

# An Investigation of Sisal Fibre Concrete Using Quarry Dust

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**ABSTRACT:** Concrete has found wide application in construction industry throughout the world because of positive attributes such as durability, high resistance to loads, and the possibility of using local raw materials in the preparation of concrete. Quarry dust and sisal fibre to be used in concrete the density was comparatively low when compared with conventional concrete. River sand or fine aggregate in making the concrete is the higher cost so the natural sand is necessary to replacement in concrete. The present research work is to use quarry dust 20% constantly as replacement of fine aggregate and to use addition of sisal fibre in the range of 0.25%, 0.50% and 0.75% for the total volume of concrete. The strength property was compared with the conventional concrete after the curing period of 7, 14 and 28 days. The sisal fibre concrete was given optimum compressive strength in 0.50% of addition of sisal fibre and also increased split tensile and flexural strength higher compared to conventional concrete. The grade of concrete was made in M30.

**KEYWORDS:** Sisal fibre, Quarry dust, Slump test, Density, Compressive, Split tensile and Flexural strength.

## I. INTRODUCTION

It is generally known that, the fundamental requirement for making concrete structures is to be produce good quality concrete. Good quality concrete is produced by carefully mixing cement, fine and coarse aggregate, water and combining admixtures as needed to obtain the optimum product in quality and economy for any use good concrete, whether plain, reinforced or prestressed, should be strong enough to carry superimposed loads during its anticipated life. Other essential properties include durability, minimum amount of shrinkage and cracking. The sisal fibre material is chosen to improve the various strength properties of the concrete to obtain sustainability and better quality concrete. Short discrete vegetable fibre (sisal) was examined for its suitability for incorporation in cement concrete. The physical property of this fibre has shown no deterioration in a concrete medium. Leaves are dried, brushed to form. Concrete is a mixture of glue and fillers, cement and water act as glue and coarse and fine aggregate are the fillers. This concrete is strong in compression and weaker in tension. Sisal fibre is introduced in concrete to improve the concrete property and given higher strength.

## II. RELATED WORK

**Dr.A.Vijayakumar, K.Revathi, C.Bharathi (2015)** have “Strength and durability studies on concrete using quarry dust as fine aggregate” they have investigate to partially replace the sand by using quarry dust in 25%, 50% and 75%. Then they are finding the 50 % of Quarry dust can be replaced in sand so as to produce the optimum strength of concrete.

**Abdul Rahuman, SaikumarYeshika (2015)** have “Study On Properties Of Sisal Fibre Reinforced Concrete With Different Mix Proportions And Different Percentage Of Fibre Addition” The present research was designed to check the workability and strength properties of sisal fibre reinforced concrete with different mix proportions and different percentage of fibre addition.

# International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 6, Issue 4, April 2017

**P.Loganathan, Dr.G.S.Thirugnanam (2015)** has “Experimental study assessing the strength and crack resistant characteristics of sisal fibre reinforced concrete” Generally, cement concrete is weak in tensile strength and even the steel reinforced concrete has limited ductility and little resistance to cracking.

**A.Sivakumar and Prakash(2011)** have “Characteristic studies on the mechanical properties of quarry dust addition in conventional concrete” Currently India has taken a major initiative on developing the infrastructures such as express highways, power projects and industrial structures etc., to meet the requirements of globalization, in the construction of buildings and other structures.

**Radhikesh Nanda et al (2010)** have conducted experiments on cement concrete paving block replacing sand by stone crusher dust as fine aggregate.

### III.MATERIALS FOR PRODUCTION OF CONCRETE

#### A) CEMENT

The cement used for this project work is Sankar 43– grade in Ordinary Portland Cement. The various properties of cement are tabulated in following.

**Table 3.1 Properties of cement**

S.No	Test	Values
1	Specific Gravity	3.15
2	Fineness Modules	2.50%
3	Initial setting time	40 minutes
4	Final setting time	620 minutes

#### B) FINE AGGREGATE

Fine aggregate or natural sand is the one of the main constituents of concrete making which is about 35% of volume of concrete used in construction industry. Properties of aggregate affect the durability and performance of concrete, so fine aggregate is an essential component of concrete. Natural sand is mainly excavated from river beds and always contains high percentage of in organic materials, chlorides, sulphates, silt and clay that is affect the strength, durability of concrete.

**Table 3.2 Properties of fine aggregate**

S.No	Test	Values
1	Specific Gravity	2.75
2	Fineness Modules	2.65%
3	Water absorption	1.25%

#### C) COARSE AGGREGATE

Coarse Aggregate is the strongest and least porous component in concrete. It reduces drying shrinkage and other dimensional changes due to moisture. For optimum compressive strength with high cement and lower water cement ratio, size of coarse aggregate must be used.

