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Influence of the heterogeneity on the hydraulic conductivity of a real aquifer

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Abstract
Many factors influence the flux in the porous media therefore the values of the representative parameters of the aquifer such as the hydraulic conductivity (k). A lot of studies have shown that this parameter increases with the portion of the aquifer tested. The main cause of this behaviour is the heterogeneity in the aquifer (Sànchez-Vila et al., 1996). It was also verified that the scale dependence of hydraulic conductivity does not depend on the specific method of measurement (Schulze-Makuch and Cherkauer, 1998).
An experimental approach to study this phenomenon is based on sets of measurements carried out at different scales. However, one should consider that for the lower scale values k can be determined by direct measurements, performed in the laboratory using samples of different dimensions; whyle, for the large scales the measurement of the hydraulic conductivity requires indirect methods (Johnson and Sen, 1988; Katz and Thompson, 1986; Bernabé and Revil, 1995).
In this study the confined aquifer of Montalto Uffugo test field was examined.
This aquifer has the geological characteristics of a recently formed valley, with conglomeratic and sandy alluvial deposits; specifically the layer of sands and conglomerates, with a significant percentage of silt at various levels, lies about 55-60 m below the ground surface, where there is a heavy clay formation. Moreover in the test field, for the considered confined aquifer, there are one completely penetrating well, five partially penetrating wells and two completely penetrating piezometers. Along two vertical lines a series of cylindrical samples (6.4 cm of diameter and 15 cm of head) were extracted and for each one of them the k value was measured in laboratory by direct methods, based on the use of flux cells. Also indirect methods were used; in fact, a series of slug tests was carried out, determining the corresponding k values and the radius of influence (R). Moreover another series of pumping tests was carried out determining again the corresponding k values and the radius of influence; in fact, changing the pumping rate, varies also R. For the different sets of k values, obtained by different measurement methods, a statistical analysis was performed, determining the meaningful statistical parameters. All the obtained k values were examined, furnishing a scaling law of k for the considered aquifer. The equation describing this experimental trend is a power law, according to Schulze-Makuch and Cherkauer (1998).
These results, obtained for the Montalto Uffugo test field, show that the hydraulic conductivity grows with the radius of influence, id est with the volume of the aquifer involved in the measurement. Moreover, the threshold value, to which k tends with the growing of R, was determined.

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