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ECO FRIENDLY DURABLE CONCRETE

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Abstract:

Concrete is one of the most widely used construction materials in the world. However, the production of Portland cement, an essential constituent of concrete, leads to the release of significant amount of CO2, a greenhouse gas; one ton of Portland cement clinker production is said to creates approximately one ton of CO_2 and other greenhouse gases (GHGs). Environmental issues are playing an important role in the sustainable development of the cement and concrete industry. Concrete is a sustainable material because it has a very low inherent energy requirement, is produced to order as needed with very little waste, is made from some of the most plentiful resources on earth, has very high thermal mass, can be made with recycled materials, and is completely recyclable. Use of "green" materials embodies low energy costs. Their use must have high durability and low maintenance leading to sustainable construction materials. Concrete must keep evolving to satisfy the increasing demands of all its users. Reuse of post-consumer wastes and industrial by products in concrete is necessary to produce even "greener" concrete. Use of the E-waste, waste rubber tyres and other plastic pollutants can reduce the quantity cement and coarse aggregate and at the same time make the concrete more durable and greener. "Greener" concrete also improves air quality, minimizes solid wastes, and leads to sustainable cement and concrete industry.

Keywords: Rubber tyres, Workability, Shrinkage, Flexural strength

I. INTRODUCTION

Cement and aggregate, which are the most important constituents used in concrete production, are the vital materials needed for the construction industry. This inevitably led to a continuous and increasing demand of natural materials used for their production. Parallel to the need for the utilization of the natural resources emerges a growing concern for protecting the environment and a need to preserve natural resources, such as aggregate, by using alternative materials that are either recycled or discarded as a waste and cement by using plastic powder. Aggregate is cheaper than cement and it is, therefore, economical to put into the mix much of the former and as little of the latter as possible. Nevertheless, economy is not the only reason for using aggregate: it confers considerable technical advantages on concrete, which has a higher volume stability and better durability than hydrated cement paste alone. Among the many threats that affect the environment are the wastes which are generated in the production process or discarded after a specific material ends its life time or the intended use. The wastages are divided as solid waste, liquid waste and gaseous wastes. There are many disposal ways for liquid and gaseous waste materials. Some solid waste materials such as plastic bottles, papers, steel, etc can be recycled without affecting the environment. However, studies on how to dispose some solid wastes such as waste tires and the plastics in the most beneficial way sere not yet fully exhausted.Tire is a thermo set material that contains cross-linked molecules of sulphur and other chemicals. The process of mixing rubber with other chemicals to form this thermo set material is commonly known as vulcanization. This makes postconsumer tires very stable and nearly impossible to degrade under ambient conditions. Consequently, it has resulted in a growing disposal problem that has led to changes in legislation and significant researches worldwide. On the other hand, disposal of the waste tires all around the world is becoming higher and higher through time. This keeps on increasing every year with the number of vehicles, as do the future problems relating to the crucial environmental issues. This is considered as one of the major environmental challenges the World is facing because waste rubber is not easily biodegradable even after a long period of landfill treatment.

One of the solutions suggested was the use of tire rubber as partial replacement of coarse aggregate in cement-based materials. Similarly the use of plastics is also increasing day by day which is also a non-bio degradable product and the outer cover called as the corn husk is also a plastic type bio-degradable one this is also replaced as a partial replacement of the cement. Hence as we use the plastics + corn husk ash as a partial replacement of cement is leads to a eco-friendly replacement as well as the use and dumping of the plastics can be reduced.

2. MATERIALS USED AND MATERIAL PROPERTY

2.1 Cement

Cement is a generic name that can apply to all binders. The chemical composition of the cements can be quite diverse but by far the greatest amount of concrete used today is made with Portland cements. For this reason, the discussion of cement in this thesis is mainly about the Portland cement. Portland cement, the basic ingredient of concrete, is a closely controlled chemical combination of calcium, silicon, aluminum, iron and small amounts of other ingredients to which gypsum is added in the final grinding process to regulate the setting time of the concrete. Lime and silica make up about 85% of the mass. Common among the materials used in its manufacture are limestone, shells, and chalk or marl combined with shale, clay, slate or blast furnace slag, silica sand, and iron ore. Each step in the manufacturing of Portland cement is checked by frequent chemical and physical tests in plant laboratories.

2.2 Aggregates

Aggregates generally occupy 70 to 80 % of the volume of concrete and can therefore be expected to have an important influence on its properties. They are granular materials derived for the most part from natural rock and sands. Moreover, synthetic materials such as slag and expanded clay or shale are used to some extent, mostly in lightweight concrete. In addition to their use as economical filler, aggregates generally provide concrete with better dimensional stability and wear resistance. Based on their size, aggregates are divided into coarse and fine fractions. The coarse aggregate fraction is that retained on the 4.75 mm sieve. While the fine aggregate fraction is that passing the same sieve.

