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Suitability of tyre scraps as a fine aggregate in concrete

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Abstract - *At present the disposal of waste tyres is becoming a major waste management problem in the world. Hence efforts have been taken to identify the potential application of waste tyres in civil engineering projects. In this context, our present study aims to investigate the optimal use of waste tyre rubber as fine aggregate in concrete composite. The conventional fine aggregates are replaced by tyre scraps. Cubes and cylinders were casted using M20 grade by replacing 10%, 15%, 20%, 25% and 30% of fine aggregates by tyre scraps by volume. Tensile strength and compressive strength were compared with that of ordinary M20 grade concrete.*

Key Words: *Tyre scraps, Mix proportion, Aggregates, Compressive strength, Tensile strength, etc.*

1. INTRODUCTION

With the development of modern society's aftermath of industrial revolution, the mobility within automobile sector got momentum. The offshoot of this pragmatic revolution gave rise to new dimensions of problems in the form of rubber garbage. Tyre rubber wastes represent a major environmental problem of increasing significance. An estimated 1000 million tyres reach the end of their useful lives every year. At present enormous quantities of tyres are already stockpiled or land filled; Tyre land filling is responsible for a serious ecological threat. Mainly waste tyres disposal areas contribute to the reduction of biodiversity also the tyres hold toxic and soluble components. Secondly although waste tyres are difficult to ignite, this risk is always present which creates high temperature and toxic fumes. High temperature causes tyres to melt, thus producing oil that will contaminate soil and water. Still millions of tyres are just being buried all over the world. Tyre rubber wastes are already used for paving purposes; however, it can only recycle a part of these wastes. Some research has already been conducted on the use of waste tyre as aggregate replacement in concrete showing that a concrete with enhanced toughness and sound insulation properties can be achieved.

2. EXPERIMENTAL DETAILS

2.1 Cement

Portland pozzolana cement with a specific gravity of 2.85 was used.

2.2 Aggregates

Coarse aggregate from stone crusher having a nominal maximum size of 20 mm was used. The specific gravity of coarse aggregate was 2.74. M Sand was used as a fine aggregate in mix of having a nominal maximum size of 4.75 mm. The specific gravity of fine aggregate was 2.73.

2.3 Tyre scraps

Scrap tyre was mechanically grinded to get fine aggregate sized particles. The specific gravity of the material was found to be 1.03.

Figure 1: Tyre scraps

2.4 Mix proportion

The process of selecting suitable ingredients of concrete and determining their relative amounts with the objective of producing a concrete of the required strength, durability and workability as economically as possible, is termed as concrete mix design. The proportioning of ingredients of concrete is governed by the required performance of concrete in two states, namely plastic and hardened states. The proportions are shown in table 1. Table 2 shows the amount of tyre scraps and fine aggregates in different percentage variations.

Table -1: Mix proportion

w/c ratio	0.45
Water	197 kg/m3
Cement	437.78 kg/m3
Coarse Aggregate	1172.72 kg/m3
Fine Aggregate	603.33 kg/m3

Table -2: Amount of fine aggregates and tyre scraps

Replaced percentage (%)	Fine Aggregate (kg/m3)	Tyre scrap (kg/m3)
0	603.3	0
10		22.76
15		34.14
20		45.53
25		56.9
30		68.29

2.5 Casting of specimens

A total of 6 mixes were prepared in this study and 36 cube samples were prepared (150 x 150 x 150 mm) for conducting the compression test. Also, 18 samples of cylinders (150 diameters x 300 height) for splitting tensile test were prepared. The samples of 6 cubes and 3 cylinders of each different types of percentage replacement mixes of fine aggregate with tyre scrap by volume in various percentages of 10%, 15%, 20%, 25% and 30% were casted. Compaction factor test for fresh mixes and Compression strength at 7 day and 28 day and Splitting Tensile strength test has been conducted to respective specimens.

3. RESULTS AND DISCUSSIONS

3.1 Compaction factor

The compaction factor test accounts for the workability of the fresh mix. The results are represented in chart 1.

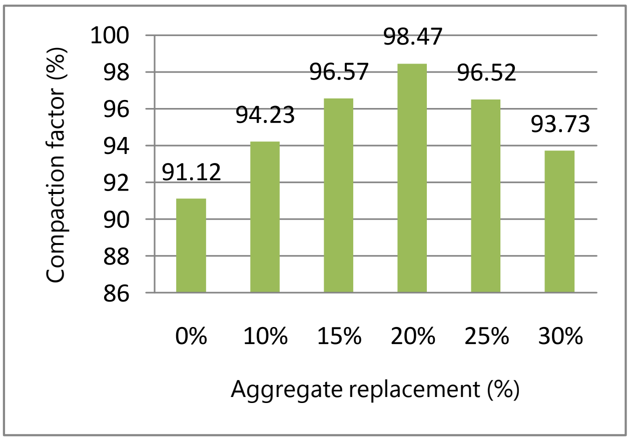

Chart -1: Compaction factor

It is observed that the compaction factor is increasing with the increase of tyre scrap up to 20% replacement. Maximum compaction factor is obtained at 20% replacement which is 98.47. As the tyre scrap quantity increases above 20%, compaction factor decreases. Compaction factor for 0% replacement is 91.12.

