

UTILIZATION OF CRUMB RUBBER IN FLEXIBLE ROAD PAVEMENT

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ABSTRACT: Today the clearance of different wastes produced from different Industries is a great problem. This waste mainly consists of considerable amount of non-biodegradable materials which cause pollution in the environment. The non-biodegradable material cause environmental pollution if they are not be treated properly. The major product after the plastic waste is crumb rubber. Cement, coarse aggregate, fine aggregates and bitumen are used for the construction of flexible pavement. Coarse and fine aggregates are naturally occurring materials but as the construction increases their demand increases and due to this their cost also increases.

Due to this problem, many researchers find the different reusable materials which are used as the aggregate for the construction of flexible pavement and hence this replacement must be beneficial for the pavement. Keeping that thing in mind engineers test these recycled materials and use the crumb rubber in large amount at specific conditions so that maximum output comes and the use of naturally occurring aggregate can be reduced.

The crumb rubber obtained from the waste tyre added to the aggregates and bitumen for good results. This article presents the use of waste rubber as a recycled material in place of the naturally occurring aggregate in flexible pavement so that their disposal in this way is beneficial to the environment as well as to the flexible pavement.

The study shows the comparison of different properties of aggregates, aggregates with crumb rubber in strength as well as the quality which proves the addition of crumb rubber in place of naturally occurring aggregate is beneficial for the flexible pavement.

Keywords: Crumb rubber plastic wastes, bitumen, aggregates, plastic bitumen aggregate.

Introduction: Waste tyre rubber is a vital source of minor raw materials. All developed countries have good transport system but still have problem with these waste tyres. Because of this in previous years many researches are done for finding the solution of these waste tyres so that they can be used for good purpose. Waste tyres are completely used tyres of the vehicles and they come mainly from urban area. The essential part of the transportation system is roadways. The roads constructed by civil engineers must be safe as well as eco-friendly for the people for achieving these goals, engineers should take the basic requirements such as materials, environment and traffic. The main motive of the engineers is to use different recycled materials in the bitumen in flexible roadway.

The waste tyres can be used in the form of recycled aggregate which on mixing with the aggregates and bitumen are used as a aggregates of flexible pavement. This usage of crumb rubber as recycled aggregate in flexible pavement reduces the environmental pollution due to which the major problem of global warming decreases and also no health problem for population is ensured. The rubber obtained from the grinding of used tyres in a proper manner is known as crumb rubber. This waste tyre mainly comes from the urban areas. This causes various environmental problems including air pollution (due to burning of tyres) and aesthetic pollution which causes severe health related issues. These are a biotic, disposable product due to which environmental pollution occurs.

In recent years, developing countries used large amount of waste rubber in road building. The waste materials used in road construction should be economical and ecofriendly so that they can be used in larger amount. While constructing the road the main things kept in mind that they require less maintenance and these are constructed under sustainable development so that these are eco-friendly to the society as well as to the environment. And hence, it is more important to fulfill the criteria of sustainable progress of the roads by utilizing the different reused resources in the bitumen. In India the waste rubber comes from the industries, as it is growing day by day in a very large scale. By using these waste resources in the pavement structure the pollution as well as disposal of these wastes becomes easier. Minding the bulk reuse of these wastes in India, it was assumed necessary to inspect these resources and to progress conditions to increase the use of rubber wastes in road construction, so that this waste can be used properly and also the cost of construction also goes down. These materials should be used in road construction in each part of our country. On the other side, the usage of crumb rubber in flexible pavement as a recycled aggregate minimizes the use of natural aggregate. The first major approach is the use of the waste tyres as crumb rubber and minimizes the wastage of rubber, the second approach is that from these scrap tyres the raw materials can be obtained for making new rubber tyres. Shredding of the scrap tyres in a

particular machine gives crumb rubber which is free of fibre and steel. It is estimated that worldwide over 1 billion tires complete their service life annually and become waste tyres.

Objective: The main objective is to increase the strength of the pavement using crumb rubber such that it can be used more in the road construction. The other factor is that the usage of the waste tyres in an ecofriendly manner, so that they cannot harm our environment. Keeping in perspective on the above point the accompanying explicit destinations have been set

For study.

1. To investigate the essential properties of coarse and fine aggregates.
2. To study basic properties of bitumen.
3. To study the characteristics of crumb rubber.
4. To compare the results obtained and to increase the usage of crumb rubber in aggregates.

Literature Review:

1. Utkarsh Sharma and Sitesh Kumar Singh (May 2008) "Use of Crumb Rubber in Flexible Pavement and Comparison in Strength & Quality" using crumb rubber finds that the water absorption percentage of rubber is 1.22 and of aggregates is 0.92. So in the end of this they got outcomes which are satisfying all the objectives, like: It improves the elasticity of the pavement. The waste rubber used is 5% to 20% of the weight of aggregates. Many problems are solved by using this in construction.

