International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 06 | June - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF CEMENT BY DOLOMITE AND SILICA FUME AND FINE AGGREGATE BY COPPER SLAG

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ABSTRACT

Concrete plays a vital role in the world of thispaper is a part of experimental investigation to study the characteristic of concrete by using the combination of partial replacement of cement by dolomite and silica fume powder and partialreplacement of fine aggregate by copper slag. The dolomite and silica fume is an anhydrous carbonate mineral made out of calcium magnesium carbonate and it is likewise used to portray as sedimentary carbonate shake. Dolomite and silica fume is also known as dolomite and silica fume. The dolomite and silica fume powder is the crushed mineral fromdolomite and silica fume. Copper slag is a rough impacting coarseness made of granulated slag from metal refining procedures and it is likewise calledas iron silicate. The replacement percentages of cement by dolomite and silica fume powder is 0%, 10% 20%, 30 & 40% and fine aggregate by copper slag is 20% by the weight of M20 grade concrete. The dolomite and silica fume powder and copper slag is mixed with natural cement and fine aggregate in the grade of M20. The concrete cubes and cylinders were casted with varying content of dolomite and silica fume powder and copper slag. The test specimens were cured and tested for compressive strength and split tensile strength in 7 days, 14 days, 28 days and 56 days for concrete.

I. INTRODUCTION

The global use of concrete is second only to water. As the demand for concrete as a construction material increases, so also the demand for Portland cement. Concrete is a durable construction material produced by mixing Portland cement, water, aggregates and additives with special proportion. Revising the ingredients and production method of conventional concrete is important with respect to high consumption of concrete as a construction material. High consumption of concrete causes vast requirements of cement production. Production of every one tonne of OPC emits about one tonne of carbon dioxide (CO2) into the atmosphere, causing global warming. Statistics expose that the Cement industry constitutes about 5 % of the total emission of green house gases (GHG) in India. Every one tonne of OPC requires 1.2 to 1.5 tonnes of lime stone as raw material and around 0.2 tonnes of coal as fuel for burning, causing depletion of natural resources. The energy requirements for manufacturing one kg cement are 750 Kcal (thermal) and 85 Kcal (electrical), which is exacting the energy sources. Therefore, an effective way to reduce the adverse environmental impacts of concrete without affecting its engineering properties is to reduce the amount of OPC in concrete. Use of mineral admixture with OPC in ternary blend cement system as a binder is an effective and practical way to achieve this objective.

On the other hand, the climate change due to global warming and environmental protection has become major concerns. The global warming is caused by the emission of greenhouse gases, such as carbon dioxide (CO_2), to the atmosphere by human activities. Among the greenhouse gases, CO_2 contributes about 65% of global warming. The cement industry is held responsible for some of the CO_2 emissions, because the production of one ton of Portland cement emits approximately one ton of CO_2 into the atmosphere. The environment must be protected by preventing dumping of waste/by- product materials in un-controlled manners.

5 OBJECTIVE OF PRESENT STUDY

The main objectives of the research work are outlined as below.

1. To determine the physical properties of OPC 53-grade cement, dolomite and silica fume ,Steel slag Natural sand, and coarse aggregates.
2. To determine the mix design for M_{30} grade concrete.
3. To determine the workability of fresh M_{30} grade concrete by partially replacing cement with Dolomite and silica fume and steel slag
4. To study the effect Dolomite and silica fume and Steel slag on compressive, Split tensile And Flexural strength of concrete at 7, 14, 28 and 56 days.
5. Comparing the results with conventional concrete mix

II. LITERATURE REVIEW

Bhavin K, presented the details of the investigation carried out on paver blocks made with cement, dolomite and silica fume block

and different percentages of polypropylene fibres.They reported that addition of 0.3% and 0.4% of polypropylene fibres improved the abrasion resistance and flexural strength of paver block**.**

Salim Barbhuiyacarried out an investigation to explore the possibilities of using dolomite and silica fume powder for the production of SCC. Test results indicated that it is possible to manufacture SCC using fly ash and dolomite and silica fume powder.

Author: Shanu Sharma Author studied use of cement and production of cement produces much more issues of environment and also it is costlier process. Hence Marble Dust Powder can used as a developing binding material which will allow the concrete industry to optimize waste material use, reduce construction cost and construction of structures will be strong, durable and sensitive to the environment. The MDP was replaced with cement 0%, 7%, 14%, & 21% by weight for M25 grade concrete. Flexural & compressive strength Test are Conducted. The results achieved from this existing study shows thatMDP has great potential for utilisation in concrete as an replacement of cement.

