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Experimental Study of Polypropylene and Bagasse Fiber as a Partial Replacement of Fine and Coarse Aggregate

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***Abstract* - Plastic is one of the most used materials in today's world. Because of its non-biodegradable characteristics, it is obligatory to recycle the plastic in order to save the nature from its adverse effect. Plastic can be recycled by using it for construction purposes. This study aims at investigating the fresh and hardened properties of concrete while adopting polypropylene (PP) as coarse aggregate in concrete. Three concrete types were prepared with crushed stones as coarse aggregate and in two cases crushed stones were partially, 10% and 20% by volume, replaced with PP. Two water cement ratio, i.e. 0.45 and 0.55, were used in the concrete mix design. The usage of natural fiber in construction is widely used in building materials engineering. However, using sugarcane fiber waste material as a natural in construction is very precious, because it can increase crack control and ductility, brittle concrete. Furthermore, the usage of sugarcane in construction can reduce of environmental pollution. In this study, a mixture of sugarcane fiber to be used in normal grade concrete and lightweight concrete to determine whether there is an increase in the compressive and tensile strength of the concrete. The objective of this study was to determine the compressive and tensile strength between control concrete and concrete mix with sugarcane fiber. In addition, the optimal volume of sugarcane fiber in the concrete mixture where the percentage of sugarcane fiber used was 0.5%, 1.0% and 1.5%. Compressive strength was tested on days 7 and 28 after curing test is carried out. Meanwhile, the tensile test has been carried out to measure the tensile strength of sugarcane fiber relations in concrete mixes only at 28day curing.**

Keywords: polypropylene, bagasse fiber.

I. INTRODUCTION

There are several construction techniques as well as construction material used presently. Concrete is a versatile building material used in a wide range of applications. Most of the materials used are detrimental to the environment which cause of several calamities. This detrimental material concludes cement, aggregate, sand and admixtures etc. The main and foremost material in construction are cement, fine aggregate, and coarse aggregate.

These are the natural things will be becoming extinct slowly by the usage of these natural thing day today life. To overcome these problems the next level of structure and materials are used for the replacement of these aggregate. And the waste management is quite more important for the world. The waste disposal is the thing which is more important in the world. Some of the wastes which can be used in construction are plastic, shell, ash and the waste products. The things in this we are going to use is project are going to use is polypropylene, and bagasse fiber for the replacement of fine and coarse aggregate.

1.1 Materials Collection

1.1.1 Polypropylene

Plastic is one of the most used materials in today's world. Because of its non-biodegradable characteristics, it is obligatory to recycle the plastic in order to save the nature from its adverse effect. Plastic can be recycled by using it for construction purposes. This study aims at investigating the fresh and hardened properties of concrete while adopting polypropylene (PP) as coarse aggregate in concrete. Three concrete types were prepared with crushed stones as coarse aggregate and in two cases crushed stones were partially, 10% and 20% by volume, replaced with PP.

Two water cement ratio, I,e. 0.45 and 0.55, were used in the concrete mix design. Compressive strength (for 7 days and 28 days) and tensile (for 28 days) tests were conducted to find out the feasibility of the plastic concrete and propose a replacement ratio for PP to be used in structural concrete. Compare to the concrete with no PP, 10 % PP replaced concrete (PRC) showed a significant increase in both compressive and tensile strengths. The polypropylene is one kind of the plastic material which is used to form the big type of material to store the water as tank.

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1.1.2 Bagasse Fiber

In construction many material are used for partial replacement fine aggregate. Using bagasse fiber for the replacement of fine aggregate may which may act as the fine aggregate material and also as the fiber admixture to it. The bagasse fiber is nothing but the byproduct of sugar cane or sugar preparation. The most important country to produce sugar cane in the large quantity is Brazil. The India is the second largest producer of sugar cane in the world. The average production of sugar in India are28.9 million metric tons of sugar. This is about 17%of the production of sugar in the world.

Approximately every year the byproduct of bagasse fiber in India is about 370 million metric ton +-2.78%. this is the natural fiber which will not emit any kind of hard gases to the environment because of this the bagasse fiber can be used for the construction. This bagasse fiber can also be used in many product in the world as the raw material for paper and also for any other material also and this can also be used as the heating element also for the cooking. If this bagasse is dumped inside the soil it may act as the radioactive material and may form the hazardous material to the environment.

