SUSTAINABLE DEVELOPMENT OF CONCRETE USING SCRAP CRUMB RUBBER AS AGGREGATE

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Abstract: **Concrete is most widely used building material in the world, as well as the largest user of natural resource. The concrete consists of natural resources that is aggregates which are responsible for the various engineering properties of concrete. These conventional materials are depleting day by day and there is the need to find the suitable replacement of these aggregates. Rubber which is consumed in large number and also the waste from rubber industry is increasing day by day and still no suitable method has been discovered for the disposal of rubber waste. Hence, efforts have been taken to identify the potential application of waste tire crumb rubber in civil engineering projects. Crumb rubber is a waste material generated by the rubber industry but i can be used in concrete mixes for its engineering application, thus it saves the natural resources that is sand. The current study is conducted to find the optimum quantity of aggregate for its engineering application. The fine aggregate has been replaced with scrap crumb rubber and also cement has been replaced with fly ash. In preparing the concrete, Ordinary Portland Cement has been used along with super plasticizer less than 1% by weight of cement to achieve required workability of the resulting concrete. In this experiment the performance of concrete mixtures incorporating 5%, 10%, 20% and 30% of scrap crumb rubber as aggregate and fly ash with cement in the same proportion will be investigated. Hence to examine characteristics of concrete specimen will be made. In the first set, different percentages by weight of scrap crumb rubber will be replaced by fine aggregate along with fly ash being replaced by the cement. The slump cone test will be performed on the fresh concrete and the compressive strength test, split tensile test and flexural test will be carried out on the specimens. The result obtained will be analyzed and compared with the conventional concrete at 7 days and 28 days**

Index Terms - Crumb rubber, Ordinary Portland Cement, fly ash, waste tire, flexural test

I. INTRODUCTION

India is the second largest country with population count exceeding 125cr. So the use of rubber products also increased, due to which the waste products from the rubber is increasing at an alarming rate and also disposal of the bulky rubber waste and the waste from discarded tires are banned on the landfill. Thus the rubber waste is shredded before disposing it on the landfill, but the disposal on landfill is also difficult because India does not have an effective solid waste management system and the count of landfill is very less as compared to the waste produced. So the crumb rubber can be used as and potential replacement to the fine aggregate because the crumb rubber size is in the range of the size of the sand and also the rubber is incompressible in nature and concrete being good in compression the crumb rubber can be replaced with aggregate and the property can be studied. Cement and sand are the important constituent of concrete their increasing demand and the concern of protecting environment has led to think about the alternatives for these material in future. Thus waste rubber which is difficult to be disposed can be recycled in the concrete as a replacement of sand and use of limited percentage of fly ash to fulfil the filler function of the cement. s. Admixtures are usually available in large quantities and can be used to replace Portland cement in green concrete, which include Fly Ash. These admixtures are added to the concrete as extra binding materials, and the benefits of using these materials in terms of workability are well established. Our project targets to study the use of large volumes of Fly Ash in concrete & crumb rubber. During the project we propose to use High Lime Fly Ash obtained from a local power plant & crumb rubber for local scrap dealers. Varying amounts of Fly Ash & crumb rubber will be used in given mixes of concrete as a partial replacement of the cement and sand. Several design mixes will be prepared, cured and tested for their compressive and bond strengths, and durability properties. Each compressive strength sample will be tested at 7 and 28 days. The results will be analyzed and compared with standard concrete and conclusions made on how best the Fly Ash & Crumb Rubber can be utilized to give optimum results. The result presented in our project address the compressive strength, bond strength, durability. The tests on concrete cubes showed a general increase in the strength of concrete with addition of High Lime Fly Ash and Crumb Rubber when these replacements were added at the 5% proportion. However, the strength was decreased for the 20% and 30% of the proportion. The test results for the 10% replacement was found out to be similar to the strength of Plain Concrete. The test results indicate that replacing proportions of cement with High Lime Fly Ash and Crumb Rubber would provide improved strength and a most cost effective solution for certain proportions.

