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# A EXPERIMENTAL USAGE OF JUTE REINFORCEMETN IN THE FOAM CONCRETE

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***Abstract-The fiber can be the effective material to reinforce concrete. It will not only improve the compressive strength it will explore the properties of concrete. By using the jute as the reinforcement material for the concrete, it will restrict the utilization of the polymer which is environmentally detrimental. Jute is locally available and hence, less expensive. To achieve this goal, an experimental investigation of the compressive strength of the Jute Reinforced Foam Concrete (JRFC) has been conducted. Cube of standard dimensions have been made to introduce jute varying the mix ratio of the ingredients in concrete, W/C ratio, and volume of the fiber to know the effect of parameters as mentioned. Compressive strength test has been conducted on the prepared samples by appropriate testing apparatus according to the standard specifications. The final conclusion of this study was the maximum strength of the jute reinforced foam concrete is 2.6MPa and 2.3MPa for the concentration of 0.3 percentage in the form of jute fiber and jute yarn respectively. The strengths of jute fiber reinforced foam concrete and jute yarn reinforced foam concrete has been increased 30% and 15% respect to the foam concrete.***

***Key words – Composition, Mix Design, Jute Fiber, Jute Yarn, Reinforcement, Compressive Strength, Concrete, Foam Concrete.***

## 1. INTRODUCTION

Foam concrete, also known as lightweight cellular concrete (LCC). It is defined as cement based slurry, with a minimum of 20% foam entrained into the plastic mortar. There is no coarse aggregate is used for production of foam concrete so it is called as mortar instead of concrete.

Fiber-reinforced foam concrete (FRFC) is concrete containing fiber material which increases its properties. It contains short length fibers that are uniformly distributed and randomly oriented. Fiber include steel fibers, glass fibers, synthetic fibers and natural fibers-each of which lend varying properties to the concrete. In addition, the character of fiber-reinforced foam concrete changes with varying concretes, fiber materials, and densities.

## 2. MATERIALS USED

### A. Cement

Ordinary Portland cement 53grade KCP conforming to the IS:12269-2013 have been procured and following tests have been carried out according to the IS:8112-1989. Experimental results tabulated in table-1 and compared the results with IS specifications.

**Table -1 Experimental results on Cement**

| S.No | Tests | Experimental Results | Suggested Values as per IS Codes |
|---|---|---|---|
| 1. | Fineness of cement | 6.6% | <10% |
| 2. | Normal Consistency | 34% | ---- |
| 3. | Specific Gravity | 2.33 | <3.15 |
| 4. | Initial Setting Time | 36 | More than 30 minutes |
| 5. | Final Setting Time | 220 | Less than 600 minutes |

### B. Fine Aggregate

The locally available river sand conforming to grading as zone-II of table-4 to the IS: 383-1970 has been used as Fine aggregate for the experimentation, Specific gravity, grading and fineness modulud of fine aggregate performed in the concrete technology laboratory as per the procedure given in IS:383-1970 and the results are presented in table-2.

**Table -2 Physical Properties of Fine Aggregate**

| S.No | Properties | Values |
|---|---|---|
| 1. | Specific Gravity | 2.62 |
| 2. | Finess Modulus | 6.35 |
| 3. | Grading | Zone-II |
| 4. | Bulking of Sand | 8% |

### C. Foaming Agent

DewFoam LW is an air entraining admixture for concrete, formulated from selected polymers specially designed to create microscopic air bubbles that are uniformly distributed in the concrete mix. The effect can be used to improve concrete cohesion and resistance to freeze thaw cycles. DewFoam LW complies with ASTM C260, BS:5075 Part-2, EN:934 Part-2 and IS:9103.

### D. Jute

Jute fibers are extracted from the ribbon of the stem. When Harvested the plants are cut near the ground with an sickle shaped knife. The small fibers, are obtained by successively retting in water, stripping, beating, the fiber from the core and drying. A single jute fiber is a three dimensional composite composed mainly of lignin, cellulose, hemicelluloses with minor amounts of protein, extractives and inorganic.