2. Asim Hassan Ali and Mohamed Rehan Karim (2001) "Using Crumb Rubber in Reinforcement of Asphalt Pavement" review utilization of piece elastic in the reinforcing of black-top is considered as a decent answer for practical advancement by reusing waste materials, and it is accepted that morsel elastic modifier (CRM) could be an elective polymer material in showing signs of improvement for hot blend black-top execution properties.

3. Mr. Niraj Kumar Gupta, Prof. Dhananjay Uyadhav (2016) the main source of the environmental pollution is the waste generated from the industries. In India the previous years are very crucial because there are many improvements in the social, economic and industrial aspects. Apart from these, there are many things such that increase in the population which leads to the environmental pollution and this happens because of not taking precaution from the problems occurred due to increase in population. From these waste tires many problems occur in the environment. And the uses the crumb rubber in pcc.

4. Naveen Sheoran & Ravi Kumar (2017) they researched on waste tyres used in the form of coarse aggregate in road construction. Different tests are carried out on aggregates with crumb rubber. And also they present the different characteristics of the researched material in their research.

5. Prof. S. B. Patil and Prof. S. S. Shinde (2016) "Use of waste tyres in road construction" concluded that crumb rubber considerably reduces noise as opposed to concrete pavements, and also is quieter than bituminous pavements. There are many advantages such as the reduction in the expense and maintenance, major reduction in noise, improved grip and accident reductions on wet roads.

Research Methodology:

Materials used and the tests conducted (Crumb rubber):-

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. Marshall 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 (VG-30). 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.

- 1) The first step is to collect the scrap tyres from different sources of the waste tyres.
- 2) Then the waste tyres which are collected from different sides are resized in the form of Aggregates. After that waste tyres are grinded in the grinding machine and the size taken of the rubber is from 20mm to 4.75mm (as per IRC-SP20). 3) The waste tyre rubber when mixed with the bitumen as in the form of small rubber particles passes through the magnetic separation and are observed very carefully then obtained in the different sizes and these particles with the aggregates are known as rubber aggregate.
- 4) After this step the rubber aggregates also known as rubber pieces are sieved through 20mm sieve and retained at 4.75mm sieve and then this aggregate rubber material is added into the bituminous mixture as per the requirements of mix design. These crumb rubber recycled aggregates were mixed with coarse, fine aggregates and bitumen.
- 5) The waste tyres should be used in such a manner that when these are mixed with the aggregates and the bitumen in the mixing plant should not be melted so that their use as an aggregate must be successful in the bituminous mix.
- 6) For the further use of these waste tyres they need a proper process. The rubber when mixed with the bitumen reacts with it and then it affects the properties of the bituminous mix, which results in the different pavement construction as compared to the normal.
- 7) The rubber mixed in the bitumen is a very different material. The waste tyre also includes the steel as well as many fibres with the rubber. There are some specific tests for aggregate, bitumen, rubber waste, etc. By the test, strength, durability and lots of factors will be acceptable. Before the testing of material, there should be proper selection of appropriate material for the research so that proper experiment should be carried out.
 - i. Sieve analysis of coarse and fine aggregates.
 - ii. Aggregate impact value test.
 - iii. Impact value test of (aggregate + rubber).
 - iv. Abrasion test of aggregate in Los Angeles Machine.
 - v. Abrasion test of (aggregate + rubber) in Los Angeles Machine.
 - vi. Crushing value test of aggregate.
 - vii. Crushing value test of (aggregate + rubber).
 - viii. Specific gravity and water absorption test of aggregate and rubber.
 - ix. Tests on bitumen (penetration and ductility test).

SIEVE ANALYSIS OF COURSE AGGREGATE:-

The sieve investigation of the coarse totals is for the most part used to discover the dissemination of the particles running from 20mm to 4.75mm. The sifter investigation of coarse totals is shown below as standard code IS: 2386 (Part I) - 1963. The coarse aggregate used in this work was locally available.

| Sieve size | Mass retained in gm | % retained | Cumulative% retained | Cumulative % passing |
|------------|---------------------|------------|----------------------|----------------------|
| 20mm | 0 | 0 | 0 | 100 |
| 16mm | 52 | 5.2 | 5.2 | 94.8 |
| 12.5mm | 536 | 53.6 | 58.8 | 41.2 |
| 10mm | 320 | 32.0 | 90.8 | 9.2 |
| 4.75mm | 92 | 9.2 | 100 | 0 |
| Total | 1000gm | | | |

