

Use of Waste Tyres in Road Construction

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ABSTRACT-In the current scenario, the wastes tyres, that are collected from nearby localities and dump yards is the major problem. If we dispose this material openly, it pollutes the environment in a more hazardous manner as it is non-biodegradable waste. Currently, the disposal of waste tyre has become a global problems.. Every year over 1.6 billion new tyres^[8]are generated and around 1 billion of waste tyres are generated. However, the recycling industry processed only 100 million tyres every year. The tyre is extensively designed with several complex processes which makes it indestructible in nature and creates difficulty in the recycling of tyres. However, leading tyre recyclers are spending huge amounts in advance technologies and equipment which can help in recycling the tyres for various applications and protect the environment. Using a blend of old tyres and rubble left over from construction projects, a newly developed material has been found to be able to take the pressures of traffic. It's actually more flexible than standard road materials, and thus less likely to crack. So, the modified bitumen, granulated, crumb rubber can be used in a proportion of the fine aggregate. This paper is intended to study the mixture of hot bitumen and crumb rubber derived from post-consumer waste or scrap tyres which will help in reducing the sound pollution of heavy traffic roads tyre.

KEY WORDS: crumb rubber, flexible pavement , modified bitumen, eco-friendly process, rubber aggregate

I. INTRODUCTION

The rubber aggregate solves the problem of permanent deformation and thermal cracking. . It is a material that can be used to seal cracks and joints, be applied as a chip seal coat and added to hot mineral aggregate to make unique asphalt paving material and Problem like thermal cracking and permanent deformation in hot temperature region. Rubber has property of absorbing sound, which also help in. reducing sound pollution. Waste rubber tyres thus can be put to use and ultimately improve the quality

and performance of the roads. When used for road construction it can withstand higher temperature. Tyre. Post construction pavement performance studies are to be done for these waste materials for construction of low volume roads with two major benefits (i) it will help clear valuable land of huge dumps of wastes: (ii) it will also help to preserve the natural reserves of aggregates, thus protecting the environment. Rubber tyres are user friendly but not eco- friendly as they are non-biodegradable generally. The practice of disposing waste tyres in landfills and open burning is becoming unacceptable because of rapid depletion of available landfill sites and stricter environment stipulations. Basic properties of bitumen are modified by adding the **crumb rubber**. Marshal stability test are conducted by taking 1200gm aggregate (coarse & fine) for a mix design. Obtained optimum bitumen content is mixed with crumb rubber 1-4% with replacing aggregate 5-15% with the waste rubber aggregate.

II. LITERATURE REVIEW

The literature related to the project crumb rubber adding in bitumen for flexible pavement have been reviewed by the group and there are some patented projects which are similar to this study as listed below:

PitiSukontasukkul Somyot Wiwat pattanapong, This study provided the test results on the mechanical and physical properties of lightweight concrete obtained by replacing portions of the conventional fine aggregate with crumb rubber from recycling waste tyres. The mechanical properties were compressive and flexural strength. The physical properties were unit-weight, permeable voids, thermal conductivity and sound absorption. Results indicated that the unit-weight of crumb rubber concrete was lower than that of plain concrete.

Mashaan et al, (2011) the penetration is a measure of hardness or softness of bitumen binder which shows an effect by adding crumb rubber to bitumen binder; it decreases as rubber content is increased. The penetration shows lower values as

rubber content increases at different mix conditions of rubberized bitumen binder, indicating that the binder becomes stiff and more viscous. The softening point refers to the temperature at which the bitumen attains a particular degree of softening. The use of crumb rubber in bitumen modification leads to an increase in the softening point and viscosity as rubber crumb content increases.

Utilization of Waste Tyre Rubber and Waste Plastic for Construction of Roads Faculty: Prof. Dharamveer Singh, Civil Engineering

(TCTD, IITB): the study evaluates the potential of waste tyres and waste plastic materials for highway construction, which can provide a sustainable and eco-friendly technique. The present study envisages how to generate quality database and guidelines on the effective use of these materials. It is expected that the utilization of industrial waste for construction of pavements will be an environmental friendly step forward to help 'Swachh Bharat Mission,' or 'Clean India Mission'^[21]

III. METHODOLOGY



3.1 PROCESS OF MAKING RUBBERISED BITUMEN

This terminology is related to the system of producing RTR-MB with the original wet process proposed by Charles McDonald in the 1960s. The McDonald blend is a Bitumen Rubber blend produced in a blending tank by blending Crumb Rubber and bitumen. This modified binder is then passed to a holding tank, provided with augers to ensure circulation, to allow the reaction of the blend for a sufficient period (generally 45–60 min). The reacted binder is then used for mix production.

Continuous Blending-reaction Systems: Here the CRM and bitumen are continuously blended during the mix production or prepared by hand and then stored in storage tanks for later use. Therefore, it consists of a unique unit with agitators, in which the reaction occurs during the blending.

3.2 Rubberized Bitumen Mix Construction

Construction of this pavement involves first mixing and fully reacting the crumb rubber with the hot bitumen as required by specification. Typically 20 percent ground tyre rubber and is added to the hot base bitumen. The bitumen needs to have a temperature of about 177OC (about 350OF) before being put into the blending unit, that heats the bitumen to 191OC to 218OC (375OF to 425OF) just prior to adding the rubber particles. The rubber and bitumen are mixed for at least one hour. After reaction, the rubberized bitumen mixture is kept at a temperature of between 163OC and 191OC (325°F and 375OF) until it is introduced into the mixing plant. Samples of the rubber, base bitumen, and AR mixture are taken and tested accordingly. The ARFC, which typically has one percent lime added to the mix, is placed with a conventional laydown machine and immediately rolled with a steel wheel roller.

