Clean Technologies and Environmental Policy
https://doi.org/10.1007/s10098-023-02681-2

ORIGINAL PAPER

Performance of sustainable cement mortar containing different types of masonry construction and demolition wastes

Navaratnarajah Sathiparan[1]

Received: 25 August 2023 / Accepted: 14 November 2023

Abstract
The primary fine aggregate in cementitious construction is often natural sand or river sand. The construction of masonry blocks, in particular, necessitates using sand as a primary raw material, including a significant proportion ranging from 70 to 90%. The demand for river sand is seeing substantial growth. However, the availability of high-quality river sand is constrained due to regulations imposed on sand extraction from river beds. The adverse environmental repercussions have arisen due to the over-mining of river sand in response to the growing demand. The researchers were motivated by the ongoing challenges to seek a viable and environmentally friendly substitute for river sand. In contrast, Construction and Demolition (C&D) waste is a major environmental issue due to its high volume, potential for hazardous materials, and potential for release of pollutants into the environment. The current study examined the viability of using three specific forms of C&D waste derived from masonry structures as substitutes for river sand in cement mortar production. Cement mortar was made and tested, each with varying C&D waste composition levels of 25, 50, and 75% as sand replacement. The examination included the assessment of physical, mechanical, and durability characteristics. The results suggest that the cement mortar with C&D had better dry and wet compressive strength and equivalent flexural and impact strength to the control mortar. The cement mortar containing C&D waste, excluding concrete block waste, absorbs more water than the control mortar. Only cement mortar with fired clay brick waste shows a minor reduction in strength to acid and alkaline chemicals, comparable to the control mortar. Findings show that C&D waste improves cement mortar strength. However, cement mortar durability remains a concern.

Keywords Masonry · Construction and demolition waste · Fired-clay brick · Stabilized earth blocks · Sustainability

Introduction

Masonry is a type of building structure composed of individual masonry units, such as brick, stone and concrete blocks, laid in mortar and held together by gravity. Masonry structures are robust and have been used for centuries to build durable and aesthetically pleasing structures (Sathiparan 2015). The mortar is mixed with water and can be either cement or lime-based. The main advantage of masonry structures is their durability. Masonry structures can withstand extreme weather conditions, such as high winds and heavy rain, and can last hundreds of years with minimal maintenance (Sathiparan et al. 2014). They are also environmentally friendly since they do not release any pollutants into the air. Masonry structures also have a high thermal mass, which means that they absorb heat and keep the interior of a building warm in the winter and cool in the summer. Masonry structures can be made from various materials, including fired brick and cement blocks. Fired brick is made from clay and other materials fired in a kiln at a high temperature. Cement blocks are made from a mixture of cement with sand and both are commonly used in masonry construction. The environmental impact of fired brick and concrete blocks is another essential factor when using them in masonry structures. Fired brick production involves burning clay, which releases pollutants into the atmosphere. Cement blocks, on the other hand, require energy to produce and can create hazardous waste if not disposed of properly (Sathiparan et al. 2022c). Also, it required a more significant amount of river sand excavated from the river bed. Excavation of river sand from riverbeds

✉ Navaratnarajah Sathiparan
sakthi@eng.jfn.ac.lk

[1] Department of Civil Engineering, Faculty of Engineering, University of Jaffna, Ariviyal Nagar, Kilinochchi, Sri Lanka

Published online: 07 December 2023