IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified ⁐ Impact Factor 8.066 ⁐ Peer-reviewed / Refereed journal ⁐ Vol. 10, Issue 5, May 2023

DOI: 10.17148/IARJSET.2023.10541

Implementing Waste Tyre Shreds in Paver Blocks

Chandan K[1], Thummala Pavan Sathya[2]

Post Graduation Student, Department of Civil Engineering, Dayananda Sagar College of Engineering, Bangalore, India[1]

Post Graduation Student, Department of Civil Engineering, Dayananda Sagar College of Engineering, Bangalore, India[2]

Abstract: Concrete is widely used in construction, but its demand is causing depletion of aggregate deposits. Researchers are exploring ways to replace aggregates with waste materials to make construction sustainable and cost-effective. Waste materials from industries and agriculture, which pose disposal challenges, can contribute to resource conservation and environmental protection while reducing construction costs. In this review focused on using waste tyre shreds in Paver blocks, trials are conducted to determine the mix design parameters. Factors such as compaction capacity, cement grade required, water content, aggregate quality and gradation, additives, handling equipment, curing method, supervision level, workmanship, quality control and compressive strength are considered. Paver blocks made with waste tyre shred may be suitable for temple yards, house yards, walking and cycling tracks, and light traffic roads in rural areas. They are lightweight, increasing waste tyre usage and facilitating easy handling. Combining them with fly ash or exploring other waste materials like coconut shell, bamboo fibre, and plastic can provide additional options for sustainable construction practices.

Keywords: Concrete, Aggregate, Paver block, Sustainability

I. INTRODUCTION

Concrete is a very commonly used material in construction worldwide. However, the increasing demand for concrete is causing problems like running out of the materials needed to make it, harming the environment, and disrupting the balance of ecosystems. To address these issues, experts are exploring alternatives to traditional concrete ingredients to make construction more sustainable and affordable. Research on environmental and sustainable practices has gained a lot of attention globally. One approach is to utilize waste materials generated by industries and agriculture. Although these wastes pose disposal and management challenges, they can be used in construction, conserving resources, protecting the environment, and reducing costs. For example, waste tyres from the automobile industry, which are typically discarded, can be used as a replacement for fine aggregate in concrete. This study aims to promote the use of discarded tyres in concrete and evaluate the resulting material's strength and density in paver blocks. To achieve this, the weights of the materials are measured and mixed accordingly. Workability tests are conducted to determine the appropriate water-cement ratio. The results are compared to those of a standard concrete mix researchers are exploring ways to make construction more sustainable by using waste materials, including discarded tyres from the automobile industry, as a substitute for traditional concrete ingredients. This approach aims to conserve resources, protect the environment, and reduce costs while maintaining the necessary strength and density of the concrete.

II. LITERATURE REVIEW

The literature review paper related to study about waste tyre shreds and steel fibre that is infused in the tyre has studied. The main objective was to recognize the finest percentage replacement of waste tyre shreds as aggregate, sustainable development and maintaining the ecological balance.

Christos G et al [1] Concrete mixtures can include small amounts of waste tire steel beads. Using up to 4% of these beads makes the mix workable, but too much reduces workability. Adding steel beads lowers the density of the concrete but also weakens its compressive strength. However, using 2% steel beads only slightly reduces strength while increasing flexibility. The control mix without steel beads has higher splitting tension strength than mixes with beads. The more steel beads added, the weaker the concrete becomes. Concrete with steel beads has greater toughness due to the

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified ⁑ Impact Factor 8.066 ⁑ Peer-reviewed / Refereed journal ⁑ Vol. 10, Issue 5, May 2023

DOI: 10.17148/IARJSET.2023.10541

reinforcement provided by the steel wires. Further research is needed to fully understand the performance of concrete mixtures with steel beads.

N. Ganesan et al [2] Adding scrap rubber to Self-compacting concrete makes it stronger by 15% and more rubber makes it even stronger. Adding crimped steel fibres to Self-Compacting Rubberized Concrete makes it stronger by 25-50%, and adding more fibres makes it even stronger (up to 13%). The fatigue life of these materials can be predicted using a statistical model called the double parameter Weibull distribution, with high accuracy. At lower stress levels, the fatigue life of Self compacting concrete, Self-Compacting Rubberized Concrete, and Steel fibre reinforced Self-Compacting Rubberized Concrete is more consistent. Increasing rubber content or steel fibre volume fraction makes the fatigue life more variable at higher stress levels.

Blessen Skariah Thomas et al [3] Experiments to investigate whether discarded tire rubber (crumb rubber) could be used as a substitute for natural river sand in concrete. They used M30 grade concrete with a water/cement ratio of 0.4, and tested ratios of 0.45 and 0.5. They replaced 0-20% of the fine aggregates with crumb rubber in increments of 2.5%. The control mix had no rubber. They tested the compressive strength, flexural strength, abrasion resistance, micro-structure, water permeability, of the concrete samples. The study found that crumb rubber can be used to replace up to 7.5% of the natural aggregates without significantly reducing its strength. Rubberized concrete can be recommended for pavements, structural works up to 7.5% substitution, and non-structural works.

