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EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF COARSE AGGREGATE BY WASTE GLASS AND CEMENT BY SISAL FIBER

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Abstract— The use of waste glass is increasing day by day, although step were taken to reduce its consumption. Waste glass is environmental effect. The current option for disposal of waste glass is land fill. The landfills is creates the environment pollution. The aim of the investigation is study the coarse aggregate has been replacement by waste glass according in the range of 0%, 10% and 20% by weight of M25 concrete. And Sisal fibre is then most widely used natural fibre and is easily cultivated in India. The processing techniques are physical and mechanical properties. Sisal fibre is an agricultural product. It is used as reinforcement in concrete. Sisal fibre is used to increase the strength of the building .Conventional concrete is strong in compression and weak in tension. Mechanical properties such as compressive strength and tensile strength are determined. The percentage of sisal fibres added by cement based such as 0%, 10% and 20% will be added in M25 grade of cement concrete are tested at the age 7, 14, 28 days of curing. It's used for reduce the cost of construction and increase the strength of the concrete. It also be used to attain a high strength and stiffness with low component weight. The concrete cube were tested for compressive strength, split tensile strength and flexure strength of concrete. This help to reduce the cost of the project.

Keywords— Cement,Sisal fibre, Coarse aggregate, Waste glass, Compression strength

I. INTRODUCTION

Concrete is a homogeneous material which is formed by mixing of Cement Sand and Aggregate in presence of water. Generally cement is used as binder material and sand as filler material which occupies the voids between aggregate .Aggregate is the most common material in concrete and it occupies more than 70-80% of total volume in concrete and it provides strength to the concrete. Now a days due to huge demand of concrete in construction work it is essential to developed or find such sources or material which can replace sand and aggregate in concrete. As aggregate is most common material in concrete and it is acquired from crushing of stones in stone queries which requires huge manpower and mechanical equipment. While crushing of stones it produces very small dust particles having less density and get easily mixed with air which creates adverse impact on environment as well as on the health of the workers at the sight. To overcome such problems, aggregate can be replaced by waste glass.

Waste glass is a major component of the solid waste stream in many countries. Glass is a transparent material produced by melting a mixture of materials such as silica, soda ash, and CaCO3 (calcium carbonate) at high temperature followed by cooling during which solidification occurs without crystallization. It is widely used in our lives through manufactured products such as sheet glass, bottles, glassware, and vacuum tubing. The use of recycled glass helps save of energy. The increasing awareness of glass recycling speeds up inspections on the use of waste glass with different forms in various fields. One of its significant contributions is to the construction field where the waste glass was reused for concrete production. During the last decades it has been recognized that sheet glass waste is of large volume and is increasing year by year in the shops, construction areas and factories. Using waste glass in the concrete construction sector is advantageous, as the production cost of concrete becomes less. The amount of waste glass is gradually increased over the recent years due to an ever-growing use of glass products. Most waste glasses have been dumped into landfill sites. The land filling of waste glasses is undesirable because they are not biodegradable, which makes them environmentally less friendly. There is huge potential for using waste glass in the concrete construction sector. When waste glasses are reused in making concrete products, the production cost of concrete will go down.

Sisal fibre has high cellulose content (70%) and density (about 1.450 g/cm3). The material is chosen to improve the various strength properties of a structure to obtain sustainability and better quality structure. The advantages of natural fibre materials are strength, durability, reduce cost of environmental compatibility and bio degradability. It is a hard and tough fibre. In components such as slabs and pavements, fibre is added to control cracking induced by temperature variation.

1.1 Scope of the work

- To study compressive and flexural strength development of concrete by using waste glasses and sisal fibers.
- To find out the optimum percentage of replacing materials.
- To minimize the utilization of cement and coarse aggregate.
- To produce a light weight concrete.

1.2 Benefits of the material

- Using waste material is reducing the cost of manufacturing
- Conserving mineral resource of a country
- Preventing environmental pollution
- Easily avaible
- Light weight material

II. MATERIALS USED

Material that go for making concrete for this study were tested before casting the specimens. The properties obtained from the tests were used in mix design.
The preliminary tests were conducted for the following materials.

- Cement
- Fine aggregate
- Coarse aggregate
- Sisal fiber
- Waste glass

2.1 cement:

Ordinary Portland cement of 53 grades, conforming to IS 12269-1987 was used. Tests were carried out on various physical properties of cement.

i) Specific gravity

ii) Fineness modules (by Sieve Analysis)

iii) Consistency

iv) Initial Setting time

Fig.1 Cement

2.2 fine aggregate:

Fine aggregate should consist of natural sand or crushed stone sand. It should be hard, durable and clean and be free from organic matter. Fine aggregate should not contain any appreciable amount of clay balls and harmful impurities such as alkalis, salts, coal, delayed vegetation. The silt content should not exceed 4%.Fine aggregates are the aggregate whose size is less than 4.75mm.Sand is generally considered to have lower size limit of about 0.07mm, also free from clay mineral sand salt.

