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USE OF WASTE RUBBER TYRE AS AN AGGREGATE IN CARPET LAYER OF BITUMINOUS PAVEMENT

Niraj Baraiya[1], Bhavika Chavhan[2], Kunal Moharkar[3], Paras Thakare[4]

Lecturer, Dept. Of Civil Engineering, A.S. Polytechnic, Wardha, Maharashtra, India.
[1]Graduate Student, Dept. Of Civil Engineering, Walchand College of Engineering, Sangli, Maharashtra, India.
[2]Graduate Student, Dept. Of Civil Engineering, Government College of Engineering, Karad, Maharashtra, India.
[3] Graduate Student, Dept. Of Civil Engineering, Dr. D.Y. Patil College of Engineering, Akurdi , Maharashtra, India.

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Abstract - *The growth of rate of vehicle is the backbone of the economic development of any country. In today's era, solid waste management is the thrust area. On the other side, the traffic intensity is also increasing. As a result amount of waste tyres is also increasing. The disposal of scrap tyres is the major issues associated with the management of waste tyres. Therefore, it is necessary to utilize the wastes effectively with technical development in each field. In this project works, an effort has been made to make use of these tyres in carpet layer of the flexible pavement. The study has been made by taking conventional aggregate and rubber tyre aggregate in percentage by replacement of conventional aggregate. The waste rubber tyre aggregate are used in cubical shape of size 11.2mm to 5.6mm and tested for its optimum quantity. Marshall Stability test is performed to determine stability. In the present study an attempt has been made to use waste rubber tyre by making aggregate of size 11.2mm and 5.6mm and utilizing it with 2, 4, 6, 8, 10, 12, 14, 16,and 18 percent by weight of conventional aggregate. This research aim to evaluate the feasibility of using waste rubber tyre in bitumen mix design several samples were prepared and tested in lab. The results are presented and discussed in this study.*

Key Words: Marshall Stability Test, Waste Rubber Tyre Aggregate, Bitumen, Carpet layer, Flexible pavement.

1. INTRODUCTION

Use of tyre shreds for civil engineering applications has several advantages. Recently an increasing attraction has been paid to find application for such materials in civil engineering. The manufacturing process for tyres combines raw material into a special form that yields unique properties such as flexibility, strength, resiliency, and high frictional resistance. If tyres are reused as a construction material instead of being burned (burning is currently the leading method of reuse accounting for 17% of scrap tires), the unique properties of tyres can once again be exploited in a beneficial manner. The present study shows, the replacement of conventional aggregate by waste rubber tyre aggregate. The use of waste tyre in hot bituminous mixes to enhance pavement performance protect environment and provide low cost roads. Basic properties of conventional aggregate are modified by using waste rubber. The waste rubber was cut in the form of aggregate (course and fine aggregate) and was mixed in the conventional mix of carpet layer of road replacing. The conventional aggregate gradually to some limited value; Marshall Stability test are conducted by taking 1200 gm. aggregate (coarse and fine aggregate) for a mix design. Obtained optimum bitumen content is mixed and the result gives the optimum percentage of waste rubber tyre aggregate for maximum stability.

2. MATRIALS AND MIX DESIGN

2.1. Conventional Aggregate

MORTH 5th gradation is used as the reference gradation, with certain restricted zones and control points. The restricted zones and control points are incorporated in order to ensure certain proportion of fines for

I. Proper interlocking of aggregates.
II. To avoid the fall in shear strength of mix due to excess of fines.
III. To maintain requisite voids in material aggregate (VMA).

Conventional aggregate of size 11.2mm and 5.6mm of having gradation as mentioned in table given below are taken for preparing the test specimen.

Table -1: Aggregate Size and percentage passing

Sieve Size	% Passing
22.4	100
13.20	80-90
11.20	25-35
5.60	Nil

2.2. Rubber Tyre Aggregate

Rubber tyre aggregate are small pieces of rubber tyre which are cut down into cubical shapes or in irregular shape. The tyres which are used in this project are obtained from motor vehicles. The tyre aggregate having size 11.2mm and 5.6mm of gradation given table 2.1. are used as aggregate by partial replacement of conventional aggregate.

Fig -1: Waste tyre rubber aggregate

2.3. Bitumen VG 30 (Penetration Grade 60/70)

Bitumen used for preparation of specimen is of grade VG-30 penetration grade of 60/70.

Table -2: Properties of bitumen are given below.

Grade	60/70
Penetration Value	60/70
Softening Value	40/55
Flash Point (min)	175^0
Fire Point (min)	250^0
Ductility	75cm
Specific gravity	0.99
Solubility	99%
Loss on heating	1%
Open grade	3.5%

Preparation of test specimens: The required quantity of the mix was taken so as to produce compacted bituminous mix specimens of 63.5 mm approximately. 1200 gm of aggregates and filler are required to produce the desirable thickness. The aggregates were heated to a temperature of 175 to 190°c. The bitumen was heated to a temperature of 150°c to 160°c and the required amount of first trial bitumen was added to the heated aggregate. Bitumen in percentage from 4% to 6% were added for three compacted sample and mixed thoroughly. The mix was placed in a mould and compacted with 75 numbers of blows on either side. The sample was taken out of the mould after few minutes using sample extractor. After the testing of the compacted sample, optimum binder was found out. The obtained optimum binder content was 5% of bitumen.