**Table 3.3 Properties of coarse aggregate**

S.No	Test	Values
1	Specific Gravity	2.70
2	Fineness Modules	7.25%
3	Water absorption	0.70%

#### D) QUARRY DUST

When rock is crushed and sized in a quarry the main aim has generally been to produce coarse aggregates. Generally, this process has left over proportion of excess fines of variable properties, finer than 5 mm size. Quarry dust is defined as a purpose of made in crushed fine aggregate produced from a suitable source material. It is necessary to

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Vol. 6, Issue 4, April 2017

replace natural sand in concrete by an alternate material either partially or completely on concrete. Quarry dust is a waste material obtained from stone quarries while crushing stones, stone crusher dust, which is available abundantly from crusher units at a low cost in many areas, provides a viable alternative for river sand in concrete. Earlier investigation indicates that stone crusher dust has a good potential as fine aggregate in concrete construction. Crusher dust not only reduces the cost of construction but also helps to reduce the impact on environment by consuming the material generally considered as a waste product with few applications. Crusher dust has potential as fine aggregate in concrete structure with a reduction in cost of concrete by about 20 percent compared to conventional concrete.

**Table 3.4 Properties of quarry dust**

S.No	Test	Values
1	Specific Gravity	2.60
2	Fineness Modules	2.35%
3	Water absorption	1.10%

### E) SISAL FIBRE

Sisal fibre is a species of Agava. It is botanically known as *Agave sisalana*. The material is chosen to improve the strength, durability and reduce the weight of concrete. It is used in automobile industry and fibre glass in composite materials.

**Table 3.5 Properties of sisal fibre**

S.No	Test	Values
1	Specific Gravity	1.35
2	Tensile strength	348 to 375 N/mm <sup>2</sup>
3	Density	1.25 g/cm <sup>3</sup>



**Fig 3.1 Sisal fibre**

## IV. EXPERIMENTAL WORKS

### A) MIX DESIGN PROPORTION

Water cement ratio of mix design 0.40. Quarry dust is replacing 20% in constantly as a fine aggregate.

**Table 4.1 Materials required for 1 M<sup>3</sup> of concrete**

Water in litres	Cement in Kg	Fine aggregate in Kg	Coarse aggregate in Kg	Sisal fibre in Kg
197	492	650	1080	Addition of sisal fibre 0.25%, 0.50% and 0.75% in total volume of concrete
Ratio	1	1.32	2.19	

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Vol. 6, Issue 4, April 2017

## B) SLUMP TEST FOR FRESH CONCRETE

The workability was tested for fresh concrete in site.

**Table 4.2 Slump value for fresh concrete in mm**

Control Sample	0.25% of sisal fibre	0.50% of sisal fibre	0.75% of sisal fibre
56	48	36	24

## C) DENSITY TEST

The density of concrete are finding the harden concrete after 28 days curing period. The cube is weighted after 24 hours. Normally Density of concrete range is 24 to 26 KN/m<sup>3</sup>.

**Table 4.3 Density of harden concrete in KN/m<sup>3</sup>**

Control Sample	0.25% of sisal fibre	0.50% of sisal fibre	0.75% of sisal fibre
24.20	23.45	23.70	23.90

## D) PREPARATION OF TEST SPECIMENS

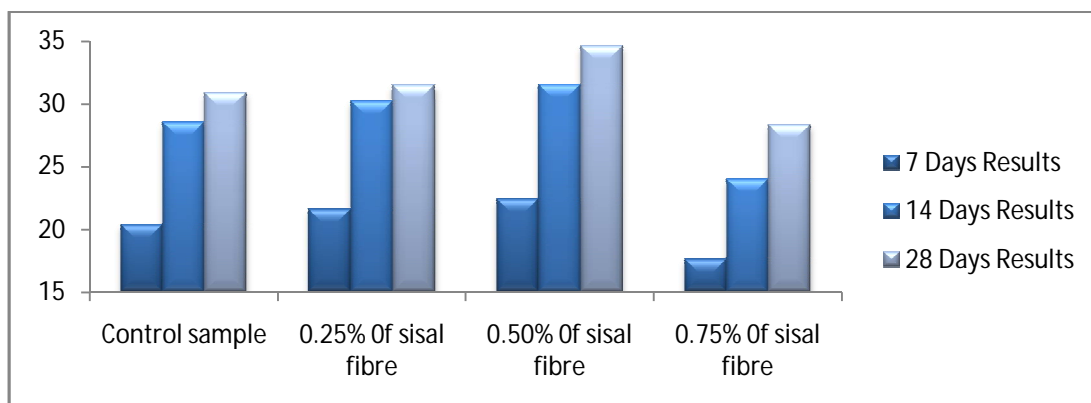
The test specimens were cast in cast-iron steel moulds. The inside of the moulds was applied with oil for easy demoulding. The solid ingredients were weighed on a digital balance and mixing the concrete in hand. It was ensured that a uniform color of the mix was obtained before adding water. Water is added for correct quantity using measuring jar. Proportioning of a concrete mix means determining the relative amounts of materials (cement, aggregates and water) required for batches of concrete of required strength. The investigation was carried out with standard mix M30 (1:1.32:2.19) with water cement ratio 0.40. This is done to know the possibilities of inclusion of quarry dust in optimum proportion in the ordinary construction activities using cement concrete.

