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AN EXPERIMENT INVESTIGATION ON PARTIAL REPLACEMENT OF COARSE AGGREGATES BY RUBBER AGGREGATES IN CEMENT CONCRETE

Aroos Karimi[1], Dr Tk Lohani[2], Er . Sajad Ahmad Mir[3]
[1]M.Tech Scholar, [2]Director Engineering, UIET, lalru, [3]Assistant Professor UIET, lalru

I. INTRODUCTION

Use of Waste tyres or used tyres has been an inveterate environmental issue in western countries but now due to the modernization and industrialization, this problem has slowly been felt in different Asian countries especially India and china. India has at a very slow pace started to work against this menace, but not effectively when compared to its western counterparts.

As India is on its way from being a developing country to a developed country, rate of vehicles hitting the road per year is increasing very fast and so is the number of tyres. Increasing number of tyres produced or used per year means more number of waste tyres being produced at the end of that year which in turn produces more number of landfills that are hazardous to the environment. Burning of these tyres has also not been recommended due to the production of a variety of poisonous gases which is again a big environmental problem.

In the last five fiscal years i.e. 2010 to 2015, the tyre industry in India has shown a growth of about 12%. This growth is considered to be very good for the nation's economy and from industrialization point of view but taking into consideration the environmental aspect; it has been seen as a challenge and an emerging threat.

Literature Review

Amjad A. Yasin et al. (2012). They partially replaced the natural aggregates with the shredded tyre rubber aggregates. The results showed that the compressive strength gets significantly reduced as compared to the compressive strength of the concrete with natural aggregates. They recommended that the shredded tyre rubber as the replacement of natural rock aggregates should not be preferred for structural uses and should only be used in non load bearing places.

Blessen Skariah Thomas et al. (2016). Rubberized concrete shows high resistance to freeze thaw, acid attacks, and chlorine ion penetration.

El-Gammal et al. (2010). They replaced natural aggregates in the concrete by tyre rubber aggregates and then studied its effect on the resultant concrete mix. It was observed that a good percentage of compressive strength is reduced. On the other hand, when the testing of the rubber aggregate concrete specimen was done, it was observed that a good amount of compressibility allowed the specimen to absorb a greater amount of energy under compressive loads. After the failure of the specimen, it remained partially intact even after it failed under the ultimate load. Thus it can be concluded that ductility of the concrete is increased.

Objectives

The objective of this study is to use the waste tyre rubber as a partial replacement of natural coarse aggregate for the positive variations in the properties of the mix and then in order to further improve those properties, we give surface treatments to the rubber aggregates before their use, in order to improve their bond strength with the cement paste. The effect of rubber aggregates used as the replacement of coarse aggregate and its surface treatment is to be determined by testing workability, tensile strength, compressive strength, durability, etc. of cement mortar. These tests will enable a complete characterization and an evaluation of application possibilities. The main objectives of the study are given below;

- The main purpose of this study is to examine the effect of addition of shredded rubber aggregates into the Portland cement concrete in three different proportions i.e. 5%, 10% and 15% by mass of coarse aggregates and evaluate the fresh and hardened rubberized concrete properties.

II. EQUIPMENT AND MATERIALS

Collection of Raw Material

The material used in the project is cement, sand, tyre rubber and sodium hydroxide. The cement, sand and sodium hydroxide are easily available in the market while the tyre rubber is available at very few sources. For this Project the tyre rubber was collected from a local garage and the sodium hydroxide was obtained from the market. Cement is a dispersed solid whose particle size is ranging from 0.1 to 250 micron-meter. The rubber thus obtained was brought down to a size comparable to the size of coarse aggregate. For this purpose the rubber obtained was cut down manually to get the desired size of particles in the workshop.

Material Testing

Below mentioned tests were conducted on the materials used:

- Cement tests: Consistency test, determination of initial and final setting time, compressive strength test, fineness test (sieve analysis), soundness test.
- Tests For fine and coarse aggregate: crushing test, impact test, abrasion test, water absorption test, soundness test, Shape test, Specific gravity and water absorption test, Sieve analysis (gradation).

Cement Tests

Table 1: Consistency test results of cement

Sample number	Consistency value	Weight of water(gm)
1	28.9	115.6
2	28.5	114
3	29.3	117.2

We consider that the average of above three sample result as the consistency value of the cement.

Therefore, consistency value (P) is 28.9 %.

Initial and final setting time

Procedure: We take the cement sample of about 400 gm and, mix it with the water quantity of about 0.85 times the water required to give a paste of standard consistency i.e. (0.85P). Like in the determination of standard consistency, the gauging time here should also be between 3-5 minutes. The gauging should be over by the time there is any sign of setting in the paste. The time period between the time of adding of water and the time we start to fill the mould is recorded. The mould is filled with the cement paste and the top surface is leveled with the mould. A very minute vibration may be given to get rid of any possible voids.

Water added = 0.85 * P = 0.85 *115.6 = 98.26 gm.

III. CONCLUSION

1 Rubber has great capability of becoming a permanent member of concrete family because of its wide variety of decent properties like better flexibility, light weight and easy availability. It can be very environmental friendly to use this waste material in construction industry.

2 Treated rubberized concrete possesses more compressive strength as compared to the untreated rubberized concrete. However, even after the surface treatment is given to the rubber, only 92.57% compressive strength of normal conventional concrete is regained.

3 Flexural and split tensile strength of almost all replacement levels of treated rubberized concrete is found to be more than in the normal conventional concretes. 28 day flexural and split tensile strength is found to be highest at NTR-5 and NTR-15 respectively.

Future Scope

Easy availability of waste tyre rubber and never ending output of waste tyres from the tyre industry means that this waste product will always need to be recycled. And based on the present research and other work done on this topic, there is great potential of tyre rubber to be used in the construction industry. The use of waste tyre rubber results in more economical and eco friendly concrete. Also if some treatments are provided to rubber, the strength properties surely increase. If some new and better techniques of its use are found to overcome the present flaws which previous researches have shown, there will be greater opportunity for waste tyre rubber to be used in the construction industry.

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