IMPACT OF QUARRY DUST & DOLOMITE POWDER ON COMPRESSIVE STRENGTH OF CONCRETE

Syed Afzal Basha[1],
Research Scholar, JNTUA, Anantapur, A.P.,
Dr. B. Jayarami Reddy[2],
Professor & HOD, Dept of Civil Engg, YSR Engineering College of YVU, Prodattur, A.P.
Dr. C. Sashidhar[3],
Director, Industrial Consultancy Services, JNTUA, Anantapur, A.P.

ABSTRACT-The purpose of this work is to describe the effect of quarry dust and dolomite on the compressive strength of concrete. The present examinations indicate that dolomite may be used as partial replacement of cement in concrete and quarry dust may be suitably replaced with fine aggregate in concrete to some extent. The results are found to be satisfactory with the individual replacements but the combination of both quarry dust and dolomite did not yield the positive results with respect to compressive strength of concrete.

KEY WORDS: **Dolomite, Quarry dust, Compressive strength, Partial Replacement**

INTRODUCTION

Concrete is a composite material that consists of binding medium, such as mixture of Portland cement and water, within which are embedded particles or fragments of aggregate, usually a combination of fine and coarse aggregate. Concrete is by far the most versatile and most widely used construction material worldwide. Today, the rate at which concrete is used is much higher than it was 50 years ago. It is estimated that the present consumption of concrete in the world is of the order of 33 billion metric tonnes every year.

The construction industry has shown great gains in the utilization of recycled industrial by-products and wastes, including Quarry dust waste. If fine aggregate is replaced by Quarry dust waste by specific percentage and in specific size range, it will decrease fine aggregate content and thereby reducing the ill effects of river dredging and thus making concrete manufacturing industry sustainable. By using these recycled by-products and wastes we can, not only save the landfill space but also it reduces the demand for fine aggregate.

The reduction in the consumption of cement will not only reduce the cost of concrete/project but also the emission of carbon-di-oxide. Dolomite powder obtained by powdering the sedimentary rock forming mineral dolostone can be used as a replacement material for cement in concrete up to certain percentage. Dolomite powder has some similar characteristics of cement. Using dolomite powder in concrete can reduce the cost of concrete and may increase the strength to some extent.

LITERATURE REVIEW

Eldhose M Manjummekudy et al., studied the effect of eco sand (extracted dolomite) as a partial replacement for fine aggregate and the results indicates that 25% of fine aggregate replacement with eco sand had maximum compressive strength and also stated that the voids are minimized with dense packing.

Huseyin Temiz et al. studied the performance of dolomite in concrete. In this research, it was found that the setting time was increased on addition of dolomite. Heat of hydration was less when compared with the cement concrete made with Ordinary Portland Cement. Compressive strength of mortar cubes were increased on addition of dolomite.

Durga.B et al. studied the effects of silica when used as a partial replacement to fine aggregate. The nearer optimal replacement percentage arrived in case of compressive strength was 60% with 39.30 N/mm^2.

K.Chinnaraju et al. studied the effects of eco sand (extracted dolomite) as a partial replacement of fine aggregates in cement mortar and cement concrete. The study revealed that the replacement of fine aggregate with eco sand beyond 40% shows higher rate of water absorption and demanded more water. The optimum replacement of eco sand was found to be 40%. The cement mortar cubes were tested for 7 days and 40% replacement showed higher compressive strength. The compressive strength was increased by 12.7%.

Olesia Mikhailova et al., conducted research on dolomite powder. From the results it is observed that the 25% of dolomite powder addition enhanced the early strength and structure of concrete was dense in the early stages without any detrimental effect to later ages.

MATERIALS AND METHODOLOGY

Cement: Ultra tech Ordinary Portland cement (OPC) conforming to Grade 53, is used in the proposed work. Cements produced by Ultra tech manufacturers conform to the following IS Codes: IS: 8812-1989 & IS: 12269-1987 respectively.

