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Analysis of Properties in Bitumen and Asphalt with Partial Replacement of Rubber Tyres

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Abstract:
Generally, pavements are broadly classified into many types according to the materials used. In this project waste rubber tyres (automobile) were utilized for the strengthening of pavement. These Waste Tyres has been a threat to environment for the past few years due to the usage of more vehicles. Disposal of the waste tyres has also become a great challenge. This project work contributes to the safe disposal of waste tyres by using them in road pavement. Modified Bitumen is one of the important construction materials for pavements. The rubber obtained from the waste tyres will be more advantageous when we use those wastes in the construction of flexible pavement are the new modifier raw-material has been sourced from disposed waste tyres. This rubber tyre is partial replaced of those wastes in asphalt and bitumen gives more strength and durability also reduces the thickness of wearing course.

1. Introduction

In recent years, disposal of different wastes materials has been a big trouble. Sometimes the materials are non biodegradable the disposal will become a big issue since some materials are very toxic to the circum. These constraints lead to the develop of an alternative material for highway pavement, by which the pollution and disposal problems may be partly reduced. The use of waste tyres in road not only reveals safe disposal method but it also reduces the material consumption for road construction in which higher economic returns is possible. When we use these waste tyres in asphalt and hot bitumen it enhances the pavement efficiency and also protects the environment.

2. Materials and Methods

For this research work, bitumen with shredded form of butyl rubber tyre and asphalt with shredded form of butyl tyre were taken. The Different properties of modified bitumen and modified asphalt have been checked. And then prepared different mix proportions of bitumen with shredded form of waste tyres as well as asphalt with shredded form of waste tyres on varying proportions are done. The different percentage weight of waste rubber tyre replaced for percentage weight of bitumen and asphalt is calculated from the test.

2.1. Tyre

A rubber overing that fits around a wheel's rim to form a soft contact with the road. The materials of modern pneumatic tyres are synthetic rubber, fabric and wires, natural rubber, along with carbon black and other chemical compounds.

2.2. Tyre Recycling

Tyre is the process of recycling rubber tyres that is no longer suitable for use on vehicles due to irreparable damage. tyres are the most well known problematic sources of waste.

2.3. Most Recyclable Component in Tyre

The most recyclable component in tyre is its inner tube. These tubes are reused for many purposes

2.4. Butyl Rubber

Synthetic rubber is a Butyl rubber, a co polymer of isobutylene with isoprene. It is used make inner tube in tyres which is manufactured in India. Butyl rubber is used in this project work

2.5. Shredded Tyres

Shredded rubber tyres, size contracted can be implementing in both pavements and in product of specific size. This type of paving is Rubber modified Bitumen, Rubber modified asphalt, and it is also used as a substitute for aggregate. Shredded rubbers are used in this project to improve the efficiency of the properties of bitumen and asphalt

Figure 1: Shredded tyres

2.6. Modified Bitumen

The Additives such as bitumen modifiers can improve properties of Bitumen and bituminous mixes. When the Bitumen is treated along with these modifiers it is said to be modified bitumen. The Polymer modified bitumen (PMB) and the shredded rubber modified bitumen (SRMB) should be used only in wearing course depending upon the requirements of extreme climatic variations. These detailed specifications for modified bitumen have been issued in IRC: SP: 53-1999. It must be taken into account that the performance of PMB and SRMB is dependent on strict control on temperature during construction. The advantages of using modified bitumen are as follows,

i. It is opt able for temperature variation of different seasons
ii. Large pavement temperature results in avoiding of bend
iii. Better age resistance properties.

2.7. 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.1 and Table.2 shows the properties of bitumen and asphalt

Penetration test @ 27◦c	**Softening Point**	**Ductility(cms) @ 27◦c**	**Viscosity(sec)**	**Specific Gravity Reading(G)**
60-70 grade	60◦c	73	26	1.036

Table 1: Properties of bitumen without shredded tyres

Penetration test @ 27◦c	**Softening Point**	**Ductility(cms) @ 27◦c**	**Viscosity(sec)**	**Specific Gravity Reading(G)**
60-70 grade	62◦c	63	21	1.036

