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Preparation and Evaluation Recycling Waste Polymers Composites

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ABSTRACT

In this work, polymeric waste materials such as tires and PVC waste have been exploited in the manufacturing of industrial speed bumps. Tires were processed into granules of approximately 0.185 mm, and PVC waste was reduced to granules with a size of about 0.275 mm. These prepared granules were combined with silicone rubber and a hardening agent to form a cohesive binder. Different prototypes were then crafted using varied proportions of tire to PVC waste specifically, 10%, 20%, 30%, and 40%. These prototypes underwent rigorous testing to evaluate their thermal conductivity coefficient, Shore A hardness, and compressive strength. It was observed that the prototype with a mix of 40% tire waste and 20% PVC waste exhibited the highest thermal conductivity. For hardness, the combination of 40% tire waste and 40% PVC waste achieved the highest Shore A value. However, the greatest compressive strength was exhibited by the prototype with a lower ratio of 10% tire waste to 10% PVC waste. Based on these results, the optimal compressive strengths of 2.25 MPa for the tire component and 2.12 MPa for the PVC. This composition was determined to be the most effective for the application envisioned in this work.

1. INTRODUCTION

A tire that is no longer used for the purpose for which it was originally made is referred to as a tire scrap, this tire, which is described as "junk", does not contain the technical requirements for recycling regeneration, but its material can be recovered through shredding, or grinding for use in many other applications such as shoes, sports surfaces, carpets, bumpers, etc. can also be used waste tires as fuel derived from tires for energy recovery. Defined as 'junk' due to their unsuitability for traditional recycling, tire scraps can still be valuable when shredded or ground for use in secondary applications like footwear, sports surfaces, and automotive parts, or as an alternative energy source [1]. The reclamation of materials from waste tires is especially critical considering the environmental hazards they pose, as they are a considerable source of pollution with the potential to release toxins into the air, water, and soil when decomposed, incinerated, or involved in fires [2]. Due to the very complex structure and composition of tire materials, it is difficult to recover and recycle used tires [3]. Continuous devulcanization is a method for recycling automotive tire rubber waste. With the new method developed, recycling can be deodorized during the process [4]. Exploring physical methods for processing automobile tires, grinding techniques stand out as a prominent approach to attain rubber crumb while preserving its essential properties [5]. The efficacy of mechanical rubber grinding hinges significantly on temperature and load application rates. Operating below the rubber's glass transition temperature induces small deformations and brittle destruction, making low-temperature physical methods a promising avenue for further exploration [6]. There are many comprehensive studies of waste tires, focusing on sustainability, environmental impact, and innovation in recycling. Several studies investigate incorporating waste tire rubber into products, polymer blends, and composites, emphasizing improved material performance and durability. Pacheco-Torgal et al. [7] emphasized using tire rubber in concrete, while Ramarad et al. [8] explained its evolving function in polymer blends. Machin et al. [9] focused on energy recovery methods like pyrolysis and gasification, which convert waste tires into valuable energy. Kida et al. [10] used experimental and computational approaches to assess the hazards of reusing recycled car tire materials. Environmental concerns are also addressed, with Kovochich et al. [11] examined tire and road wear particles in dust, illustrating their ecological risks, waste tires and plastics researches made significant strides in the past few years. Studies such as Palos et al. [12] examined waste refinery processes, converting end-of-life tires into valuable products. Pyrolysis, specifically for hydrogen production, has also been emphasized, with Sołowski et al. [13] providing an in-depth review of its potential. In addition, the reuse of recycled tire materials has raised concerns regarding safety and environmental impact. The applications of waste tires in construction, such as