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A Study on Sisal Fiber Concrete by Partial Replacement of Cement with Quarry Dust

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Abstract: *In developing countries where concrete is widely used, the high and steadily increasing cost of concrete has made construction very expensive. The production of concrete requires various materials like Cement, water, Fine aggregate and Coarse Aggregate .Due to extensively use of concrete which lead to an increase in cost of materials. Therefore an alternate material is used for partial replacement of Fine aggregate, coarse aggregate, cement and admixtures in concrete. In this project experimental investigations are carried out to reduce the cost of concrete. In this research work experiments have been conducted with collection of materials required and the data required for mix design are obtained by partial replacement of cement with quarry dust and sisal fibers as admixtures. Specific gravity tests are carried out for quarry dust.*
In this project cement is replaced by Quarry dust up to 40% along with addition of sisal fiber. The cement is replaced with 10%, 20%, 30 % and 40% by quarry dust and addition of sisal fiber 0.5%, 1%, 1.5% and 2% respectively. The design Mix used for the project is M30 grade with W/C Ratio 0.45.The Conventional concrete and Cement with quarry dust and adding sisal fiber as admixture concrete specimens were casted and tested for compressive strength for 7 and 28 days The compressive strength of the QD10%+SF0.5% and QD20%+SF1.0% at 28days was 46 N/mm^2 and 31 N/mm^2.

Keywords: *Coarse aggregate, Quarry dust, Sisal fibers*

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I. Introduction

Concrete is the civil engineering construction material. Its manufacturing involves the utilization of ingredients like cement, sand, aggregates, water and admixtures. The Demand for the construction material is increasing day by day due to the infrastructural development across the world. Considering the high prices of Portland cement there is a considerable need in our India for promoting supplementary cementations material cheaper than ordinary Portland cement. Day to day different types of waste materials production is increasing and creating many environmental issues. Making use of these waste materials in manufacturing of concrete will decrease environmental pollution and the cost of concrete. Portland cement, already being a very expensive material constitutes a substantial part of the total construction cost of any project and the situation has further been aggravated by energy crisis, which has increased the cost of production of Portland cement .Therefore, it is of current importance for the country to explore and develop cementing materials cheaper than Portland cement. The disadvantages of using concrete include poor tensile strength, low strain of fracture and formwork requirement. The minor cracks developed under applied stress during curing because of low tensile strength of the material. Hence fibers are added to concrete to overcome these disadvantages. Regular concrete is normally reinforced with steel fibers but using steel fibers in concrete is costly one, to overcome this natural fiber like sisal fiber is used as secondary reinforcement to increase properties of concrete.

II. Methodology

The hardened concrete testing plays an important role in the concrete works. The compressive strength of the concrete is one of the important properties of concrete. In this chapter we deal with the mix design with various proportions, the process of preparing cubes for different curing periods in UTM to find the compressive strength. In the present experimental investigation quarry has been used as a partial replacement of cement and sisal fibre additional ingredient in concrete mixes. The effect of adding different percentages of quarry dust and sisal fibres additional material to concrete mixes on their compressive strength are studied. They have forced to focus on recovery, reuse of natural resources and find other alternatives. Presently large amounts of quarry waste are generated in quarry mines with an important impact on the environment and humans. The quarry mines inevitably generates wastes, irrespective of the improvements introduced in mining processes. In the granite quarry mines, about 25%-40% goes as waste. The concept of replacement of cement by quarry dust

could boost the consumption of quarry dust generated from quarries. The Quarry dust is the by-product obtained in the processing of granite stones which broke down in the coarse aggregates and powder of different sizes. Sisal fiber is the natural fiber from tree which is eco friendly. By adding fibers in concrete tensile strength will increases to the concrete by using steel fibers it is not economical so sisal fiber can be preferred as an alternative fibers to steel fibers as sisal fibers are eco friendly to.

Materials used:
1) Cement
2) Sisal fibre
3) Fine aggregate
4) Course aggregate
5) Quarry dust

Chemical properties of SISAL FIBERS:

Table Chemical properties of sisal fibers

Cellulose	65
Hemicelluloses	12
Lignin	9.9
Materials	Sisal fibers (%)
Waxes	2
Total	100

Quarry Dust:
Quarry dust is obtained by the process of crushing of the aggregates. The replacement of the sand with the quarry dust results in the reduction of workability of the concrete is due to the absorption of water by the quarry dust.

Properties:
The physical and chemical properties of quarry dust are obtained by testing the samples as per Indian standards.

Table - Physical Properties of Quarry Dust

S.NO	Property	Test result
1.	Shape	Fine powder
2.	Specific gravity	2.54
3.	Fineness Modulus	2.90

Table -Observations of Quarry Dust

S.NO	I.S.Sieve No.	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative percentage retained	Cumulative Percentage passing
1.	10mm	0	0	0	100
2.	4.75mm	6	6	0.6	99.4
3.	2.36mm	278	284	28.4	71.6
4.	1.18mm	368	652	65.2	34.8
5.	600µ	176	828	82.8	17.2
6.	300µ	82	910	91.0	9.0
7.	150µ	42	952	95.2	4.8
TOTAL					336.8

