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Mechanical Properties of Concrete with Quarry Rock Dust

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ABSTRACT
Quantities of quarry rock dust from industries have been on the rise in recent years due to the rapid improvement in the standard of living and the increase in industrialization. In this research various proportions of quarry rock dust is used as supplement to sand in cement concrete. The works under taken here dealt with the use of quarry rock dust as a supplementary material in cement concrete. In this investigation,% of water absorption and compressive strength criteria were analyzed by introducing quarry rock dust into the cement concrete.

Key words: Quarry Rock dust

I. INTRODUCTION

Concrete is the most commonly used building material but suitable sand for making concrete is in high demand. Quarry dust is a by product of the crushing process which is a concentrated material to use as aggregate for concreting purpose especially as fine aggregates. In quarrying activities, the rock has been crushed into various sizes. During the process, the dust generated is called quarry rock dust and it is formed as waste.

Quarry rock dust should be used in construction works which will reduce the cost of construction and the construction material would be saved and the natural resources can be used properly.

II. MATERIALSAND THEIR PROPERTIES

The following materials are used in this study
1. Sand
2. Cement
3. Quarry Rock dust

2.1. SAND

Medium size sand from a local quarry near Nagercoilwith a modulus of fineness = 2.80, Specific gravity 2.677, normal grading with the silt content 0.8%

2.2 CEMENT

Ordinary Portland Pozzolana Cement (Fly ash based) conforming to BIS(Part1):1991having specific gravity of 3.15 was used. The consistency value becomes 30% and the initial and final setting time were 90 and 195 minutes respectively.

2.3QUARRY ROCK DUST

The quarry rock dust was obtained from local crusher at Kumarapuram , Tirunelveli District. The specific gravity of the quarry rock dust is 2.677. Moisture content and bulk density of waste are less than the sand properties.

Fig 3.1 Quarry rock dust

III. METHODOLOGY

Replacement of sand by quarry rock dust is used in this study with different proportions based on the literature review . In this mix, cement and water are taken as constant then by varying quarry rock dust as 10%,20%,30%. The basic mix proportions used for the trial mixtures are as per IS: 10262-2009 mix design procedure. The material for each mix proportion is mixed separately. M_{20} grade concrete is used for this research.

3.1 TESTS ON CONCRETE

- Compressive strength test
- Water absorption test

3.1.1 COMPRESSIVE STRENGTH TEST

Compressive test is the most common test conducted on hardened concrete, partly because it is

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an easy test to perform, the partly because most of the desirable characteristic properties of concrete are qualitatively related to its compressive strength. The cube specimen is of the size 150 X150 X 150 mm. The fresh concrete were cast and allowed to set for 24hours before being removed from the moulds and kept at room temperature (20º C). Compressive strength for each mortar mixture was obtained from an average of 3 specimens.. The tests are done on Compression-testing machine and compressive load is applied on opposite faces axially, slowly at the rate of 140 Mpa/minute. The compressive load is noted for the ultimate failure. Record the total maximum load indicated by the testing machine, and calculates the compressive strength as followsFck = P/A

3.1.2 WATER ABSORPTION TEST

Three cubes of size 150mm were casted for each mix. All specimens were removed after 24 hours of casting and subsequently water cured for 24 hours. Samples were removed from water and wiped out any traces of water with damp cloth and difference in weight was measured.