These fibers were designed, after millions year of evolution, to perform, in nature, in a wet environment. Nature is programmed to recycle jute, in the timely way, back to basic building blocks of carbon dioxide, and water through biological, thermal, aqueous, photochemica1, chemical, and mechanical degradation. Presently, the application of natural fiber composites is fairly studied in conditions of dimensional constancy under moist and high thermal. Natural fibers like cotton, sisal, jute, abaca, pineapple and coir have already been studied like as reinforcement and filler in composites. Among the various natural fibers, jute fiber is considered as very high strength and stiffness.

**Table -3 Physical Properties of Jute Fiber**

| Physical Properties | Values |
|---|---|
| Density($g/cm^3$) | 1.3 |
| Tensile Strength(MPa) | 393-773 |
| Young's Modulus(GPa) | 26.5 |
| Diameter (μm) | 20-200 |

**Figure1: Jute Yarn**

**Figure2: Jute Fiber**

**E. Water**

Locally available bore water is used for the experimentation and curing purpose. The water is free from any contamination, substance and other organic matter.

## 3. PREPARATION OF FOAM CONCRETE

The foam concrete is mainly prepared by mixing the cement slurry with the foam in a designed quantity. For the preparation of the samples we have adopted the mix quantities for the different samples by various percentages of jute fiber and jute yarn w.r.t the reinforcement percentages.

**Table -4 Mix Design**

| S.no | Sample Name | Weight of cement (Kg) | Weight of Fine Aggregate (Kg) | W/C Ratio | Weight of Jute Fiber Added (Kg) |
|---|---|---|---|---|---|
| 1. | F | 4 | 8 | 0.33 | 0 |
| 2. | J-0.1 | 4 | 8 | 0.33 | 0.03 |
| 3. | J-0.2 | 4 | 8 | 0.33 | 0.06 |
| 4. | J-0.3 | 4 | 8 | 0.33 | 0.09 |
| 5. | J-0.4 | 4 | 8 | 0.33 | 0.12 |
| 6. | Y-0.1 | 4 | 8 | 0.33 | 0.03 |
| 7. | Y-0.2 | 4 | 8 | 0.33 | 0.06 |
| 8. | Y-0.3 | 4 | 8 | 0.33 | 0.09 |
| 9. | Y-0.4 | 4 | 8 | 0.33 | 0.12 |

Foaming agent is taken 1% of weight of cement and for dilution of foaming agent water is added to the foaming agent in 1:30 ratio.

## 4. COMPRESSIVE STRENGTH TEST

**i. Foam Concrete without Jute Fiber (Sample-F)**

**Table -5 Compressive strength for Sample F Cubes**

| No of days | Compressive Strength (N/mm2) | | Density (Kg/m3) |
|---|---|---|---|
| 7 | 1.067 | 1 | 500 |
| 14 | 1.78 | 1.6 | 500 |
| 28 | 2 | 2.08 | 500 |

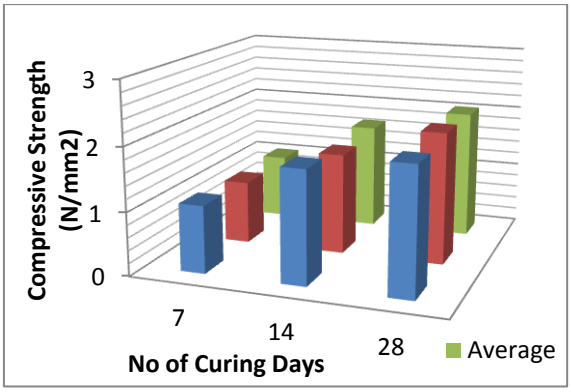


**Figure-3 Compressive Strength Graph for Sample F Cubes**

**ii. Foam Concrete with 0.1% Jute Fiber (Sample J-0.1)**

**Table -6 Compressive strength for Sample J 0.1 Cubes**

| No of days | Compressive Strength (N/mm2) | | Density (Kg/m3) |
|---|---|---|---|
| 7 | 1.5 | 1.4 | 510 |
| 14 | 1.7 | 1.75 | 510 |
| 28 | 2.07 | 2.1 | 510 |

