

Vertical hydraulic conductivity of riverbank and hyporheic zone sediment at Muda River riverbank filtration site, Malaysia

ABSTRACT

In analysing the stream–aquifer interactions and riverbank filtration (RBF) systems, it is very crucial to determine the vertical riverbank and streambed hydraulic conductivity. The riverbank and streambed focused in this investigation are a riverbank of six layers with depths of 38 m and streambed with depths of 9 m connected layers of sediments at 22 test locations and 4 test wells in the Muda River, Malaysia. In the analysis, there were a few tests involved to determine riverbank and hydraulic conductivity of vertical streambed, such as analysis of grain size, pumping test and in situ falling head standpipe permeability tests. The approximate K values of 114 samples and 15 samples taken from riverbanks and streambeds, respectively, were then calculated by employing empirical equation methods [Hazen, Hazen K (cm/s) = d_{10} (mm), Terzaghi, Beyer, Slichter, Sauerbrei, Kruger, Kozeny–Carman, Zunker, USBR, Zamarin, Barr, Alyamani and Sen, Chapuis, and Krumbein and Monk]. The geometric mean of K for six layers, namely the sandy silt (8.30 m/day), silty sand (47.66 m/day), gravelly sand (150.24 m/day), sandy gravel layer (418.48 m/day), gravelly sand (151.09 m/day) and silty clay (9.36 m/day) as identified characteristics by using grain-size analyses, was greater than the K of pumping test (geometric mean) (31.10 m/day) and the mean obtained from K of permeability tests (7.03 m/day). In general, the K values of upper layer of sediments of streambed were recorded to be larger in comparison with their respective lower layer of sediments. The K value for the upper layer of sediments from all tests located at the left, right and middle parts of the river ranged from 7.56 to 54.77 m/day for upper layer, from 39.80 to 128.40 m/day for middle layer and from 9.11 to 49.92 m/day for lower layer, as described by the grain-size analysis. The value of K ranges based on permeability test indicated that the value of K was from 0.036 to 1.09 m/day for the upper layer and 0.16 to 0.68 m/day for the lower layer of hyporheic sediments zone. Based on the acquired results, the conclusion that the aquifer of the focused area shows possibility for RBF and has the potential to improve the water quality and quantity is referable.

Keyword: Grain-size analysis; · Streambed; · Riverbank; · Hydraulic conductivity; · Riverbank filtration; · Malaysia