Trilok Gupta et al [4] We are informed that the use of rubber ash and modified concrete in construction. Rubber tire particles, in the form of rubber ash or combined with rubber fibres, were added to partially replace fine aggregate. The study found that the workability of rubber ash concrete decreased as the rubber ash content increased, but the workability of modified concrete was not affected by adding rubber fibres. The compressive strength of rubber ash decreased with increasing rubber ash content, while the flexural strength decreased with increasing rubber ash content in rubber ash concrete. However, in modified concrete, the flexural strength increased with the addition of rubber fibres. The density of both types of concrete decreased with increasing replacement level, and water absorption increased as well. The depth of wear on the concrete surfaces was within acceptable limits. Carbonation depth increased with higher replacement levels, but remained within the required limits. The reduction in modulus of elasticity indicated higher flexibility, which is a positive feature in rubberized concrete. The concrete showed resistance to chloride-ion penetration. Micro-structural analysis revealed weak bonding between rubber ash/fibre and cement paste, leading to reduced strength. Surface treatment of rubber aggregates can improve this bonding.

Adam J. Kardos et al [5] Experiments are conducted a study on a type of concrete used by the Colorado Department of Transportation. They wanted to see how well the concrete performed when recycled waste tire particles were added to it. They created eight different mixtures of concrete and tested them to see how they behaved when fresh and after hardening. They replaced varying amounts of sand with the waste tire particles and replaced half of the original coarse aggregate with recycled concrete aggregate. The study found that replacing up to 30% of the fine aggregate with crumb rubber was acceptable and did not affect the concrete's performance.

Yue Li et al [6] When 5% rubber particles are added to concrete, its strength and stiffness decrease. However, when 0.9% steel fibres are added, the strength and stiffness slightly increase. Steel fibres also improve the flexibility of concrete. The impact of rubber particles on concrete's toughness is unclear, but steel fibres greatly enhance its toughness. Steel fibres change the way concrete breaks, making it more flexible with multiple cracks and a slow decrease in load deflection. Both rubber particles and steel fibres improve concrete's ability to withstand compression, but they work differently. Rubber particles absorb energy and enhance deformation capacity before cracking, while steel fibres act as bridges to prevent crack spreading. Combining rubber particles and steel fibres makes the concrete more resilient, improving its ductility and energy absorption during seismic events.

Kunal Bisht et al [7] An overview of the use of crumb rubber as a replacement for fine aggregate in concrete. The researchers experimented with different percentages of crumb rubber mixed with PPC (Portland Pozzolana Cement) and observed that at a 4% replacement level, the concrete achieved a strength of 33 N/mm2. Previous studies using OPC (Ordinary Portland Cement) showed similar strength at a 2.5% replacement level. Based on these findings, a 4% replacement level can be chosen. However, using crumb rubber reduces the workability and compressive strength of the concrete due to poor adhesion between rubber and cement paste. Flexural strength decreases as well, and the density of crumb rubber concrete decreases while water absorption and permeability increase. The abrasion resistance also decreases with higher proportions of crumb rubber.

Farhad Aslani et al [8] Experiment focuses on finding new ways to create sustainable infrastructure that can support our growing population without harming the environment. The researchers experimented with using recycled materials, such

DOI: 10.17148/IARJSET.2023.10541

as concrete, crumb rubber, and scoria aggregates, in different types of self-compacting concrete. They found that by increasing the percentage of recycled aggregates, they could reduce the amount of cement needed and make the concrete lighter. However, this also led to a decrease in density and flowability. To improve flowability, they needed to use more admixtures. They also discovered that using recycled fine aggregates improved the mechanical strength of rubberized and lightweight self-compacting concrete. Overall, this research aims to promote environmentally friendly practices in the construction industry.

Agampodi S.M. Mendis et al [9] Reinforced beams made of Crumb rubber concrete respond to shear forces. They examined factors like the strength of steel reinforcements (stirrups), the beams' ability to withstand shear, failure patterns, and deformation under load. They compared the shear capacities of Crumb rubber concrete beams to guidelines for regular concrete and assessed if existing models for regular concrete could be used for Crumb rubber concrete. The experiments showed that beams without stirrups failed due to shear, and the amount of rubber influenced shear capacity. However, more research is needed to understand the relationship between rubber content and shear capacity. The behaviour of Crumb rubber concrete beams was like regular concrete, but design guidelines overestimated shear capacity, indicating the need for modifications.

Priya M. Mistry et al [10] Using waste crumbled tire particles in construction has shown that as the percentage of these particles increases, the strength of the concrete mix decreases rapidly. However, it is still feasible to replace 10% of the mix with waste tire particles. Adding crumbled tire particles to the concrete mix can enhance its durability since they function as fibres. Considering that tires are highly flammable, it is crucial to include a small quantity of fire-resistant material in the mix to prevent fires from occurring.