Authors: Preethi Author done experimental study on possibility of use of dolomite and silica fume powder as an partial replacement material to cement. The some partial replacement percentages in experimental study were 0%, 5%, 10%, 15%, & 20% by weight of cement. The compressive, split tensile & flexural strengths of M20 concrete was conducted with dolomite and silica fume powder were compared with those of reference specimens. It is found use of replacement of cement with dolomite and silica fume powder to improve the strength of concrete is successful.

III. MATERIALS AND METHODOLOGY

In making any type of concrete, selection andtype of materials is very important as all the properties depends on them.

The following materials are being used and arelisted below.

- Cement
- Fine aggregate (sand)
- Coarse aggregate
- Water
- Dolomite and silica fume Powder
- Copper Slag

Mix Proportions

Mix	DOLOMITE AND SILICA FUME % of cement	DOLOMITE AND SILICA FUME (Kg/m³)	Cement (Kg/m³)	Fine aggregate (Kg/m³)	Copper slag 20%	Coarse aggregate (Kg/m³)	Water (lit/m³)
CC	**0%**	0	360	584	0	1223.8	180.42
Mix-1	**10%**	36	324	467.2	116.8	1223.8	180.42
Mix-2	**20%**	72	288	467.2	116.8	1223.8	180.42
Mix-3	**30%**	108	252	467.2	116.8	1223.8	180.42
Mix-4	**40%**	144	216	467.2	116.8	1223.8	180.42

Mix	DOLOMITE AND SILICA FUME % of cement
CC	**0%** Dolomite and silica fume + 100% Cement
Mix-1	**10%** Dolomite and silica fume + 90% Cement
Mix-2	**20%** Dolomite and silica fume + 80% Cement
Mix-3	**30%** Dolomite and silica fume + 70% Cement
Mix-4	**40%** Dolomite and silica fume + 60% Cement

Batching and Mixing

Batching is process of measuring the quantities of concrete either by volume or by mass for preparation of concrete mix. In this weight batching method is adopted to measure the quantities of fine aggregate, cement, coarse aggregate, and Recycled aggregate. For mix proportion for design were measured by using weighing balance. The ingredients of concrete in the required quantities were enhanced into the capacity laboratory concrete mixer. After through mixing i.e., having achieved uniform colour, workable consistency to concrete, the concrete was shipped into tray for casting specimens.

Casting and Curing of Specimens

IS standard specimen were casted with the concrete has been placed in the standard metallic moulds in three layers and compacted with tamping rod by giving 25 blows. Before placing the concrete in moulds, a thin coat of oil was applied for the walls of the mould inside for easy removal. Then moulds were placed on needle vibrator for 10 r 15 seconds after finishing smoothly on the top surface of specimens

IV EXPERIMENTAL INVESTIGATION

Casting of Concrete Cubes, Cylinders and Beams is done. The test moulds are kept ready before preparing the mix. Tighten the bolts of the moulds carefully because if bolts of the moulds are not kept

tight the concrete slurry coming out of the mould when vibration takes place.

In the present investigation according to IS standards the following dimensioned specimens were casted

- 150mm×150mm ×150mm of cubes,
- 150mm ×300mm of cylinders, and
- 150mm×150mmx700mm of beams.

The following are the tests which was conducted in the project:

Strength Tests:

- Compressive strength test
- Split tensile strength test
- Flexural strength test

A. Compressive Strength Test

Concrete cubes ofsizes150mm×150mm×150mm were tested for crushing strength. Compressive strength depends on loads of factor such as w/c ratio, cement strength, excellence of concrete material and excellence control during manufacture of concrete. These cubes are tested by compression testing machine after 7 days, 14 days 28 days and 56 days curing. The sample is placed centrally on the base plate of machine and the load have to be apply gradually at the rate of 140 kg/cm2 per minute till the specimen fails.

Compressive strength

B. Split Tensile Strength Test

The tensile strength of concrete is one of the basic and important properties. Splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. The concrete is very weak in tension due to its brittle nature and is not expected to resist the direct tension. The concrete develops cracks when subjected to tensile forces. Thus, it is necessary to determine the tensile strength of concrete to determine the load at which the concrete members may crack. The splitting of cylinder is shown in figure. The following relation is used to find out the spilt tensile strength of cylinder (1) Where Ft is split tensile strength, P= Ultimate load in KN L = Length of the cylinder in mm, D = Diameter of the cylinder in mm.