2.3 Water

Water is a key ingredient in the manufacture of concrete. Attention should be given to the quality of water used in concrete. A large amount of concrete is made using municipal water supplies. However, good quality concrete can be made with water that would not pass normal standards for drinking water. Mixing water can cause problems by introducing impurities that have a detrimental effect on concrete quality. Although satisfactory strength development is of primary concern, impurities contained in the mix water may also affect setting times, drying shrinkage, or durability or they may cause efflorescence. Water should be avoided if it contains large amounts of dissolved solids, or appreciable amounts of organic materials.

2.4 Chemical Admixtures

Admixtures are ingredients other than water, aggregates, hydraulic cement, and fibers that are added to the concrete batch immediately before or during mixing. A proper use of admixtures offers certain beneficial effects to concrete, including improved quality, acceleration or retardation of setting time, enhanced frost and sulfate resistance, control of strength development, improved workability, and enhanced finish ability. "Engineers choice" is the admixture hitch we have implemented in our project. This improves the workability and the bond between the cement and rubber, plastic& corn.

2.5 Rubber Aggregate

Rubber aggregates are obtained by reduction of scrap tires to aggregate sizes using two general processing technologies: mechanical grinding or cryogenic grinding. Mechanical grinding is the most common process. This method consists of using a variety of grinding techniques such as 'cracker mills' and 'granulators' to mechanically break down the rubber shred into small particle sizes ranging from several centimetres to fractions of a centimetre.

The steel bead and wire mesh in the tires is magnetically separated from the crumb during the various stages of granulation, and sieve shakers separate the fibre in the tire .Cryogenic processing is performed at a temperature below the glass transition temperature. This is usually accomplished by freezing of scrap tire rubber using liquid nitrogen.

The cooled rubber is extremely brittle and is fed directly into a cooled closed loop hammer-mill to be crushed into small particles with the fibre and steel removed in the same way as in mechanical grinding. The whole process takes place in the absence of oxygen, so surface oxidation is not a consideration. Because of the low temperature used in the process, the crumb rubber derived from the process is not altered from the original material. Shredded tires can be used as filler material for soils, foundations and pavements. Crumbed or pulverized tire rubber can be combined with other polymeric material to form mats, playground tiles, or road barriers among others. The idea of using tires as aggregates initially emerged from the reason that they have physical properties that can be substituted for existing materials, or because their properties provide an advantage over existing materials. These include; Durability, low unit weight, high hydraulic conductivity, low horizontal stress, flexibility for construction and thermal resistivity.

2.6 Surface Treatment of Rubber Aggregates

Studies have suggested that the rougher the rubber aggregate used in concrete mixtures the better the bonding developed between the particles and the surrounding matrix, and therefore the higher the compressive strength achieved. If the bond between rubber aggregate and the surrounding cement paste is improved, then significantly higher compressive strength of rubberized concrete could be obtained and to achieve enhanced adhesion, it is necessary to pre-treat the rubber aggregate.

FIGURE 1: Rubber used for experiments

Fig.1 shows the rubber tyres are washed thoroughly and immersed in the water for one day so that the waste impurities can be removed and the dust can also be removed then these water cleaned tyres are dipped increment paste with a clear coating on each and every molecule .these rubber tyres are then made dry for some hours and then used for the project.

2.7 Plastic waste

It is one of the dangerous waste pollution on earth. For the reduction of this, so much research is going in the field of recycling process. Among them plastic replacement in concrete is one of the effective methods. Mostly plastic materials are amorphous solids, in those some of them are crystalline materials. Long chain mixtures of polymers are usually called as plastics. Plastics in there fresh form has a distinct order. By using the waste plastic in construction materials the construction cost of buildings can be reduced and the accumulation of the waste plastic on the earth can be reduced. The waste plastic papers and covers are seen thrown on the streets and made the surrounds look unpleasant and these waste plastics are collected and given to the water pot manufacturing industries and from that industries the waste coming out is also a kind of plastic and we are collecting and implemented in our project.

2.8 Corn cob husk ash

Corn cob is the hard thick cylindrical central core of corn and the husk the outer cover of the corn. It is the agricultural waste product obtained from maize or corn. This corn cob and the husk are collected from the streets and washed thoroughly. Then these are made dried in direct sun light for 72 hours. These dried materials are then burnt and these ash is collected .These ash is then sieved in 1.18mm sieve. The ash which passes through the 1.185mm sieve is collected then used for the project as a partial replacement of the cement.

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3. MIXPROPOTION

In this project the mix design ratio used as 1:1.29:2.66 M30 grade concrete.

4. FRESH CONCRETE

4.1. Slump test

The slump value decreased with increase in percentage of tyres. Table 1 show the various percentages of tyres used in slum test.

Splitting tensile strength Test

The common method of estimating the tensile strength of concrete is through an indirect tension test. The splitting tensile test is carried out on a standard cylinder tested on its side in diametric compression. The horizontal stress to which the element is subjected is given by the following equation.

Horizontal tension $\sigma t = 2P/\pi LD$

The test is carried out on cylindrical specimens using a bearing strip of 3 mm plywood that is free of imperfections and is about 25 mm wide.

