Suitability of Quarry Dust as Fine Aggregate in Concrete

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Abstract - ***This study is an attempt to investigate the suitability of quarry dust as a partial replacement of fine aggregates in concrete casting. In the experiment, fine aggregates were replaced by quarry dust as 0%, 25%, 50%, 75% and 100% by weight for M-25 mix. The concrete specimens were tested for compressive strength and the results obtained were compared with those of normal concrete. The results showed that by increasing the quarry dust content workability decrease and compressive strength increased***.

***Keywords*:** Concrete, Compressive Strength, Fine Aggregate, Quarry Dust, Water Cement Ratio

1. INTRODUCTION

The increasing demand in sand can cause environmental deterioration and other bad effects. Lack of proper planning and sand management damage piers of bridge and can cause bad effect to the river. So, an alternative method is considered. Quarry waste fine aggregate could be an alternative of natural sand. It is a by-product generated from the production of crushed quarry rock. Quarry dust, which is generally considered as a waste material after the extraction and processing of rocks to form fine particles, causes an environmental load due to disposal problem. Quarry dust is also used as cement in concrete brick production industry. Certain proportion of quarry dust as cement in concrete brick can be applied as it can retain strength as made only with cement. Concrete plays an important role in construction of buildings and massive structures. Its strength greatly depends on all of constituents: cement, sand, aggregate, and water. The experiment may help to reduce the disposal problems of quarry dust and enhance properties of concrete and to find out if quarry dust is a suitable replacement of sand or not.

1.1 Material Properties

(i) Cement

Cement is the most important constituent in concrete. The research is carried out with normal Portland cement: Double Rhinos (Class – 42.5).

Specific gravity of cement = 2.76

(ii) Sand

It consists of particles of ASTM sieve no. 4 and less in size. It must be clean and free from fine dust, loam, silt and clay. Sand not more than 5 percent of silt is used in experiment.

Specific gravity of sand = 2.38

(iii) Aggregate

The maximum size of coarse aggregate should be 20 mm and minimum size should be 10 mm. The coarse aggregate with angular in shape and the rough surface texture is used.

Specific Gravity of coarse aggregate = 2.63

(iv) Quarry Dust

Quarry dust is fine rock particles. When boulders are broken into small pieces, quarry dust is formed. It is grey in color and it is like fine aggregate.

Specific Gravity of quarry dust = 2.5

(v) Water

Water is an important ingredient of concrete and it initiates chemical reaction with cement. Ordinary potable water is used. Range for ordinary portable water is that turbidity is less than 5 NTU, and pH value is within the range of 6.5-8.5. For this test,

Turbidity = 0 mg/l
pH value of water = 7

2. EXPERIMENTAL INVESTIGATION

(i) Concrete having normal mix proportion of 1:2:4 is used by weight.
(ii) Fixed water-cement ratio is used.
(iii) For the concrete mix, quarry dust will be added for replacement of sand from 0% to 100% in step of 25%.
(iv) Mould Size is 150mm x 150mm x 150mm.
(v) The specimens were cast, tested at the age of 7 and 28 days after curing.

Compression test results are shown in Table 1, and Figures 1 to 3 describe the comparison of 7 day and 28 day strength for respective water cement ratio.

Table 1: Compressive Strength Test Results

W/C ratio	Age of Test	Quarry Dust (%)				
		0%	25%	50%	75%	100%
0.57	7 day	3368.7	2926.4	1271.6	2549	1297.7
	28 day	4910.5	6023.6	5545.5	5402.2	2369.1
0.62	7 day	3442	3114.8	2307.9	2569.9	2777.3
	28 day	3933.1	4329.1	4965.4	4954.3	4524.5
0.67	7 day	3166	2716.4	2683.7	2893.7	2369.1
	28 day	3553.2	4070.2	5742	5066.2	3525.7

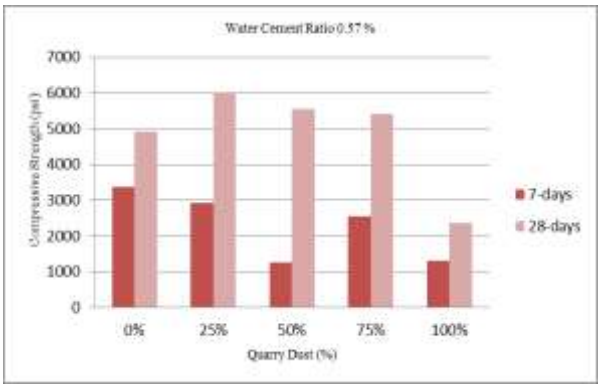

Fig 1: Strength test results for w/c ratio of 0.57%

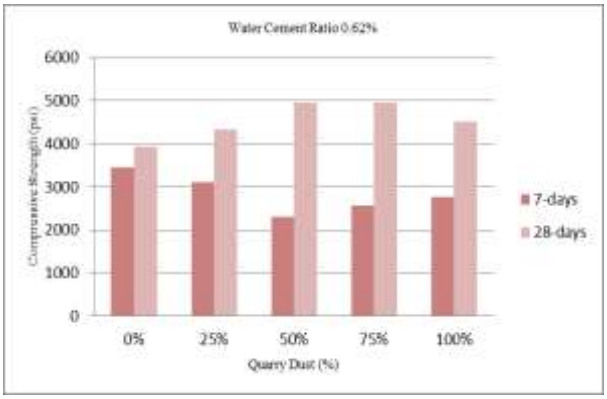

Fig 2: Strength test results for w/c ratio of 0.62%

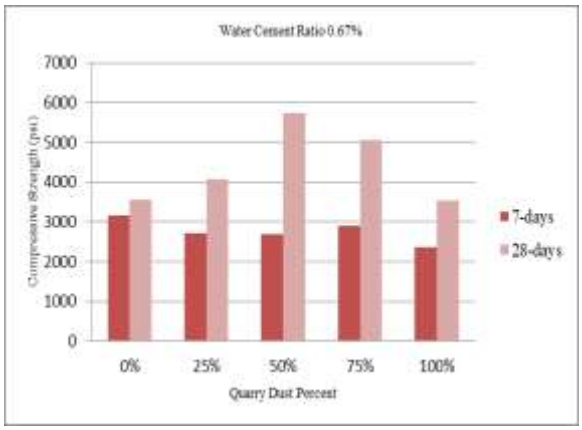

Fig 3: Strength test results for w/c ratio of 0.67%

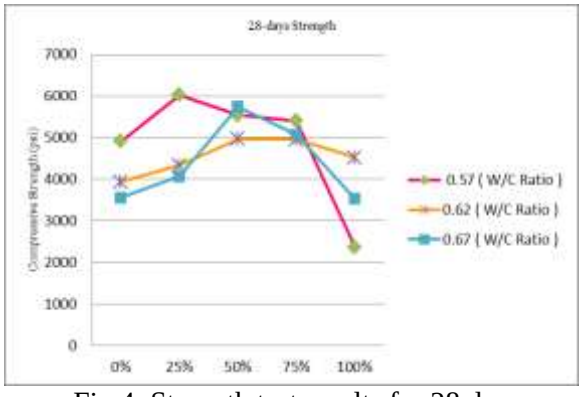

Fig 4: Strength test results for 28 day

3. CONCLUSION

The experimental results show that lower strength is obtained with increment of water-cement ratio in normal concrete casting. The presence of quarry dust in concrete can give high compressive result which is greater than normal concrete for 28 day. The optimum percentage of quarry dust in mix design is 50% except for w/c 0.57%. Certain proportion of quarry dust can be used as fine aggregate in concrete.

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