3.2 Compressive strength

The test for compressive strength of the concrete cubes was carried out to find the 7 day and 28 day compressive strength.

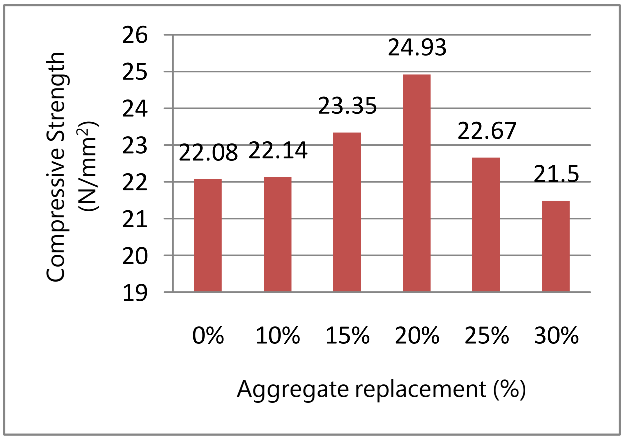

Chart -2: 7 Day compressive strength

The maximum 7 day compressive strength is 24.93 N/mm^2 at 20% replacement of fine scrap tyre rubber aggregate. It is 13% greater than the compressive strength of traditional concrete. Up to 20% replacement of fine scrap tyre rubber aggregate compressive strength is more than the compressive strength of traditional concrete. Above 20%, the compressive strength seems to be decreasing.

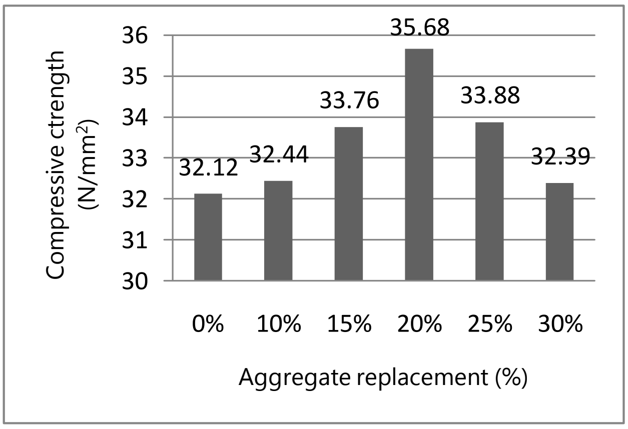

Chart -3: 28 Day compressive strength

The maximum 28 day compressive strength is 35.68 N/mm^2 at 20% replacement of fine scrap tyre rubber aggregate. It is 11% greater than the compressive strength of traditional concrete. Up to 20% replacement of fine scrap tyre rubber aggregate compressive strength is more than the compressive strength of traditional concrete. Above 20%, the compressive strength seems to be decreasing.

3.3 Splitting tensile strength

After 28 days curing of concrete cylinder, split tensile strength test carried on each concrete cylinder of each blend.

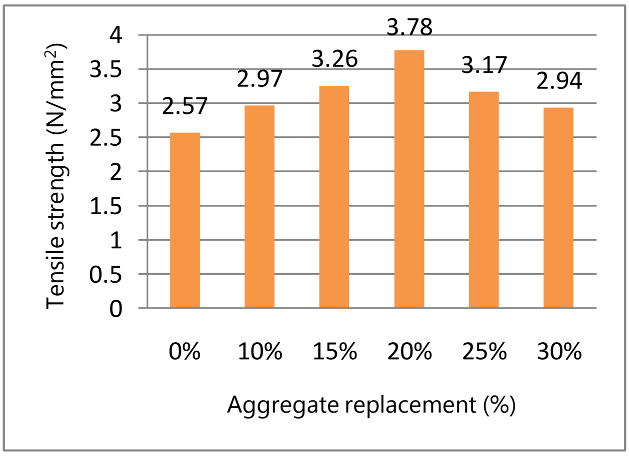

Chart -4: Splitting tensile strength

The maximum splitting tensile strength is 3.78 N/mm^2 at 20% replacement of fine scrap tyre rubber aggregate. It is 47% greater than the compressive strength of traditional concrete. Up to 20% replacement of fine scrap tyre rubber aggregate tensile strength is more than the tensile strength of traditional concrete. Above 20%, the tensile strength seems to be decreasing.