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Table 1: Physical property of PP and BF

Physical Property	Polypropylene	Bagasse Fiber
Youngs Modulus	553-759Mpa	19.7-27.1
Tensile Strength	13450Mpa	20.290Mpa
Specific Gravity	0.9	2.1-2.7
Absorption	---	0.8-2.0
Melting Point	160-170*C	----

II. METHODOLOGY

To achieve the objectives of this study, there are many approaches and methods that should be taken. Methods of work such as literature review, methods of mixing and testing in the laboratory are important to get a more accurate analysis results. The volume of sugarcane are 0.5%, 1.0% and 1.5% and use volume method for the design mix concrete for normal concrete that shown in Table 1 and lightweight concrete that shown in Table 2. The sugarcane fiber was used as shown in Fig. 1.

Figure 1: Sugarcane fiber

The sugarcane bagasse will dry under the sun until completely dry for 7 days. Then the bagasse will cut into small relatively uniform strips with estimation 5cm until 10cm. Fig. 2 shows the sugarcane bagasse dry under sun.

Figure 2: Sugarcane was dried

Furthermore, bagasse needs to be treated first with Sodium Hydroxide NaOH Solution 50% dilute for 3 days as in Fig. 3. Purpose of the treatment is to remove the impurities and ensure the sugarcane withstand longer to use in concrete. Then, the treated sugarcane bagasse need to be dried under the sun to ensure it completely dried before adding into concrete

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mixture. The volume of sugarcane are 0.5%, 1.0% and 1.5% and use volume method for the design mix concrete for normal concrete that shown in Table 1 and lightweight concrete that shown in Table 2.

The size of the cube used are 100 mm x 100 mm x 100 mm for the compression test for the tensile test size of cylinder used are 100 mm x 200 mm. There are several tests conducted to achieve the objectives, which is compression and tensile tests of concrete that was done according to standard test [12, 13]. The curing process was carried out for 7 and 28 days in water at room temperature to let the concrete in the moist state as long as possible so that the hardening process happens in moderation in order to achieve maximum strength.

Table 1: Mix design of concrete for 1 m^3

Water (kg/m^3)	Cement (kg/m^3)	Sand (kg/m^3)	Coarse aggregate (kg/m^3)
209	300	980	805

Table 2: Mix design of lightweight concrete for 1 m^3

Water (kg/m^3)	Cement (kg/m^3)	Sand (kg/m^3)	Foam (kg/m^3)
175	390	800	235

III. RESULTS AND DISCUSSIONS

The results reveal that the 3,7,28 days strength of the concrete mixes designed by Indian code.

3.1 Testing

After complete the curing process the testing of cube is done by using the compression testing machine.

6.1.1 Compression test

Compressive strength of concrete made with 15cm X 15cm X 15 cm Cubes are made with M25 grade of concrete, concrete mixed and cured and tested with reference to Indian standard code.

Table 3: Contains the values of conventional concrete during the compression test Load (KN)

Days	3 Days	7 Days	28 Days
Conventional Concrete	280	360	500

Table 4: Contains the values of replacement (polypropylene) during the compression test. Load (KN)

Percentage/Days	3 Days	7 Days	28 Days
5%	285	470	580
6%	280	465	570
7%	290	450	575
10%	260	430	550
15%	230	360	530

Table 5: Contains the values of replacement of (bagasse fiber) during the compression test. Load (KN)

Percentage/Days	3 Days	7 Days	28 Days
2%	280	450	585
3%	275	440	580
4%	285	430	530
5%	240	410	520

Combined replaced materials in concrete during compression test (MPa)

Days	3 Days	7 Days	28 Days
PP (5%) + BF (3%)	10.2	19	29.3

Combined replaced materials in concrete during tensile test (MPa)

Days	3 Days	7 Days	28 Days
PP (5%) + BF(3%)	1.6	3	4.6

IV. CONCLUSION

Our project is to replace the waste materials to use in the concrete. By the waste materials the environment can be affect, by adding we can reduce it. Here that we are going to conclude that the addition of waste materials we can utilize the waste materials. Then the polypropylene is added instead of coarse aggregate to reduce the shrinkage. The compressive strength of the both replaced materials is giving somewhat equal strength to the conventional concrete. Then the replacement of bagasse fiber is absorbing the water level high. We cannot replace the material more than 5%. The replacement of bagasse fiber act also as the admixture as the fiber which could act as the extra binding material.

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