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Investigations on Replacement of Coarse Aggregates by Waste Tires for Road Construction

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Abstract: *Disposal of the waste and worn out tires has become a major issue in India in the past few years as it has very few uses, and if new tires are to be produced from waste rubber then it has to be melted and remolded. This process intern increases the pollution and releases toxic gases in the air, which are harmful to the environment as well as living creatures. Natural Coarse Aggregates are extracted from quarries and as a result these quarries will soon be depleted in few decades if the rate of their usage continues at this pace. As a result there was a need of a permanent solution to this perpetual problem. Keeping this in view the feasibility of use of waste tires as replacement for coarse aggregates for road construction has been experimentally assessed in this paper. Basic Mechanical and physical tests has been carried out .The experimental results by replacement of coarse aggregates up to 15% by waste tire have shown remarkable improvement in the physical properties of coarse aggregates.*

Keywords: *Aggregates, Durability, Road Construction, Replacement, Strength Testing, Waste Tires.*

I. Introduction

India being a developing country has grown in the field of infrastructure and development leading to more number of vehicles used i.e. more road construction and as a result more number of used tires is produced. India, being third in the world produces more than 1.3 billion waste tires [1]. Storage of such waste tires is a major issue as they can easily catch fire due to lightening, and it can undergo spontaneous combustion. Tire material is non biodegradable and stacking of such tires can also cause mosquito breeding which intern leads to epidemics such as malaria and dengue [2]. Therefore proper care has to be taken for their storage.

Aggregates, which are totally nature dependent obtained from natural quarries are depleting due to excessive usage. Continuous explosives used on these quarries has disturbed the natural structure of these rocks, as a result they have loosened and during rainy seasons they collapse and the debris cause notable damage to life and property. Replacement to aggregates is necessary by considering the future problems.

Efficient amount of waste rubber can be replaced as aggregates up to some amount in the road construction without hampering the strength of the road.

The principle element of tire is rubber, about 85% of the tire where both synthetic and natural rubber may be used. Natural rubber is an elastic hydrocarbon polymer while synthetic rubber is a thermoset polymeric material. Rubber is a polymeric material which may be obtained from natural or synthetic rubber by polymerization [3]. The melting point of rubber being 180^{o} C has no effect of temperature stresses up to certain limits.

II. Research Objectives

1. To investigate the mechanical and physical properties of partially replaced coarse aggregates by waste tires with varying percentages.
2. Comparison of test results with conventional coarse aggregates.
3. Finding the optimum percentage of replacement.

III. Experimental Investigations

Source Of Materials

Rubber:

1. Source: Ashrafiya Traders, Nigdi, Pune.
2. Cost: Purchased for Rs. 16 per kg.
3. Methodology: Initially the rubber washed and cut into the required sizes i.e. 20mm-12.5mm and 12.5mm-10mm.
4. Properties:

a) The internal friction angle varies from 19^0 to 26^0 depending upon size and shape of the rubber.
b) Cohesion values are ranged from 4.3 KPa to 11.5 KPa.
c) Permeability coefficient ranges from 1.5 to 15 cm/sec.

Aggregates:
1. Source: Hari Om Crushers.
2. Sizes: As per the standard test specifications.
3. Properties: The Physical properties of aggregates are as follows.

Property	Value
Type	Natural Crushed
Specific Gravity	2.7
Dry Loose Bulk Density (DLBD)	1.5
Fineness Modulus	3.2

Tests: The following tests were conducted on coarse aggregates as well as partially replaced coarse aggregates as per IS standards [6] and the standard values for Sub Base layer were compared.

SR.NO	TEST NAME	IS CODE	STD VALUE (Max)	TEST RESULTS			
				0%	5%	10%	15%
1.	AGGREGATE CRUSHING VALUE TEST	IS 2386 (part IV)-1963	45%	12.70	12.83	10.56	8.73
2.	IMPACT TEST	IS 5640-1970	50%	11.63	9.46	9.39	5.82
3.	LOS-ANGELES ABRASION TEST	IS 2386(part IV)-1963	40%	14.06	11.67	10.56	10.00
4.	WATER ABSORPTION TESTS	IS: 2386(Part III)-1963	4%	2.62	2.66	2.68	3.26
5.	SPECIFIC GRAVITY TEST	IS: 2386(Part III)-1963	2.7	2.83	2.24	2.45	2.33

SHAPE TEST	
FLAKINESS INDEX	11.82%
ELONGATION INDEX	10.81%

IV. Results And Discussion

1. Crushing Test: The aggregate size ranging from 12.5mm to 10mm were tested. It was observed that with the increase in the Waste Rubber content, the crushing value decreases from 12.7% to 10% (as shown in fig.1).
2. Impact Test: The aggregate size ranging from 12.5mm to 10 mm were tested. It was observed that with the increase in the Waste Rubber content, the impact value decreases. Depending on the layer in which the aggregates are to be used, the impact value may differ. The replacement of aggregates with 20% of Waste Rubber was also tried but due to the rebound effect the test could not be conducted.
3. Abrasion Test: The test was carried out using Grading B specification. Replacement by Waste Rubber led to decrease in abrasion value (as shown in fig. 1).
4. Water Absorption Test: It was observed that with the increase in the Waste Rubber content, the water absorption value remains constant with negligible variation up to 10% of replacement but the value increases after that.
5. Specific Gravity Test: The specific gravity of coarse aggregates normally used in road construction ranges from 2.5 to 3.2. The replacement of aggregates by rubber led to decrease in the value of specific gravity up to 2.24.