## E) COMPRESSIVE STRENGTH

The cubes size is 150 mmx150mmx150mm were tested in plain surface dried condition as per IS 456, using a compression testing machine of 100 tonne capacity.

**Table 4.4 Compressive strength results at 7, 14 and 28 days in N/mm<sup>2</sup>**

Days	Control Sample	0.25% of sisal fibre	0.50% of sisal fibre	0.75% of sisal fibre
7	20.35	21.60	22.40	17.60
14	28.50	30.20	31.55	24.00
28	30.85	31.50	34.60	28.30



**Fig 4.1 Compressive strength results**

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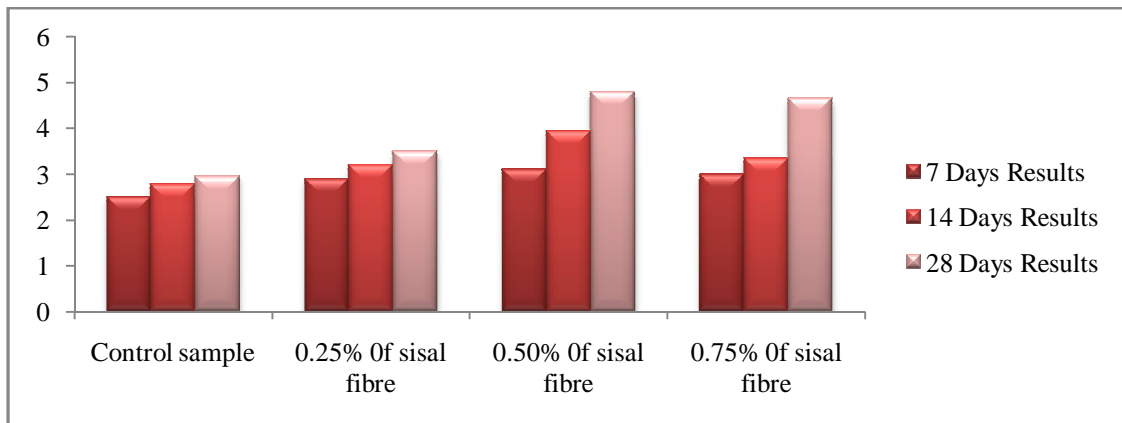
Vol. 6, Issue 4, April 2017

### F) SPLIT TENSILE STRENGTH

This is an indirect tension test method where a cylindrical specimen is placed horizontally between the loading surfaces of a compression testing machine and the load is applied along the vertical diameter. The specimen size is 150mmx300mm.

**Table 4.5 Split tensile strength results at 7,14 and 28 days in N/mm<sup>2</sup>**

Days	Control Sample	0.25% of Sisal fibre	0.50% of Sisal fibre	0.75% of Sisal fibre
7	2.50	2.90	3.10	3.00
14	2.78	3.20	3.95	3.35
28	2.95	3.50	4.80	4.65