Quarry dust: The concept of replacement of natural fine aggregate by quarry dust which is highlighted in the investigation could boost the consumption of quarry dust generated from quarries. By replacement of quarry dust, the requirement of land fill area can be reduced and can also solve the problem of natural sand scarcity. Quarry dust is a byproduct of the crushing process

which is a concentrated material to use as aggregates for concreting purpose, especially as fine aggregates. Many quarries are present in and around Kurnool district of Andhra Pradesh State. This waste is disposed near road sides. It is causing problems to human health and environmental pollution. To reduce the environmental pollution, quarry dust waste is being utilized as a fine aggregate replacement in different proportions. The waste material i.e., Quarry dust is obtained from Chinna Malkapuram Village, near Dhone Mandal of Kurnool Dist. in A.P and its specific gravity is found to be 2.11.

Fine aggregate: The sand used in this investigation is ordinary river sand obtained from the banks of Tungabhadra River. The sand is free from clayey matter, silt and organic impurities etc. The sand passing through 4.75 mm size sieve is used in the preparation of specimens. The sand conforms to Zone-II as per IS: 383- 1970. The properties of sand such as fineness modulus, water absorption & specific gravity are determined as per IS: 2386-1963.

Coarse aggregate: The coarse aggregate used in the investigation is 20 mm down size locally available crushed stone obtained from quarries. Specifications for coarse aggregate are included in IS: 383-1970.The physical properties have been determined as per IS: 2386-1963.The coarse aggregate is free from clayey matter, silt and organic impurities etc. The coarse aggregate is also tested for specific gravity and it is 2.71. Fineness modulus of coarse aggregate is 3.79.

Water: Potable water free from suspended solids and organic materials, which might affect the properties of the fresh and hardened concrete, is used. The water used for both mixing and curing of concrete is free from impurities, injurious amounts of acids, alkalis, oils, salts, organic matter or other substances that may be deleterious to concrete or steel. The presence of chlorides and sulfates are injurious to reinforcing bars as they may be corroded. The general requirements of water for mixing and curing concrete shall be as per IS 456- 2000.

Dolomite: It is an anhydrous carbonate mineral composed of calcium magnesium carbonate. The term is also used for a sedimentary carbonate rock composed of mineral dolomite. An alternative name sometimes used for the dolomitic rock type is dolostone. Dolomite is a rock forming mineral which is noted for remarkable wet ability and dispensability as well as moderate oil and plasticizers absorption. It has good weathering resistance.

EXPERIMENTAL INVESTIGATION

In this investigation, the fine aggregate is replaced by quarry dust at a proportion of 0%, 10%, 20%, 30%, 40% & 50% and compressive strength is computed after 7, 14 & 28 days curing. At 30% replacement, the compressive strength is found to be higher than the remaining proportions. Hence maintaining 30% of quarry dust, dolomite powder is incorporated to replace cement at 0%, 10%, 20%, 30%, 40% & 50% respectively. Cement is substituted with dolomite from 0% to 20% at an interval of 5% and the results are tabulated. The preliminary properties of cement, fine aggregate and coarse aggregate are studied. The cement concrete specimens were prepared and tested for 28 days strength. Results of various tests are as follows-

Table-1: Tests on Cement

Sl.no	Property	Values obtained	Standards (Codal requirements)
1.	Specific Gravity	2.78	IS 2720 Part 3
2.	Fineness	2.9%	Not greater than 10% as per IS 4031 Part 1
3.	Standard Consistency	30%	IS 4031 Part 4
4.	Initial Setting Time	39 minutes	Not less than 30 min as per IS:4031 Part 5
5.	Final Setting Time	490 minutes	Not more than 600 min as per IS:4031 Part 5

Table-2: Tests on Dolomite

Sl. no	Property	Values obtained	Standards (Codal requirements)
1.	Specific Gravity	2.71	IS 2720 Part 3 (3.15)
2.	Fineness	5.8%	Not greater than 10% as per IS 4031 Part 1
3.	Standard Consistency	28%	IS 4031 Part 4
4.	Initial Setting Time	41 minutes	Not less than 30 minutes as per IS:4031 Part 5
5.	Final Setting Time	420 minutes	Not more than 600 minutes as per IS:4031 Part 5

Table-3: Tests on quarry dust

Sl.no	Property	Value/Description
1.	Specific Gravity	2.20
2.	Size for Fine Aggregate replacement	Passing through 1.18mm sieve and retained on 150µsieve
3.	Color	Light grey

MIX DESIGN: M25

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. The concrete mix is designed as per the code provisions of IS 10262-2009.

