Use of Waste Rubber Tyres In Flexible Highway Pavements

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Abstract

Use of Crumb Rubber i.e. the rubber obtained from the waste tires of vehicles in the construction of flexible pavement is gaining importance. It is also worth mentioning that, the modifier raw-material has been sourced from disposed crumb rubber. This not only allows us to collect modifier raw material at low cost, but also provides a solution towards ecological menace posed by increased use of rubber. In the present study, an attempt has been made to use Crumb Rubber, blended using wet process .Marshal method of Bituminous mix design was carried out for varying percentages of Crumb Rubber to determine the different mix design characteristics. Marshall's mix design was carried out by changing the modified bitumen content at constant optimum rubber content and subsequent tests have been performed to determine the different mix design characteristics and for conventional bitumen. This has resulted in much improved characteristics when compared with straight run bitumen and improve the strength of pavement Modified Bitumen is one of the important construction materials for flexible pavements

Keyword:- *non-biodegradable material, road type, tests.*

Introduction-

Considerable research into the wet process and the production of CRM binders have been undertaken in North America over the last ten years. The wet process has the advantage that the binder properties are better controlled although it needs special equipment to blend bitumen and rubber. On other hand, the dry process is a far less popular method due to increased costs for specially graded aggregate to incorporate the reclaimed tyre crumb, construction difficulties and most importantly poor reproducibility and premature failures in terms of cracking and ravelling of the asphalt road surfacing (Amirkhanian, 2000, Fager, 2001, Hunt, 2002). However, the dry process has the potential to consume larger quantities of recycled crumb rubber compared to the wet process resulting in greater environmental benefits. In addition, the production of CRM asphalt mixture by means of the dry process is logistically easier than the wet process and, therefore, the dry process is potentially available to a much larger market. However, research into the dry process is limited.

Result and Discussion

The SDBC was prepared by Marshall method using the 60/70 grade bitumen and the various mix design characteristics of the Marshal stability value, Flow value, Bulk Density , Air Voids (Vv) , Voids in mineral aggregate (VMA) , Voids filled with bitumen(VFB) were found out.

Table 1 Results of SDBC Mix Design using 60/70 Grade Bitumen

S. No	Bitumen %	Marshal stability (Kg)	Flow value (mm)	Bulk Density (gm/cc)	Air voids % Vv	VMA	VFB %
1	4.5	845	2.86	2.234	4.93	14.97	67.23
2	4.75	865	3.1	2.236	4.44	15.05	70.12
3	5	945	3.26	2.245	3.64	14.85	74.58
4	5.25	880	3.71	2.235	3.24	14.98	77.1
5	5.5	850	3.98	2.23	3.04	15.29	77.96

Table 2 shows the results of SDBC Mix for Varying Percentages of Crumb Rubber. The Crumb Rubber was added to 60/70 grade bitumen in varying percentage of 8%, 10% and 12%. The SDBC mix was prepared with 5 % bitumen and the varying percentages of Crumb Rubber. The bitumen when mixed with Crumb Rubber is termed as Crumb Rubber Modified Bitumen (CRMB).

Table 2 Results of SDBC Mix for Varying Percentages of Crumb Rubber

S. No	Crumb Rubber %	Bitumen %	Marshal stability (Kg)	Flow value (mm)	Bulk Density (gm/cc)	Air voids % Vv	VMA	VFB %
1	5%	5	1065	3.1	2.23	3.87	14.99	74.12
2	10%	5	1190	3.62	2.24	3.86	15.03	74.35
3	15%	5	1180	3.76	2.26	3.98	15.24	73.25

Table 3 CRMB & bituminous concrete mix with varying percentage

S. N	Crumb Rubber %	Bitumen %	Softening point	Penetration	Elastic recovery	Marshal stability (Kg)
1	5	5	55	61	52	883.86
2	10	5	60	54	57	1049.59
4	15	5	65	45	63	1137.97

Modified Asphalt

Some additives called as asphalt modifiers can improve properties of asphalt and asphalt mixes. A modifier with treated asphalt is known as modified asphalt. These asphalt and the shredded rubber modified asphalt (SRMB) should be used only in wearing course depending upon the climatic variations.

