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EFFECT IN MARSHAL STABILITY DUE TO WASTE TYRE RUBBER IN BITUMEN CONCRETE

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Abstract

Bitumen concrete, commonly known as asphalt, is widely used in the construction industry for various applications such as road pavements, parking lots, and airport runways. The increasing demand for bitumen concrete and growing concerns about environmental sustainability have stimulated research efforts to incorporate waste materials into bituminous mixes. This paper aims to provide a comprehensive experimentation of tyre rubber waste in bitumen concrete ranging from 5 to 10 %. The test conducted is for Stability. The result shows that the case having waste tyre rubber having 10 % are showing better performance as compared to other cases. It has been concluded that the higher percentage of tyre rubber incorporated in bitumen will have better stability.

Keywords: Bitumen, Stability, Tyre Rubber

1. Introduction

The application of waste materials in construction, particularly in bitumen concrete, has gained significant attention in recent years due to its potential environmental and economic benefits. One such waste material is tyre rubber, which has emerged as a promising additive in bitumen concrete mixes (Chava Venkatesh, 2020). With the growing concern over the disposal of used tires and their adverse environmental impacts, recycling and reusing tyre rubber waste in construction applications offer a sustainable solution ((Katara,2014); M. Abukhettala (2016) ; Kar D (2014) ; Poorna (2015)) . Tyre rubber possesses unique properties that can enhance the performance and durability of bitumen concrete. The incorporation of tyre rubber into bituminous mixes can improve the resistance to cracking, increase flexibility, enhance skid resistance, and reduce noise levels. These properties make it an attractive option for various applications, including road pavements, parking lots, and recreational surfaces. The composition of tyre rubber waste consists of both natural and synthetic rubber, reinforcing fibers, and fillers. To utilize tyre rubber in bitumen concrete, it undergoes a processing stage where it is ground or shredded into fine particles of various sizes, known as crumb rubber. The crumb rubber can then be blended with bitumen or used as an aggregate replacement in the mixture. The use of tyre rubber waste in bitumen concrete brings several advantages. Firstly, it promotes waste management by diverting used tires from landfills and reducing the environmental burden associated with their disposal. Secondly, it helps conserve natural resources by substituting virgin materials with recycled rubber. Additionally, the incorporation of tyre rubber can improve the performance and lifespan of pavements, reducing maintenance costs and increasing overall sustainability. However, there are challenges and

considerations associated with the application of tyre rubber waste in bitumen concrete. These include concerns about compatibility between rubber and bitumen, long-term performance and durability, optimal crumb rubber content, and appropriate blending techniques. Research efforts have been directed towards addressing these challenges and optimizing the use of tyre rubber in bituminous mixes.

1.1 Objectives –

This paper aims to provide a comprehensive experimentation of tyre rubber waste in bitumen concrete ranging from 5 to 10 %. It will explore the effects of tyre rubber content, particle size, and blending methods on the engineering properties of bituminous mixes. Furthermore, it will discuss the environmental implications, economic feasibility, and potential challenges associated with the incorporation of tyre rubber waste. The knowledge gained from this experimentation will contribute to the development of sustainable and eco-friendly practices in the construction industry, promoting the circular economy and reducing environmental impacts.

2. Materials

The waste rubber used in this research work are collected from Raipur district, Chhattisgarh. The rest material such as coarse aggregate, fine aggregate, cement, bitumen is obtained from the local market for the continuation of the work. Each materials have such physical properties which is to be studied to produce bitumen concrete.

3. Case Trials for the Considered Study

In this study, the specimens were utilized for testing to identify the properties. The design is been carried by Marshall Mix-design in which four basic requirement is evaluated for Stability, Density, Voids in Mineral Aggregate, Voids Filled with Asphalt to obtain optimized Asphalt content from the mix-design.

