

An effect of pore water flow on the re-suspension of cohesive sea bottom sediment

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In order to clarify an effect of pore water flow on the re-suspension of cohesive sea bottom sediment, water content variation experiments and re-suspension experiments of the cohesive sea bottom sediment in pore water flow field were carried out. By the pore water flow, water content of cohesive sea bottom sediment was increased and it depends on the amount of organic matter and C/N ratio. Water content influenced on the re-suspension of the cohesive sea bottom sediment. And it is experimentally clarified that the re-suspension of cohesive sea bottom sediment occurred at the current velocity of 4cm/s, which is observed in Hiroshima Bay, due to a decrease of critical erosion threshold in the pore water flow field.

Introduction

Hiroshima Bay, a semi-closed bay located in western Japan, is connected with Seto Inland Sea. Cohesive sea bottom sediment have been excessively deposited around the river mouth due to inflow of domestic wastewater and aquaculture, especially from 1950s to 1970s, the period of high economic growth in Japan. Several articles have reported that re-suspension of cohesive sea bottom sediment plays an important role in the functionality and health of coastal area (Lee and Hoshika, 2000; Ali and Lemckert, 2009). Therefore, analysing the mechanism of cohesive sea bottom sediment re-suspension is an important component in the assessment of the health of aquatic environments.

Most papers concerning re-suspension of the cohesive sea bottom sediment approached from bottom shear stress. However, behaviours of cohesive sea bottom sediment is characterized by plasticity, consolidation pressure, pore water quality and eroding fluid (Kamphuis, 1987). And our previous study has proven that pore water flow is one of the main factors that influences the re-suspension of cohesive sea bottom sediment in Hiroshima Bay (Imagawa *et al.*, 2007). The objective of this paper is to investigate the changes in water content and critical shear stress of the cohesive sea bottom sediment by the pore water flow.

Materials and methods

Changes in water content of the cohesive sea bottom sediment by the pore water flow was investigated by experiments using parted water tank shown in Fig. 1. And experiments for the analysis of critical shear stress of the cohesive sea bottom sediment in the pore water flow field were carried out using unidirectional flow channel (Fig. 2).

Cohesive sediments sampled in several areas of Hiroshima Bay were used for in-door experiment. IL and C/N of the sampled sediments ranged 11.9 – 17.0% and 10.8 – 14.0, respectively.

Results and discussion

Fig. 3 shows the results of the water content variations by the pore water flow. Water content of the cohesive sea bottom sediment in the condition without pore water flow ($dh=0$) ranged 270 - 420%, while it increased to 470 - 710% in the pore water flow condition ($dh=1$). From these, it can be said that the pore water flow increase water content of the cohesive sea bottom sediment. And water content tended to increase with IL and to decrease with C/N ratio.

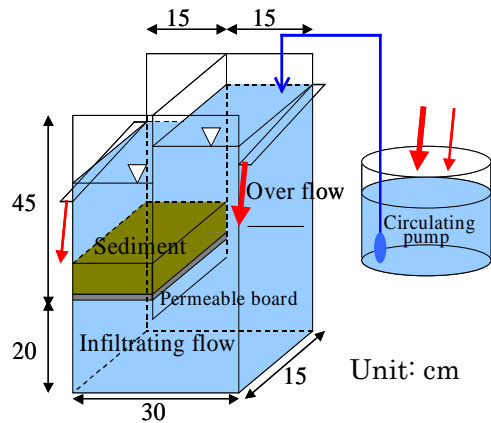


Fig. 1. Parted water tank.

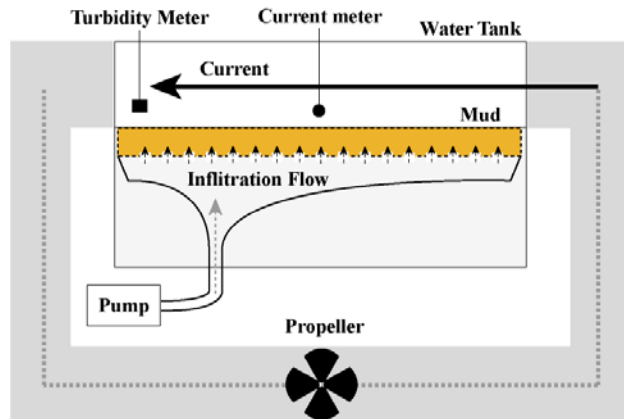


Fig. 2. Unidirectional channel.

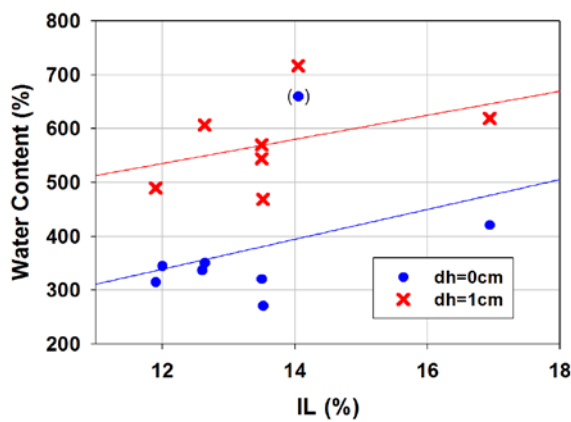


Fig. 3. Relationship between IL and water content.

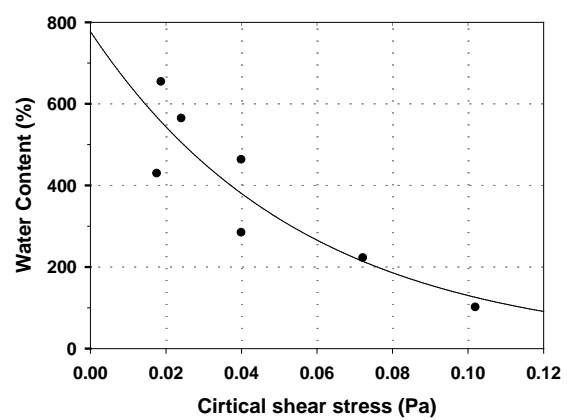


Fig. 4. Relationship between critical shear stress and water content.

Fig. 4 shows the relationship between critical shear stress and water content. The cohesive sea bottom sediment with over 400% of water content started to re-suspend at the critical shear stress of 0.02 - 0.04 Pa (current velocity of 4 - 8cm/s) and this may be contributed by the pore water flow. From the results obtained above, it is concluded that the re-suspension of cohesive sea bottom sediment is enhanced due to both expansion of the sediment (increase of water content) and lifting force on the sediment particle accompanied by the pore water flow. And it is experimentally clarified that the re-suspension of cohesive sea bottom sediment occurred under current velocity of 4cm/s, which is observed in Hiroshima Bay, due to decrease of critical erosion threshold in the pore water field.

References

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