Table-4: Mix proportions

Cement (kg/m^3)	Fine Aggregate (kg/m^3)	Coarse Aggregate (kg/m^3)	Water (kg/m^3)
459	594	975	201.89
1	1.26	2.07	0.43

RESULTS/DISCUSSIONS

Testing plays an important role in controlling the quality of cement concrete work. Systematic testing of the raw materials, the fresh concrete and the hardened concrete is an inseparable part of any quality control program for concrete which helps to achieve higher efficiency of the materials used and greater assurance of the performance of the concrete in regard to both strength and durability. The test methods used should be simple, direct and convenient to apply. A minimum of three specimens should be tested at each selected age. If strength of any specimen varies by more than 15 per cent of average strength, results of such specimen should be rejected. Average of three specimens gives the crushing strength of concrete. The cube compressive strength of concrete specimens is determined by conducting test on 150mm x 150mm x 150mm cube specimens at 7,14 & 28 days of curing. After normal curing, three cube specimens were tested on a compression machine. The specimens were tested in the compression testing machine of 2000 kN capacity. The load shall be applied without shock and increased continuously at a rate of approximately 1400 N/sq.cm/min until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained. The maximum load applied to the specimen shall then be recorded and the appearance of the concrete and any unusual features in the type of failure shall be noted. The mean value of the three results is taken as the compressive strength. Table shows the strength of concrete at various replacement proportions of fine sand with quarry dust.

Table-5: Compressive strength of concrete specimens with replacement of sand by quarry dust

Sl.no	%age replacement of fine sand by quarry dust	3 days strength (N/mm^2)	14 days strength (N/mm^2)	28 days strength (N/mm^2)	% rise/decrease in 28 days strength
1	0%	30.69	42.11	46.56	-
2	10%	31.63	44.23	47.51	2.04
3	20%	34.84	48.23	51.89	11.44
4	30%	38.99	52.31	57.57	23.65
5	40%	36.11	46.81	49.57	6.46
6	50%	33.41	45.06	43.36	-6.87

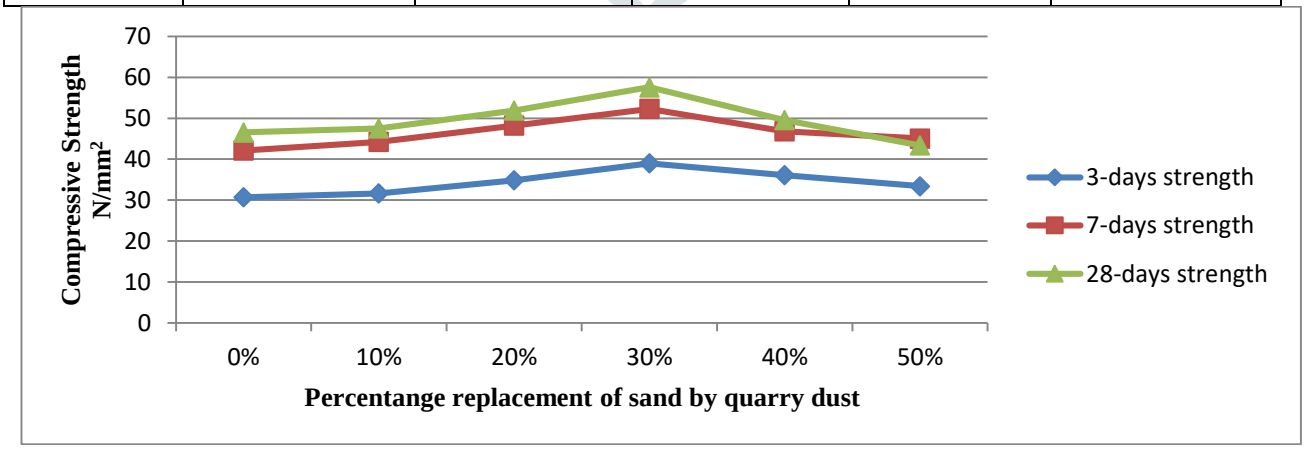


Table-6: Compressive strength of concrete specimens with replacement of cement by dolomite