Table 2: Properties of Asphalt without shredded tyres

2.8. Preparation

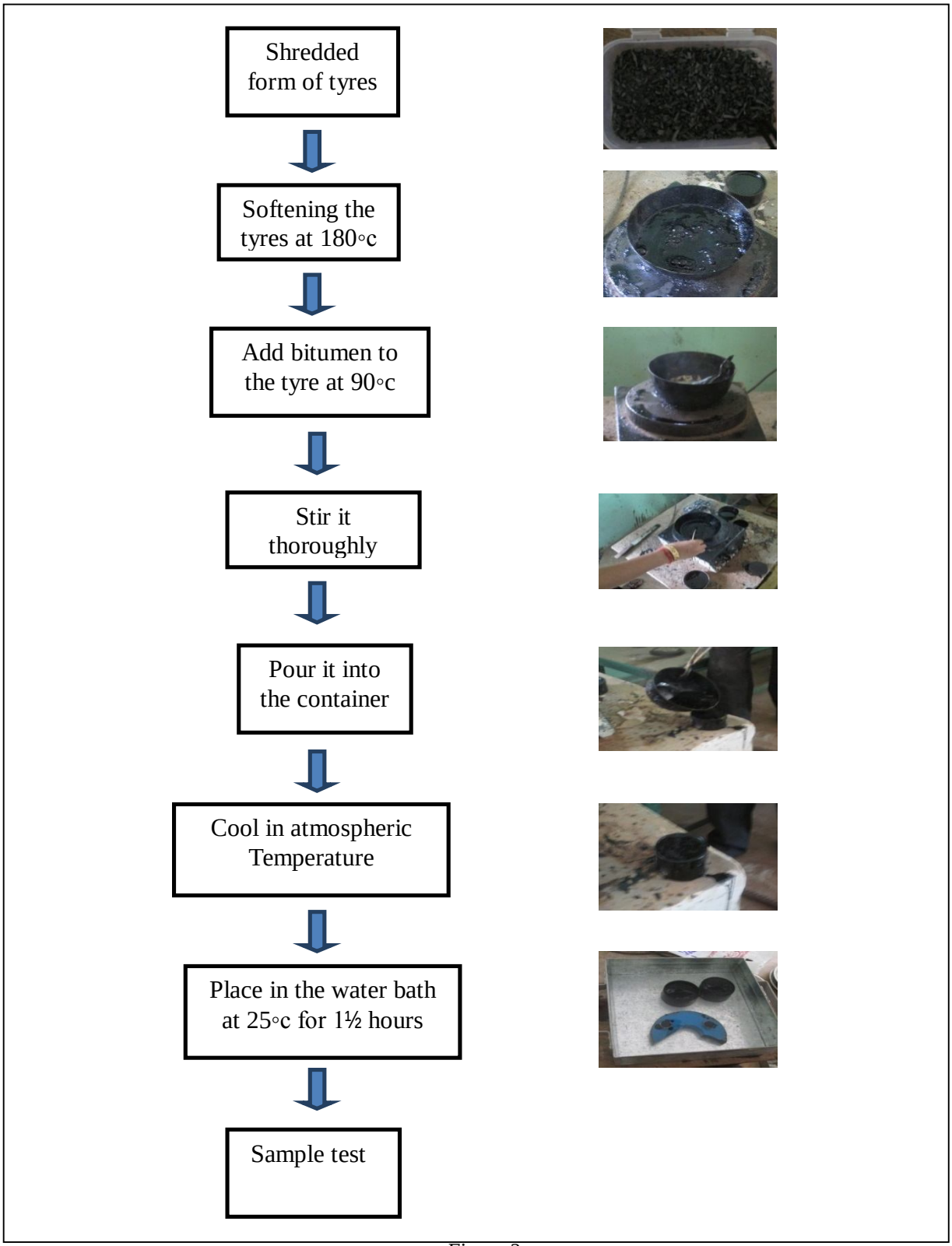

Figure 2

2.9. Procedure

Procedure for preparing the test sample is given below,

i. Collect the materials such as tyre, asphalt and bitumen, cut the tyres as in the form of shreds.

ii. Mix the shredded form of rubber tyres in asphalt with at various proportions such as 5%, 10%, 15%, 20%, 25% and 30% of rubber tyre out of the total percentage of asphalt as well as the same proportion in bitumen.
iii. Rubber and asphalt as well as rubber with bitumen are blended by using blender machine.
iv. Modified asphalt is blended with aggregates as well as for bitumen.
v. Now, the sample is ready to use as a wearing course.

