

FACULTAD DE INGENIERÍA

Escuela Académico Profesional de Ingeniería Civil

Tesis

**Development and Evaluation of Sustainable
Concrete: Effect of Coffee Husk Ash and Pineapple
Fiber on Mechanical Properties**

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Abstract The improvement of concrete properties is critical for advancing sustainable construction materials, and this study introduces an innovative approach to achieve this by repurposing agroindustrial waste. Peru faces a growing environmental challenge due to the vast amounts of agricultural residues generated, particularly from coffee and pineapple production. This research demonstrates how coffee husk ash (CHA) and pineapple fiber (FHP) can be effectively incorporated into concrete to enhance its mechanical performance while addressing waste management issues. The experimental program focused on developing a concrete mix with a target strength of 210 kg/cm²; integrating CHA and FHP as sustainable additives. These materials underwent specific pre-treatment processes—drying, calcination, and sieving for CHA, and drying and cutting for FHP—before being introduced into the mix in varying proportions. The mechanical properties of the modified concrete, including compressive, tensile, and flexural strengths, were evaluated through rigorous testing. Results revealed that an optimal combination of 1.60% CHA and 1.10% FHP significantly enhanced the concrete's performance, achieving a compressive strength of 271.55 kg/cm²; a tensile strength of 32.71 kg/cm²; and a flexural strength of 82.81 kg/cm² at 28 days. These improvements represent a

remarkable leap in material strength compared to standard concrete. However, excessive dosages of additives led to slight declines in performance, emphasizing the importance of dosage optimization. This study highlights the dual benefits of incorporating agroindustrial waste into concrete: improving the mechanical properties of construction materials and contributing to environmental sustainability. By transforming waste into valuable resources, the research provides a practical and scalable solution for the construction industry, aligning with circular economy principles. The findings offer a roadmap for future innovations in sustainable construction, showcasing the potential to revolutionize concrete design while mitigating environmental impacts.

Keywords Coffee Husk Ash, Pineapple Fiber, Mechanical Properties, Natural Fiber, Material Optimization

1. Introduction

In 2023, Peru faced a significant challenge in the management of agroindustrial waste derived mainly from