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Utilization prospects of eggshell powder in sustainable construction material – A review

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HIGHLIGHTS

- The main component of ESP is $CaCO_3$.
- The ESP can be used as cement replacement in construction materials.
- The effects of ESP on cementitious materials depend on its replacement level.
- The ESP as soil stabilizer improved it mechanical properties.

GRAPHICAL ABSTRACT

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ABSTRACT

With the rapid growth of infrastructure development, the demand for construction materials has also increased. Cement is one of the materials used widely around the world. Using nonrenewable resources in the production of cement and the CO_2 emissions has created significant environmental issues. Using waste materials as a partial or full replacement for cement is one of the practical solutions available. The conversion of waste materials into a cement replacement may reduce the environmental issues caused by the open dumping of the waste. Eggshell is a waste material that can be obtained from restaurants, bakeries and households. If effective uses for eggshell can be found, it would create an opportunity for a sustainable solution. This paper presents the latest studies on the use of eggshell powder in construction materials such as concrete, cement mortar, brick, alkali-activated binder and a soil stabilizer. The physical and chemical properties of the eggshell powder and the factors that influence the characteristics of eggshell power were also analyzed. The results indicate that the characteristics of cementitious materials improved. Specifically, a 10–15% cement replacement with eggshell powder results in strength development comparable to the control. Several studies have shown the potential of using eggshell powder as a stabilizer for soil and brick to improve its mechanical properties. Eggshell powder is therefore energy and cost-effective solution to the problem of sustainable construction materials.

1. Introduction

The manufacturing of construction materials has a significant impact on the environment. With the rapid growth of infrastructure development, the demand for cement-based materials has also increased. Cement is one of the materials used widely around the world. Fig. 1(a) illustrates the worldwide cement production for the last 25 years. With the rapid growth in the manufacturing of cement in the 2000 s, it reached 4000 million tons in the last decade. As shown in Fig. 1(b), China has been contributing to more than 50% of cement production over the last several years [1]. The manufacturing and use of cement have contributed to 8% of global CO_2 emissions [2], and out of which 50% is associated with clinker

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