Split-Tensile strength

C. Flexure Strength Test

Flexural strength test on concrete beam to determine the strength of concrete. Flexural strength test was conducted by using the method prescribed by IS 516 – 1959. Beams of dimension 150mm × 150mm ×700mm were used for this test, the test specimen is placed in the machine at the bearing surfaces of the supporting and loading rollers.

Modulus of rupturef = PL/BD2

P is the load in KN.

L, B is the length and breadth in mm.

D is the depth in mm. f is the flexure strength in N/mm

Flexure Strength

V RESULTS

Compressive Strength Test Results @ CopperSlag

Mix	7days	14 days	28 days	56 Days	90 Days
C0	12.32	18.72	29.8	31.8	38.18
C10	17.8	26.9	30.21	39.98	43.18
C20	**19.2**	**29.98**	**34.34**	**42.87**	**50.18**
C30	18.1	25.12	32.85	40.18	48.16

From the above table it is clear that 20 percent copper slag is maximum, taking that optimum and constant 20%copper slag used for further experimental work

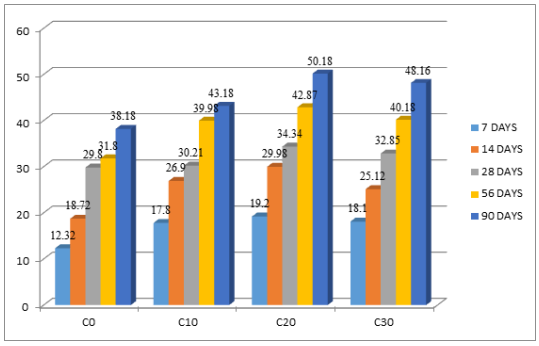
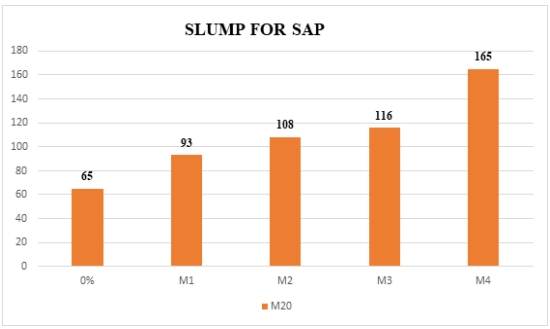


Fig.: Compressive Strength Test Results @Copper Slag

Slump test for M20 grade of concrete

S.No.	Id	M20
1	M1	65
2	M2	93
3	M3	108
4	M4	116
5	M5	165



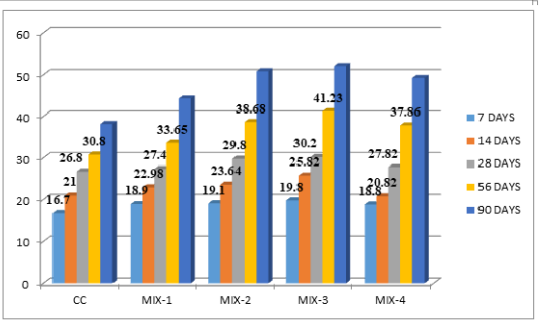
Slump cone test results M20 Grade of Concrete

Compaction Factor Test @ M20 Grade ofConcrete

Mix Id	Dolomite Powder	Factor
M1	**0%**	0.781
M2	**10%**	0.795
M3	**20%**	0.801
M4	**30%**	0.805
M5	**40%**	0.816

Compaction Factor Test Compressive strength of concrete with mix design of M20 Copper Slag and Dolomite andsilica fume

Mix id	7 DAYS	14 DAYS	28 DAYS	56 DAYS	90 Days
CC	21.0	26.8	29.8	31.8	38.18
MIX-1	18.9	22.98	27.4	33.65	44.25
MIX-2	19.1	23.64	29.8	38.68	50.85
MIX-3	19.8	25.82	30.2	41.23	52.12
MIX-4	18.8	20.82	27.82	37.86	49.25



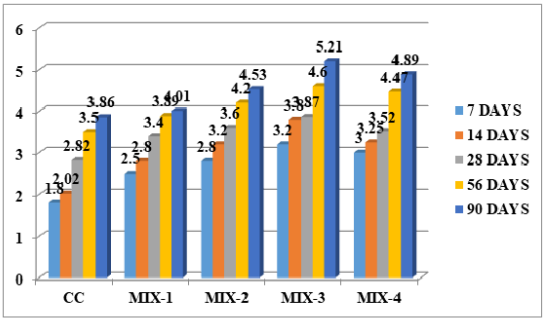
It was found that the optimum dosage for M20 was 30% replacement of cement with dolomite and silica fume specimens further increment in dosage will results in decrease in s Compressive Strength i.e., 40% so with this we can conclude that with the increase in dosage of dolomite and silica fume in concrete decrease in strength results