IV. MATERIALS

4.1 CRUMB RUBBER



Crumb rubber is recycled rubber produced from automotive and truck scrap tyres. During the recycling process, steel and tyre cord are removed, leaving tyre rubber with a granular consistency.

4.2 ASPHALT



Asphalt, also known as bitumen, is a sticky, black, highly viscous liquid or semi-solid form of petroleum. It may be found in natural deposits or may be a refined product, and is classed as a pitch. Before the 20th century, the term asphalt was also used.

V. INFRASTRUCTURE

5.1 BITUMEN MODIFYING PLANT



The plant is specially designed for polymer modification of bitumen with a capacity up to 40ton/h (theoretical capacity, with 5% SBS granular

polymer and bitumen temperature at 180°C) and is fitted into a containerized body for stronger structure and easy transportation.

5.2 CRACKER MIL



Crumb rubber is recycled rubber produced from automotive and truck scrap tyres. During the recycling process, steel and tyre cord (fluff) are

removed, leaving tyre rubber with a granular consistency. Crumb rubber is often used in artificial turf as cushioning.

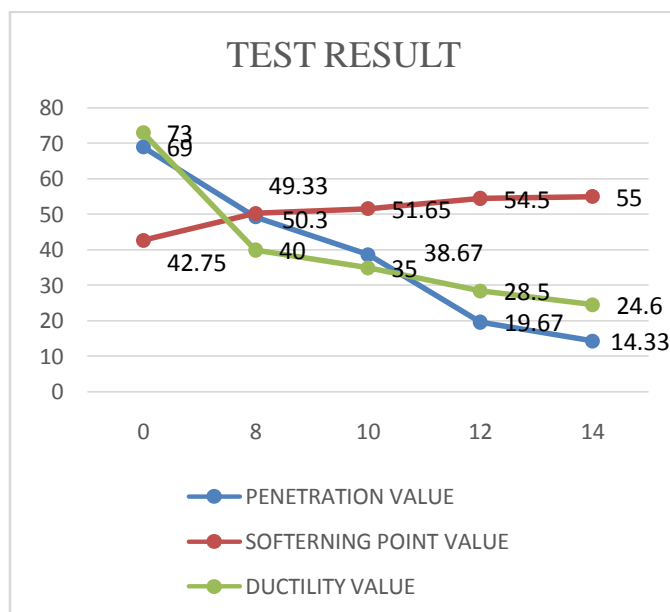
5.3 GRANULATOR



Granulators are a necessary piece of equipment for tyre recycling, reducing rubber shreds and chips into finely ground rubber pieces

VI. RESULTS

Based on the literature surveys and various simulation studies, the following have been observed:



Penetration value decreases with the increased amount of the rubber waste added. Lower penetration value making a harder grade of asphalt, giving additional strength to the road and reduces damage caused due to water.. **Softening Point** increased with the increased amount of the rubber waste added. This shows that the bitumen becomes less susceptible to temperature changes as the content of rubber waste increased. Increase in Softening Point provides protection against hot climatic conditions. **Ductility Value** shows that the rubber waste added will harden the bitumen. The bitumen becomes more viscous and harden, which would be useful to obtain stiffer bitumen asphalt.

VII. ADVANTAGES

- Rubberized bitumen has higher softening point, giving more stability to the pavement during summer days..
- Much improved Elastic Modulus increases load carrying capacity.
- Improved cohesion increases resistance to weathering and adhesion to reduce risks of binder being stripped by water.
- Better resistance properties (cracking, deformation and creep).
- The biggest advantage of using rubberized bitumen is that the cost decreases by over 70% in comparison to the normal bitumen and also increases life of the road.
- Rubber has property of absorbing sound, which also help in reducing the sound pollution of heavy traffic roads.

VIII. FUTURE SCOPE

Viscosity grade bitumen in four different types including VG10, VG20, VG30 and VG40 is the most widely used bitumen in India currently produced by Indian petroleum Refineries which has been replaced by bitumen penetration grade according to the Indian Standard (IS:73). The driving force behind using waste tyre is the environmental concern for safe disposal of discarded tyres of automobiles and long-lasting roads. As per MORTH (**Ministry of Road Transport & Highways**) directives for NHAI states that an approx. 30 km road is to be constructed every day and for this construction approx. of 750 MT of bitumen is to be used for wearing course every day but if waste tyre crumb is to be used with bitumen (Rubberized Bitumen) for wearing course, an approx. 250 no's of tyre waste can be consumed in roads every day or 100,000 no's of waste tyre annually.

IX. CONCLUSION

The addition of rubber aggregate in bituminous mix decreases the quantity of stone aggregate by a significant volume and increases the flexibility and flexural strength of the carpet layer of the highways. Aggregate is the granular material used in bitumen concrete mixtures, which makes up **90 to 95 percent** of mixture weight and provide most of the load bearing characteristics of the mix. Use of rubberized bitumen and rubber aggregate will not only reduce substantial burden on refineries for bitumen production but also reduce the burden of stone aggregate and thus saving in road construction costs.

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