# A Study On The Impact Of Recycled Aggregate On The Lime Dust Modified Sisal Fibre Reinforced Concrete

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***Abstract-*** *Concrete is a composite material, and consists of several different constituent parts. These parts are cement, water, aggregate and usually one or more special additives to ensure that the concrete has the desired properties. Concrete is being the second most consumed material in the world after water and the waste produced from different industries is in tones, that can be partially utilized in the regular concrete in place of cement and aggregate and thus it will reduce carbon dioxide emission and waste disposal at large scale. On the other hand the development of recycled aggregate concrete will have remarkable impact on the construction industry by overcoming the problems associated with recycled aggregate concrete. The increasing difficulty in securing natural coarse and fine aggregates for the production of concrete coupled with the environmental issues and depletion of natural aggregates makes the usage of recycled aggregate. Concrete is the ones with compression strongness and weakness in tension. So concrete needs reinforcement to increase the tensile strength. Natural fibers are less chemically compatible with the cement matrix. As a result, it is essential to modify the surface of natural fibers to achieve good fiber-matrix interfacial bonds. In the current study, sisal fibers intended for use as reinforcement in concrete matrices. In the present prospect a variety of waste product additives can be combined with concrete to optimize strength properties. The combination of these, often called hybridization, is introduced by using different material proportions like Lime dust, Sisal fibers and Recycle Aggregate. For the present study various laboratory experiments were done on different combinations of Lime dust, Sisal fibers and Recycle Aggregate with M40 grade of concrete..*

***Keywords***- Recycled coarse aggregate, compressive strength, split tensile strength test and flexural test.

## I. INTRODUCTION

With increasing capacities, disposal of large quantities of RCA becomes a big environmental concern and a critical issue for Recycled coarse aggregate makers. Over the last few years, with a better understanding of RCA, its functions and improvements in process technologies have led to a significant reduction in the volume of RCA generated. At the same time, the re-use of Recycled coarse aggregate making RCA has also been expanded, and has led to a significant reduction in the environmental impact of these by products. However RCA generation remains inevitable and emphasis on its recycling remains the greatest concern. The present work aims at developing a material that can replace the conventional aggregate in concrete work using the Recycled coarse aggregate. Quality assessment of eco friendly concrete that is made out of cement, RCA as coarse aggregate. This will solve the problem of waste disposal side by side preserving our natural resources.

So, we have to search for different materials to reduce the quantity of basic natural materials in the concrete mix without changing any mix design procedure and considerations. We cannot replace the whole basic material in the concrete, but some extent we can replace with other materials. There are some research were done on waste materials which are very near to our surroundings like crushed plastic, Stone dust, over burnt bricks, M – sand , glass powder, coconut shells, waste tires, RCA, fly ash produced from industries, broken glass pieces, rich husk ash, coconut shell ash, etc. to use them in concrete mix along with basic natural aggregates. In their methodologies, some of the above materials were used to replace the cement and some of the materials used to replace the aggregate. In those researches observed that these materials can be used in some extent percentages.

The increase in demand for the ingredients of concrete is met by partial replacement of materials by the waste materials which is obtained by means of various industries. Recycled coarse aggregate is a by-product of metal smelting and hundreds of tons of it are produced every year all over the world in the process of refining metals and making alloys. Recycled coarse aggregate can be used in the

construction industry as aggregate in concrete by replacing natural aggregates.

Concrete is being the second most consumed material in the world after water and the waste produced from different industries is in tones, that can be partially utilized in the regular concrete in place of cement and aggregate and thus it will reduce carbon dioxide emission and waste disposal at large scale. On the other hand the development of recycled aggregate concrete will have remarkable impact on the construction industry by overcoming the problems associated with recycled aggregate concrete. The increasing difficulty in securing natural coarse and fine aggregates for the production of concrete coupled with the environmental issues and depletion of natural aggregates makes the usage of recycled aggregate. of alternative aggregate materials is one of the solutions.

