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Compression and Bond Properties of Fired Clay Brick Masonry with Cocopeat Blended Binding Mortar

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Abstract

The production of agricultural, industrial, and demolition trash increases along with global population growth and industrial expansion. They endanger the environment when they are not properly recycled, repurposed, or disposed of. Cocopeat is one such agricultural waste. The use of cocopeat in binder cement is urged to support sustainable construction methods. Because it is seen as trash and discarded in landfills. Cocopeat is an environmentally friendly by-product which can be got during the coconut fibre extraction process. The current study investigates the strength properties of masonry built with binding mortar that incorporates cocopeat as opposed to traditional cement-sand mortar. The mortar prepared with four different integrations of cocopeat as sand replacement of 0, 4, 6 and 8% by weight was used for masonry. Fresh properties of cocopeat binding mortar and their effect on the mechanical characteristics of masonry were investigated. The test results revealed that the mechanical characteristics of masonry were enhanced with increased cocopeat content in the mortar.

Keywords

Masonry, Cocopeat, Binding mortar, Sustainability

1 Introduction

The production of agricultural, industrial, and demolition waste increases along with global population growth and industrial expansion. They endanger the environment when they are not properly recycled, reused, or disposed of. Since cocopeat is a byproduct of the extraction of coconut fiber, it is frequently regarded as waste and disposed of in landfills. Typically, coco husk pieces, coir, and cocopeat are produced when fiber is extracted from coco husk. Although coco husk pieces and coco coir may be utilized to make a variety of goods with added value as shown in Figure 1, coco peat is only employed as a plant-growing medium and the majority of it is disposed of or mixed with nearby water sources. By contaminating the water and the air, these acts put the environment at hazard (Erdogmus 2015).

Cementitious composite materials, such as mortar, are being used more frequently for a variety of construction activities, including masonry blocks, wall finishes, binding mortar, and more. To increase cementitious composite material's ability to provide improved efficiency in construction, there is a growing need for their utilization. Microcracks start to show up along planes that suffer tensile stresses when mortar is subjected to different types of loading. Applying additional loads causes cracks to expand out of control (Chandramouli et al. 2010).

Most of the masonry failure is initiated by the binding mortar itself or the intersection between brick and binding mortar. A good bond between brick and binding mortar has a significant effect on the mechanical characteristic of the masonry wall. This is influenced by many factors such as moisture content, initial water absorption rate, the surface roughness of brick unit and sand grading, composition, consistency, and water retention capacity of the binding mortar. So, improving the performance of binding mortar is one of the optimum ways to im-prove the strength of masonry structures. Generally, by incorporating by industrial waste or fibres are used to improve the performance of binding mortar (Sundaralingam et al. 2021, Thanushan & Sathiparan 2022). Fibers in the mortar mixture serve to counter-act the hydraulic shrinkage, preventing the development of cracks and fissures on the surface of the plaster that has been applied. Also, it was improving the direct tensile strength of the mortar as well as due to roughness, it was improving the bond be-tween the masonry unit and the binding mortar.

Although coconut coir has been continually utilized in cementitious composites such as concrete (Ali et al. 2022), cement mortar (Sathiparan et al. 2017), stabilized earth blocks (Thanushan et al. 2019), surface plaster (Sathiparan & Rupasinghe 2019), etc., the use of cocopeat in cementitious materials is very limited. Priyadarshini et al. (2021) investigate the strength of concrete featuring cocopeat as a partial replacement for sand. Results show that treated cocopeat improved the compressive strength and bonding characteristic of concrete. The strength and durability properties of cement mortar including cocopeat as a substitute for river sand were evaluated by Sathiparan et al. (2022). The findings demonstrated that adding up to 4% of cocopeat content to cement-sand mortar enhances its physical and mechanical characteristics without negatively affecting crucial durability factors. Furthermore, both studies show that using cocopeat as raw materials in construction materials reduces the usage of river sand, so it is a cost-effective and sustainable option. Although these studies show that cocopeat is one sustainable option to reduce sand consumption and value added to cocopeat, still the usage of cocopeat in binding mortar for masonry is one of the areas to explore.

The emphasis of the present study is to investigate the effects of cocopeat-incorporated binding mortar on the mechanical properties of masonry. For that fresh mortar properties, characteristics of hardened binding mortar, and strength characteristics of masonry were investigated through an experimental program.

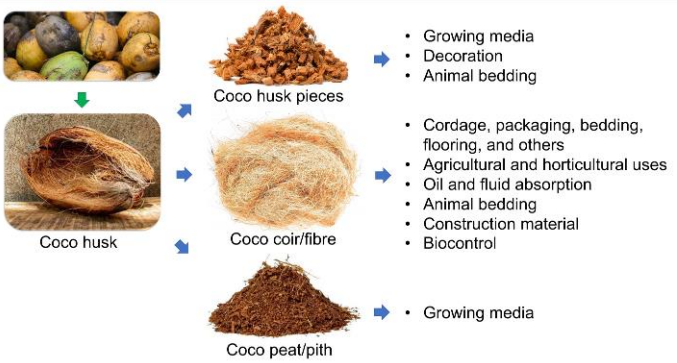

Fig 1. Derivation of by-products of the Coconut extraction process and its commercial use

2 Methodology

1.1 Materials used

The details about raw materials used for the present experimental program are described below.

- Cement: In this investigation, OPC (Ordinary Portland cement) was used as a binder. OPC was found to have a bulk density of 1,280 kg/m3 and a specific gravity of 3.15.
- Fine aggregate: The river sand had a bulk density and specific gravity of 1,680 kg/m3 and 2.41, respectively. Figure 2a displays the grain size distributions of river sand. According to the grain size distribution, fine aggregate contains 3.8% gravel, 95.6% sand, silt, and