Fig.2 Fine aggregate

2.3 coarse aggregate:

Coarse aggregate are a broad category particulate inert materials used in construction. Hard stones are crushed to the required size and are used as coarse aggregate

i) Surface moisture

ii) Fineness modulus

iii) Specific gravity

The materials that is retained on as IS Sieve of size 4.75 mm is called coarse aggregate. The coarse aggregates are tested before the concrete mixing. The test such as specific gravity and fineness modulus. The size of coarse aggregates are 7 mm, 14 mm, 20 mm. The aggregates are taken as 77% of mass of concrete in the preparation of 65:35.The aggregate most of which are retained on the 4.75mm IS sieve are termed as coarse aggregates. 20mm and 12.5mm size of coarse aggregate.

Fig.3 Coarse aggregate

2.4 sisal fiber:

Sisal is a long, soft, shiny plant fiber that can be spun into coarse, strong threads. It is produced from plants in the genus Corchorus. Sisal is one of the cheapest natural fibers, and is second only to cotton in amount produced and variety of uses. Sisal fibers are composed primarily of the plant materials cellulose and lignin. Sisal is a rainy season crop, growing best in warm, humid climates.

Fig.4. Sisal fiber

2.4.1 Properties of Sisal Fiber

- Sisal Fiber is exceptionally durable with a low maintenance with minimal wear and tear.
- It is Recyclable.
- Sisal fibers are obtained from the outer leaf skin, removing the inner pulp.
- It is available as plaid, herringbone and twill.

- Sisal fibers are Anti static, does not attract or trap dust particles and does not absorb moisture or water easily.
- The fine texture takes dyes easily and offers the largest range of dyed colours of all natural fibers.
- It exhibits good sound and impact absorbing properties.
- Its leaves can be treated with natural borax for fire resistance properties.

2.5 waste glass:

Glass is a transparent material produced by melting a mixture of materials such as silica, soda ash, and CaCO3 at high temperature followed by cooling during which solidification occurs without crystallization. It is widely used in our day today life. It can be found in many forms, including container glass, flat glass such as windows, bulb glass and cathode ray tube glass. The use of glass as aggregates in concrete has a great potential for high quality concrete development. Its shape and size have potential benefit in obtaining a good particle size distribution in glass concrete.

Fig.5. waste glasses

The present investigation, the crushed waste glass and RCA was used for the following tests:

1. Specific Gravity
2. Water absorption

III. MIX DESIGN

3.1 Mix Design for M25 grade

Cement	= 419kg/m^3
Water	= 197 kg/m^3
Fine aggregate	= 656 kg/m^3
Coarse aggregate	=1127kg/m^3
Water cement ratio	= 0.47

IV. CASTING AND TESTING OF CUBES

The quantities as per mix design are mixed with care and concrete cubes of size (150mmx150mmx150mm).The concrete specimens are cured for 7, 14 and 28 days in laboratory. Then concrete cubes are tested in laboratory to get their compressive strength values for various proportions.

Fig.6. Casting of cube

4.1 Testing of cube specimen

After curing harden concrete is tested in compression testing machine. The testing of cube is done for 7, 14, and 28 days.

4.1.1 Compression strength test

Compression strength test is the most test conducted on hardened concrete, because it is easy to test and desirablecharacteristic properties of concrete are measured.

The cube specimen is of the size (150mmx150mmx150mm) isused for testing. The compressive strength test of concrete is done by using compressive testing machine. The specimen is placed in compression testing machine in such a way that load applied gradually in cast surface. The load at failure has been noted.

Compressive strength= (Failure load/Cross sectional area (N/mm^2)

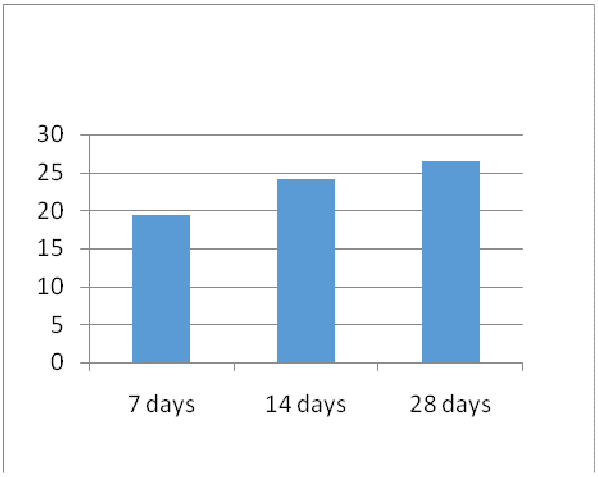
Fig.7. Compressive testing machine

V. RESULT AND DISCUSSION

TEST RESULTS OF COMPRESSIVE STRENGTH:

Compressive strength of concrete with various mix combination is determined at 7, 14 and 28 days for M25 grade of concrete. The result of compressive strength are given below in table:

Compressive strength values of cubes for 28 days



CONCLUSION

- Based on this experimental investigation, it is found that Sisal fibre and Waste glass can be used as an alternative material to the Cement and coarse aggregate.
- Use of Waste glasses and Sisal fibre in concrete to gives a light weight concrete.The maximum compressive strength is obtained when 20% Sisal fibre and 20% waste glasses aggregate was replaced with Cement and coarse aggregate.
- Future work to be performed will include investigation of flexural strength of the concrete.

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