IV. RESULTS AND DISCUSSIONS

4.1WATER ABSORPTION TEST

Table 4.1 Water absorption test

S:NO	MIX	% OF WATER ABSORPTION
1	CC	1.02
2	Q-10%	0.9975
3	Q-20%	1.05
4	Q-30%	1.058

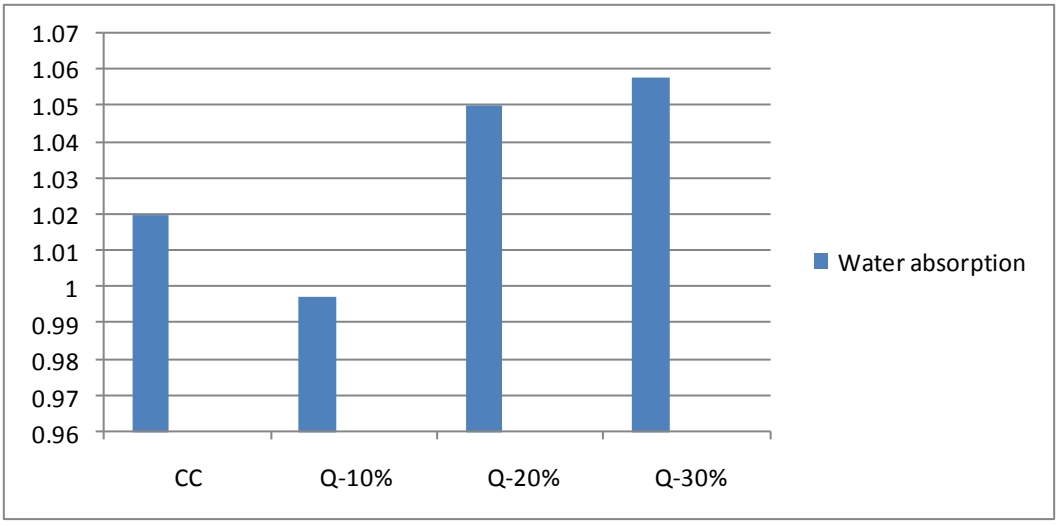

Fig 4.1 Water absorption test

Fig 4.1 shows the percentage of water absorption for various types of mixtures at the age of twenty four hours curing. The absorption characteristics indirectly represent the porosity. The result clearly shows that the mix containing quarry rock dust can have more percentage of water absorption (ie. % of voids) when compare to control concrete.

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4.2 28 DAYS COMPRESSIVE STRENGTH

Table 4.2 Compressive strength for various types of mixes

MIX	28 DAYS COMPRESSIVE STRENGTH N/mm^2
CC	34.00
Q-10%	39.11
Q-20%	35.78
Q-30%	35.11

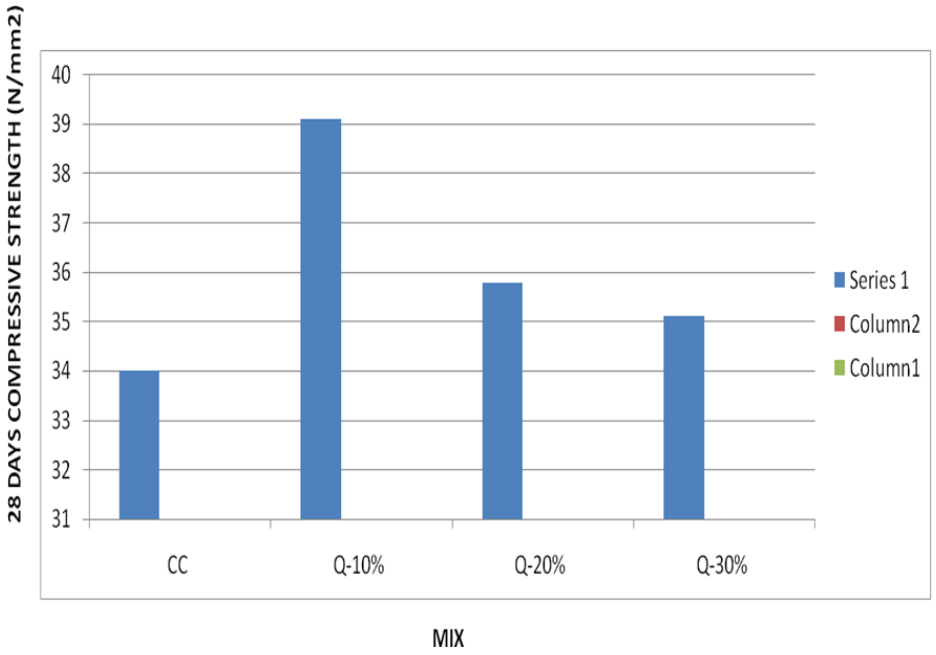

Fig. 4.2. 28 Days Compressive Strength

Figure 4.2 represents compressive strength for replacement of sand by quarry rock dust in cement concrete after 28 days of curing. The sand is replaced by quarry rock dust in cement concrete at three different percentage such as 10%,20% and 30%.The result shows that the higher compressive strength is achieved in 10% replacement of sand by quarry rock dust. If the percentage of quarry rock dust is increased, the strength decreases due to the increase in voids content..It is observed that 10%,20% and 30% replacement of sand by quarry rock dust induced 15%,5% & 5%increase in compressive strength with respect to the control concrete.The use of quarry rock dust exhibited excellent performance due to the efficient micro filling ability.