The present work is aimed at assessing the suitability of percentage of recycled coarse aggregate as coarse aggregate in making of M50 grade concrete and evaluating its resistance to marine environment and durability.

The present project involves a comprehensive laboratory experimentation study for the application of new waste materials in the preparation of concrete. The main objective of investigation is to study the strength behaviour i.e. compressive strength and impact resistance of concrete with different percentages replacement of coarse aggregate with recycled coarse aggregate and cement with lime dust.

The objective of the present study was to investigate experimentally the properties of Concrete with the following test results

1. Workability
2. Compressive strength
3. Flexure strength
4. Tensile strength

## II. REVIEW OF LITERATURE

Aggregate composed of recycled concrete generally has a lower specific gravity and a higher absorption than conventional gravel aggregate. New concrete made with recycled concrete aggregate typically has good workability, durability and resistance to saturated freeze-thaw action. Lack of widespread reliable data on aggregate substitutes can hinder its use. To design consistent, durable recycled aggregate concrete, more testing is required to account for variations in the aggregate properties. Also, recycled aggregate generally has a higher absorption and a lower specific gravity than conventional aggregate. Research has revealed that the 7-day and 28-day strengths of recycled aggregate concrete are generally lower than values for conventional concrete. Mandal et al. (2002) have found that there will be no affect on the concrete strength with the replacement of 30% of recycled aggregate. But the compressive strength was gradually decreasing when the amount of replacement of recycled aggregate increased. Hansen and Narad (1983) found that the compressive strength of recycled concrete is strongly correlated with the water-cement ratio of the original concrete if other factors are kept the same. When the water-cement ratio of the original concrete is the same or lower than that of the recycled concrete, the new strength will be as good as or better than the original strength, and vice versa. Aggregate composed of recycled concrete was reported to have a lower specific gravity and a higher absorption than conventional gravel aggregate.

Quasrawi et al. (2009) conducted a research on the utilization of steel slag as fine aggregate. Compressive strength and 28-day tensile strength tests were performed based on different slag ratios. The results indicated the improvement of compressive strength for replacement slag ratios of 15-30% and tensile strength for replacement slag ratios of 30-50%. The total substitution of natural fine aggregate with crystallized slag affects positively the tensile, flexural and compressive strength. The partial substitution of natural aggregate with slag aggregates permits a gain of strength at long term. The entire substitution of fine aggregates with slag aggregates should be avoided, it affects negatively the strength.

Frigione (2010) establishes minor values of splitting tensile strength in material covering plastic collection ready consuming great water/cement value than in parallel mix ready at little w/c value. Through exchanging 5% by weight of fine collection (natural sand) per an equal mass of plastic collection man-made from the unwanted plastic bottles. Example with dissimilar cement contented and water cement relation were man-made.

**Jung-Ho Kim (2019)** the number of construction wastes and recycled mixture has been increasing every year in2019. However, because the recycled mixture was poor quality, it's not used for concrete, and the Korean government has strong the standard standards for recycled mixture for concrete. In this was study, Determine was conducted on the mechanical and sturdiness characteristics of concrete using recycled mixture, once developing instrumentality to boost the standard of recycled mixture to increase the utilization of recycled mixture for environmental enhancements. The results illustrated improvements within the air volume, slump,

compressive strength, state change and thawing resistance, and drying shrinkage. Moreover, this was study was predicted to contribute to the redoubled use of recycled aggregate within the future.

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**Jitender Sharma et al (2014)** presented a case study on Influence of Recycled Concrete Aggregates on Strength Parameters of Concrete. The tests were conducted by replacing the recycled concrete aggregates by 0,25,50,75 and 100 % replacement of natural aggregates. It was found that the compressive strength, split tensile strength and hardened density of concrete made with RCA decreases with increase in the percentage of recycled concrete aggregates.

## III. MATERIALS AND METHODS

The experimental investigation work is started with various tests on the constituent materials. The constituent materials are given below.