6. Shape Test: It gives only a rough idea of the relative shapes of aggregates. Flaky and elongated aggregates may cause inherent weakness with possibilities of breaking down. The maximum allowable flakiness index is 30%.

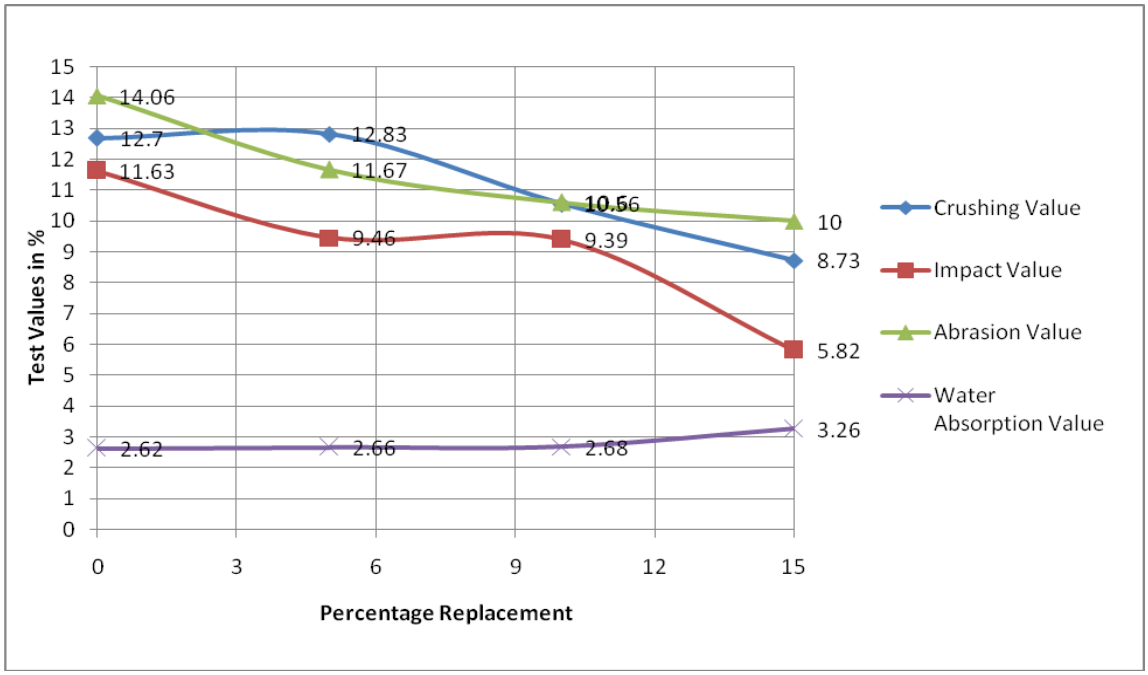

Fig.1 Test Results

V. Conclusion

Replacement of coarse aggregates by tire leads to decrease of the aggregate impact value. After replacing the rubber content by 15 % the impact hammer starts bumping and it becomes difficult to conduct the test by increasing the percentage of waste rubber. The present tests are not completely adequate for higher percentages of replacement of rubber. Percentage wear of aggregates after replacing decreases as the rubber is tough enough but not as tough as Natural Coarse Aggregates. Water Absorption Value of the aggregates also increases with an increase in rubber content. Due to the usage of waste rubber in road construction, the burden on the dumping yards reduces. By replacing aggregates with waste rubber in the sub- base layer of road we can save up to 1537 tons of aggregates in a stretch of 1 km of road. The replacement of coarse aggregate by rubber has shown remarkable improvement in the physical properties, therefore the above method can be used in the actual road construction.

References

[1]. Divya International Pyrolysis and Recycling Plant, www.divyaint.com
[2]. Amjad A. Yasin, "Using Shredded tires as an Aggregate in Concrete", Contemporary Engineering Sciences, Vol.5,2012,no. 10, 473- 480.
[3]. Michelle Danko, Edgar Can, Jose A. Pena, "Use of recycled tires as partial replacement of coarse aggregates in the production of concrete".
[4]. Dr. S.K. Khanna, Dr. C.E.G. Justo, Dr. A. Veeraragavan, "Highway materials and pavement testing", Nem Chand & Bros., Roorkee 247 667, India, Revised Fifth Edition,2009.
[5]. Rubber recycling- Scrap tires news online, http://scraptirenews.com/area/crumb/standard.html
[6]. Kotresh K. M, Mesfin Gatahun Belachew, "Study on Waste Tire Rubber as Concrete Aggregates", International Journal of Scientific Engineering and Technology, Vol No.3 Issue No.4,pp : 433- 436.
[7]. B. Damodhara Reddy, S. Aruna Jyothy, P. Ramesh Babu, "Experimental Investigation on Concrete by Partially replacement of Ware Aggregate with Junk Rubber", Publication- IJES
[8]. M. Mavroulidou, "Discarded Tire rubber as Concrete aggregate: A Possible outlet for Used Tires", Global NEST Journal, Vol 12, No.4,pp : 359- 367.