Split tensile strength of concrete with mix designof

M20 (Copper Slag and Dolomite and silica fume

silica fume in concrete decrease in strengthresults

Mix id	7 DAYS	14 DAYS	28 DAYS	56 DAYS	90 DAYS
CC	1.8	2.02	2.82	3.5	3.86
MIX-1	2.5	2.8	3.4	3.89	4.01
MIX-2	2.8	3.2	3.6	4.2	4.53
MIX-3	3.2	3.8	3.87	4.6	5.21
MIX-4	3.0	3.25	3.52	4.47	4.89

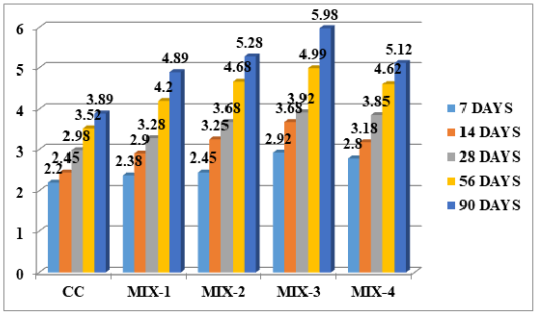


S f

It was found that the optimum dosage for M20 was 30% replacement of cement with dolomite and silica fume specimens further increment in dosage will results in decrease in Split Tensile Strength i.e., 40% so with this we can conclude that with the increase in dosage of dolomite and silica fume in concrete decrease in strength results

Flexural strength of concrete with mix design of M20 Copper Slag and Dolomite

Mix id	7 DAYS	14 DAYS	28 DAYS	56 DAYS	90 DAYS
CC	2.2	2.45	2.98	3.52	3.89
MIX-1	2.38	2.9	3.28	4.2	4.89
MIX-2	2.45	3.25	3.68	4.68	5.28
MIX-3	2.92	3.68	3.92	4.99	5.98
MIX-4	2.8	3.18	3.85	4.62	5.12



Flexural strength of concrete with mix design of M20 Copper Slag and Dolomite and silica fume It was found that the optimum dosage for M20 was 30% replacement of cement with dolomite and silica fume specimens further increment in dosage will results in decrease in s Flexure Strength i.e., 40% so with this we can conclude that with theincrease in dosage of dolomite and

VI. CONCLUSIONS

Research on the utilization of waste construction material is very essential because material waste is gradually increasing day by day with the increasing population and increase in infrastructure development. The aim of the present research work is to determine the workability and mechanical properties of concrete with dolomite and silica fume as cement replacement and constant copper slag introduction as fine aggregate as 20%. for M_{20} Grade concrete. On the basis of Experimental investigation of the present research study, the following conclusions have been drawn.

1. As compared Reference concrete mix the workability is initially good after decreased as percentage of Dolomite and silica fume increased due to more fineness the voids present in the concrete are fulfilled.
2. The workability for M_{20} grade of concrete increase in 30% of waste Dolomite and silica fume and replacement by cement.

- Also, it was found that the optimum dosage for M20 was 30% replacement of cement with dolomite and silica fume specimens further increment in dosage will results in decrease in Compressive Strength i.e., 40% so with this we can conclude that with the increase in dosage of dolomite and silica fume in concrete decrease in strength results
- It was found that the optimum dosage for M20 was 30% replacement of cement with dolomite and silica fume specimens further increment in dosage will results in decrease in Split Tensile strength i.e., 40% so with this we can conclude that with the increase in dosage of dolomite and silica fume in concrete decrease in strength results
- Then it was found that the optimum dosage for M20 was 30% replacement of cement with dolomite and silica fume specimens further increment in dosage will results in decrease in Flexural strength i.e., 40% so with this we can conclude that with the increase in dosage of dolomite and silica fume in concrete decrease in strength results
- The cost of conventional concrete was less as replacement of materials in concrete.

FUTURE SCOPE

Dolomite and Copper slag can be replaced up to 50% by weight of cement for all grades of concrete.

2. Copper Slag can be replaced up to 10% by weight of cement for all grades of concrete

Effect of Dolomite and Copper Slag may be investigated on the Durability, reducing efflorescence and chemical attack aspects of concrete.

3. Study may also carried out using Dolomite and Copper slag in the concrete mix in place of cement.

4. Study may also carried out using some other supplementary cementitious materials like Brick powder, Met kaolin, GGBS etc.

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