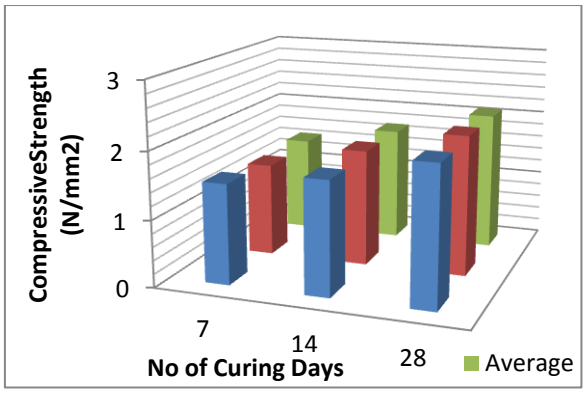


**Figure-4 Compressive Strength Graph for Sample J 0.1 Cubes**

**iii. Foam Concrete with 0.2% Jute Fiber (Sample J-0.2)**

**Table -7 Compressive strength for Sample J 0.2 Cubes**

| No of days | Compressive Strength (N/mm2) | | Density (Kg/m3) |
|---|---|---|---|
| 7 | 1.5 | 1.55 | 520 |
| 14 | 1.8 | 1.72 | 520 |
| 28 | 2.2 | 2.15 | 520 |

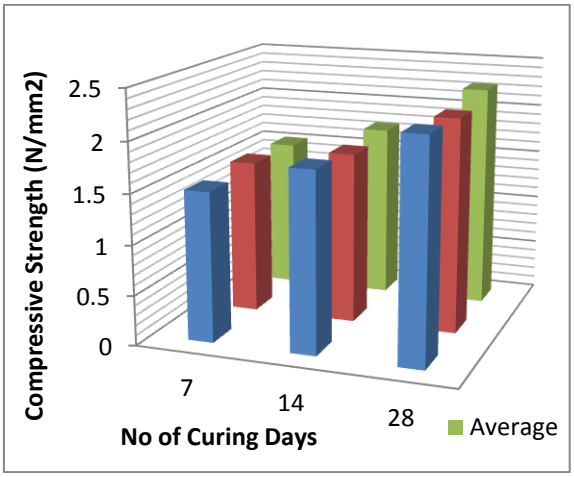


**Figure-5 Compressive Strength Graph for Sample J 0.2 Cubes**

**iv. Foam Concrete with 0.3% Jute Fiber (Sample J-0.3)**

**Table -8 Compressive strength for Sample J 0.3 Cubes**

| No of days | Compressive Strength (N/mm2) | | Density (Kg/m3) |
|---|---|---|---|
| 7 | 1.67 | 1.7 | 530 |
| 14 | 2 | 2.07 | 530 |
| 28 | 2.3 | 2.25 | 530 |

