

Ripple development and grain sorting with multiple-sized sand: wave-flume experiments

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Introduction

It has been observed that coastal sediments typically have an extensive range of grain size. Although there is evidence, the previous studies about coastal sediment transport and depositional processes have focused on uniform material. The problem of multiple-sized materials has often been explained in terms of a straightforward generalization of results obtained for the simpler uniform case, as pointed out by Parker (1991). The importance of studying the appropriate problem about the transport and deposition of multiple-sized materials has recently been recognized. Comprehending of bottom morphology in shallow-water environments requires advanced investigation of the selective sediment transport on bedforms, which may enhance the process of grain-size sorting.

Only a few studies (Foti, 1993; Foti & Blondeaux, 1995) have investigated the development of ripples and grain-sorting processes on them, although ripples develop well in shallow water. The processes under various wave conditions, involving waves asymmetric flow inherent in waves in the shallow-water region, remains unanswered after those previous studies. Thus, this wave-flume study focused on this point and defined the effect of difference of wave conditions.

Laboratory Experiment

The multiple-sized sand used in the present experiments was obtained by mixing two kinds of well sorted quartz sands which had different grain-size distribution. The two sediments, the coarse sand

(red-colored sand, mean diameter $D = 0.40$ mm) and the fine materials (quartz sand, $D = 0.18$ mm), were mixed with same weight.

The wave flume at Disaster Prevention Research Institute, Kyoto University was used in this study. The flume is 34 m long, 40 cm wide and 1.2 m deep. It has a piston-type wave generator at one end, and a fixed slope of 1/18 at the other. A flat sand bed (2.5 m long, 40 cm wide, and 8 cm thick) with small a notch was initially placed in a horizontal portion of the flume. The water depth over the sand bed was 50 cm. The wave period ranged from 1.25 to 4 s, and wave height from 4.0 to 19.9 cm. Ripple formation was recorded using a digital video camera during each run, and photographs taken at the start and the end of each run. Grain-size analysis about samples, which were obtained from the troughs, the crests, the onshore-side slopes and the offshore-side slopes on ripple surface with absorption pipette, was performed with settling tube (Naruse, 2005).

Grain Sorting on Developed Ripples

The results of flume experiments indicated the follows:

- 1) In many case, the coarser sediments deposited on the crests than the troughs. These results were consistent with Foti (1993).
- 2) Asymmetrical flow provided the coarser sediments on the onshore-side slopes than the offshore-side slopes. The difference on them suggested to reflect the magnitude of vortices over ripple surfaces.