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Experimental Study on Partially Replacement of Cement and Fine Aggregate with Phosphogypsum and Quarry Dust in Concrete Mix

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Abstract
The Quarry rock dust can be an economic alternative to the river sand. Quarry Rock Dust can be defined as residue, tailing or other non-voluble waste material after the extraction and processing of rocks to form fine particles less than 4.75mm.Usually,Quarry Rock Dust is used in large scale in the highways as a surface finishing material and also used for manufacturing of hollow blocks and light weight concrete prefabricated Elements..

Phosphogypsum is a by-product in the wet process for Manufacture of phosphoric acid by the action of sulphuric acid on the rock phosphate. It is produced by various process such as dehydrate, hemihydrates or anhydrate processes. In India the majority of phosphogypsum is produced by the dehydrate process due to its simplicity in operation and lower maintenance as compared to other processes. The annual production of phosphogypsum from one dozen phosphoric acid and fertilizers plants is of the order of approximately five million tons. To investigate the best mix proportion of the partial replacement of phosphogypsum for cement and quarry dust for fine aggregate in concrete by the value of strength per weight ratio of sample specimen. To investigate the feasibility of the partial replacement of above material in concrete by Determining its compressive strength and split tensile strength. Based on the test results, to suggest most approximate level of adding phosphogypsum. To investigate the utilization of Industrial wastes as a replacement for cement and fine aggregate in concrete and influence of this on the Strength of concretes made with different cement replacement levels with admixtures. Cement motor ratios

Key words: Compressive strength,

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I. INTRODUCTION

Concrete is an artificial mixture of Portland cement, water, fine and coarse aggregates. The mixture of the materials results in a chemical reaction called hydration and a change in the mixture from plastic to a solid state occurs over a period of time. The cost of concrete can be reduced by reducing cost alternative material, instead of conventional materials.

To overcome the stress and demand for river fine aggregate, research and practitioners in the construction industries have identified some a lternative materials such as fly ash, slag, limestone powder and siliceous stone powder. In India attempts have been made to replace river sand with quarry dust.

The successful utilization of quarry dust as fine aggregate would turn this was material that causes disposal problem in to a valuable resource. The utilization will also reduce the strain on supply of natural fine aggregate, which will also reduce the cost of concrete.

3. MATERILS USED

3.1 CEMENT: Cement is a binder, a substance that sets and hardens independently, and can bind other materials together. The most common use for Portland cement is in the production of concrete.

Physical Properties of Cement (OPC 53 GRADE) (IS 8112-1989)

1. Specific Gravity – 3.12
2. Fineness of cement – 2.5
3. Standard Consistency – 31%
4. Initial and Final Setting time of cement – 140min and 260 min
5. Compressive Strength – 3 days -27 Mpa, 7days – 37 Mpa, 28days – 53 Mpa

3.2 AGGREGATES: Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy. One of the most important factors for producing workable concrete is good gradation of aggregates.

3.2.1. COARSE AGGREGATE: The material which is retained on IS sieve 4.75mm is termed as coarse aggregate. The broken stone is generally used as a stone aggregate.

3.2.2. FINE AGGREGATE: The material which passes through IS sieve 4.75mm is termed as fine aggregate usually natural sand is used as a fine aggregate The sand used for the experimental works was locally procured and confirmed to grading zone II, sieve analysis of the fine aggregate was carried out in the laboratory as per IS 383-1970 and results are provided.

3.3.1.Physical Properties of Aggregates:

S.No	Type of Aggregates	LAB VALUES OF AGGREGATES	IS CODE ALLWABLE	IS CODE ALLWABLE	PROPERTY OF AGGREGATES
			For road & AGGREGATE pavements	For other structures	
1	Aggregate crushing value (IS 2386-Part 4)	33.03%	<30%	<45%	Crushing
2	Aggregate impact value (IS 2386-Part 4)	35.67%	<30%	<45%	Toughness
3	Specific Gravity (IS 2386 -part 3)	2.66	2.5 to 2.9	2.5 to 2.9 Specific	gravity
4	Waterabsorption (IS 2386- Part 3)	1.82	0.5 to 1%	1.0 to	2.0%

3.3 CONCRETE: Concrete is an artificial material in which the aggregates both fine and coarse are bonded together by the cement when mixed with water.