	%age	3 days	14 days	28 days	%

Sl.no	replacement of cement by dolomite	strength (N/mm^2)	strength (N/mm^2)	strength (N/mm^2)	rise/decrease in 28 days strength
1	0%	12.52	16.67	28.91	-
2	5%	14.28	18.92	30.78	6.46
3	10%	13.67	17.31	27.52	-4.81
4	15%	12.46	18.41	25.67	-11.21
5	20%	10.39	12.33	22.34	-22.72

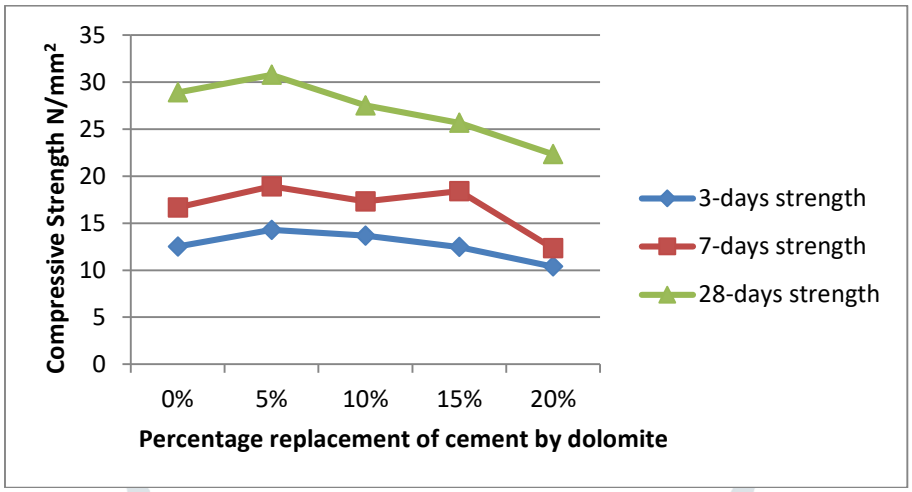
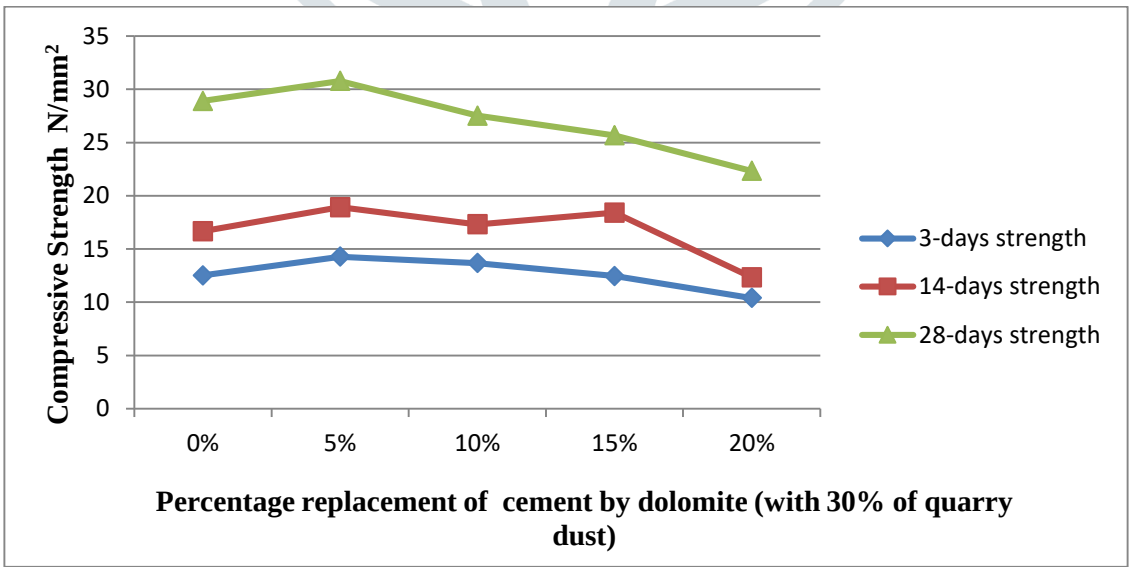