The Table.4 and Table.5 shows the properties of bitumen and asphalt

Table 4: Properties of bitumen without shredded tyres

Penetration test @27oc	softening Point	Ductility (cms)@ 27oc	viscosity (sec)	Specific Gravity Reading (G)
60-70 grades	60oc	73	26	1.036

Table 5: Properties of Asphalt without shredded tyres

Penetration test @27oc	softening Point	Ductility (cms)@ 27oc	viscosity (sec)	Specific Gravity Reading (G)
60-70 grades	62 oc	63	21	1.036

Test result for bitumen

Table.6 shows the test result for bitumen with shredded tyres

Properties	Bitumen without rubber content	Bitumen with rubber content in %		
		5	10	15
Ductility test (cms) @ 27°C	61	7	55	41.6

Test Result for Asphalt

Table.7 shows the test result for asphalt with shredded tyres

Properties	asphalt without rubber content	Bitumen with rubber content in %		
		5	10	15
Ductility test (cms) @ 27°C	63	70	64.8	52

Conclusion

- The study on the use of CRMB reveals that the Marshal Stability value, which is the strength parameter of SDBC has shown increasing trend and the maximum values have increased by about 25 % by addition of CRMB. The density of the mix has also increased in both the cases of CRMB when compared with 60/70 grade bitumen.
- This will provide more stable and durable mix for the flexible pavements. The serviceability and resistance to moisture will also be better when compared to the conventional method of construction. The values of other parameters i.e. Vv, VMA and VFB in both the cases CRMB have found out to be within required specifications. This study not only constructively utilizes the waste plastic and tyres in road construction industry but it has also effectively enhanced the important parameters which will ultimately have better and long living roads.
- The modified asphalt and bitumen gives the better properties for road construction.
- Modified asphalt and modified bitumen reduces the thickness of the wearing coarse when compare to the normal thickness. In wearing coarse 20% thickness will be reduced. This results in cost control.
- Waste tyre modified bituminous surface increases the life period of the pavement by 35% and it requires low maintenance costs.

References

[1] Justo C.E.G., Veeraragavan A "Utilization of Waste Plastic Bags in Bituminous Mix for Improved Performance of Roads", Centre for Transportation Engineering, Bangalore University, Bangalore, India, 2002.

[2] Aslam Shahan-ur-Rahman "Use of Waste Plastic in Construction of Flexible Pavement", New Building Materials & Construction World, 2009.

[3] Vasudevan, R., Utilization of waste plastics for flexible pavement, Indian High Ways Indian Road Congress, Vol. 34, No.7, 2006.

[4] Yadav Kajal, Sangita and Chandra A, Identification, Characterization and Quantification of Elastomeric/Plastomeric Waste for Sustainable Waste Minimization American Journal of Environmental Sciences 1 (3) pp-202-205, 2005.

[5] T. Awwad Mohammad and Sheeb Lina The Use of Polyethylene in Hot Asphalt Mixtures, American Journal of Applied Sciences 4 (6) pp-390-396, 2007.

[6] Vasudevan R., Nigam S.K., Velkennedy R., Ramalinga Chandra Sekar A., Sundarakannan B. Utilization of Waste Polymers for Flexible Pavement and Easy Disposal of Waste Polymers, International Conference on Sustainable Solid Waste Management, 5 - 7, Chennai, India pp-105-111, 2007.

[7] Sabina,Khan Tabrez A, Sangita, Sharma D.K., Sharma B.M, Performance Evalution. of Waste Plastic/ Polymers Modified Bituminious Concrete Mixes,Journal of Scientific and Industrial Research Vol.68,2009.