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Tesis

Potential of Trema Micrantha and Coconut Ash-Trees in Sustainable Innovation for the Repair of Rigid Pavements

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Abstract The premature deterioration of rigid pavements represents a serious road safety problem, affecting connectivity and causing human losses, while the production of Portland cement contributes significantly to CO_2 emissions. Therefore, this study proposes the use of natural materials, such as coconut shell ash (CSA) and Trema micrantha fibre (TMF), known as 'sachahuasca', to improve the durability and sustainability of pavements, offering alternatives that reduce dependence on cement and its environmental impact. The process began with the procurement and preparation of both materials: sachahuasca fibre was selected, washed, dried and cut, while coconut husk was collected, cleaned, washed and dried and then treated in a kiln, obtaining ashes that were incorporated into concrete in concentrations of CSA (0%, 0.5% and 1%) and TMF (0.5%, 1% and 1.5%) for the repair of rigid pavements. A total of 126 cylindrical and 21 prismatic samples were then manufactured and tested for compressive, tensile and flexural strength, with curing at 7, 14 and 28 days, for a total of 147 samples, in addition to slump, density and temperature tests. The results indicated that the mechanical and physical properties improved in the rigid pavement, highlighting an increase in strength during the first few days, which favours its durability. The low slump achieved is suitable for concrete in rigid pavements, promising not only to improve road infrastructure, but also to reduce CO_2 emissions.

Keywords Rigid Pavement, Coconut Shell Ash, Trema Micrantha Fibre, Sachahuasca

1. Introduction

In Peru, rigid pavements are widely used on roads connecting cities due to their durability, with an estimated service life between 10 and 20 years [1]. However, many of these roads show signs of deterioration before reaching this timeframe, which represents a challenge for road infrastructure. Despite the fact that 95% of the country's roads are paved, a large proportion are in poor condition, a situation that has contributed to the loss of 1,376 lives between January and July 2024 in accidents related to these defects [2] [3]. As if this were not enough, according to the National Institute of Statistics and Information (INEI), this problem is aggravated by the constant increase in traffic, as vehicle flow grew by 6.1% in the first four months of the year [4] [5]. In addition, infrastructure problems are compounded by the environmental impact of Portland cement production, a key material in rigid pavement construction, responsible for approximately 5% of the country's CO_2 emissions [6] [7]. This scenario highlights