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Viscosity effects in clear water scouring around structures

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Local scouring in clear water conditions is a phenomenon of great interest for the design and risk assessment of a plethora of hydraulic structures, in particular for bridge foundations. Traditionally, the study of local scouring has been addressed by means of empirical approaches where dimensional analysis and data fitting techniques were used to develop predictive formulae for the computation of equilibrium scour depths in steady flow conditions. A recent study (i.e. Manes and Brocchini (2015), Journal of Fluid Mechanics, vol. 779, pp. 309-324) proposes a different approach where a predictive formula for local scour in clear water and live-bed conditions was derived by applying principles pertaining to the Kolmogorov theory of Turbulence and classical paradigms of sediment transport mechanics, such as the Shields' criterion for sediment entrainment. The proposed approach was derived under the hypothesis of negligible viscosity effects in determining the shear stress and the critical shear stress within the scour hole. In the present work this hypothesis is relaxed and a theoretical study about viscosity effects on clear-water scouring processes is presented and discussed. Theoretical predictions are then validated by means of experimental data taken from the literature pertaining to local scour around piers and abutments.