Materials Today: Proceedings xxx (xxxx) xxx

Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

Compressive strength and fire resistance of mortar containing crushed cockle shell as fine aggregate replacement

Hanis Nadiah Ruslan, Khairunisa Muthusamy *, Mohd Faizal Md Jaafar, Nabilla Mohamad, Nur Farah Aziera Jamaludin

Faculty of Civil Engineering Technology, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang, Pahang, Malaysia

ARTICLE INFO

Article history:
Available online xxxx

Keywords:
Fine aggregate
Cockle shell
Pollution control
Mortar
Compressive strength
Fire resistance

ABSTRACT

Continuous extraction of sand from the river without any control would disrupt the ecosystem in the river. In addition, disposal of cockle shells as garbage contributes to pollution and an unpleasant atmosphere. Thus, the current study investigates the influence of substitution of crushed cockle shell as a partial fine aggregate on the compressive strength and fire resistance of mortar. Five mortar mixes were created by using 0%, 10%, 20%, 30%, and 40% crushed cockle shell replacement by weight of sand. Compressive strength and fire resistance tests were carried out. The results demonstrate that using 10% crushed cockle shell produces mortar with the highest compressive strength value. All mixes met the target strength at 28 days, with values ranging from 17.52 MPa to 22.21 MPa. Up to 600 °C, the mortar containing 10% crushed cockle shell exhibits more mass and strength loss almost compared to control mortar. Excessive use of crushed cockle shell results in greatest mass loss and strength when exposed to high temperatures. On overall, the incorporation of cockle shell substitute as fine aggregate would reduce the demand for natural river sand and pollution caused by cockle shell disposal.

Selection and peer-review under responsibility of the scientific committee of the Engineering Technology International Conference.

1. Introduction

Globally, there has been a rise in both population and development in the twenty-first century, which has lead to growth in demand for the construction sector. Mortar is one of the construction building material that is used during the construction process of a structure. This material functions as a wall finisher and a means of holding the structure's components (blocks or stones) together. Mortar is typically composed of at least one mineral binder and one aggregate, either natural or manufactured, sand, which are combined with water [1]. Sands represent the majority of the volume of mortar due to their considerable effect on the physical, rheological, and mechanical characteristics of this building material [2]. Sand harvested from the river is desirable owing to its better quality compared to sea sand. However, excessive sand extraction can contribute to environmental and biodiversity problems. Besides the undesirable environmental degradation, activities during sand processing and its transportation also cause surge in sand price and discharge of CO_2[3]. Thus, using alternative materials obtained from waste from the industrial trade, agriculture industry, or aquaculture sector as a partial sand replacement in concrete production would be able to minimize the significant reliance on river sand supplies [4].

At the same time, the prospering of aquaculture industries owing to growing demand of consumers also generates undesirable waste that need to be managed. Cockle industry is one of the trades that supply fresh cockle meat or canned processed cockle meat of diverse flavour for the consumer. Malaysia has relied on the blood cockle as a key source of revenue since 1948, making it one of the most important aquaculture species in South East Asia [5]. The cockle farming concept that was successful in Teluk Lekir, Perak, is planned to be reproduced in Kedah, Penang, Negeri Sembilan, Selangor, and Johor, with output reaching 150,000 metric tons by 2025 [6]. The flourishing industry generates the inedible shell waste which discarded at dumpsite. These wastes are typically classified as solid food waste with little economic use [7]. Continuous practice of waste dumping would create the need for allocation of more area for disposal which would be otherwise utilized for better purpose. In addition, accumulation

* Corresponding author.
E-mail address: khairunisa@ump.edu.my (K. Muthusamy).

https://doi.org/10.1016/j.matpr.2023.06.320
2214-7853/
Selection and peer-review under responsibility of the scientific committee of the Engineering Technology International Conference.