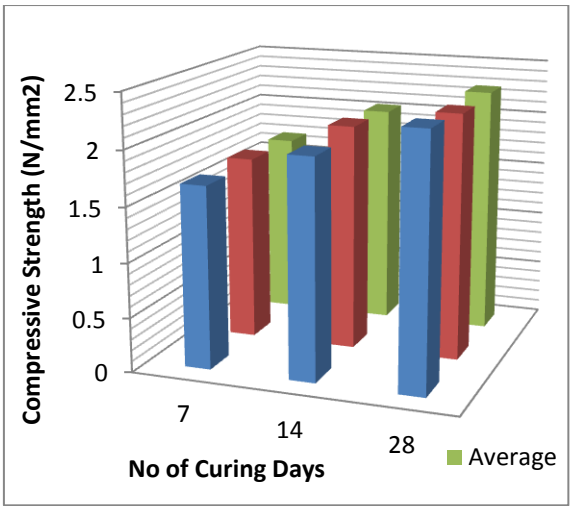


**Figure-6 Compressive Strength Graph for Sample J 0.3 Cubes**

**v. Foam Concrete with 0.4% Jute Fiber (Sample J-0.4)**

**Table -9 Compressive strength for Sample J 0.4 Cubes**

| No of days | Compressive Strength (N/mm2) | | Density (Kg/m3) |
|---|---|---|---|
| 7 | 1.4 | 1.55 | 525 |
| 14 | 1.7 | 1.8 | 525 |
| 28 | 2.2 | 2.1 | 525 |

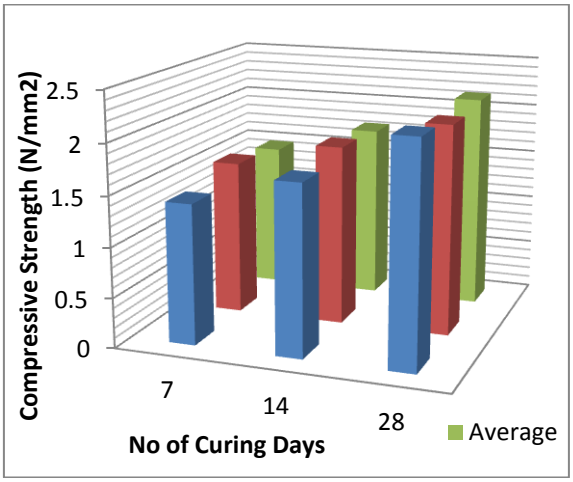


**Figure-7 Compressive Strength Graph for Sample J 0.4 Cubes**

**vi. Foam Concrete with 0.1% Jute Fiber (Sample Y-0.1)**

**Table -10 Compressive strength for Sample Y 0.1 Cubes**

| No of days | Compressive Strength (N/mm2) | | Density (Kg/m3) |
|---|---|---|---|
| 7 | 1.4 | 1.3 | 505 |
| 14 | 1.8 | 1.9 | 505 |
| 28 | 2.07 | 2.1 | 505 |

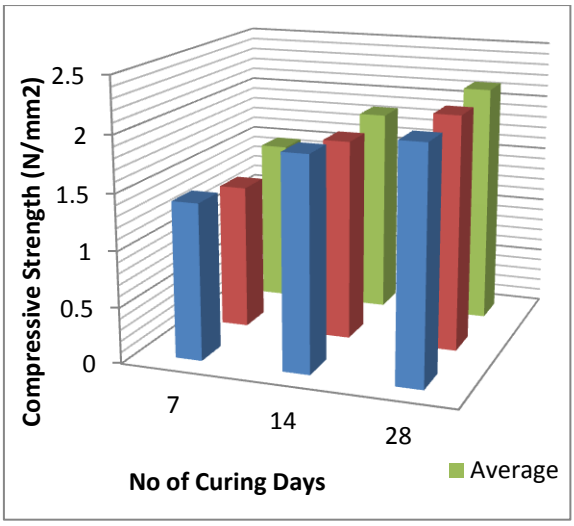


**Figure-8 Compressive Strength Graph for Sample Y 0.1 Cubes**

**vii. Foam Concrete with 0.2% Jute Fiber (Sample Y-0.2)**

**Table -11 Compressive strength for Sample Y 0.2 Cubes**

| No of days | Compressive Strength (N/mm2) | | Density (Kg/m3) |
|---|---|---|---|
| 7 | 1.6 | 1.7 | 527 |
| 14 | 2.067 | 2.1 | 527 |
| 28 | 2.2 | 2.24 | 527 |