1. Cement
2. Coarse aggregate
3. Water
4. Nano silica
5. Metakaolin

### *1. Cement*

Ordinary Portland cement of 43 grades manufactured by Shree Ultratech Cement was used throughout the Experimental investigation. The quality of the cement was confirming to IS 8112:1989 was used in the field.

### *2. Fine Aggregate*

Fractions from 4.75 mm to 150 microns are termed as fine aggregate. Locally available river sand passed through 4.75mm IS sieve is applied as fine aggregate conforming to the requirements of IS 383:1970.

### *3. Coarse Aggregate*

Coarse aggregate shall be of hard broken stone of granite shall be of hard stone, free from dust, dirt and other foreign matters. The stone ballast shall be of 20mm and down and should me retained in 5mm square mesh and well graded such that the voids do not exceed 42 percent. Aggregate most of which is retained on 4.75-mmIS Sieve and containing only so much finer material as is permitted for the various types described in this standard.

### *4. Recycled coarse aggregate*

It is now widely accepted that there is a significant potential for reclaiming and recycling demolished debris for use in value added applications to maximize economic and environmental benefits. Recycling industries in many part of the world, at present converts low-value waste into secondary construction materials such as a variety of aggregate grades, road materials and aggregate fines. Often these materials are used in as road construction, backfill for retaining walls, low-grade concrete production, drainage and brickwork and block work for low-cost housing.

### *5. Lime dust*

Limestone powder, also known as lime dust, is a common filler in concrete because it's inexpensive and easy to find. It can affect both the mechanical and durability properties of concrete

Mechanical properties

Limestone powder can increase compressive strength, splitting tensile strength, flexural strength, and modulus of elasticity. It can also improve early strength when mixed with Portland cement.

Durability properties

Limestone powder can impact water absorption, water penetration, acid resistance, carbonation resistance, and more. It can also increase the surface tension between water and cementitious materials, which helps concrete retain water.

## IV. MIX DESIGN

The property of workability, therefore, becomes of vital importance. The mix design is done as per IS 10262-2009. Percentage dosage of super plasticizer (high range water reducers) is an additional parameter to be considered for designing an OPC mix. Percentage dosage of super plasticizer was fixed as per the mix design method described in IS 10262-2009. Mix proportion was arrived through various trial mixes. The grade of concrete prepared for the experimental study was M40.

## V. RESULTS AND DISCUSSIONS

This session provides an outline of the experimental results and endeavors to draw some conclusions. The take a look at result covers the workability, mechanical properties and sturdiness properties of concrete with and while not admixtures.

### 5.1 **REPLACEMENT DETAILS**

The replacement details of cement with lime dust and coarse aggregate with recycled aggragate and further addition of sisal fibre. andmetakaolin has been given in the below table. The replacement of cement with lime dust by percentages 0, 10 and 20% and coarse aggregate by percentages by 0, 25, 50, 75, 100% with recycled coarse aggregate.

### 5.2 SLUMP TEST

The vertical settlement of unsupported fresh concrete, flowing to the sides and sinking in height is known as slump. Slump is a measure indicating the consistency or workability of cement concrete. It gives an idea of water content needed for concrete to be used for different works. A concrete is said to be workable if it can be easily mixed, placed, compacted and finished. A workable concrete should not show any segregation or bleeding.

. A concrete, which is considered workable for mass concrete foundation, is not workable for concrete to be used in roof construction, even in roof construction, concrete considered workable when concrete is to be compacted by hand. Workability was measured by Slump Cone Test.

Workability of concrete is a composite property which depends on many parameters of the components of the concrete. Workability for the fresh concrete was tested by slump cone test method.