3. METHODOLOGY

In preparing the test specimen, about 1200gm. of the conventional aggregate was heated in a container by giving a flame from burner. Later on rubber aggregate was added in 2% of conventional aggregate, mixed effectively with the conventional aggregate with the continuous heat and observed the temperature with the help of thermometer as the temperature passes above 120 degree Celsius add bitumen 5% of total weight of specimen and mix up properly by stirring with iron rod whenever the temperature reaches 150 degree Celsius. Fill the mixture in the Marshall mould as early possible as the temperature of material mould should not decrease and place the cover plate on mould then give the 75 blows of hammer weighing 4.865 kg and remove specimen after cooling.

The conventional aggregate of sizes 13.2 mm where weighted up to 600 gm. Then the same conventional aggregate of size 11.2 where mixed properly and weighted as total 1200 gm. The same procedure was repeated for taking the waste rubber tyre aggregate and then it is mixed as percentage by weight of the conventional aggregate. The bitumen as binder was taken by 5% of the total weight of conventional waste rubber tyre aggregate.

Rubber aggregate and conventional aggregate are heated to 150 degree Celsius, the bitumen is added by maintaining temperature of mix to 150 degree Celsius and it is mixed properly. Then the mixed is poured in the mould and filled up to top. The cover plate is put on the mould then 75 blows of hammer weight 4.865 kg are given. After some time the specimen is excavated from the mould. Then the specimen was allowed to cool then Marshall Stability test was carried out on the specimen as per the procedure.

4. RESULT AND DISCUSSIONS

The observation table is prepared by Marshall Method using 60/70 Grade bitumen and the various mix design characteristics of Marshall Stability value, Flow value etc. were found out.

Mixing Temperature : 250^0c

Number of blows : 75

Grade of Bitumen : VG-30

Table -3: Observation and calculation

specimen no	%of Rubber aggregate	%of bitumen	Sample thickness (mm)	Wt. of sample in air (gm)	Wt. of sample in water (gm)	Volume (mm^3)
1	0	5	7.0	1182	697	485
2	2	5	7.4	1221	737	484
3	4	5	7.0	1099	645	454
4	6	5	7.3	1063	619	444
5	8	5	7.7	1153	646	507
6	10	5	6.6	1085	612	473
7	12	5	5.6	815	445	370
8	14	5	6.9	911	491	420
9	16	5	6.7	872	461	411
10	18	5	7.1	876	454	422

Table -4: Marshall Stability Test Results

% of Rubber aggregate	stability (KN)	Flow (mm)
0	265	2.5
2	90	3.5
4	30	6
6	25	6.5
8	20	7
10	110	3
12	30	6
14	20	7
16	30	6
18	25	6.5

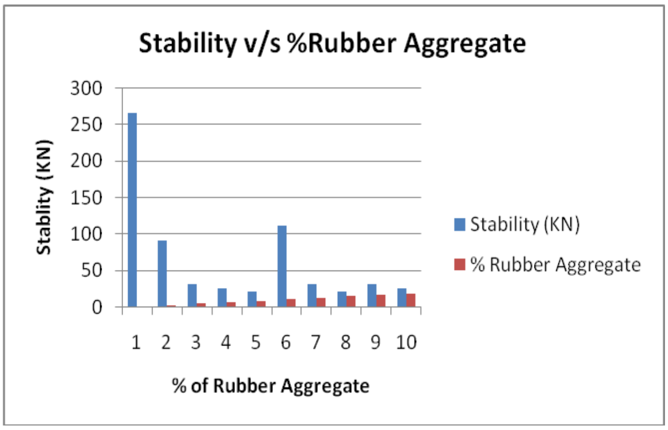

Chart-1: The graph between Stability and % of Rubber Aggregate.

From the above graph, it is observed that carpet layer of bituminous pavement with rubber aggregate have achieved an optimum value of stability for 10% replacement of conventionl aggregate.

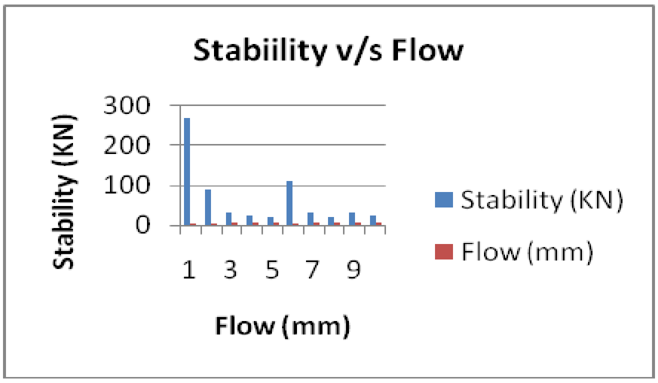

Chart-2: The graph between Stability and Flow

From the above results, it is observed that the stability of rubber aggregate increases with decrease in flow value.

Marshall stability test was done for conventional aggregate and rubber tyre aggregate in 0%, 2%, 4%, 6%, 8%, 10%, 12% , 14%, 16% and 18% by replacement of conventional aggregate. The result was shown in Table 5. From the result of the test, the stability of conventional aggregate was 265 KN. And flow was 2.5 mm. The optimum value of stability obtained on 10% of rubber aggregate was 110KN with 3mm of flow.

5. CONCLUSION

From present experimental study, we conclude that if percentage of rubber aggregate goes on increasing will decrease the stability and increase the flow. The optimum value of stability obtained on 10% of rubber aggregate. Due to this the occurrence of pot holes, cracks and undulation will be reduced up to certain extent. Despite the reduced stability of waste rubber tyre aggregate in comparison to conventional aggregate, there is a potential for carpet layer of bitumen pavement in which inclusion of rubber aggregate would be feasible which will utilize the discarded rubber tyres the disposal of which, is a big problem for environment pollution. There is a chance of increasing stability of flexible road pavement by adding more percentage of rubber aggregate along with the conventional aggregate considering various factor affecting, so the study will be further continues.

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