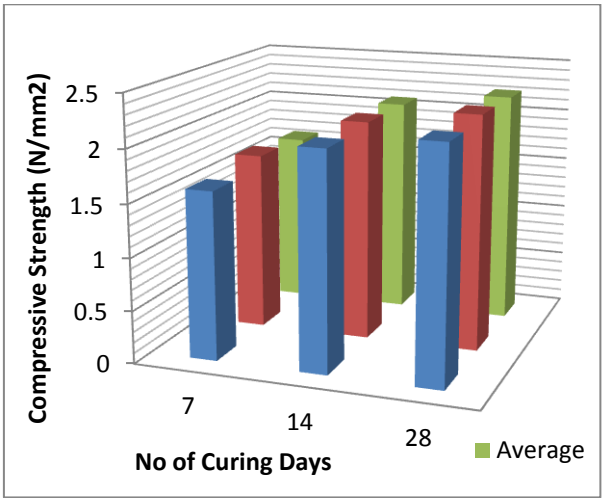


**Figure-9 Compressive Strength Graph for Sample Y 0.2 Cubes**

**viii. Foam Concrete with 0.3% Jute Fiber (Sample Y-0.3)**

**Table -12 Compressive strength for Sample Y 0.3 Cubes**

| No of days | Compressive Strength (N/mm2) | | Density (Kg/m3) |
|---|---|---|---|
| 7 | 1.8 | 1.9 | 560 |
| 14 | 2.2 | 2.3 | 560 |
| 28 | 2.5 | 2.6 | 560 |

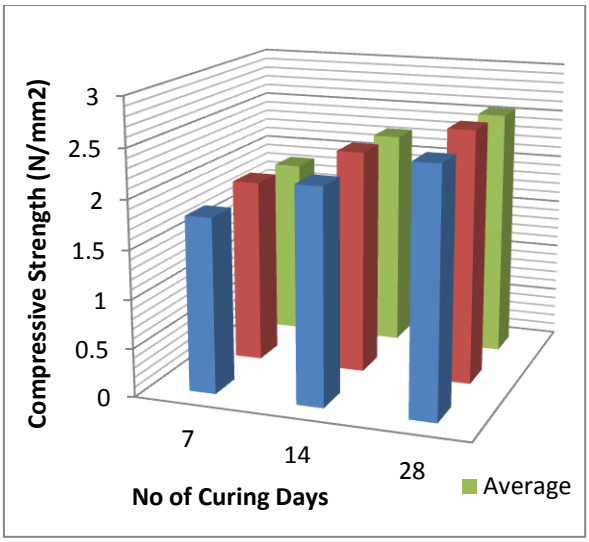


**Figure-10 Compressive Strength Graph for Sample Y 0.3 Cubes**

**ix. Foam Concrete with 0.4% Jute Fiber (Sample Y-0.4)**

**Table -13 Compressive strength for Sample Y 0.4 Cubes**

| No of days | Compressive Strength (N/mm2) | | Density (Kg/m3) |
|---|---|---|---|
| 7 | 1.5 | 1.53 | 550 |
| 14 | 1.65 | 1.7 | 550 |
| 28 | 2.4 | 2.42 | 550 |

