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The performances of the baking-free bricks of non-sintered wrap-shell lightweight aggregates from dredged sediments

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HIGHLIGHTS

- Preparation of bricks of non-sintered wrap-shell lightweight aggregates (WSLAs) in non-sintered method.
- Non-sintered wrap-shell lightweight aggregates concrete bricks (WSLABs) is characterized by its light weight.
- The compressive strength of WSLABs decrease then increase with increasing WSLAs content.
- When the WA % is 100%, WSLABs have relatively excellent performances.

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ABSTRACT

The massive accumulation of dredged sediments and the heavy consumption of gravel are urgent environmental problems in human productive activities. To overcome these issues, a new technology of baking-free bricks of non-sintered wrap-shell lightweight aggregates (WSLAs) from dredged sediments was studied. The baking-free technology was adopted in craft to prepare the WSLAs whose macro and micro structures were used for characterization, and then WSLAs were used in replacing crush stone (CSAs) in the process of bricks making. In this paper, the density, water absorption rate, compressive strength, and frost resistance properties of non-sintered wrap-shell lightweight aggregates concrete bricks (WSLABs) from dredged sediments were studied from two aspects: the volume replacement ratio of WSLAs (WA%), and aggregates-to-binder ratio (A/C). Results show that WSLAs, as a lightweight material, was used to press the lightweight brick with a minimum density of 1820 kg/m^3. Due to the unique core shell structure of WSLAs and its cylinder pressure strength is much lower than CSAs, when the WA % is up to 50%, the aggregates inside the bricks were crushed and damaged by mutual compression, thus Water absorption rate is up to 4.78%. After 25 freeze-thaw cycles, as the WA% reached 100%, the mass loss rate and strength loss rate of the WSLABS were as low as 1.56% and 6.18% respectively. In the study, WSLAs with porosity and excellent characteristics of Water absorption and drainage can be well combined with cement stone, when the WA % is 100%, WSLABs have relatively excellent strength performance, reaching 35 MPa and meeting the requirement of Chinese National Standards (GB/T 28635-2012). The above research results reveal that the feasibility of pressing WSLABs from dredged sediment by non-sintered process. This technology not only solves the problem of dredged soil disposal, but also protects the over-exploitation of mineral resources, and the technology has a broad application prospect and market value.

1. Introduction

In nature, the accumulation of sediment in the riverbed at the bottom of rivers and lakes is a common phenomenon, which is accelerated by the development of human society and economy [1]. Therefore, dredging activity plays a vital role in dredging waterways and maintaining the natural environment. Many countries carry out dredging every year in the world. In France, about 50 million m^3 of sediment is dredged every year [2]. In the USA, up to 2.4 million m^3 of sediment is dredged every year from 2011 to now [3]. Germany's Bremen port produces approximately 0.6 million m^3 dredged sediment per year [4], while in Brazil 8 million m^3

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