

Comparative Study on Waste Tyre Powder and Carbon Black Filled Natural Rubber and EPDM Blends

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Structured Abstract

Background: The disposal of waste tyres poses significant environmental challenges due to their resistance to degradation and the inefficiency of traditional disposal methods like landfilling and incineration. This study explores the use of waste tyre powder (WTP) as an alternative filler to carbon black in natural rubber (NR) and ethylene propylene diene monomer (EPDM) blends, aiming to develop a sustainable and high-performance material.

Methods: The use of waste tyre powder (WTP) as a filler in EPDM-NR rubber blends, comparing its impact on the mechanical and physical properties of the composites at loadings ranging from 10 phr to 50 phr, against a control without WTP. The curing behavior of the blends is also investigated. Waste tyre powder is characterized using Fourier Transform Infrared Spectroscopy (FTIR) to identify functional groups and Scanning Electron Microscopy (SEM) to analyze the particle morphology and tensile fracture surfaces. The rubber composites are prepared on a two-roll mill using a blend of natural rubber (NR) and ethylene propylene diene monomer (EPDM) as the base polymers. The physical and mechanical properties of the rubber blends are assessed through comprehensive tests, including tensile strength, abrasion resistance, rebound resilience, swelling behavior, and hardness evaluations.

Results: The results show that WTP possesses the potential to serve as a reinforcing filler, comparable to carbon black. However, by comparing the two fillers, carbon black has a higher tensile strength and hardness test compared to WTP. The analysis demonstrates that the particle morphology and surface functional groups of WTP contribute to its compatibility with the rubber matrix. Additionally, the mechanical performance of NR-EPDM blends with WTP filler meets industry standards, particularly in tensile strength and abrasion resistance.

Conclusion: The study concludes that WTP is an applicable sustainable alternative to carbon black, providing a dual advantage of reducing environmental pollution and optimizing material performance in rubber products. This research promotes the circular economy by repurposing waste materials into value-added applications, ultimately contributing to the development of eco-friendly and cost-effective polymer technologies.

Keywords: Natural rubber, EPDM, waste tyre powder, carbon black, physical and mechanical properties

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