Geophysical Research Abstracts
Vol. 20, EGU2018-991, 2018
EGU General Assembly 2018

Single ring Beerkan infiltration of Newtonian and non-Newtonian fluids for hydraulic SuDS (Sustainable Drainage Systems) characterization

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The urban sustainable drainage systems are mostly based on the infiltration function of constructed structures included in the urban landscape, such as gardens and parks, or on the storage-infiltration function of porous parking lots and public roads combined with storage structures. It is important then to define the hydrodynamic characteristics of these structures to ensure their optimal functioning. This work aims to improve the knowledge of pore distribution in compacted infiltration porous materials by using Newtonian and non-Newtonian fluids. The study of infiltration velocity of water in addition to N-1 non-Newtonian solutions in a soil enables to establish an independent system of N Hagen–Poiseuille flow equations providing a set of N mean pore radii (Ri) and their corresponding proportions (wi) among the total porosity (Abou Najm et al., 2016). This model allows the estimation of both the water retention curve and the effective hydraulic conductivity corresponding to each pore Radii Ri by using Young-Laplace and Darcy equations. The current study is an experimental application of this method by combining the Beerkan protocol to the use of four Xanthan Gum solutions (i.e. non-Newtonian fluids). The rheological properties of these solutions is given by Zhong et al. (2013). Infiltration tests are conducted on sand boxes, on an embankment of a grass-covered garden and on three urban stormwater management structures. The studied SuDS are a vegetated hollow core slab, and a parking lot with a waterproof pavement ensuring the runoff of rainwater towards a receiving drainage ditch. The non-Newtonian fluid method is compared to the BEST method (Beerkan estimation of soil transfer parameters) (Lassabatere et al., 2006) having served to characterize the same structures in a previous study using Newtonian fluids. This study shows that non-Newtonian Fluids are a complementary alternative to upgrade the in-situ infiltration tests.

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