FIGURE 2: Split tensile test

Fig.2 shows specimen is aligned in the machine and the load is then applied and Table shows the splitting tensile strength test results. The relative percentage of strength loss with respect to the control mixes are also tabulated in table 2.

TABLE 2: splitting tensile test values

Replacements	7days	14 days	28days
0%	1.980	2.334	2.687
10% rubber&5%corn,plas	2.758	2.864	3.819
10%rubber&7.5%corn,plas	2.864	3.501	4.031

10%rubber&10%corn,plas	1.909	2.758	2.192

Various percentage of rubber tyres used in split tensile test and different values are shown in fig.3.

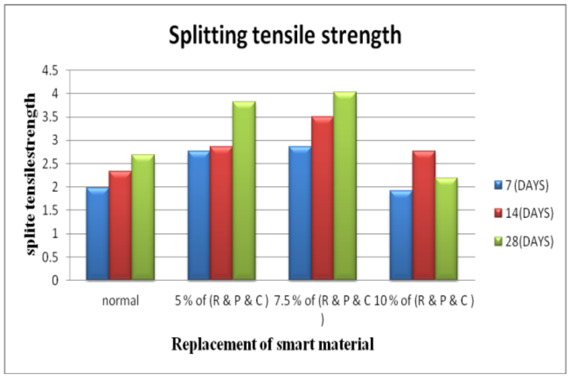

FIGURE 3: Comparison of split tensile test

Flexural strength of beams

This test gives another way of estimating tensile strength of concrete. During pure bending, the member resisting the action is subjected to internal actions or stresses (shear, tensile and compressive). For a bending force applied downward on a member supported simply at its two ends, fibres above the neutral axis are, generally, subjected to compressive stresses and those below the neutral axis to tensile stresses. For this load and support system, portions of the member near the supports are subjected to relatively higher shear stresses than tensile stresses. In this test, the concrete member to be tested is supported at its ends and loaded at its interior locations by a gradually increasing load to failure as shown in fig 4. The failure load (loading value at which the concrete cracks heavily) is then recorded and used to determine the tensile stress at which the member failed, i.e. its tensile strength [38]. The prepared beam samples were tested after 28 days of standard curing and the results of flexural strength tests for the control concretes and the rubberized concretes are summarised in table 3. The calculation of the flexural stress at failure is as follows:

$$\mathbf{F_b} = 3Pa/bd^2$$

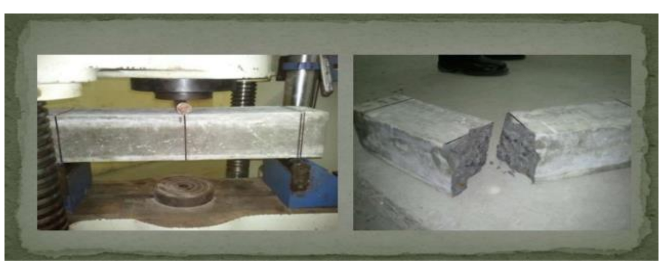

FIGURE 4: Flexural strength of beams

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TABLE 3: Flexural strength values

Replacements	Load	7 days
0%	180.3	33.60
10% rubber&5%corn,plas	141.4	24.53
10%rubber&7.5%corn,plas	112.0	22.60
10%rubber&10%corn,plas	101.8	15.7

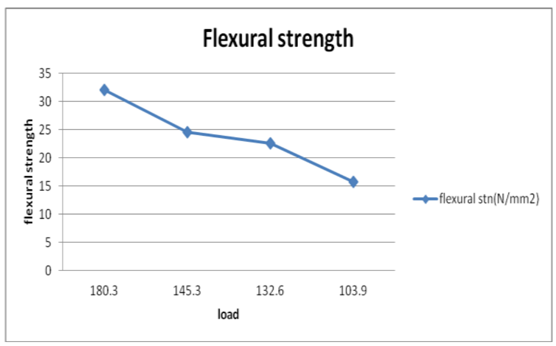

FIGURE 5: Flexural strength of beams

CONCLUSION

- Introduction of recycled rubber tyres into concrete mix leads to decrease in slump and workability for the various mix samples.
- Reduction in unit weight of 12.33 % was observed corresponding to 10% by volume of coarse aggregates was replaced by rubber aggregate in sample A3 which is with a targeted compressive strength of 12.14 Mpa.
- A much similar trend of reduction in unit weight of rubberized concrete was observed in all other samples containing rubber aggregates.
- For rubberized concrete, test results show that addition of rubber aggregates resulting to significant reduction in compressive strength compared to conventional concrete which is in the range of 10 %.
- Although the compressive strength is still in the reasonable range for the 5% replacement. Rubberized concrete can be used in non-load bearing members i.e. lightweight concrete walls, other light

architectural units, thus rubberized concrete mixes could give a viable alternative to where the requirements of normal loads, low unit weight, Medium strength, high toughness etc.

- The basic test were carried out, cubes and cylinders were caste for 7, 14 and 28 days strength test.

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