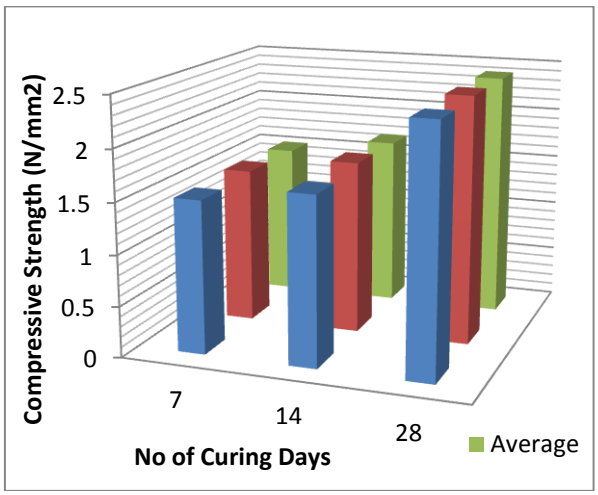


**Figure-11 Compressive Strength Graph for Sample Y 0.4 Cubes**

## 5. DENSITY

The densities of the foam concrete will vary for the 300 to 1600 Kg/m$^3$ and the 28-days compression strength for the cubes will vary for the 1 to 15 MPa.

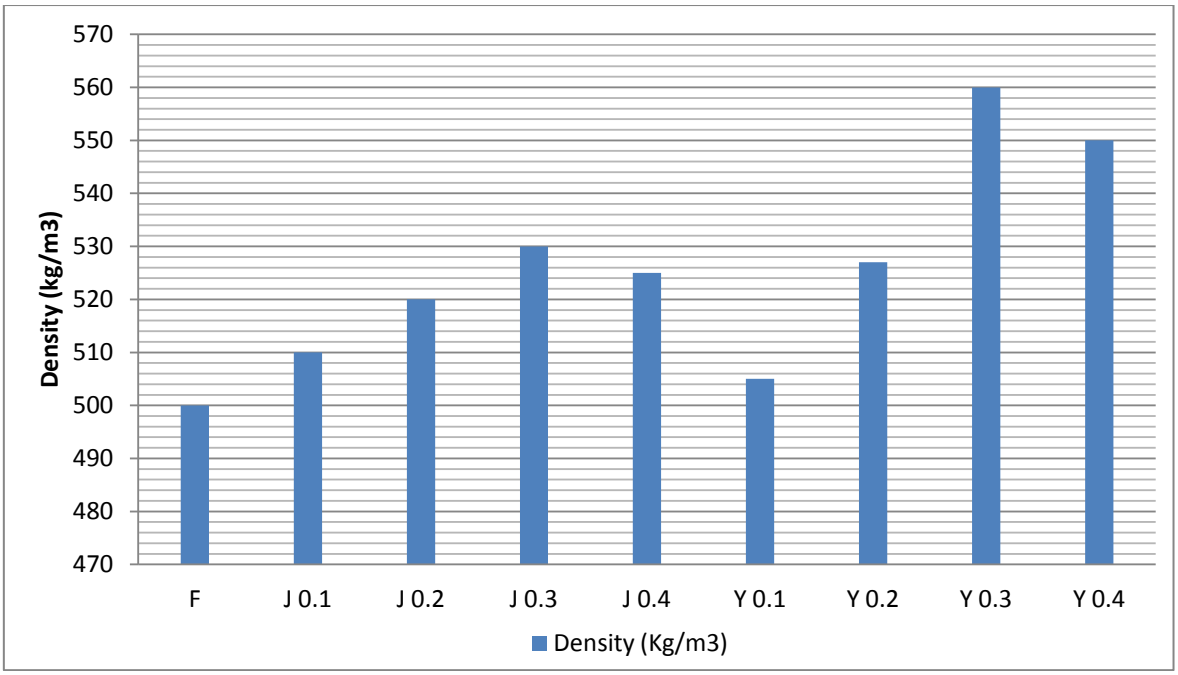


**Figure-12 Comparison of Densities for all the samples taken**

## 6. CONCLUSION

The above study is done for two forms of jute fiber and jute yarn. The samples are made by varying the reinforcement percentage in the foam concrete. The final conclusion of this study was, the maximum strength of the jute reinforced foam concrete is 2.6MPa and 2.3MPa for the concentration of 0.3 percentage in the form of jute fiber and jute yarn respectively. The strengths of jute fiber reinforced foam concrete and jute yarn reinforced foam concrete has been increased 30% and 15% respect to the foam concrete.

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