Hydrodynamics in a coarse porous layer above a sandy bed with application to contact erosion in hydraulic structures

Pierre Philippe*[1] and Rémi Beguin

[1]Risques, Ecosystèmes, Vulnérabilité, Environnement, Résilience – Aix Marseille Université, Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement, Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement : UMR1467 – France

Résumé

Many natural or industrial processes take place within a porous medium subject to flow, and it is essential to characterise this type of flow as accurately as possible. Applications include the transport of particles of all types, the diffusion of chemical compounds, depth filtration and some of the mechanisms of internal erosion of soils. Of particular interest here is contact erosion where porous flow along a coarse layer induces erosion of particles from a finer soil layer in contact. Once eroded, the fine particles are transported through the pores and constrictions of the coarse material. This phenomenon is often suspected in river embankments. The present work provides a better understanding of flow at the pore scale through the use of an experimental model system based on an optical technique combining refractive index matching with plane laser-induced fluorescence. Pore flow can then be measured by particle image velocimetry within a granular layer in contact with an underlying fine sand layer, in a situation where erosion of the sand layer is not active. The results demonstrate in particular that correct modelling of such flows cannot be satisfied solely with average values, as is often suggested in the literature, but must take account of the variability of porous flow, in time for turbulent flow or in space in the present porous geometry case. With this in mind, statistical modelling of contact erosion is proposed and compared with previous sample-scale contact erosion tests, with satisfactory agreement.

*Intervenant