2.10. Test result for bitumen

The table.3 shows the test result for bitumen with shredded tyres

Properties	**Bitumen without rubber content**	**Bitumen with rubber content in %**		
		5	**10**	**15**
Penetration value @ 25°C	65.6	56.3	59.3	63
Softening point (°C) @ ring ball test	57	62	72.5	77.5
Ductility test (cms) @ 27°C	61	73	55	41.6
Viscosity test @ 27°C	26	22.5	20	17

Table 3: bitumen with rubber tyre

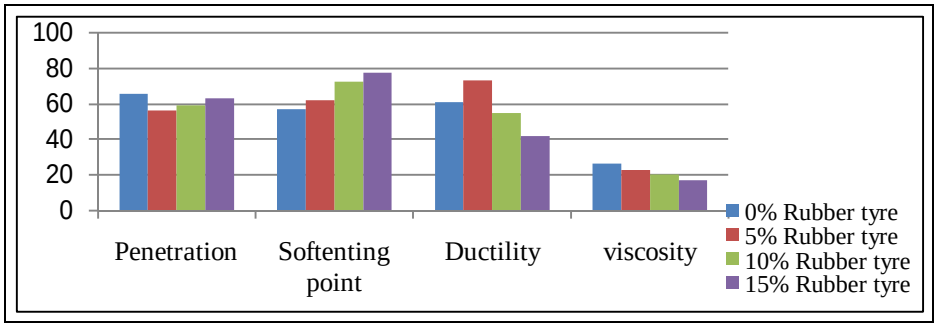

Figure 3: graphical representation of bitumen with rubber content

2.11. Test Result for Asphalt

The table.4 shows the test result for asphalt with shredded tyres

Properties	**asphalt without rubber content**	**Bitumen with rubber content in %**		
		5	**10**	**15**
Penetration value @ 25°C	67	55.6	58	69
Softening point (°C) @ ring ball test	62	67	71	78.5
Ductility test (cms) @ 27°C	63	70	64.8	52
Viscosity test @ 27°C	21	24	18	15.5

Table 4: asphalt with rubber tyre

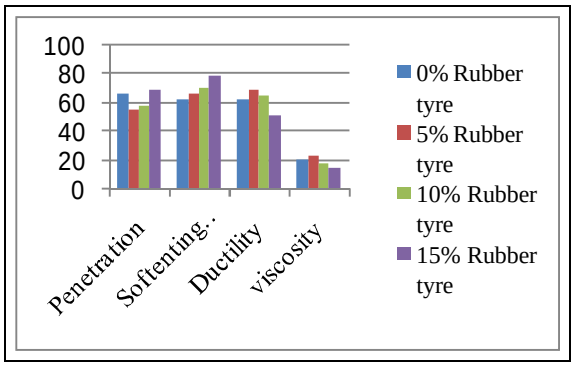

Figure 4: graphical representation of asphalt with rubber content

3. Results and Discussion

The tests that were done in bitumen and asphalt shows the variations between ordinary bitumen and modified bitumen as well as ordinary asphalt and modified asphalt. The tests are taken as per the following proportion

i. Without adding rubber tyres with bitumen & asphalt.
ii. 5 percentages of rubber tyres with bitumen & asphalt.
iii. Rubber tyres 10 % with bitumen and asphalt.
iv. Bitumen & asphalt with 15% of rubber tyres.

Table 3 shows the bitumen with different percentage of rubber tyres (modified bitumen) outcome.

4. Conclusion

i. After careful evaluation of the properties and taking various tests as per standards the results shown by 5% addition of rubber shreds has best suitability for blending it with bitumen. Rubberized bitumen gives more strength than ordinary bitumen as well as rubberized asphalt gives more strength than ordinary.
ii. 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.
iii. Waste tyre modified bituminous surface increases the life period of the pavement by 35% and it requires low maintenance costs.
iv. These study is not only utilizes the waste tyres in road construction but it has also effectively enhanced the important factors which help to have better and long living roads ultimately.
v. The modified asphalt and bitumen gives the better properties for road construction.
vi. This helps to have better binding property with aggregate. These type of project is not only enhances the strength of road, but it also found the solution to dispose the waste tyres in safe and useful manner for the welfare of environment.

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