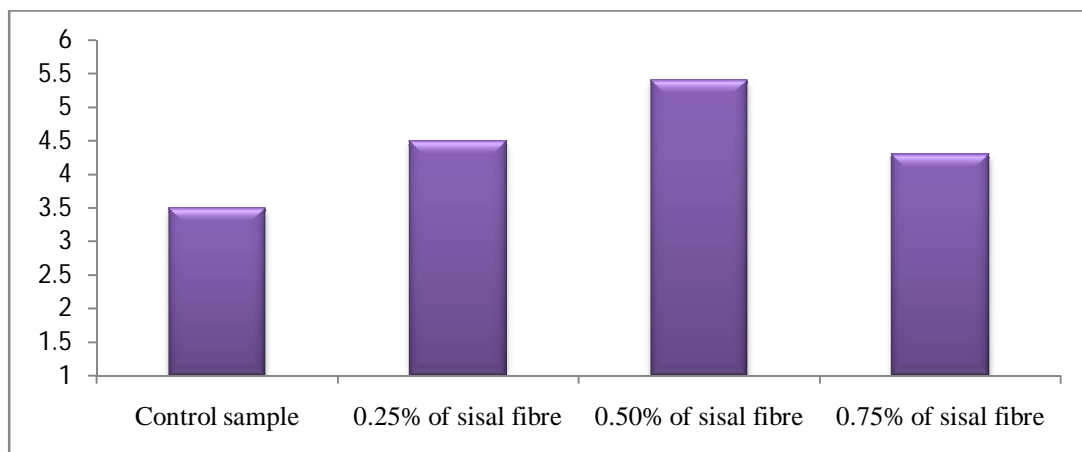
**Fig 4.2 Split tensile strength results**

### G) FLEXURAL STRENGTH

The prism specimens size is 100 mm x 100 mm x 500 mm were tested at the age of 28 days of curing. The one third of point loading was applied, using a Universal Testing Machine of 100 tonne capacity.

**Table 4.6 Flexural strength results at 28 days in N/mm<sup>2</sup>**

Control sample	0.25% of sisal fibre	0.50% of sisal fibre	0.75% of sisal fibre
3.50	4.50	5.40	4.30



**Fig 4.3 Flexural strength of concrete**

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Vol. 6, Issue 4, April 2017

## V. RESULTS

### A) COMPRESSIVE STRENGTH

The compressive strength result was discussed after curing period of 7, 14 and 28 days as following.

**Table 5.1 Compression strength results for M30**

Days	Percentage of Increased strength for 0.25% Addition of Sisal fibre	Percentage of Increased strength for 0.50% Addition of Sisal fibre	Percentage of Decreased strength for 0.75% Addition of Sisal fibre
7	6.14	10.07	13.51
14	5.96	21.40	15.79
28	3.10	13.25	7.36



**Fig 5.1 Compressive strength test**

### B) SPLIT TENSILE STRENGTH

The split tensile result was compared the conventional concrete after curing period 7, 14 and 28 days.

**Table 5.2 Split tensile results for M30**

Days	Percentage of Increased strength for 0.25% Addition of Sisal fibre	Percentage of Increased strength for 0.50% Addition of Sisal fibre	Percentage of Increased strength for 0.75% Addition of Sisal fibre
7	16	24	20
14	15.10	42.08	20.50
28	18.64	62.71	57.62

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(An ISO 3297: 2007 Certified Organization)

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Vol. 6, Issue 4, April 2017



**Fig 5.2 Split tensile strength test**

### C) FLEXURAL STRENGTH

Flexural strength result was compared the conventional concrete after curing period 28 day as following.

**Table 5.3 Flexural strength results for M30**

Days	Percentage of Increased strength for 0.25% Addition of Sisal fibre	Percentage of Increased strength for 0.50% Addition of Sisal fibre	Percentage of Increased strength for 0.75% Addition of Sisal fibre
28	28.75	54.28	22.85



**Fig 5.3 Flexural strength test**

## VI. CONCLUSION

This investigation is used to the development of modern technology in the field of construction industry. The future aspect of this research works is helpful to improving the strength, workability and durability of concrete.

- ❖ Using the quarry dust we are reduce the cost and density of concrete.
- ❖ The quarry dust properties are matches to fine aggregate so the quarry dust are used an alternative material for natural sand.
- ❖ The study of conclusion is addition of sisal fibre, thus gives more compression, tensile and flexural strength in concrete.

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Vol. 6, Issue 4, April 2017

- ❖ 20 % of quarry dust and 0.50% of sisal fibre was given the optimum strength of the concrete.
- ❖ From the compressive strength results it is observed that when increased sisal fibre above 0.50%, then the compressive strength values are decreased.
- ❖ The strength may be increased without quarry dust or sisal fibre and adding of admixture.

## ACKNOWLEDGEMENT

I express my deep love and graceful regards to my **Parents** and **Dr.P.Amudha** for their support, constant encouragement and timely help for completing project work.

My sincere thanks to Project guide, **Mrs.J.Thivya**, Assistant Professor, for the valuable guidance, suggestion and source of inspiration throughout this project.

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