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"Experimental Investigation on Quarry Dust as a Partial Replacement of Sand for M-40 Grade Concrete"

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Abstract— *To increase the strength of the concrete, the stone dust will be presented as a partial replacement of the fine aggregate in M40 concrete mix with water reducer admixture. The strength parameters such as compressive strength, flexural strength and split tensile strength of the casted cubes, beams and cylinders will be tested respectively. Cubes cylinders and beams will be casted by a partial replacement of natural fine aggregate in concrete mix and quarry dust will be used as a fine aggregate. The quarry dust is replaced by sand varying different percentage (0%, 15%, 30%, 45%, 60% & 75%). then test data of quarry dust concrete will be compared with test data from a standard concrete without quarry dust*

Keywords: Quarry, water cement ratio, compressive strength, flexural strength, tensile strength

1. INTRODUCTION

Concrete is that the most generally used stuff nowadays. The constituents of concrete are coarse combination, fine combination, binding material and water. Among these ingredients, river sand is commonly used as fine aggregate in concrete which is becoming scarce and hence expensive due to excessive cost of transportation from natural sources. In this experimental study, the byproduct of crushing stone plant i.e. quarry dust is used as a sand replacement. Due to the lack of natural construction materials, we have to think about the other alternatives available for replacement. For the past few years, many substitutions have been found to replace the main binding material of concrete i.e. cement. But there is a need to find a better replacement option for sand which is available entirely in the local area, even the option may be a waste material.

2. MATERIAL USED

2.1 Cement: Portland Pozzolana cement (PPC) is used in this research work.

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2.2 Sand: Sand is available near Narmada River. This sand is used for the above research work.

2.3 Natural aggregate: 20 mm natural coarse aggregate is used having a specific gravity of 2.72..

2.4 Quarry Dust: Quarry dust is fine rock particles obtained from crushing of natural stone it was initially in dry condition and then sieved before mixing. The specific gravity of quarry dust is 2.65 and fineness modulus is 2.32.

3. EXPERIMENTAL WORK AND TEST

3.1 Mix Design for M-35 Grade: The proportion of M-40 grade concrete is calculated as per IS 10262-2009 & IS 456-2000 is 1:1.83:2.65. Water binder ratio is taken as 0.44.

3.2 Workability test: In the workability test the slump value vary from 75 mm to 98 mm

3.3 Compressive Strength Test: The mould is prepared for cubes used in the compression test having a size of 0.15mX0.15mX0.15m. After preparing cubes rest on the compression testing machine and load is applied. After applying load the value noted from the dial gauge. Compressive strength determine at 7 & 28 days.

3.4 Flexural Strength Test: The mould is prepared for beams used in the bending test having a size of 0.10mX0.10mX0.50m. After preparing beams rest on the flexural testing machine and load is applied. After applying load the value noted from the dial gauge. Bending strength determine at 7 & 28 days

3.5 Split Tensile Strength: The mould is prepared for cylinder used in the tensile test having a size of 0.15m diameter and 0.30m height. After preparing cylinder rest on the compression testing machine and load is applied. After applying load the value noted from the dial gauge. Tensile strength determine at 7 & 28 days

4. TEST RESULTS

4.1 Workability As shown in below table 2 for different percentage of micro silica slump value were calculated..

Table 2: Workability Result

Mix	Percentage of Quarry Dust	Slump (mm)
Mix-01	0%	75
Mix-02	15%	78
Mix-03	30%	84
Mix-04	45%	89
Mix-05	60%	96
Mix-06	75%	98

4.2 Compressive Strength; The below table shows the compressive strength for different percentage of quarry dust which is vary from 0%-75%..

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Table 3: Compressive Strength Result

Mix Design	Percentage of Quarry Dust	7 days Compressive Strength	28 days Compressive Strength
Mix-01	0%	32.07	44.81
Mix-02	15%	32.96	45.70
Mix-03	30%	33.62	47.18
Mix-04	45%	34.16	48.81
Mix-05	60%	30.21	44.22
Mix-06	75%	28.81	43.88

4.3 Flexural Strength The below table shows the Bending strength for different percentage of quarry dust which is vary from 0%-75%..

Table 4: Flexural Strength Result

Mix Design	Percentage of Quarry Dust	7 days Flexural Strength	28 days Flexural Strength
Mix-01	0%	3.09	4.44
Mix-02	15%	3.31	4.82
Mix-03	30%	3.33	4.98
Mix-04	45%	3.57	5.44
Mix-05	60%	3.06	4.40
Mix-06	75%	2.82	4.23

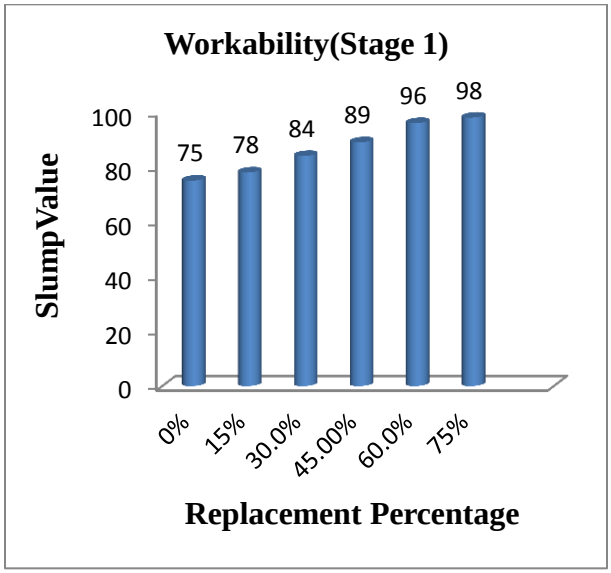
4.4 Split Tensile Strength The below table shows the tensile strength for different percentage of quarry dust which is vary from 0%-75%.

