

Experimental study on the reinforcement mechanism and wave thumping resistance of EICP reinforced sand slopes

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Abstract: Sand slope is an important part of coastal zone and islands, which is severely affected by wave erosion and causes problems such as degradation of coastal zone and reduction of island area. Enzyme-induced calcium carbonate precipitation (EICP) technology is a new reinforcement technology with environmental friendly and excellent effect, which has been widely studied in the field of geotechnical engineering in recent years. In this research, we focus on the coastal or reef sand slopes in marine environments. The EICP reinforcement of representative sand slope units and large scale flume wave thumping experimental study are conducted indoors. By analyzing the physical and mechanical properties, erosion resistance, and microstructure of EICP-reinforced sand slopes, the mechanism of EICP reinforced sand slopes is revealed, the feasibility of EICP reinforced sand slopes is confirmed, and a feasible solution for EICP reinforced sand slopes is finally obtained. Results show that:

(1) EICP reinforcement effectively enhances the surface strength and erosion resistance of sand slopes. Higher calcium carbonate content in the sand slopes corresponds to greater surface strength and improved erosion resistance. When the calcium carbonate content is similar, using low-concentration reinforcement twice is more advantageous than using high-concentration reinforcement once due to its superior uniformity. (2) The intensity of waves, the angle of the sand slope, and the severity of erosion damage are interrelated. Higher wave intensity, steeper sand slope angles, and more serious erosion damage require stronger reinforcement measures. (3) Scanning Electron Microscope (SEM) image analysis reveals that the reinforcing effect of sand slopes primarily depends on the amount of calcium carbonate crystals cemented between sand particles. A higher content of calcium carbonate crystals leads to better erosion resistance in the sand slope.

Keywords: Enzyme induced calcium carbonate precipitation (EICP) ; Sand slope; Wave thumping; Erosion resistance