3.4 Density

Density of concrete is found by measuring of weight of concrete cube and then by dividing it by volume of cube.

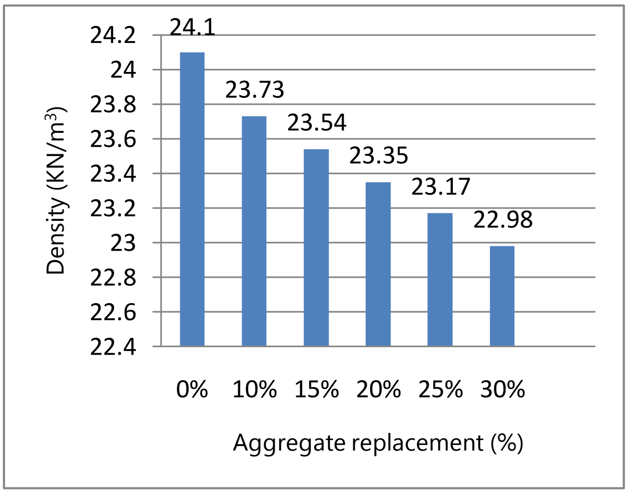

Chart -5: Density

The density of the concrete is decreasing as the percentage of tyre scrap increases. This is because the low specific gravity of tyre scraps comparing to fine aggregate.

3.5 Specific heat capacity

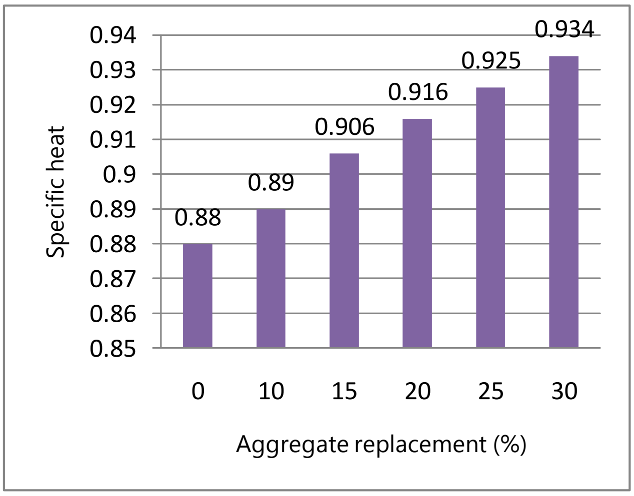

Chart -6: Specific heat capacity

Vulcanized rubber has a specific heat of 2.71 J/kg K and that of concrete is 0.88 J/kg K. Since the specific heat capacity of the tyre scrap aggregate is higher than that of conventional concrete, the new concrete also will have higher specific heat capacity. As the amount of tyre scrap increases in the concrete, the value of specific heat also increases.

4. CONCLUSION

Use of the waste rubber tyre in concrete is a techno-economically feasible and environmentally consistent method of waste disposal. Based on the results and then analysis, the following conclusions have been arrived. The compaction factor is increasing up to 20% replacement of fine aggregate and then decreasing. Maximum value is obtained at 20% replacement. The maximum compressive strength is at 20% replacement of fine aggregate by scrap tyre rubber aggregate. Up to 20% replacement of fine scrap tyre rubber aggregate compressive strength is more than the compressive strength of traditional concrete. Above 20%, the compressive strength seems to be decreasing. This pattern also repeats for splitting tensile strength. These three properties of concrete are highest at 20% replacement. Addition of tyre scrap also reduces the weight of concrete and increases the specific heat capacity. Thus there is great potential to use rubber tyre waste in concrete.

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REFERENCES

[1] Kotresh K.M, Mesfin Getahun Belachew, "Study On Waste Tyre Rubber As Concrete Aggregates" ,*International Journal of Scientific Engineering and Technology*, Vol.3, No.4, Apr. 2014,pp.: 433-436.

[2] K.C. Panda, P.S. Parhi and T. Jena, "Scrap-Tyre-Rubber Replacement for Aggregate in Cement Concrete: Experimental Study" ,*International Journal of Scientific Engineering and Technology*, Vol. 5, No. 6 (01), Dec.2012,pp.: 1692-1701.

[3] G. Nagesh Kumar, V. Sandeep, Ch. Sudharani, "Using Tyres Wastes as Aggregates in Concrete to form Rubcrete – Mix for Engineering Applications ,*International Journal of Research in Engineering and Technology*, Vol.3, No. 11, Nov-2014.

[4] Pravin A,Shirule, Mujahid Husain, "Reuse of Scrap Tyre as Partial Replacement of Fine Aggregate in Concrete and its Impact on Properties of Concrete", *International Journal of Civil and Structural Engineering*, Vol. 5, No. 4, 2015