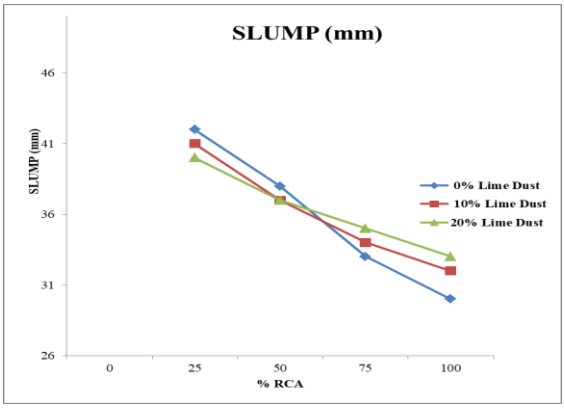


**Fig 5.1** shows the slump values for Mix with different % of lime dust and RCA

### 5.3 COMPRESSIVE STRENGTH

Concrete specimen cubes are used to determine compressive strength of concrete and were tested as per IS 516:1959. The compressive strength is usually obtained experimentally by means of a compressive test.

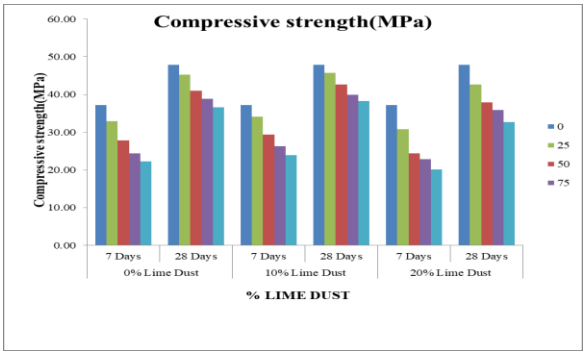


**Fig 5.2 shows the summarized results of Compressive strength with different % of RCA and % lime dust**

### 5.4 SPLITTING TENSILE STRENGTH

The size of specimens 150 mm dia and 300 mm length was used and the specimens were cured in normal water. Concrete specimen cubes are used to determine compressive strength of concrete and were tested as per as per IS 516 (1959) and IS 5816 (1999).

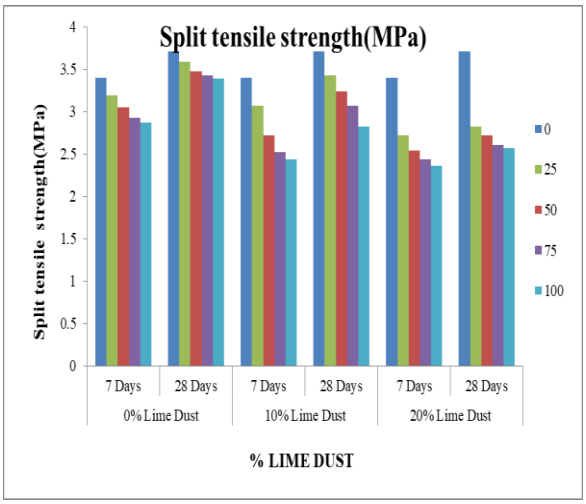


**Fig 5.3** summarized results of Split tensile strength with different % of RCA and % lime dust

Tests were carried out to evaluate the Split tensile strength which is a very important property of concrete. The Average Split tensile strength at the end of 7 and 28 days of curing for the M40 grade of concrete for different percentage replacements of recycled aggregate namely 0%, 25%, 50%, 75% and 100% are shown in Fig. 6.9.

The Split tensile strength of the two sets is decreased with the increase in percentage of recycled aggregates. Generally, 30MPa strength value is widely used in construction purposes. At 28 days 100% replacement of RCA with addition of lime dust achieves strength of 3.39MPa. In long period of time this strength can the equal or exceed to the strength of natural aggregate concrete. But for 25% replacement of coarse aggregate and 10% lime dust achieves strength of 3.43MPa.

### 5.5 FLEXURAL STRENGTH

The size of specimens 100 mm x 100 mm x 500 mm was used and the specimens were cured in normal water. Concrete specimen cubes are used to determine compressive strength of concrete and were tested as per as per IS 516 (1959). After 7 and 28 days curing, prismatic specimens are placed on flexural testing machine having a maximum of 100 KN and a constant rate of loading of 40 kg/m2 per minute is applied on the test specimen by placing the specimen in such a way that the two point loading should be placed at a distance of 13.3 cm from both the ends. Ultimate load at which the prismatic specimen fails is noted down from dial gauge reading.

