Utilization of Scrap Tyre as Resource for Flexible Road Pavement

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Abstract—Use of four wheeler, two-wheeler vehicles etc. is increasing day by day. It is estimated that about 60 per cent of waste tyres are disposed via unknown routes in the urban as well as rural areas. The increase of waste tyre disposal is a serious problem that leads to environmental pollution. It can be used as a cheap and environmental friendly modification process to minimize the damage of pavement. Use of crumb rubber helps to excellent pavement life, driving comfort and low maintenance. Therefore, it is necessary to replacing the bitumen with the same percentage as 7,9,11,13,15 and carried out the different test on bitumen to analyse or comparing the normal and rubber pavement and rubber is cheaper than bitumen.

Index Terms-aggregate, crumb Rubber, modified Bitumen, pavement.

I. INTRODUCTION

A country like India an efficient road network is necessary for national integration, industrial development and as well as for socio-economic development and about 0.6 million tonne of scrap tyre are generated annually [5]. Day by day with the increase in number of automobiles in India during recent years. Due to wear and tear of tires the life of tire reduces and at last it becomes useless. The disposal of these tires has become a serious problem. These tires are disposed easily by either burning or by dumping. Disposal by burning causes air pollution and dumping causes valuable land to be wasted for stacking up the tires, Whole tyres are difficult to landfill because they tend to float to the surface. These stockpiles are also direct loss of energy and resources in addition to fire and health hazards and also environmental issues. The main constituent of tyre is rubber and the largest single application of rubber is vehicle tyres. Also, the requirement of tyre is directly related to growth of automobile. Hence it is required to dispose these tires safely and economically. Hence, the modification of bitumen to meet the required performance standards of the pavement appears to be logical and economical approach. Hence use of crumb-rubber in bitumen modification helps in achieving better performance of wearing courses. This paper is intended to study the feasibility of the waste tire rubber as a blending material in bitumen, which is used for road construction. Replacing bitumen by waste crumb rubber to give proper strength by taken various test like Penetration test, Ductility test, Marshal Stability and flash and Fire point Test.

II. METHODOLOGY

1. Waste rubber tyres were collected from roads sides, dumpsites and waste-buyers. 2. The waste tyres were cut in the

form of various sizes ranging from 600 microns to 100-micron size in the tyre cutting machine. 3. The crumb rubber is sieved through 300 microns and retain on 150 microns and add with bitumen. 4. It was cleaned by de-dusting or washing if required These rubber particles were mixed with bitumen in 7,9,11,13 and 15% by weight of bitumen at temperature between $160^{\circ}c$ to $170^{\circ}c$ for proper mixing of bituminous mix. Also, we have conducted a different test on bitumen. Bitumen are replacing with rubber in percentage after conducting all the tests we are making two sample one is normal and other is rubber mixed and comparing on different basis.

III. MATERIALS

A. Bitumen[1]

Bituminous materials or asphalts are extensively used for roadway construction, primarily because of their excellent binding characteristics and water proofing properties and relatively low cost. Bituminous materials consist of bitumen which is a black or dark coloured solid or viscous cementitious substances consists chiefly high molecular weight hydrocarbons derived from distillation of petroleum or natural asphalt, has adhesive properties, and is soluble in carbon disulphide. Tars are residues from the destructive distillation of organic substances such as coal, wood, or petroleum and are temperature sensitive than bitumen. Bitumen will be dissolved in petroleum oils where unlike tar. The desirable properties of bitumen depend on the mix type and construction.



Fig. 1. Bitumen

B. Crumb Rubber

Crumb rubber is a term usually applied to recycled rubber from automotive and truck scrap tires. During the recycling process steel and fluff is removed leaving tire rubber with a granular consistency. From physical and chemical interaction of crumb rubber with conventional bitumen Crumb Rubber Modified Bitumen (CRMB) is made.



Fig. 2. Crumb rubber

C. Modified Bitumen[10]

Certain additives or blend of additives called as bitumen modifiers can improve properties of Bitumen and bituminous mixes. Bitumen treated with these modifiers is known as modified bitumen. Polymer modified bitumen (PMB)/ crumb rubber modified bitumen (CRMB) should be used only in wearing course depending upon the requirements of extreme climatic variations. The detailed specifications for modified bitumen have been issued by IRC: SP: 53-1999. It must be noted that the performance of PMB and CRMB is dependent on strict control on temperature during construction. The advantages of using modified bitumen are as follows,

- Lower susceptibility to daily and seasonal temperature variations
- Higher resistance to deformation at high pavement temperature
- Better age resistance properties
- Higher fatigue life for mixes
- Better adhesion between aggregates and binder
- Prevention of cracking and reflective cracking

IV. TESTS AND RESULTS

A. Marshal Stability Test

Objective: To determine the Optimum Bitumen content of given sample using Marshall Stability Test.



Fig. 3. Mixing of sample



Fig. 4. Filling of sample



Fig. 5. Compaction of sample



Fig. 6. After compaction



Fig. 7. Weighting of sample

B. Flash and Fire Point

Objective : To determine the flash and fire point of modified bitumen.

TABLE I. Plain Bitumen

S. No.	Parameter	Specimen-1	Specimen-2	Specimen-3	Specimen-4
1.	Stability value (kg.)	1180	1220	1190	1196.6
2.	Flow value, 0.25 mm unit	3	3.5	3.6	3.36

TABLE II. Marshal Stability Test

Percentage	Parameter	Specimen-1	Specimen-2	Specimen-3	Specimen-4
7%	Stability value (kg.)	1010	995	1090	980
7%	Flow value, 0.25 mm unit	3.1	2.3	2.6	2.9
9%	Stability value (kg.)	997	940	14	1012
9%	Flow value, 0.25 mm unit	2.9	2.4	2.3	2.2
11%	Stability value (kg.)	985	940	965	920
11%	Flow value, 0.25 mm unit	2.5	2.7	3.1	2.8
13%	Stability value (kg.)	940	905	920	933
13%	Flow value, 0.25 mm unit	2.5	2.8	2.9	2.4
15%	Stability value (kg.)	880	872	890	910
15%	Flow value, 0.25 mm unit	3.3	3.2	3.4	3.5



Fig. 8. Rubber percentage in bitumen (%) vs. Marshall stability (Kg)



Fig. 9. Penesky-martens flash apparatus



Fig. 10. During test

	TABLE	III.	Flash	and	Fire	point
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Modified bitumen(%)	Flash point (^{o}C)	Fire point (^{o}C)
7	240	260
9	260	270
11	266	279
13	271	283
15	276	290

V. CONCLUSION

After studying the test results of common laboratory tests on plain bitumen and crumb rubber modified bitumen it is concluded that: 1.Flash and Fire Point test of plain bitumen can be improved significantly by modifying it with addition of crumb rubber which is a major environment pollutant. After careful evaluation of the properties and taking various tests as per standards the results shown by 15% addition of rubber crumbs has best suitability for blending it with bitumen. 2.From Marshal Stability test, 9% addition of crumb rubber has best suitability for blending it with bitumen.

VI. FUTURE SCOPE

To get more precise results to make comments about replacement of bitumen by crumbled rubber. Conduction of the marshal stability test, fire flash point and field test can be performed to judge the performance precisely.

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