Table-7: Compressive strength of concrete specimens with 30% replacement of sand by quarry dust & substitution of cement by dolomite for various proportions

Sl.no	%age replacement of fine sand by quarry dust	%age replacement of cement by dolomite	3 days strength (N/mm^2)	14 days strength (N/mm^2)	28 days strength (N/mm^2)	% rise/decrease in 28 days strength
1	30%	0%	38.99	52.31	57.57	
2		10%	30.42	34.27	39.38	-31.59
3		20%	22.58	26.81	31.45	-45.37
4		30%	13.13	17.41	20.18	-64.94
5		40%	12.25	14.54	18.31	-68.19
6		50%	10.36	12.76	15.17	-73.64



CONCLUSIONS

Experimental investigations assert that quarry dust can be used as partial replacement for fine aggregate in cement concrete. It is practically proved that 30% replacement of sand by quarry dust enhanced the compressive strength at 14 & 28 days considerably.

Substitution of cement by dolomite has displayed better compressive strength. At 5% replacement, there is an increase of compressive strength by 6.46%. The increase in strength is found only at 5% and beyond 5%, there is reduction in the strength.

Specimens containing 30% of quarry dust, and varying percentages of dolomite suffered the reduction in compressive strength.

The technical knowhow behind the investigation includes the preferment and concretion of the structure and feasible increase in early strength without any inimical effects on the long term properties of concrete.

REFERENCES

[1] Chinnaraju K, V R Ramkumar, K Lineesh, S Nithya, V Sathish, " Study on Concrete using Steel Slag as Coarse Aggregate Replacement and Eco Sand as Fine Aggregate Replacement", IJREAT, Volume-1, Issue 3, June 2013, pp1-6.

[2] Vishnumanohar A, "Performance of Normal Concrete with Eco Sand (Finely Graded Silica) As Fine Aggregate ", International journal of engineering and invasion, Volume 3, Issue 5, May 2014, pp1-9.

[3] Olesia Mikhailova, Gregory Yakovlevb, Irina Maeve, Sergey Senkovd, "Effect of Dolomite Limestone Powder on The Compressive Strength of Concrete", 11th International Conference on Modern Building Materials, Structures and Techniques, Elsevier, Volume 4, Issue 8, 2013, pp1-6.

[4] Eldhose M Majummekudy, Anju K Govind, Shibi Varghese, "comparative study on the effect of concrete using eco sand, weathered crystalline rocks sand and GBS as fine aggregate replacement", International journal of engineering research and technology, volume 3, Issue 10, October 2014, pp1-6.

[5] Huseyin Temiz, Fatith Kantarci, M Emin Inceer, "influence of blast furnace slag on behavior of dolomite used as a raw material of MgO type expansive agent", ELSEVIER, volume 94, Issue 42, 2015, pp28-35.

[6] Dominika Debska,"The effect of exposition conditions on the durability of cement concrete with dolomite aggregate sourced near krakow, poland", ELSVIER, Volume 3, Issue7, 2015, pp1-8.

[7] M.Prabhu, S.Logeswaran, Dr. Sunilaa George, "Influence of GGBS and Eco Sand in Green concrete", International Journal of Innovative Research in Science, Engineering and Technology", Volume 4, Issue 6, June 2015, pp1-6.

[8] Aswani, M.Indira,T.M.Jeyashree," A study on effect of crystalline dolomite silica as a partial replacement of cement", IJETS, Volume 3, Issue 3, March 2016, pp1-6.

[9] B.Durga, M.Indira,"Experimental study on various effects of partial replacement of fine aggregate with silica sand in cement concrete and cement mortar", IJETT, Volume 33

[10] Preethi G, Prince Arulraj, "Effect of Replacement of Cement with Dolomite Powder on the mechanical Properties of Concrete", International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 4, April 2015.

[11] Olesia Mikhailova.et.al "Effect of Dolomite Limestone Powder on The Compressive Strength of Concrete" 11th International Conference on Modern Building Materials, Structures and Techniques, MBMST 201, Science Direct Procedia Engineering 57 (2013) 775 – 780