Green house gas like CO2 leads to global warming and it contributes to about 65% of global warming. The global cement industry emits about 7% of green house gas to the atmosphere. To reduce this environmental impact alternative binders are introduced to make concrete.Concrete is a blend of cement, sand, coarse aggregate and water. The key factor that adds value to concrete is that it can be designed to withstand harshest environments significant role. Today global warming and environmental devastation have become manifest harms in recent years, concern about environmental issues, and a changeover from the mass-waste, mass consumption, mass-production society of the past to a zero-emanation society is now viewed as significant. Normally glass does not harm the environment in any way because it does not give off pollutants, but it can harm humans as well as animals, if not dealt carefully and it is less friendly to environment because it is non-biodegradable. Thus, the development of new technologies has been required. The term glass contains several chemical diversities including soda-lime silicate glass, alkali-silicate glass and boro-silicate glass. To date, these types of glasses glass powder have been widely used in cement and aggregate mixture as pozzolana for civil

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works. The introduction of waste glass in cement will increase the alkali content in the cement. It also help in bricks and ceramic manufacture and it preserves raw materials, decreases energy consumption and volume of waste sent to landfill. As useful recycled materials, glasses and glass powder are mainly used in fields related to civil engineering, for example, in cement, as pozzolana(supplementary cementitious materials), and coarse aggregate. Their recycling ratio is close to 100%, and it is also used in concrete without adverse effects in concrete durability. Therefore, it is considered ideal for recycling Recently, Glasses and its powder has been used as a construction material to decrease environmental problems. The coarse and fine glass aggregates could cause ASR (alkali-silica reaction) in concrete , but the glass powder could suppress their ASR tendency, an effect similar to supplementary cementations materials (SCMs). Therefore, glass is used as a replacement of supplementary cementitious materials.

Applications & Properties of Dolomite

- Dolomite is a uniform amorphous solid material, which is generally produced when the viscous molten material cools very rapidly to below its glass transition temperature, without giving sufficient time for a regular crystal attice to form.
- The most familiar form of dolomite is the silica-based material used for windows, containers and decorative objects.
- Dolomite falls in the category of biologically inactive material that can be formed with very smooth and impervious surfaces.

Physical properties

Physical properties	Cement	Dolomite power
Fineness % passing (sieve size)	3 - 3.2	2.42 – 3.01
Specific gravity	< 90 µm	< 75 µm
Colour	Gray	White

EFFECT OF CHEMICAL COMPOSITION OF CEMENT ON STRENGTH OF CONCRETE:- The raw materials used for manufacturing of cement consist mainly of lime, silica, alumina and iron oxide. These oxides interact with one another in the kiln at high temperature to form more oxide compound. The relative proportions of these oxide compositions are responsible for influencing the various properties of cement. The oxides present in the raw materials when subjected to high clinkering temperature combine with each other to form complex compounds which are termed as Bogue's compound. Tricalcium silicate and dicalcium silicate are the most important compound responsible for early strength and late strength of concrete simultaneously. In modern cement together they constitute 70-80% of cement while contents of C3A and C4AF have decreased slightly. The calculated quantity of the compound in cement varies greatly even for a relatively small change in the oxide

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composition it becomes absolutely necessary to closely control the oxide composition of the raw materials. High C3S content (low C2S content) lead to much faster hydration rate contributes to higher early strength gain. Thus, cement with higher proportion of C3S, as is the case in most of today's cement, will tend to have a higher early strength, and allow for early form removal or post tensioning. C3A liberate a large amount of heat during the first few days of hardening and together with C3S and C2S may somewhat increase the early strength of hardening cement. Low % of C3A cement is more resistant to sulfates. C4AF contributes very slightly to strength gain and contribute to the colour effects that makes cement gray

II EXPERIMENTAL PROCEDURE

2.1 MATERIALS:- Portland slag cement [1] of Ultra-Tech brand available in the local market was used in the present studies. The coarse aggregate used were 20 mm and 10 mm down size. Natural river sand has been collected from River, and conforming to the Zone-III as per IS-383-1970 [2]. Cement was replaced by the dolomite powder in the proportion of 0%, 10%, 20%, 30%, 40% and 50%.