Table no.1 – Sieve Analysis of Coarse Aggregates

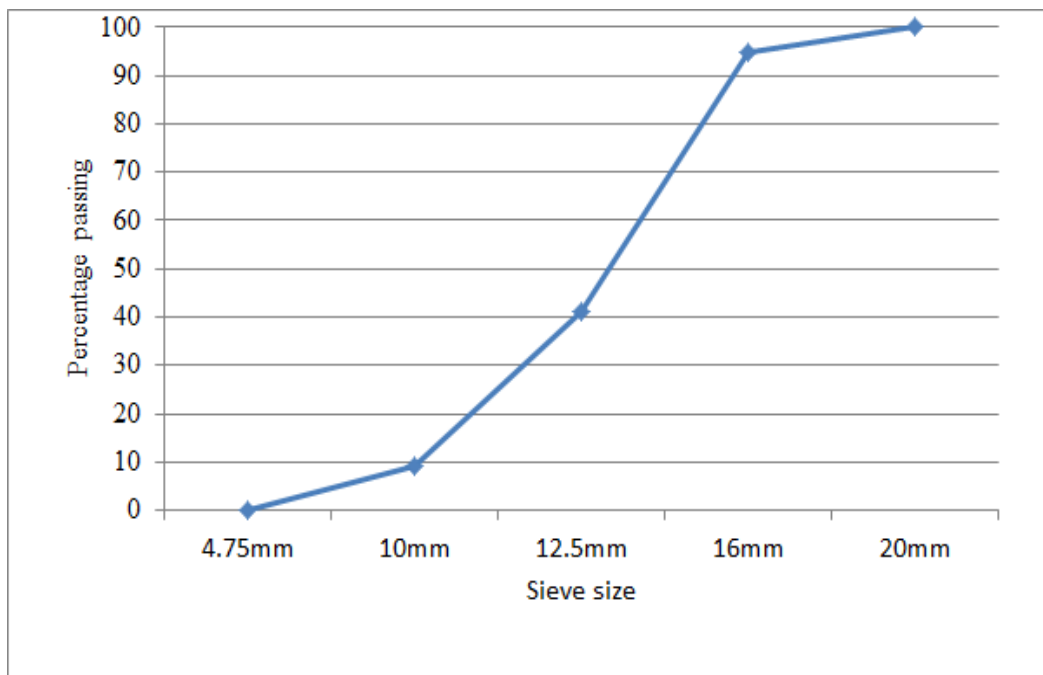


Table no.2 - Graph of sieve analysis of coarse aggregates

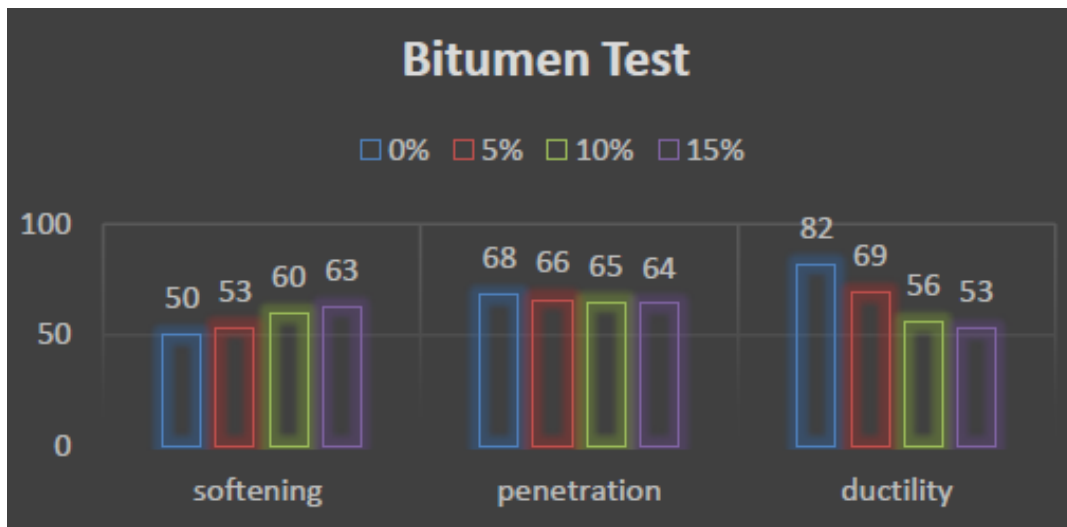


Fig. 1 Graph represent results of various test on bitumen

Conclusions:

In the present study, the importance was to add the shredded waste crumb rubber to aggregate and to estimate the various mix properties like Impact value, abrasion value, crushing value, etc. And also, to check the property of Crumb rubber aggregate. So in the end of this we get outcomes which are satisfying all the objectives, like: It modifies the flexibility of surface layer. Waste rubber tyres to be used are between the ranges of 5% to 20%. Problem like thermal cracking (Fatigue) and permanent distortion (Rutting) are reduce in hot temperature region. Rubber has property of sound absorption, which also helps in reducing the sound pollution of heavy traffic roads. The use of rubber can improve the quality and performance of road. We can be save a certain quantity of natural stone aggregate.

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