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# TIRE DERIVED AGGREGATES IN RIGID CONCRETE PAVEMENTS

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***Abstract: The increased traffic on roads has led to the increased discarded tires, which in turn adds to the environmental hazards. These waste tires need to be disposed off and the best way to dispose them is to use them in construction industry. One such use is to use them as aggregates in concrete. This paper evaluates the properties of concrete in which the tire derived aggregates have been used. The discarded tires are used as partial replacement of fine aggregates in concrete. These were replaced in the percentages of 1%, 3%, 5%, 7%, 9% and 11% of fine aggregates and the properties of fresh and hardened concrete were evaluated.***

***Key words: Rigid Pavements, Slump test, Compressive strength, waste tire, Rubber aggregates.***

## I. INTRODUCTION

India is the fastest developing nation in the world. It is developing its infrastructure such as expressways, major roads, power projects, etc. for the construction of these projects, concrete is the basic component. The key component of concrete is the aggregates, both fine and coarse aggregates. But the source of aggregates is becoming depleting day by day hence making the aggregates quite expensive. On the other hand the number of vehicles on the roads is increasing tremendously. Tires are an important component of all the vehicles. Every year millions of tires are being discarded and these tires being non-biodegradable pose a greater problem to the environment. They are dumped or burned every year, often in an uncontrolled manner, causing a major environmental and health problem [1].Waste tire management is a global issue. Therefore these discarded tires should be disposed off in some other manner. One of the most suitable way is to use these tires in the construction industry. Investigations carried out so far have proved that rubber modified concrete can be very effectively used in seismic areas. In this paper, these discarded tires have been used as partial replacement of fine aggregates in concrete.

## II. LITERATURE REVIEW

The reduction in compressive strength of concrete manufactured with rubber aggregates limit its use in most applications [2] [3]. However, rubberised concrete has possibly some desirable characteristics such as lower density [2] and higher toughness and ductility [4]. Moreover, the better sound insulation, fire resistance [5] [6] and resistance against cracking [7] make rubberised concrete a preferred option to be used for pavement applications.

## III. MATERIALS USED

The following materials were used for conducting the research:

1. *Scrap tires*: These were shredded and decreased to the size passing 4.75 mm sieve.
2. *Well graded quarry dust* passing through 4.75 mm sieve.
3. *Coarse aggregates*
4. *Cement:* John & Kardos (2011) stated that the cement content in range of 300-400 kg/m3 utilised for preparing rubberised concrete [8].
5. *Water*

## IV. METHODOLOGY

Standard M35 mix of concrete was prepared with the partial replacement of fine aggregates. The fine aggregates were replaced with fine tire aggregates (crumb rubber) in the percentages of 1%, 3%, 5%, 7%, 9% and 11%. The properties of fresh (slump value) and hardened (Compressive strength) concrete were then determined.

## V. RESULTS

The tests were initially conducted on the materials collected.
Table 1 shows the properties of coarse aggregates used.

Table 1: Properties of coarse aggregates

| S.No | Property | Value |
|---|---|---|
| 1 | Water Absorption | 0.95% |
| 2 | Specific Gravity | 2.68 |
| 3 | Impact Value | 27 |
| 4 | Crushing Value | 21 |

Table 2 shows the properties of well graded quarry dust (fine aggregates).

Table 2: Properties of fine aggregates

| S.No | Property | Value |
|---|---|---|
| 1 | Water Absorption | 11% |
| 2 | Specific Gravity | 2.59 |
| 3 | Fineness modulus | 3.16 |
| 4 | Grading Zone | Zone II |

Table 3 shows the properties of cement.

Table 3: Properties of cement

| S.No | Property | Value |
|---|---|---|
| 1 | Specific Gravity | 3.15 |
| 2 | Standard consistency | 35% |
| 3 | Initial Setting time | 140 min |
| 4 | Final Setting Time | 320 min |
| 5 | Average compressive strength | 56.5 ($N/mm^2$) |

Slump test was conducted on the fresh concrete mix having varying percentages of crumb rubber to determine the workability of concrete. The test procedure as per IS: 1199-1959 was followed. Table 4 shows the results of the test.