4.3 COMPRESSIVE STRENGTH FOR VARIOUS TYPES OF MIXES

Mix	Compressive strength in N/mm^2		
	3 days	7 days	28 days
CC	17.33	30.00	34.00
Q-10%	19.33	19.55	39.11
Q-20%	22.44	28.89	35.78
Q-30%	18.00	21.33	35.11

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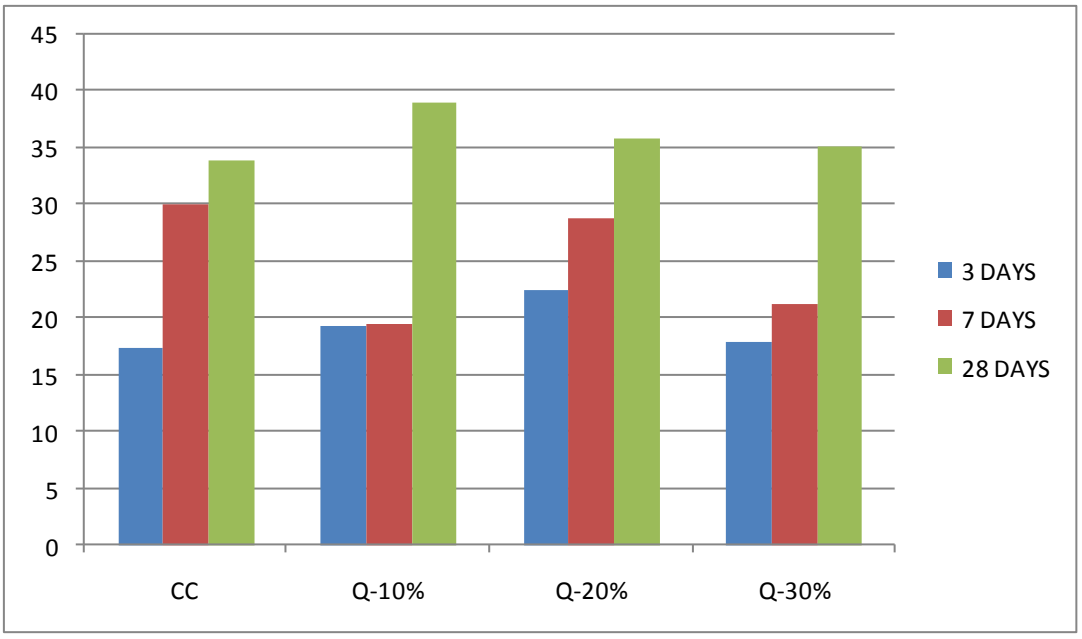

Fig.4.3 Compressive strength for various types of mixes

Fig 4.3 shows the 3days,7days and 28days compressive strength of various types of mixes.The compressive strength of cement concrete made with PPC (i.e. the control) is compared to concrete made with quarry rock dust. 10% quarry rock dust revealed the highest compressive strength, where it recorded a 15% increase in compressive strength with respect to the control specimen. The compressive strength of specimens containing quarry rock dust is higher than the control concrete. This indicates that the quarry rock dust greatly improves the mechanical performance of concrete.

FURTHER STUDIES

Future studies need to focus by increasing the percentage of quarry rock dust content above 30% of partial replacement of fine aggregate.

V.CONCLUSION

The various combinations of cement, sand, coarse aggregate, quarry rock dust were mixed and casted into 150mm cubes and tested for their water absorption and compressive strength at 3 days, 7 days and 28 days curing.

- All the experimental data shows that addition of quarry rock dust improves the strength. From the above study, it is concluded that the quarry rock dust may be used as a replacement material for fine aggregate.
- The water absorption test result clearly demonstrate that the water absorption of mixture containing quarry rock dust is slightly higher than conventional concrete.
- The use of quarry rock dust exhibited excellent performance due to the efficient micro filling ability. Therefore, the results of this study provide a strong recommendation for the use of quarry rock dust as fine aggregate in concrete manufacturing.

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The author has pursued her master's degree in engineering Thetotal teaching experience is more than 32 years.

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