Geophysical Research Abstracts, Vol. 7, 01571, 2005
SRef-ID: 1607-7962/gra/EGU05-A-01571

The mechanical behaviour of structured and homogenised soils under cyclic loading

S. Peth and R. Horn

Institute for Plant Nutrition and Soil Science, University of Kiel, Germany, e-mail: s.peth@soils.uni-kiel.de

Soils may be subject to cyclic loading under various circumstances. Civil engineers often encounter the phenomenon of cyclic soil deformation due to the application of traffic loads on pavements or the dynamic action of waves along dams. Frequent wheeling events resulting from field traffic or the trampling action of animals in livestock husbandry also lead to repeated ("cyclic") stress applications on agriculturally used soils. In view of an intensified use of cropland by man an increasing number of load repetitions may result in unfavourable cumulative soil deformation accompanied by the deterioration of soil functions particularly underneath the ploughing zone. The importance of a well developed soil structure not only for soil functioning but also for the mechanical stability of soils is well known in agricultural soil mechanics. Based on Hooke's elasticity theory usually soils are considered to react fully elastic when exposed to stresses lower than their pre-compression stress while exceeding pre-compression stresses often leads to a significant reduction in pore volume by plastic deformation. This assumption might be true for a low number of load applications. However, repeated loading events result in small incremental soil deformations even if the "critical" pre- compressions stress will not be surpassed finally adding up to sometimes substantial cumulative changes in pore volume. This paper presents some results of cyclic oedometer test conducted on homogenised "unstructured" soils (various textures) as well as on aggregated structured soils of different tillage systems (conventional vs. conservation tillage). Undisturbed soil cores (d=10cm, h=3cm) have been taken at a field experimental site close to Göttingen/Germany. Samples were saturated and afterwards adjusted to a matric potential of -6 kPa. After preparation the undisturbed cores were then loaded with an axial stress of 40 kPa in an oedometer device for a duration of 30 sec and subsequently unloaded for another 30 sec, i. e.

one load cycle is completed after 1 min. During the test water suction and vertical soil deformation have been measured. Each test was completed after a repetition of 100 loading - unloading cycles. After the cyclic loading tests were completed the samples have been homogenised, re-filled into the cylinder with the aid of a loading frame to give the same bulk density as was found in the undisturbed samples and subsequently tested again with the same initial matric potential of -6 kPa. Further, homogenised soil samples of various textures have been prepared with the same procedure at various initial soil bulk densities to investigate the influence of soil texture and bulk density on cyclic soil deformation. The mechanical behaviour of soils under cyclic loading is discussed concerning the role of soil texture and structure in the deformation process. Furthermore, the reaction of soil matric potentials during the tests with respect to the sudden change in the external stress situation and its implication for the deformation sensitivity will be addressed.