Table 1 Case Trails for the Study (All Values are in percentage)

Test Specimen Case Id	Coarse Aggregate	Fine Aggregate	Filler (Cement)	Waste Tyre rubber	Bitumen Asphalt
Case 1	34	50	6	5	5
Case 2	31	50	6	7	5
Case 3	30	49	6	10	5

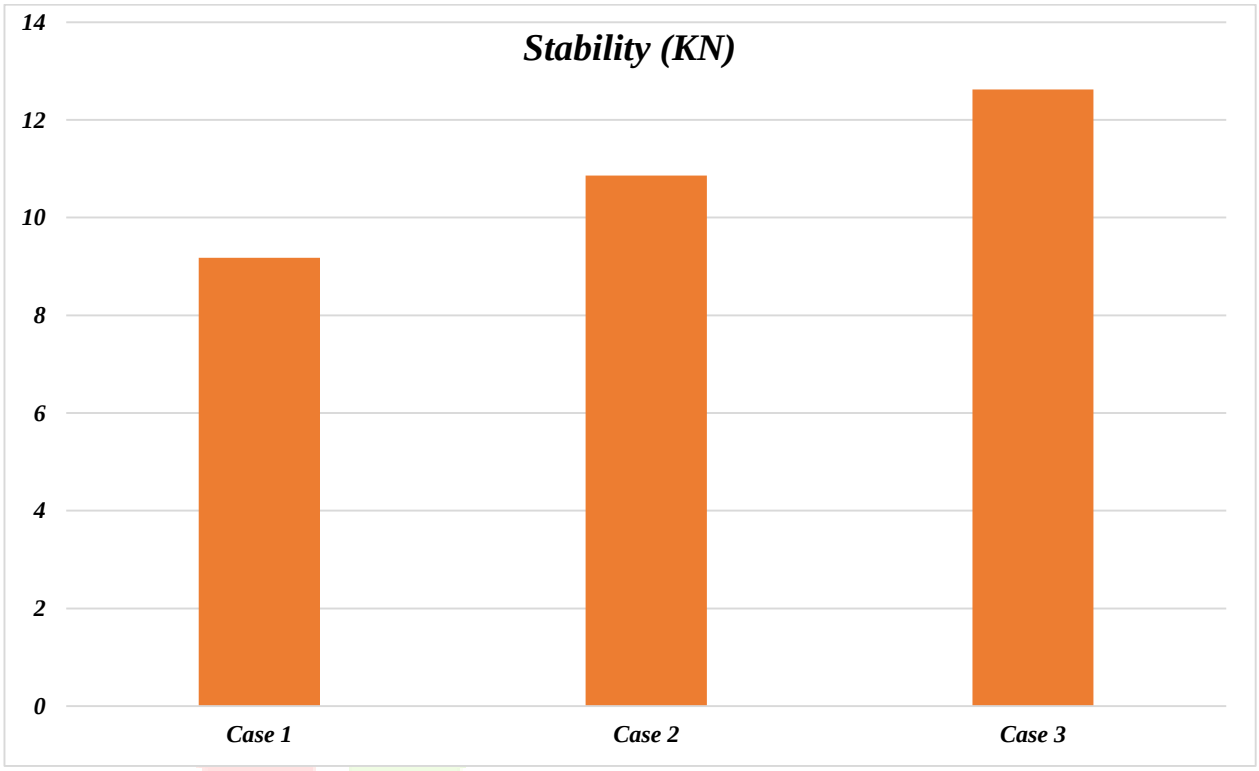
4 Stability Test

The result values according to the test are given in table and graph below in which the stability is calculated as per equation-

$$G_{mm} = \frac{W_f + W_b + W_{ca} + W_{fa} + W_{fs}}{\frac{W_f}{G_f} + \frac{W_b}{G_b} + \frac{W_{ca}}{G_{ca}} + \frac{W_{fa}}{G_{fa}} + \frac{W_{fs}}{G_{fs}}} \quad \text{.....(1)}$$

Table 2 Marshall Stability values of Foundry Sand–Asphalt Bitumen Mixtures

Test Specimen Case Id	Bitumen Content (%)	Waste Tyre rubber (%)	Load (KN)
Case 1	5	5	**9.18**
Case 2	5	7	**10.86**
Case 3	5	10	**12.62**



Graph 1 Stability Report

5 Conclusions

The stability value indicates that the maximum Marshall stability obtained for the mixture having 12.62 KN for the mixture with 10 % waste content. The stability increases with increase in bitumen content. This concludes that the waste tyre play major role in bitumen concrete making it a sustainable material.

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