TESTING INDIRECT METHODS TO INFER HYDRAULIC CONDUCTIVITY IN STREAMBED SEDIMENTS: PRELIMINARY RESULTS

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The saturated hydraulic conductivity (K) is an essential parameter in physically-based models for simulating water flow and chemical transport in soils.
Streambed K can be derived from empirical relationship between K and various statistical grain-size parameters such as the geometric mean, median, and effective diameter (Vukovic & Soro, 1992).
Although many direct and indirect methods can be selected to determine hydraulic conductivity of unconsolidated sediments, each method has faults that limit its application. Compared to other methods, grain-size methods are less expensive and less dependent on the geometry and hydraulic boundaries of the streambed (Song et al., 2009).
The aim of this study is to test about fourteen methods to determine the permeability by indirect measurement estimating the value of the hydraulic conductivity (K) from the particle size distribution curves. Reliability of the methods were evaluated comparing the calculated parameters with those obtained through in situ infiltration tests with the double ring infiltrometer and with constant head permeability test in the laboratory carried out on the same samples used for grain size characterization.
To test the methodologies, seventeen samples ranging between poorly sorted gravelly sand with fines and poorly sorted sandy gravelly silt with fines were used. The uniformity coefficient (Cu) varied in the range of 40-7000.
Different empirical methods have been used based on the equation presented in Vukovic & Soro (1992), as a function of certain coefficient and effective grain size, usually corresponding to d10. Because of the high value of the coefficient of uniformity of samples, according to Urumovic & Urumovic (2014) the Kozeny-Carman model was applied using the value of the geometric mean of the grain size in place of the effective diameter d10. Indeed, for alluvial samples showing a wide range of diameters, the geometric scale is much more suitable than the arithmetic scale. Conversely, when d10 is used, the Kozeny-Carman model returns correct values of permeability only for uniform deposits (Urumovic & Urumovic, 2014). The K values obtained from distribution curves have been compared with the results of infiltration tests. These values were generally lower of an order of magnitude, compared to the calculated dataset. This may be due to the different depth of sediments sampling for laboratory analysis compared to the infiltration test in situ. In fact the infiltration double ring tests were carried out on the surface in places subject to grazing cattle, were compaction of soil occurs. Instead, the preliminary permeability tests provided results more consistent with those obtained from the application of the Kozeny-Carman model.

References

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