Introduction

The instability of the stream flow occurs either when scouring causes the channel degradation or when excessive deposition causes the bed aggradation. The origin of these river changes could be due either to human interferences (construction of dams, levees, bridges, canals, bank protection, and navigation works) or to natural changes (variation of the annual rainfall, variation of the frequency precipitation and of the distribution of the rainfall, etc…). A hydraulic structure realized in a natural river modifies the characteristics of flow velocity field near the structure itself. The variation of the flow velocity field produces changes in flow sediment transport capacity and this involves to disequilibrium between the actual sediment transport and the flow capacity to transport sediments. The scouring process is an important research topic in engineering practice.

The presence of a hydraulic structure (such as bridge piers, abutment, positive-step stilling basin, bed sill and grade control structures) causes flow obstruction and, consequently, erosion downstream and/or around the structure. This produces a scour hole which might undermine the stability of the structure. Thus, it is necessary to design adequate protective measures against local scour developing around the structure. For this reason it would be extremely important to have a full knowledge of the initiation mechanism and the time-space evolution of the scour hole.

Breusers et al. (1977) defined local scour as a natural phenomenon determined as consequence of the erosive action of the flow. Usually scouring phenomena occur in river beds consisting of granular alluvial materials, but it also may occur in cohesive materials (clay) and/or in deeply weathered rock.

In literature, the scour process is classified according with the circumstances and/or structures that give rise to it. May et al. (2002) suggest to classify scour phenomenon into three categories: local scour, contraction scour and general scour. The *local scour* results from the impact of an individual structural element on the flow and it occurs only close to the element. The presence of the structural element produces an increase of the local flow velocities and the turbulence intensities, which, depending on structure's shape, can give rise to the formation of turbulent vortices. As a result, the rates of ersoion and sediment movement are locally enhanced around the structures. The *contraction scour*, also called *constriction scour* (Richardson et al., 1990), which occurs often in the vicinity of a bridge, is associated with the high values of the velocities caused by the narrowing of the channel. Contraction scour determines the removal of material from most of the river width due to the increasing of velocities and shear stress at the bed. The *general scour* includes the bed degradation, the bend scour and the confluence scour. These phenomena are often associated to the variations both of the catchment characteristics and of the river plan form.

The basic information required for the prediction of the local scour include the quantification of the ability of the bed material to resist to the erosive action of flow, the quantification of the erosive capacity of flow itself, and the definition of threshold relationships (Annadale, 2006). Several factors influence the development of scour and they differ according to the type of the considered structure. Protection works for preventing scour need to be designed to withstand the flow forces imposed on them, and have to be practicable to build and install while minimizing environmental effects.