2.2 DOLOMITE POWDER:- The mineral dolomite crystallizes in the trigonal-rhombohedral system. It forms white, tan, gray, or pink crystals. Dolomite is a double carbonate, having an alternating structural arrangement of calcium and magnesium ions. Unless it is in fine powder form, it does not rapidly dissolve or effervesce (fizz) in cold dilute hydrochloric acid as calcite does. Crystal twinning is common.

Solid solution exists between dolomite, the iron-dominant ankerite and the manganese-dominant kutnohorite. Small amounts of iron in the structure give the crystals a yellow to brown tint. Manganese substitutes in the structure also up to about three percent MnO. A high manganese content gives the crystals a rosy pink color. Lead, zinc, and cobalt also substitute in the structure for magnesium. The mineral dolomite is closely related to huntite $Mg_3Ca(CO_3)_4$. Because dolomite can be dissolved by slightly acidic water, areas of dolomite are important as aquifers and contribute to karst terrain formation. It was sieved by IS-90 micron sieve before mixing in concrete.Dolomite is a carbonate material composed of calcium magnesium carbonate $CaMg(CO_3)_2$. The term is also used to describe the sedimentary carbonate rock dolostone. Dolostone (dolomite rock) is composed predominantly of the mineral dolomite with a stoichiometric ratio of 50% or greater content of magnesium replacing calcium, often as a result of digenesis.

MIX DESIGN:-

Material	Cement	Fine aggregates	Coarse aggregates	dolomite powder	water
Quantity	276.81 kg	668.88 kg	959.76	92.91 kg	154.8 litres

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III RESULT & DISCUSSION

No. of specimens to be casted

s. no	% of replacement	Compressive strength			Split tensile strength		Flexural strength	
		7	14	28	7	28	7	28
1	0%	3	3	3	3	3	3	3
2	10%	3	3	3	3	3	3	3
3	20%	3	3	3	3	3	3	3
4	30%	3	3	3	3	3	3	3
5	40%	3	3	3	3	3	3	3
6	50%	3	3	3	3	3	3	3
Total		54 cubes			36 cylinders		36 prisms	

Slump cone test

% of replacement of dolomite powder	Slump value
0%	33
10%	50
20%	60
30%	70
40%	75
50%	100

Compaction factor test

s. no	% of replacement of dolomite powder	Compaction factor test
1	0%	0.932
2	10%	0.948
3	20%	0.965
4	30%	0.968
5	40%	0.972
6	50%	0.980

Compressive strength for M30 grade of concrete

% of replacement of dolomite powder	Compressive strength in N/mm^2		
	7 days	14 days	28 days
0%	21.98	29.64	31.08
10%	18.47	30.89	33.06
20%	19.28	28.5	32.06
30%	16.64	27.04	30.96
40%	16.38	25.46	28.86
50%	15.98	25.30	27.90

Split Tensile strength for M30 grade of concrete

% of replacement of dolomite powder	Spilt tensile strength in N/mm^2	
	7 days	28 days
0%	3.46	3.93
10%	3.28	4.04
20%	2.37	4.49
30%	2.21	3.91
40%	2.18	3.84
50%	2.10	3.56

Flexural strength for M30 grade of concrete

% replacement of dolomite powder	Flexural strength	
	7days	28 days
0%	2.48	3.15
10%	2.25	3.39
20%	2.38	4.01
30%	2.11	3.06
40%	2.3	3.04
50%	2.05	2.98

IV CONCLUSION

The following conclusions are made based on the above study:

i. The 7 days, 14 days and 28 days compressive strengths of concrete increase initially as the replacement percentage of cement with dolomite powder increases, and become maximum at about 20% and later decreases.

ii. The flexural strength of concrete increases initially as the replacement percentage of cement with dolomite powder increases–and becomes maximum at about 20% and later decrease.

iii. The split tensile strength of concrete increases initially as the replacement percentage of cement with dolomite powder increases and becomes maximum at about 20% and later decrease.

iv. The slump of concrete decrease monotonically as the replacement

v. Percentage of cement with dolomite powder increases. The workability decreases when cement is replaced partially with dolomite powder

vi. The present study shows that there is a great potential for the utilization of dolomite powder concrete as partial replacement of cement. About 20% of cement may be replaced with dolomite powder without any sacrifice on the compressive strength

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