第 II 部門

Effect of Non-Cohesive Sediment Transport on Erosion Rate of Cohesive Sediment

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1. Introduction

Non-cohesive and cohesive materials are coexist in rivers and interactions between these materials always occurred naturally. For example, the coarse non-cohesive material from the Mekong River flows on the fine cohesive material in the Tonle Sap River during the flood season around Phnom Penh in Cambodia. This fact indicates that the cohesive material can be eroded by both non-cohesive material and water under certain condition. However, suggested erosion rate equations of cohesive material in the previous studies are base on the erosion rate by water only (Parchure *et al*. 1985, Sekine *et al*. 2000, and Aberle *et al*. 2002). In this study experimental test was conducted to study the effect of the transport of non-cohesive materials on the erosion rate of the cohesive sediment.

2. Experimental Study

The cohesive sediment for this experiment was prepared from dry kaolinite powder. Two types of cohesive sediment samples are used (i.e. type A and type B cohesive sediment). Type A is composed of 100% kaolinite. Type B is composed of 50% kaolinite and 50% non-cohesive materials which have specific gravity 2.65 and d_{50} is 0.8 mm. The experiments were carried out in the flume with 800 cm long, 15 cm wide and 25 cm deep. The cohesive sediment was laid on the flume test with 5 cm thickness. All experiments were conducted under specific hydraulics condition. The discharge and bed slope is 1.3 liter/s and 0.004, respectively. In order to produce the transport of non-cohesive material, the non-cohesive material was fed on the flume during experiment. volumes considering the potential sediment transport under equilibrium condition (Ashida *et al*. 1982). The transport rate of the non-cohesive material is 0%, 25%, 50%, 100% and 150% of the equilibrium sediment transport rate, *qb*. The sediment feeding materials is the same as the coarse materials which is used in Type B sample. In order to evaluate the effect of the transport of non-cohesive sediment on erosion rate of cohesive sediment, the bed change elevation on the surface of cohesive sediment was measured. Bed levels were measured at 11 points in a cross section and 5 cross sections are measured. The longitudinal step between the cross sections is 5 cm.

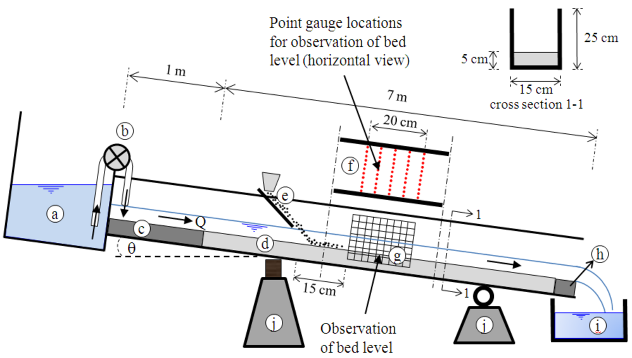

Figure 1 Experimetal setup

Figure 1 shows the experiment setup, where a) water tank, b) pump, c) rigid bed, d) cohesive sediment, e) sediment feeding location, f) horizontal view of cross sections, g) screen grid, h) downstream weir, i) downstream tank, and j) tilting machine).

3. Results and Discussions

The erosion rate for each cross section was calculated with dividing the bed elevation changes during experiment by experiment duration.

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Figure 2 and **Figure 3** show the erosion rate on cohesive sediment type A and type B, respectively. From those figures can explain that the presence of transport of non-cohesive sediment affects on erosion rate of cohesive sediment. **Figure 2** indicates that the total shear stress on the surface of cohesive material which produced by water and by non-cohesive sediment that has volume 25% *qb* and 50% *qb* more than shear stress which produced only by water (case 1). On the other hand, on case 4 and case 5 show the erosion rate is smaller than that in case 1. The maximum erosion rate is appeared at around 25% of the equilibrium sediment transport rate (case 2) and the erosion rate is decreased with increase in sediment discharge.

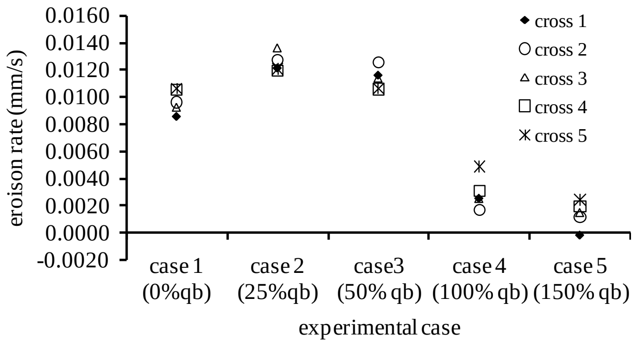

Figure 2. Erosion rate on cohesive sediment type A

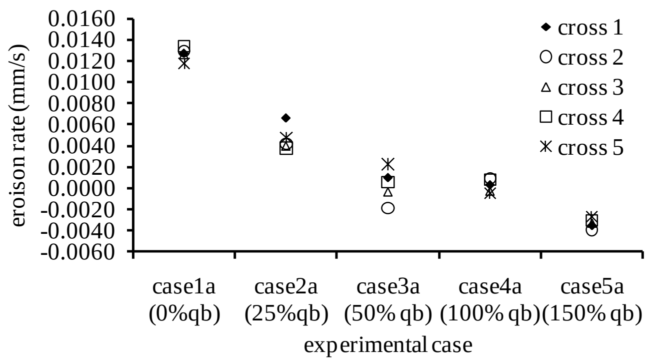

Figure 3. Erosion rate on cohesive sediment type B

Figure 3 shows that the increasing of non-cohesive sediment transport affects on decreasing erosion rate of cohesive sediment type B. The erosion rate in case 1a (without sediment supply) is the maximum among the 5 cases. Sediment supply due to the bed erosion between the upstream end of cohesive material layer and the measurement location affects on the result. So in actually, during experiment the volume of non-cohesive sediment transport at the observation points more than the amount of supplied sediment. Hence, it is considered that the distance from the upstream end of cohesive material layer and the measurement location, which is 4 m, is not enough to get the equilibrium sediment transport rate. As a result, the sediment transport rate at the measurement location in case 1a is close to the sediment transport rate in case 2 and the erosion rate in case1a is larger than case 1. Furthermore, erosion rate of the cohesive material decrease with increase in the sediment supply.

4. Conclusions

The cohesive sediment that composed of 100% kaolinite, the erosion rate with sediment supply (25% *qb* and 50% *qb*) are more than that without sediment supply and erosion rate will decrease with increasing of sediment discharge (100% *qb* and 150% *qb*). The cohesive sediment that composed of 50% kaolinite and 50% coarse sand, the erosion rate of the cohesive material decrease with increase in the sediment supply. This tendency is the same as the cases with bed composed of 100% kaolinite.

5. References:

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