Fineness modulus, $\sum F = 336.8/100 = 3.368$

III. Results And Discussions

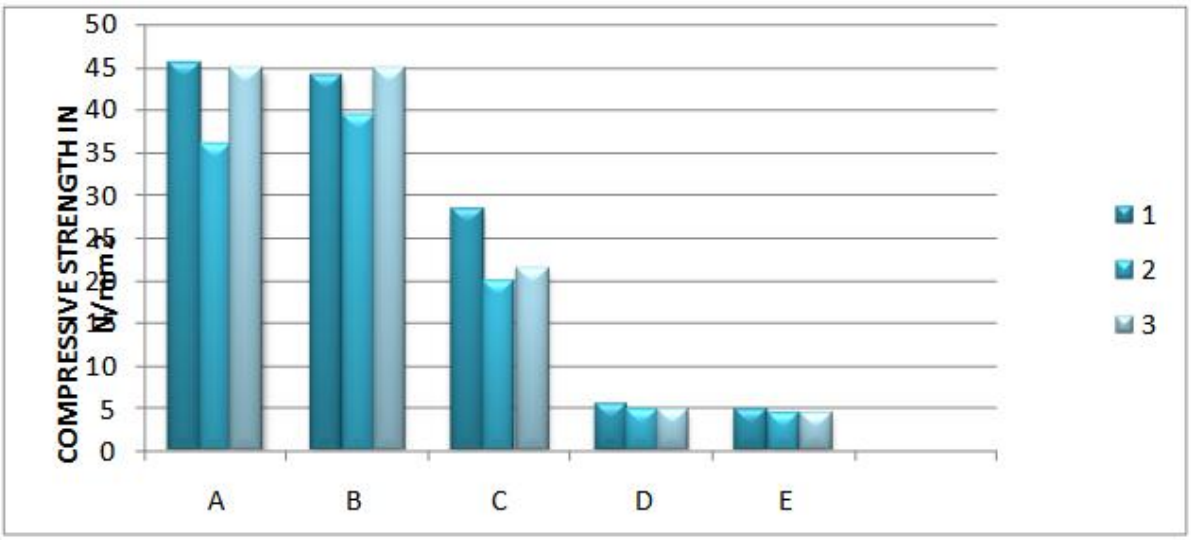
Series of tests are conducted on concrete specimens to obtain the strength of concrete in which cement is replaced with quarry dust and simultaneously adding sisal fibre in different proportions the experimental investigation values have been tabulated and represented graphically to show the compressive strength of concrete

Compressive Strength:

In accordance with IS 516-1959 the compressive strength of conventional and simultaneously replaced cubes for 7 days and 28 days strengths are determined by testing the cube specimens in compression testing machine

Table-: Compressive strengths for simultaneous placement of cement with quarry dust and adding sisal fiber for different percentages at the age of 7 days:

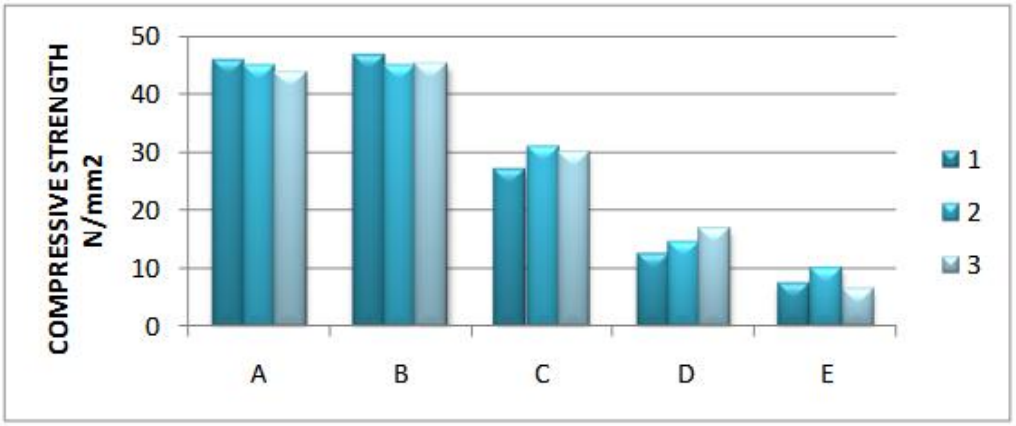
Cube codes	Quarry Dust %	Sisal fibre %	Compressive strength (N/mm^2)
A1	0	0	45.5
A2	0	0	36
A3	0	0	45
B1	10	0.5	44
B2	10	0.5	39.5
B3	10	0.5	45
C1	20	1.0	28.5
C2	20	1.0	20
C3	20	1.0	21.5
D1	30	1.5	5
D2	30	1.5	5.5
D3	30	1.5	5
E1	40	2.0	5
E2	40	2.0	4.5
E3	40	2.0	4.5



Graph -: Compressive strength at 7 days

Table-: Compressive strengths for simultaneous placement of cement with quarry dust and adding sisal fiber for different percentages at the age of 28 days:

SET	Cube codes	Quarry Dust%	Sisal fibre %	Compressive strength (N/mm^2)
A	A4	0	0	46
	A5	0	0	45
	A6	0	0	44
B	B4	10	0.5	47
	B5	10	0.5	45
	B6	10	0.5	45.5
C	C4	20	1.0	37
	C5	20	1.0	31
	C6	20	1.0	30
D	D4	30	1.5	12.5
	D5	30	1.5	14.5
	D6	30	1.5	17
E	E4	40	2.0	7.5
	E5	40	2.0	10
	E6	40	2.0	6.5



Graph : Compressive strength at 28 days

IV. Conclusion

- The compressive strength at the age of 7 days is obtained at 10% replacement of Cement with quarry dust and simultaneously 0.5% addition of sisal fibre is equivalent to the compressive strength of conventional concrete.
- The maximum compressive strength is occurring at the age of 28 days is obtained at 10% replacement of Cement with quarry dust and simultaneously 0.5% addition of sisal fibre which is 2% greater than conventional concrete.
- By adding 10%replacement of cement with quarry dust and simultaneously 0.5% addition of sisal fibre giving best results compared to conventional concrete and decreasing the cost of concrete upto 137 rupees $/m^3$.
- Utilization of sisal fibers and its applications are used for the development of the construction industry, material sciences.

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