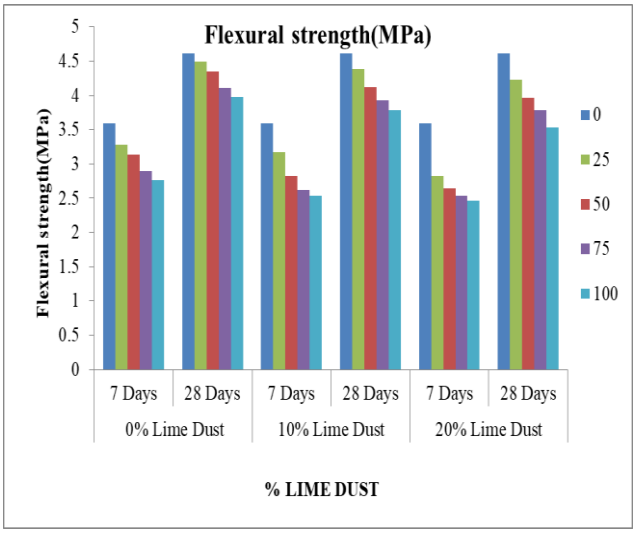


Fig 5.4 shows the summarized results of flexural strength with different % of RCA and % lime dust

The Flexural strength of the two sets is decreased with the increase in percentage of recycled aggregates. Generally, 30MPa strength value is widely used in construction purposes. At 28 days 100% replacement of RCA with addition of lime dust achieves strength of 3.98MPa. In long period of time this strength can the equal or exceed to the strength of natural aggregate concrete. But for 25% replacement of coarse aggregate and 10% lime dust achieves strength of 4.49MPa.

### 5.6EFFECT OF SISAL FIBRE ON STRENGTH PROPERTIES OF RCA AND LIME DUST MODIFIED CONCRETE

From the results of compressive, split tensile and flexural strength results it is observed that for the mix 10% lime dust + 25% RCA in cement concrete shows nearer results to the target mean strength. For more strength different percentages of sisal fiber were added and results are shown in below table and figures.

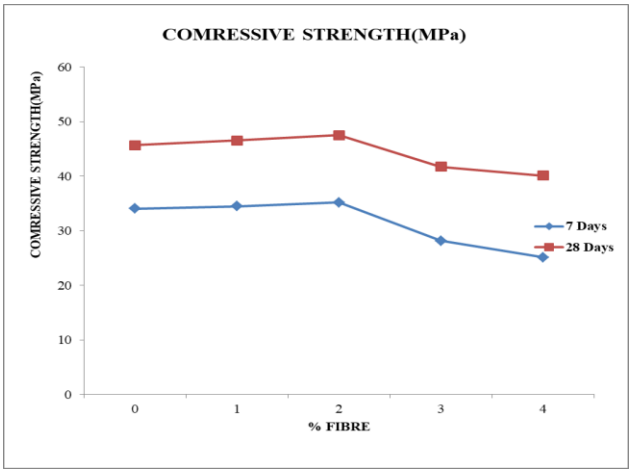


Fig 5.5 shows the results of compressive strength with different % of sisal fibre

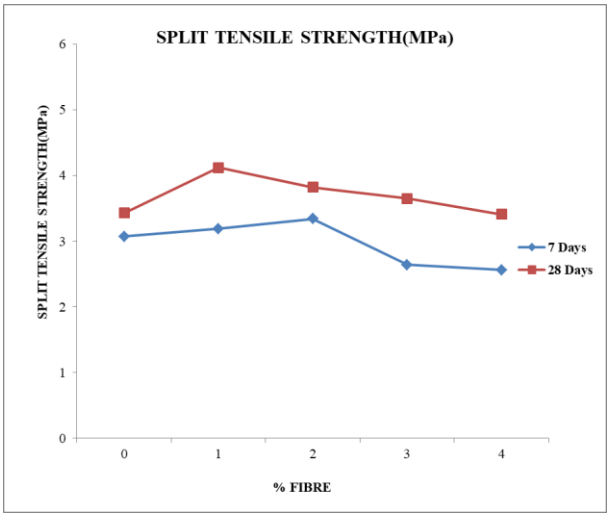


Fig 5.6 shows the results of split tensile strength with different % of sisal fibre