3.4 QUARRY ROCK DUST: Quarry Rock Dust Collected from the Quarry of S.S Rocks which is located at Anakapalli; Visakhapatnam is used as a fine aggregate replacement material in concrete. The Physical and chemical properties of quarry rock dust is satisfied the requirements of code provision in properties studies.

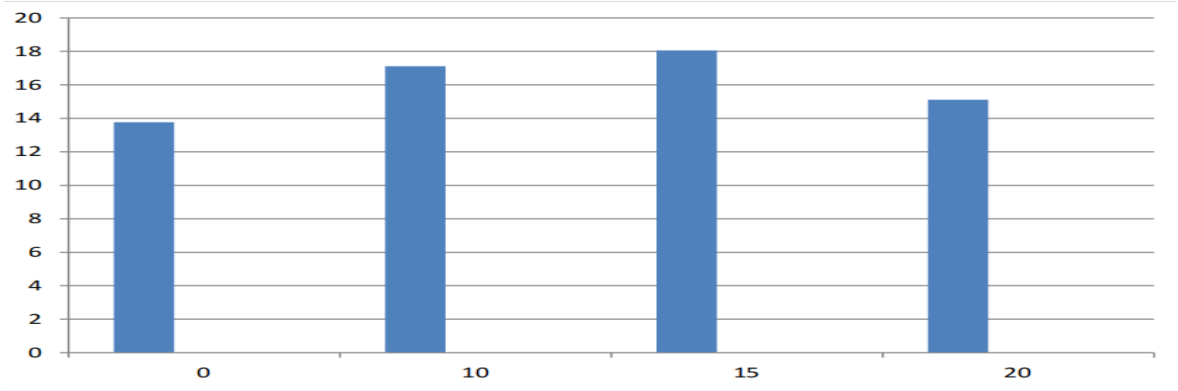
4. STRENGTH STUDIES ON CONCRETE

4.1. Compressive Strength test according to IS 516-1959

The test setup for conducting cube compressive strength test is depicted in Plate No. Compression test on the cubes is conducted on the 300T compression testing machine. The cube was placed in the compression testing machine and the load on the cube is applied at a constant rate up to the failure of the specimen and the ultimate load is noted.The cube compressive strength of the concrete mix is then computed.. This test has been carried out on cube specimens at 7,14 and 28 days age. The values are presented in below.

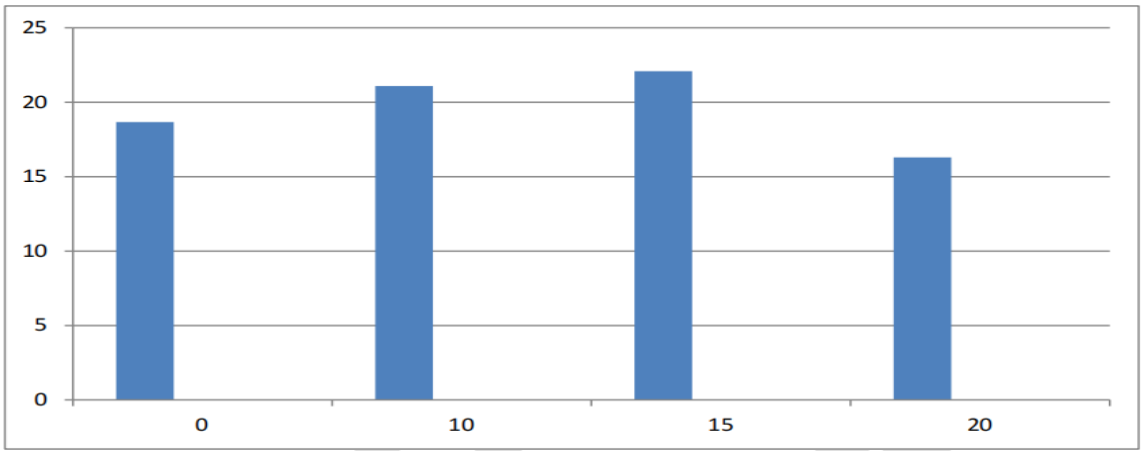
Phosphogypsum in(%)	7 Days (N/mm2)	14 Day (N/mm2)	28 Days (N/mm2)
0 %	13.77	18.66	22.22
10 %	17.11	21.09	24.22
15 %	18.06	22.09	27.44
20 %	15.11	16.29	15.99

