Experimental Investigation on Jute Fibre Concrete with Partial Replacement of Cement with Alccofine and Metakaolin Using M30 Grade of Concrete

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Abstract **- Present days the construction activities increased day by day. Concrete technology upgrading has harmed the environment to a greater level. Concrete is one such basic component that has always undergone continuous improvement in order to improve the strength properties by adding various admixtures. The strength of concrete is improved by substituting Alccofine and Metakaolin for cement and adding jute fibres to the mix. Jute fibers are added in concrete to improve strength without any environmental effect. In this experimental investigation 1% of jute fiber added by the volume of concrete. The partial replacement of cement with Metakaolin and Alccofine with percentages of 3, 6, 9, 12, 15 and 0.3, 0.6, 0.9, 1.2, 1.5 respectively. The mechanical properties are determined.**

Index Terms **- Alccofine 1203, Jute fiber, Metakaolin.**

1.INTRODUCTION

Concrete is one of the most commonly used construction materials. It's made up of fine aggregate, coarse aggregate, water, and other materials. Global warming is caused by a variety of factors, including CO_2 from cement. Cement manufacturers can assist reduce CO_2 emissions by optimising their manufacturing processes. In the manufacturing of concrete, supplemental cementing elements such as fly ash, blast-furnace slag, natural pozzolans, and biomass ash polymers can be used to reduce cement content. In addition, the chemical and agricultural process sectors generate huge amounts of industrial by-products each year, causing pollution and raising the cost of disposal for the industry. The use of these materials not only helps to get them used in cement, concrete, and other construction materials, but it also helps to reduce the cost of cement and concrete manufacturing. It also has numerous indirect benefits, such as reduced land-fill costs, energy savings, and pollution protection. Furthermore, their use may improve the microstructure and mechanical properties of concrete, which are difficult to obtain with regular Portland cement alone.

2. MATERIALS

Cement:

Cement is a binder, which means it sets and hardens on its own and may hold other materials together. The Portland Cement 53 grade is employed in this project. The properties of cement are presented in Table 1.

Table 1. Properties of cement

S.No.	Property	Cement (53 grade)
1	Specific gravity	3.15
2	Consistency	36%
3	Initial setting time	68 min
4	Final setting time	508 min

Fine aggregates:

River sand is used as a fine aggregate (zone-II). The pebbles are entirely eliminated using sieve analysis and its properties are presented in table 2.

Table 2: Physical properties of fine aggregates

S.No.	Characteristics	Value
1	Type	Natural sand
2	Specific gravity	2.48
3	Fineness modulus	2.57
4	Grading zone	Zone II

Coarse aggregates:

Stones which are obtained from crushing of gravel are used as coarse aggregate. The maximum size of coarse aggregate is limited to 20mm. The aggregates are added strength to the composition. The coarse aggregates are crushed from natural rocks, so the all properties like hardness, stability are derived from parent rock and the 12.5 mm aggregates are used. The physical properties of natural coarse aggregate are presented in table 3.

Table 3: Physical properties of the recycled and natural coarse aggregate

S. No	Properties	Natural aggregates
1	Specific gravity	2.56
2	Water absorption (%)	1.89

Water:

Water is most important material in construction for mixing of cement mortar and curing. The water gives the binding matrix in between cement and aggregates. The pH range of surface water must in between 6.5 to 8.5 and ground water is 6 to 8.5.

Metakaolin:

Metakaolin is a new type of clay that has been produced in recent years. It's manufactured by heating kaolin to a specific temperature. Because of its pozzolanic characteristics, metakaolin is frequently utilised as a concrete ingredient, replacing a portion of the cement content.

Alccofine 1203:

Alccofine 1203 is a new generation micro fine material with a particle size significantly smaller than cement, fly ash and other similar materials. Alccofine 1203 is a supplemental cementitious ingredient that can be used in high-performance concrete to replace silica fume. It's made from materials used in the iron ore industry. Alccofine has a higher percentage of alumina and silica content in its chemical composition.

Jute fibres:

The most affordable natural fibre is jute, which has the biggest manufacturing volume. These fibres are taken from the stem's ribbon. The plant components cellulose and lignin make up the majority of jute fibres. Jute fibre has been shown in recent study to slow the hardening of concrete and increase its resistance to cracking. The use of tannin as an additive improves the workability of jute fibre reinforced concrete mixtures. The current work was reduced to a length of 15mm.

3. RESULTS AND DISCUSSIONS

In this paper According to Referenced Journals Compressive Strength, Split-Tensile Strength tests are conducted.

3.1 Compressive strength test

Compression test was conducted on the cast specimen of 150mm cubes. The cured specimen was tested to evaluate compressive strength at 7 and 28 days and their results are furnished in table 4.

Table:4 Compressive strength at 7 and 28 days

S.No.	Type of Mix	Compressive strength, N/mm^2	
		7 days	28 days
1	0% MK+ 0% AF+ 0% JF	26.84	38.85
2	3% MK+ 0.3% AF+ 1% JF	30.29	43.4
3	6% MK+ 0.6% AF+ 1% JF	32.22	47.05
4	9% MK+ 0.9% AF+ 1% JF	34.04	49.7
5	12% MK+ 1.2% AF+ 1% JF	37.12	52.14
6	18% MK+ 1.5% AF+ 1% JF	35.13	50.07

3.2 Spilt tensile strength test

The cylinder specimen has a diameter of 150 mm and a length of 300 mm. The test is performed by inserting a cylindrical specimen horizontally between the loading surfaces of a compression testing machine and applying a load along the cylinder's longitudinal direction until the cylinder fails at 7 and 28 days and the results are furnished in table 5.

Table:5 Split tensile strength at 7 & 28 DAYS

S.No.	Type of Mix	Split tensile strength, N/mm^2	
		7 days	28 days
1	0% MK+ 0% AF+ 0% JF	2.59	3.76
2	3% MK+ 0.3% AF+ 1% JF	2.94	4.30
3	6% MK+ 0.6% AF+ 1% JF	3.23	4.63
4	9% MK+ 0.9% AF+ 1% JF	3.44	4.92
5	12% MK+ 1.2% AF+ 1% JF	3.71	5.20

6	18% MK+ 1.5% AF+ 1% JF	3.56	5.05

4. CONCUSSION

1. For nominal concrete the compressive strength found to be 26.84 and 38.85 N/mm ^{2} for 7 and 28 days respectively.
2. The maximum compressive strength found to be 37.12 and 52.14 N/mm ^{2} for 7 and 28 days by adding 1% jute fibers and partial replacing of Alccofine-1203 (1.2%) and Metakaolin (12%) respectively.
3. For nominal concrete the split tensile strength found to be 2.59 and 3.76 N/mm ^{2} for 7 and 28 days respectively.
4. The maximum split strength found to be 3.71 and 5.20 N/mm^2 for 7 and 28 days by adding 1% jute fibers and partial replacing of Alccofine-1203 (1.2%) and Metakaolin (12%) respectively.
5. Both the tensile and compressive strength value decreased in the combination of 18% MK+ 1.5% AF+ 1% JF.

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