Diffusion of Waves Propagating over a Series of Submerged Breakwaters

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ABSTRACT

Experiments were conducted to study the diffusion characteristics of wave propagation over a series of submerged breakwaters. Three different concentration NaCl (C_0 = 1M , 0.5M and 0.25M ), as spreader is applied. After constantly spraying 400 seconds NaCl, the observation is conducted by taking t = 101~150 sec (the beginning of spreading) and t = 301~350 sec (spreading stabilizing). Water concentration values getting from different horizontal and vertical axis locations are analyzed. Based on the observed, the reflection rate is stronger; the spreading range in the water of the test is wider due to the water particle vibration will be getting active when the reflection range is getting stronger.

KEY WORDS: diffusion, submerged breakwaters, reflection.

INTRODUCTION

In order to protect the beach, several kinds of coastal structures were established. Recently hydrophilic structures, such as submerged breakwaters, have been introduced instead of traditional structures to protect coast from wave attack and beach erosion when we consider the environmental impact. Nowadays, a series of submerged breakwaters could be installed to protect shores or offshore structures from wave attack with the concept of Bragg scattering. Bragg scattering is a phenomenon that resonance waves occur when the wavelength of incident waves is equal to twice of the wavelength of bottom undulation. It means that reflected waves will return strongly when the surface wavenumber is equal to one half of bed wavenumber K, i.e. 2k / K = 1. Davies and Heathershaw (1984) and Mei (1985) used the physics theory and experiments to examine the reflective mechanism of the Bragg resonance. Davies et al. (1989), O’Hare and Davies (1993), Zhang et al. (1999) and Hsu et al. (2003) also demonstrate that the superimposition of two sinusoidal bottoms having different wavenumbers, the sub-harmonic and higher-harmonic resonances will occur. Kirby and Anton (1990) applied previous theories for Bragg reflection of surface waves by parallel bars to the case of artificial bars placed discretely on the seabed. Bailard et al. (1990) and Tsai et al. (2005) explored the feasibility of the Bragg reflection of artificial bars placed offshore on a natural beach. Wen and Tsai (2008) investigated the characteristics of the Bragg reflection under various conditions of incident wave and seabed. Their results concluded that the Bragg reflection of artificial bars may have merits as an appropriate shore protection method. However, all these works are only considered impermeable seabed and breakwaters. Furthermore, their attention was focused on the reflection while wave transmission and wave dissipation were seldom discussed. Twu and Liu (2004) pointed that Bragg reflection produced by permeable bars than that by impermeable bars by computational model. Ting and Lin (2004) observed the effect of wave transformation over porosity submerged breakwaters. It has been reported that the porosity of breakwater has played an important role in the interaction between the free wave and structure. The corresponding incident wave conditions near the peak of Bragg reflection were conducted to discussion in this paper. The standard solution, NaCl, was used as source of diffusion. Experiments were conducted to study the diffusion characteristics of wave propagation over a series of submerged breakwaters. Three different concentration...