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Review

The development of coral concretes and their upgrading technologies: A critical review

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HIGHLIGHTS

- Coral concretes are highly demanded in the construction of offshore structures.
- Porous coral aggregates affect workability, mechanical properties and durability.
- Many proper ways can improve the suitability of using coral aggregates.

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ABSTRACT

The utilization of locally available raw materials is extremely necessary for the offshore island construction in ocean. Coral can be used as aggregate but is usually light and porous, having rough surface, weak adherence to the attachments and high concentration of sea salts. These characteristics affect the workability, mechanical properties, volume stability and durability of resulting concretes. This review paper discussed the instability of Portland cement hydration products under the ocean environment, the low strength and stiffness of coral aggregates, their large connected porosity and the weak interface microstructure between the cement matrix and coral aggregates. To overcome these problems, such as low grade of strengths, inadequate corrosion resistance and high brittleness, this paper proposed some perspective techniques: modification of coral aggregate, development of new cementitious materials, fiber reinforcement and mix proportion design.

Contents

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1. Introduction

With the rapid development of human society but limited land resources, people are turning their attention to the ocean. The exploitation and utilization of marine resources have become an important topic for the expanding of living space and the increase of resources. The marine development has been a civil reality, not only defense safety, for many countries and area where high population density is. In recent years, many countries have increased their investments in marine engineering, and the construction of an artificial island is one of the most noticed by the international community. Fig. 1 shows a contrastive overlook of Vietnam's reclamation project in the Sand Cay (also known as Son Ca Island) in 2011 and 2015. Fig. 2 shows the Chinese in 2014 and 2015 on the island reclamation construction of the Yongshu Reef. The development and construction of other islands and reefs will increase the demand for marine engineering materials. Concrete is an important foundation material in the marine infrastructure construction. Aggregates are a significant component in concrete, which accounts for about 70% to 80% in volume, and their demand in the marine construction project is very large. The transportation of coarse and fine aggregates from inland not only increase the cost of project but also affect the project schedule because of some unexpected ocean climate conditions. Therefore, most of the offshore reefs are made of coral concretes. Without damage to the ecological environment, local coral reefs in the islands are used to manufacture both coarse and fine aggregates and then prepare coral concrete on site. This approach is of great significance to the civil engineering construction of islands.

The attention on the development and research of coral concrete has risen in recent years. The United States is the earliest country conducting research on the coral concretes, which were used to build roads and airports on islands such as Midway island, Wake island and Saipan island in the western Pacific Ocean. As

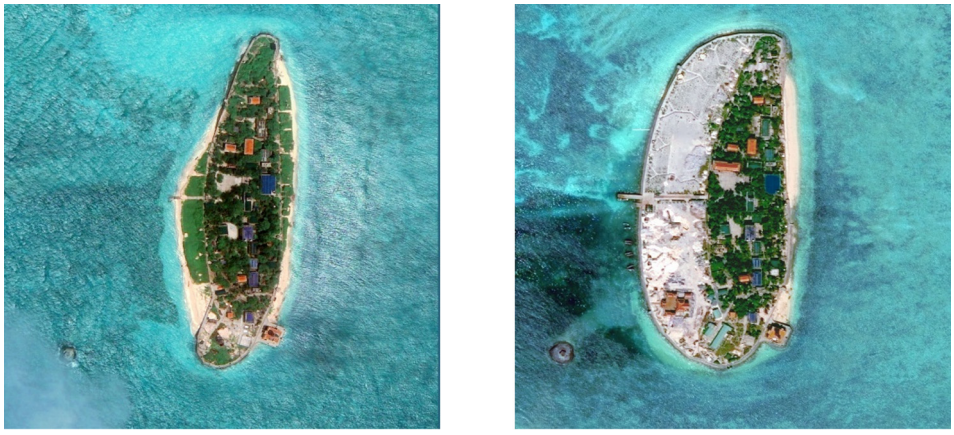

Fig. 1. Vietnam's reclamation project in the Sand Cay in 2011 (a) and 2015 (b) [1].

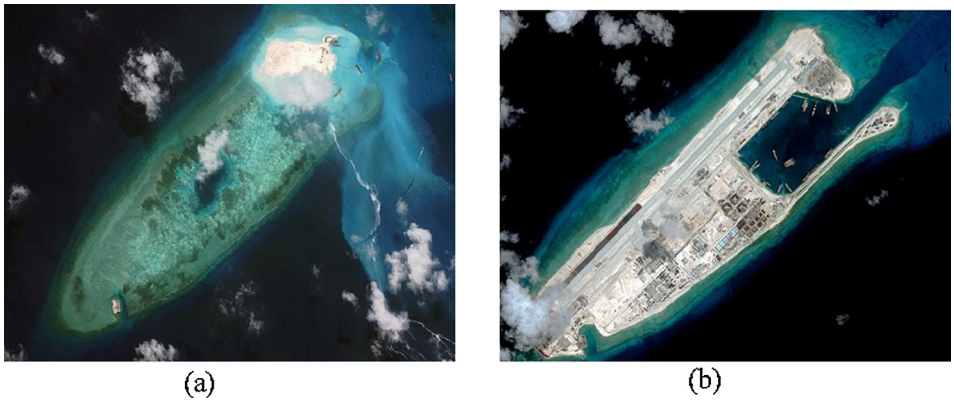

Fig. 2. Chinese reclamation project in the Yongshu Reef in 2014 (a) and 2015 (b) [1].