Table 5: Tensile Strength Result

Mix Design	Percentage of Quarry Dust	7 days Split Tensile Strength	28 days Split Tensile Strength
Mix-01	0%	2.29	4.48
Mix-02	15%	2.46	4.70
Mix-03	30%	2.69	5.10
Mix-04	45%	2.87	5.26
Mix-05	60%	3.33	5.64
Mix-06	75%	2.48	4.60

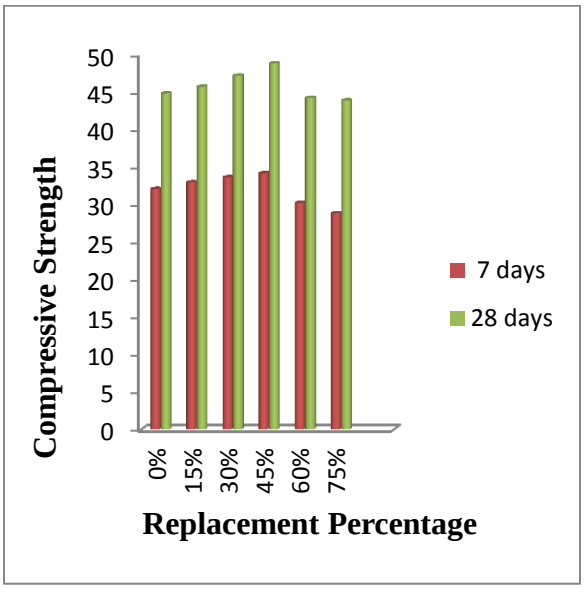
5. DISCUSSION ON TEST RESULTS

5.1 Workability: As shown in graph, we found that the highest slump obtained was 84 mm and the lowest slump was 58 mm. It has been observed that the workability of the concrete mix was decreases with increase in the replacement level of sand with quarry dust.



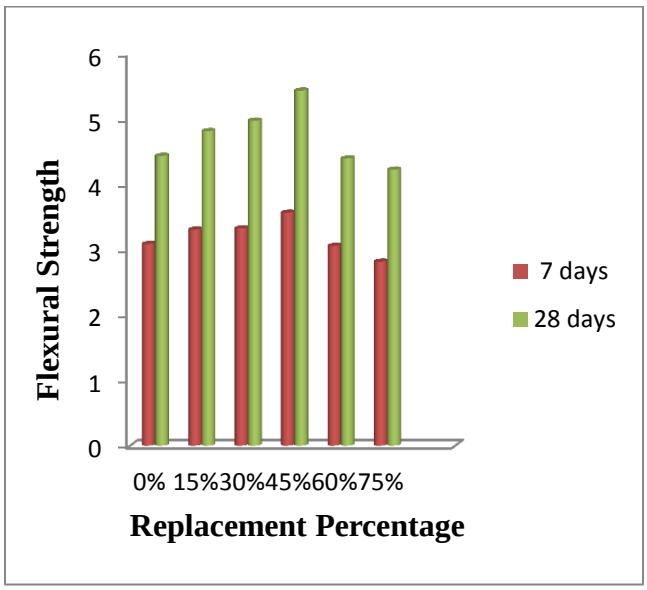
Graph 1: Slump Test for workability (mm)

5.2 Compressive Strength Test: From the graph 2 it is conclude that 7 & 28 days compressive strength 7.67% & 10.12% increases when percentage upto 45%. After that strength decreases when percentage of quarry dust increases.



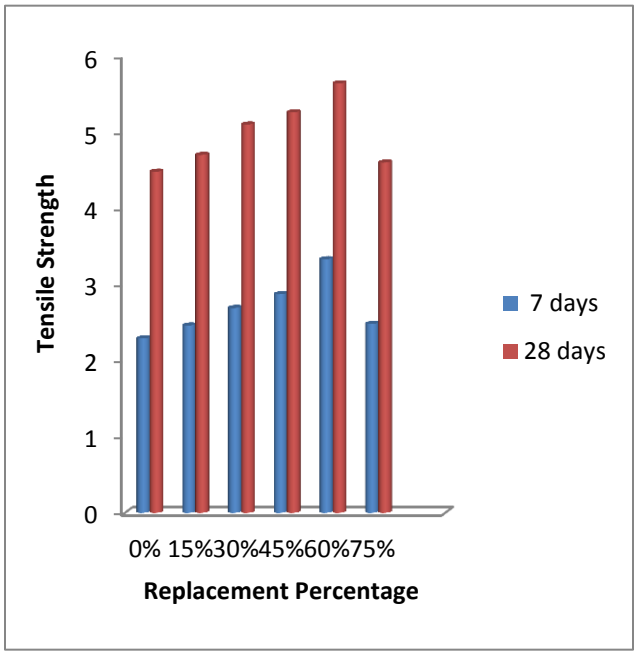
Graph: 2. Compressive Strength in N/mm2

5.3 Flexural Strength: It is conclude that 7 & 28 days bending strength 15.57% & 22.22% increases when percentage upto 45%. After that strength decreases when percentage of quarry dust increases.



Graph:3 Flexural Strength in N/mm2

5.4 Split Tensile Strength: It is conclude that 7 & 28 days tensile strength 27.07% & 20% increases when percentage upto 45%. After that strength decreases when percentage of quarry dust increases.



Graph 4: Split Tensile Strength in N/mm2

6. CONCLUSIONS: From the above research work the conclusion are as follows:

1. Workability of concrete increases as proportion of quarry dust increases.
2. Maximum compressive strength was observed when quarry dust replacement is about 45%.
3. Maximum split tensile strength was observed when quarry dust replacement is about 45%.
4. Maximum flexural strength was observed when quarry dust replacement is about 45%.

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