II. OBJECTIVE

The specific objectives of this experimental proposal are:

- As partial substitute for fine aggregate (sand) in concrete composites.
- To investigate structural behaviour of such replaced concrete components.
- To determine the percentage of waste crumb rubber particles which gives More strength compared to conventional concrete.

III. METHODOLOGY

The study employed the experimental method to investigate the effect of incorporating different classification of rubber crumbs as part of the volume of fine aggregates and part of volume of fly ash in cement in order to obtain the structural strength of the concrete. IS procedures were followed in selecting the materials, making and curing test specimens, and the nominal mix design for proportioning of normal concrete. The rubber crumbs and the fly ash will be partially replaced in 5%, 10%, 20%, and 30% by Volume in fine aggregate and cement respectively for the evaluation of compressive strength, tensile strength, workability of the concrete.
The project is carried out in four major steps & they are: -

1. Designing M30 mix as per IS 10262:1982 & fixing the mix proportion cement, Fine aggregate, coarse aggregate, Fly Ash, Crumb rubber and water.
2. Casting of concrete cube, beam & cylinders as per IS, without using Fly Ash, Crumb Rubber & testing it for compressive strength, flexural strength & split tensile test respectively.
3. Casting of concrete cube, beam & cylinders as per IS, with using various proportion (5%, 10%, 20% and 30% partial replacement of Fly Ash with cement & 5%,10% ,20% and 30% crumb rubber with fine aggregate) of Fly Ash & Crumb rubber and testing it for compressive strength, flexural strength & split tensile test respectively.
4. Comparing the results.

IV. Material Constituent

1. **Cement**
   Ordinary Portland cement of 53 grade conforming to Indian Standard IS 12269– 1987, out the experimental program
2. **Crushed Sand**
   Crushed Sand, Zone II conforming to Indian Standard IS 383-1970 was used throughout the experimental program.
3. **Coarse Aggregate**
   CA conforming to Indian Standard IS 383-1970 was used throughout the experimental program.
4. **Fly Ash**
   High Lime Fly Ash is a type of sub-bituminous Fly Ash that is self-cementing as well as pozzolanic in nature was used in the experiment.
5. **Crumb Rubber**
   The waste crumb rubber was obtained from the local scrap store and was used in the experiment
6. **Admixtures**
   Super plasticizer was used in order to reduce the water content and enhance workability

V. MIX DESIGN

Water	Cement	Fine Aggregate	Coarse Aggregate
186ltr	387.5kg	711kg	1283kg
.48	1	1.83	3.31

Table 1: Mix Proportion Standard As Per Is (10262-1982)

VI. RESULTS

TESTS CONDUCTED	0% Replacement	5% Replacement	10% Replacement	20% Replacement	30% Replacement
Compressive Strength	34.80Mpa	38.06 Mpa	34.29 Mpa	28.58 Mpa	23.18 Mpa
Tensile Strength	2.07 Mpa	2.40 Mpa	2.31 Mpa	1.85 Mpa	1.60 Mpa
Flexural Strength	6.43 Mpa	7.56 Mpa	4.42 Mpa	3.5 Mpa	2.71 Mpa
Slump Cone	110mm	110 mm	100 mm	95 mm	105 mm

Table 2: Test Results after 28 Days

VII. Conclusion

- Optimum quantity of cement was obtained as 5% proportion.
- Increase in compressive strength of concrete at 5% proportion by 8.56%.
- Decrease in compressive strength of concrete at 20% and 30% proportion.
- Increase in tensile strength at 5% and decrease in tensile strength for rest of proportion.
- Increase in Flexural Strength at 5% and decrease in flexural strength for rest of proportion.
- The cost analysis shows that rubcrete is cheaper than conventional concrete

VIII. Acknowledgment

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