Siong Kang Lim et al [11] Using recycled waste tires, specifically crumb rubber, in the production of rubberized concrete pavement blocks. The study experimented with different percentages of crumb rubber in the blocks and found that replacing sand with rubber was the best option. It is suggested that a maximum of 20% rubber should be used for pavement areas with heavy traffic, while 10% rubber is more suitable for areas with moderate traffic. Rubberized concrete blocks offer advantages such as better riding quality and sound absorption. The study also conducted laboratory tests that showed promising results for the structural performance of these blocks. Overall, rubberized concrete pavement blocks can be used in various paving applications.

III. CONCLUSION

Extensive research and experimentation have been conducted to explore the potential of utilizing waste tyre shreds in the production of paver blocks. With the depletion of natural aggregates and the need for sustainable solutions, incorporating waste tyres from the automobile industry as a replacement for 5% to 10% of the aggregate by weight of cement. The implementation of waste tyre shreds in paver blocks has several benefits. Firstly, it demonstrates comparable strength to conventional concrete, ensuring the quality and durability of the blocks. Additionally, this approach reduces the production cost of paver blocks, providing a cost-effective alternative. Moreover, it addresses the issue of waste management in the automobile industry, contributing to a more sustainable waste disposal system. Furthermore, the implementation of waste tyre shreds in paver blocks helps maintain ecological balance. By substituting aggregates with waste tyres, the environmental impact is significantly reduced. Although the percentage of replacement is small, its impact on the environment is substantial. Thus, waste tyre shreds paver blocks may be suitable for laying in house yards, temple yards, cycle tracks, walking tracks, and low-traffic roads. Waste tyre shreds paver blocks may be an economical and sustainable solution for various applications, providing benefits to both the construction and automotive sectors while minimizing environmental impact.

REFERENCES

[1]. Christos G. Papakonstantinou, Matthew J. Tobolski, Use of waste tire steel beads in Portland cement concrete,Cement and Concrete Research, Volume 36, Issue 9, 2006, //doi.org/10.1016/j.cemconres.2006.05.015.

[2]. N. Ganesan, J. Bharati Raj, A.P. Shashikala, Flexural fatigue behavior of self compacting rubberized concrete, Construction and Building Materials, Volume 44, 2013, //doi.org/10.1016/j.conbuildmat.2013.02.077.

[3]. Blessen Skariah Thomas, Ramesh Chandra Gupta, Pawan Kalla, Laszlo Cseteneyi, Strength, abrasion, and permeation characteristics of cement concrete containing discarded rubber fine aggregates, Construction and Building Materials, Volume 59, 2014, //doi.org/10.1016/j.conbuildmat.2014.01.074.

[4]. Trilok Gupta, Sandeep Chaudhary, Ravi K. Sharma, Assessment of mechanical and durability properties of concrete containing waste rubber tire as fine aggregate, Construction and Building Materials, Volume 73, 2014, //doi.org/10.1016/j.conbuildmat.2014.09.102.

DOI: 10.17148/IARJSET.2023.10541

[5]. Adam J. Kardos, Stephan A. Durham, Strength, durability, and environmental properties of concrete utilizing recycled tire particles for pavement applications, Construction and Building Materials, Volume 98, 2015, //doi.org/10.1016/j.conbuildmat.2015.08.065.

[6]. Yue Li, Yaqiang Li, Experimental study on performance of rubber particle and steel fiber composite toughening concrete, Construction and Building Materials, Volume 146, 2017, //doi.org/10.1016/j.conbuildmat.2017.04.100.

[7]. Kunal Bisht, P.V. Ramana, Evaluation of mechanical and durability properties of crumb rubber concrete, Construction and Building Materials, Volume 155, 2017, //doi.org/10.1016/j.conbuildmat.2017.08.131.

[8]. Farhad Aslani, Guowei Ma, Dominic Law Yim Wan, Gojko Muselin, Development of high-performance self-compacting concrete using waste recycled concrete aggregates and rubber granules, Journal of Cleaner Production, Volume 182, 2018, //doi.org/10.1016/j.jclepro.2018.02.074.

[9]. Agampodi S.M. Mendis, Safat Al-Deen, Mahmud Ashraf, Flexural shear behaviour of reinforced Crumbed Rubber Concrete beam, Construction and Building Materials, Volume 166, 2018, //doi.org/10.1016/j.conbuildmat.2018.01.150.

[10]. Priya M. Mistry, Hiral P. Lad, Chaitali A. Patel, Himani H. Patel, Krutika A. Chauhan, Experimental Study on Paver Blocks using Waste Tyres, volume 06, 2019, irjet.net.

[11]. T. C. Ling MEng, H. M. Nor MSc, PGradDip, S. K. Lim MEng, Using recycled waste tyres in concrete paving block, 2009, //doi.org/10.1680/warm.2010.163.1.37.