Table 4: Slump Value

| S.No | Percentage of Rubber aggregates | Slump (mm) |
|---|---|---|
| 1 | 0 | 115 |
| 2 | 1 | 115 |
| 3 | 3 | 112 |
| 4 | 5 | 109 |
| 5 | 7 | 105 |
| 6 | 9 | 99 |
| 7 | 11 | 94 |

 

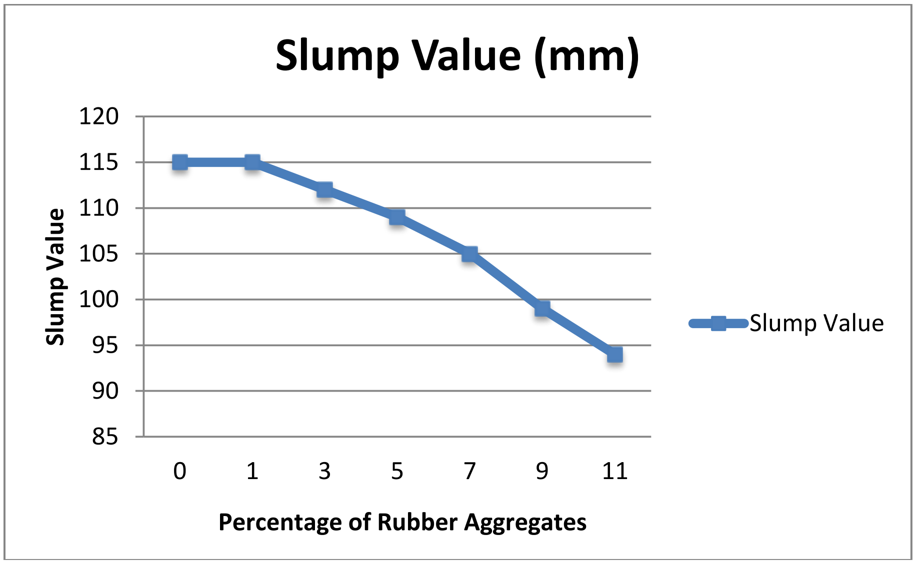


Fig 1: Graph between Slump Value in mm and the percentage of rubber aggregate

Compressive test was carried out on the three standard cubes of sizes 150 x 150 x150 mm in a compression testing machine. The 7 day and 28 day strength was evaluated. The table 5 below shows the results after 7 days and table 6 shows the results after 28 days.

Table 5: 7 day compressive strength

| S.No | Percentage of Rubber | Compressive Strength ($N/mm^2$) |
|---|---|---|
| 1 | 0 | 32 |
| 2 | 1 | 28 |
| 3 | 3 | 26 |
| 4 | 5 | 23 |
| 5 | 7 | 19 |
| 6 | 9 | 17 |
| 7 | 11 | 16 |

