Geophysical Research Abstracts,
Vol. 10, EGU2008-A-08488, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-08488
EGU General Assembly 2008

Effect of oversized material on soil permeability

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Fine grained and coarse grained soils are widely used for engineering purposed. For example, clay is frequently used as core material for earth dams and as base liners for landfills, while sand is widely used for various construction purposes, e.g. pavement, railway and dam. Their mechanical and hydrological properties are usually determined in laboratory on soil samples of standardized size. Frequently, soils are composed of different grain fractions. For laboratory tests, the oversized material is to be sorted out in order to obtain reliable results. For example, the German Standard requires that grains larger than 1/5 of the sample diameter are to be sorted out before testing. As a consequence, the experimental results provide only information on the properties of the soil excluding the oversized material. The effect of oversized material must be taken into consideration by corrections. The present paper is an experimental investigation into the effect of the oversized material on the permeability of soils.

Three typical soils were investigated: clayey, silty and sandy soil. The permeability depends on the soil density and is about 10^{-10} - 10^{-9} m/s for clay, 10^{-9} – 10^{-7} m/s for silt and 10^{-6}-10^{-5} m/s for sand. Two kinds of tests were carried out, namely tests with constant water head and falling water head. While the former test is primarily applicable to fine grained soil, the latter is suitable for coarse grained soil. As oversized material, three gravels were used, i.e. well graded gravel: d_{min}= 2 mm/d_{max}= 18 mm, intermediate graded gravel: d_{min}= 4 mm/d_{max}= 18 mm and poorly graded gravel: d_{min}= 8 mm/d_{max}= 18 mm.

The following observations can be made for the tests on clay. The grading of gravel has significant effect on the permeability of clay. For well graded clay, the permeabil-

ity increases with the amount of gravel till the threshold of about 20%. Beyond the threshold, the permeability was found to decrease with the amount of gravel. For intermediate graded gravel, only minor change of permeability could be observed. For poorly graded gravel, the permeability decreases with the amount of gravel. The tests on silty soil, similar observations can be made. The tests on sand show that the effect of gravel on permeability is less pronounced than for clay. Our test results can be used to correct the routine laboratory tests by considering the effect of the oversized material.