LABORATOIRE DE CONSTRUCTIONS HYDRAULIQUES

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Influencing river morphodynamics by means of bubble screens. Fundamentals and application to open-channel bends.

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Introduction

Low-gradient rivers often develop a meandering morphology. Each curve of a meander is thereby characterized by a particular morphological profile. Outer banks are vulnerable to scouring whereas deposition occurs near the inner bank.

This variation in the bed topography is related to the existence of a recirculating cell which redistributes the velocities and the boundary shear stresses. In the particular case of a navigable channel, this morphological evolution can create troubles because of the reduction of the navigable width in the curved part of the channel.

The purpose of this research project is to investigate how a bubble screen can be apply to counteract sedimentation in open-channel bends.

Experimental procedure

Experiments are carried out in a 22.7 m long laboratory curved flume of 1.3 m wide with a central radius of curvature of 1.7m.

Bubbles are generated by means of a porous tube, connected at both ends to a pressurized air circuit.

Two experiments were performed under clear-water conditions with no sediment recirculation but with similar hydraulic conditions. The first one, M57_14_00 was performed without bubble generation and the MB55_14_00 experiment with bubble generation.

The objective was to compare the final bed topography and determine the influence of the bubble screen.

Results

Figure 1 illustrates in detail the morphology for the two experiments. Without bubble screen, a bar is formed at the inner bank between the cross-section located at 30° and 150° in the bend. Maximum scour depth is about 25 cm under the flume-averaged level. In the bubble experiment, the bed level is in general much flatter than in the reference experiment. However, a scour hole with a maximum depth of 12 cm under the flume-averaged level associated to a small bar can be noticed in the upstream part of the bend.

These experiments suggest that a bubble screen can be applied to actively influence and modify the morphology in rivers.

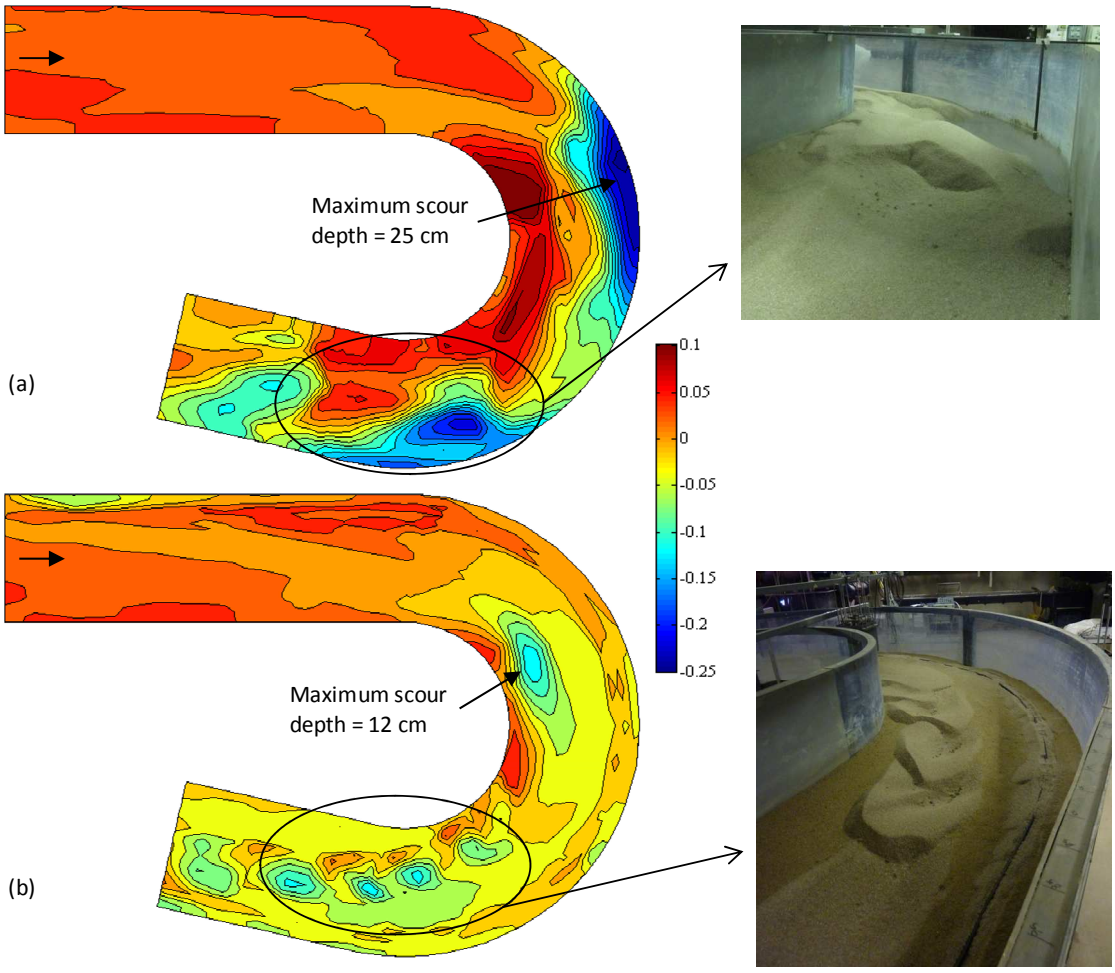

Figure 1 : Isolines of the bed level with an interval of 2 cm (a) for the experiment without the bubble screen and (b) for the experiment with bubble screen. The inserted pictures provide visualization of the mesoscopic bedform features in the downstream part of the bend.)