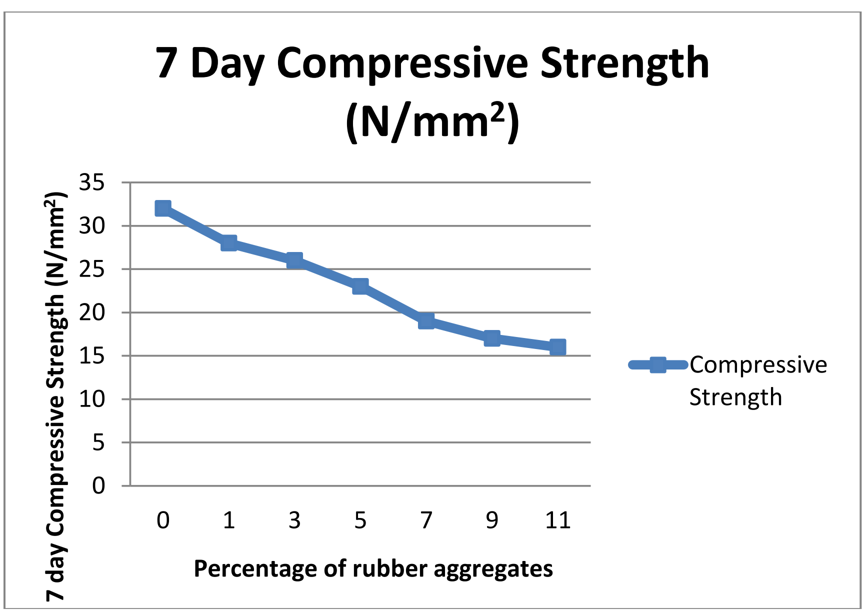


Fig 2: Graph between 7 day compressive strength and percentage of rubber aggregates

 

Table 6: 28 day compressive strength

| S.No | Percentage of Rubber | 28 day Compressive Strength ($N/mm^2$) |
|---|---|---|
| 1 | 0 | 45 |
| 2 | 1 | 42 |
| 3 | 3 | 39 |
| 4 | 5 | 37 |
| 5 | 7 | 32 |
| 6 | 9 | 26 |
| 7 | 11 | 21 |

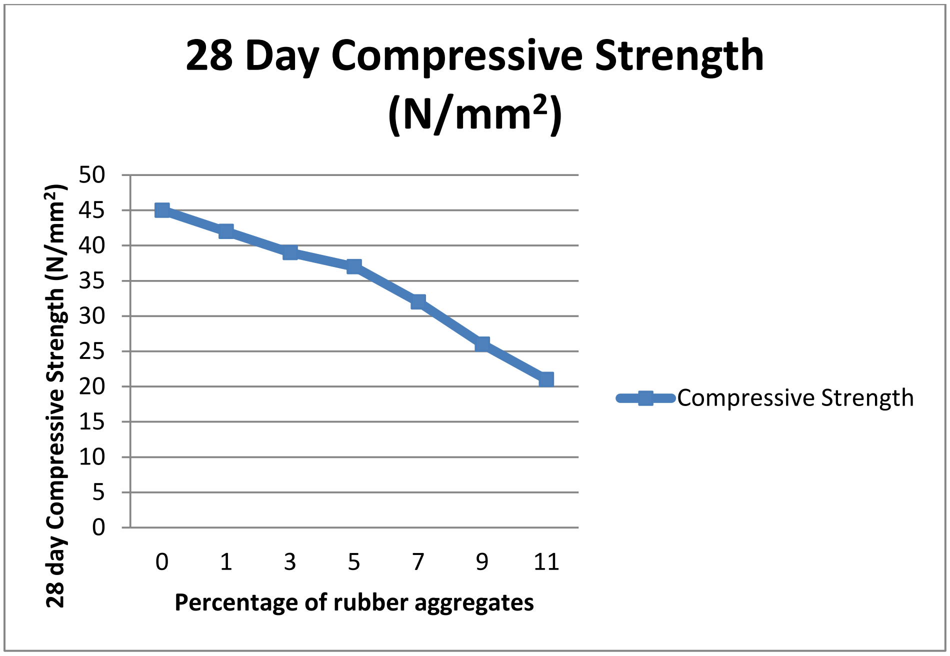


Fig 3: Graph between 28 day compressive strength and the percentage of rubber aggregates

## VI. CONCLUSION

The tests were conducted by adding different percentages of rubber aggregates to the M35 mix. It can be seen that there is not much increases in slump value with the increases in the percentage of rubber aggregates, thus making the concrete workable for our construction. However there was a slight reduction in the compressive strength of concrete as can be seen from the about results. It can be concluded that the rubber aggregates upto 9% do not show any appreciable reduction in the strength. Therefore, it can be rightly concluded that the addition of upto 9% of rubber aggregates to the concrete mix will very well solve the problem of tire waste and will also make our pavements economical and viable.

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