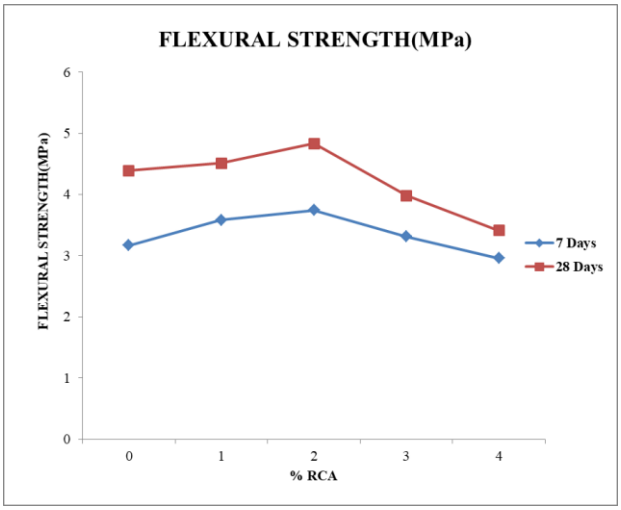


Fig 5.7 shows the results of flexural strength with different % of sisal fibre

The figure shows that the test results of splitting tensile strength and flexural strength of specimens after water curing, it is concluded that the percentage increase in strength increases with the increase in percentage of fiber content. Also, from the results it is evident that compressive and flexural strength also increases with the increase of fiber content.

## I. CONCLUSIONS

The Conclusions and Recommendations that could be drawn from the results of this project and experiments are summarized and the use of Recycled coarse aggregate as a coarse aggregate replacing material and lime dust as a replacement of cement in concrete A production was studied and after the research work is done, the following conclusions were made:

- It has been observed that workability decreases linearly with increase in percentage of lime dust and Recycled coarse aggregate.
- Workability of RAC concrete can be improved by replacing cement with lime dust about 10% and 20% by weight of cement.
- The strength of concrete decrease with increase in the percentage of recycle aggregate, this may be because of the loose mortar around the recycle aggregate which do not allow the proper bonding between the cement paste and aggregate.
- Generally, lime based concrete has the ability to develop strength over prolonged periods of time. So at a long period of run the compressive strength of RAC with lime dust achieves similar strength of natural aggregate concrete by adding lime dust.
- At 28 days 100% replacement of RCA with addition of lime dust achieves strength of 38.32Mpa. In long period of time this strength can the equal or exceed to the strength of natural aggregate concrete. But for 25% replacement of coarse aggregate and 10% lime dust achieves strength of 45.71MPa.
- As like compressive strength, split tensile strength and flexural strength of concrete of decreases with increase in percentage of lime dust and Recycled coarse aggregate.
- . At 28 days 100% replacement of RCA with addition of lime dust achieves strength of 3.39MPa. In long period of time this strength can the equal or exceed to the strength of natural aggregate concrete. But for 25% replacement of coarse aggregate and 10% lime dust achieves strength of 3.43MPa.
- At 28 days 100% replacement of RCA with addition of lime dust achieves strength of 3.98MPa. In long period of

time this strength can the equal or exceed to the strength of natural aggregate concrete. But for 25% replacement of coarse aggregate and 10% lime dust achieves strength of 4.49MPa.

- The test results of splitting tensile strength and flexural strength of specimens after water curing, it is concluded that the percentage increase in strength increases with the increase in percentage of fiber content.Also, from the results it is evident that compressive and flexural strength also increases with the increase of fiber content.
- In conclusion, if properly designed RAC, especially that containing lime dust, can be an effective alternative to natural concrete for structural purposes.

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