7 day compressive strength test results:



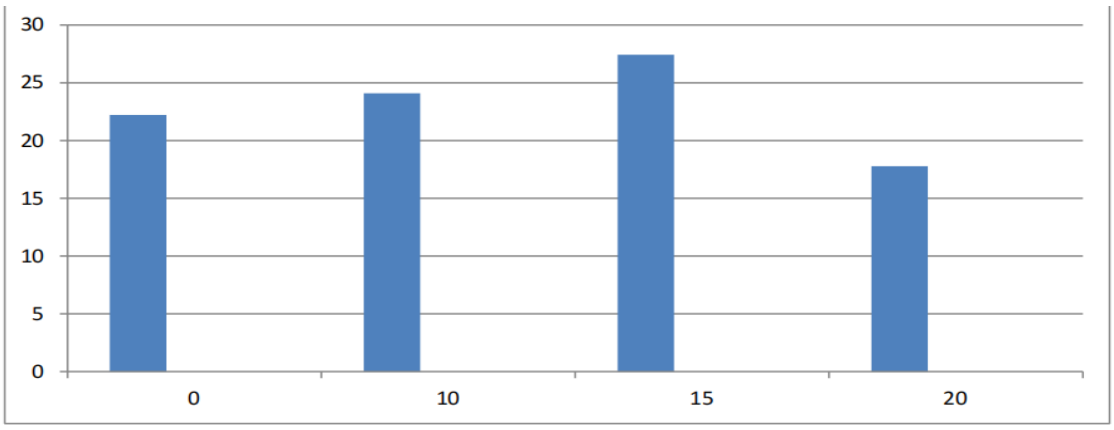
NOTE : ON X – AXIS PERCENTAGE OF PHOSPHOGYPSUM (%)
ON Y – AXIS COMPRESSIVE STRENGTH (N/mm2)

14 Days compressive strength test results.



NOTE : ON X – AXIS PERCENTAGE OF PHOSPHOGYPSUM (%)
ON Y – AXIS COMPRESSIVE STRENGTH (N/mm2)

28Days compressive strength test results



NOTE : ON X – AXIS PERCENTAGE OF PHOSPHOGYPSUM (%)
ON Y – AXIS COMPRESSIVE STRENGTH (N/mm2)

5. CONCLUSION

1) The partially replaced phosphogypsum to cement and quarry dust as fine aggregate leads to increased in workability and setting time.
2) Compressive strength of concrete is increased with 15% of phosphogypsum and 30% of quarry dust added in cement and fine aggregate compared to nominal concrete.
3) The phosphogypsum as a use full material instead of a waste material (harm to the environment) that they were hurled in many hundred tons annually had been utilized in an engineering context.
4) After studying all these papers it is observed that, phosphogypsum can be used as a substitute for cement in concrete. Mostly cases, phosphogypsum are replaced with cement in range of 0-30%.
5) It is found that, 10-15% replacement is optimum for compressive strength of
concrete.
6) It has been observed that, in some instances, the cement's setting time increases as a result to use of phosphogypsum.
7) New researchers and users will benefit from this experimental investigation regarding how and where the waste phosphogypsum can be used as building and construction material in glance.
8) Based on experimental investigation to addition phosphogypsum in concrete changes the concrete's durability and strength while also increasing its strength.

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