Geophysical Research Abstracts,
Vol. 11, EGU2009-463-1, 2009
EGU General Assembly 2009

Development of an evaporation-optimized and water-permeable pavement

P. Starke, P. Göbel, and W. G. Coldewey

Chair of Applied Geology, Institute of Geology and Palaeontology, University of Muenster (WWU Muenster), Corrensstr. 24, D-48149 Muenster, Germany (angeo@uni-muenster.de / Tel.: +49-251-8333977)

During recent decades, urban areas have been threatened more frequently by flood events. Furthermore, the potential for damage from these events has increased on average. The construction of houses, streets and parking lots has caused this trend by sealing the ground surface, i.e. these water-impermeable areas reduce the natural infiltration and evaporation-rates, and in some cases it is even completely stopped. The consequence is the so called “urban water cycle”. Water from precipitation cannot be stored anywhere and so there is an immediate and very high surface run-off effect. Especially after intense rain events, canalisations and sewage-treatment plants are overloaded and this leads to higher costs for water treatment and to environmental damage.

A practical solution to this problem is the use of water-permeable pavements. Here higher infiltration rates lead to a groundwater recharge that is greater than that of natural soils. The consequences from using these surfaces are already noticeable in many places through increasing groundwater levels. These increases cause damage to buildings. A second difference from a natural-soil water-balance is a lower evapotranspiration rate. Up to now the evaporation rates for water-permeable pavements has not been established accurately.

The aim of the applied research project at the University of Muenster, which is sponsored by the DBU (The German Federal Environmental Foundation), is to gain knowledge of urban evaporation rates and of water-permeable surfaces, especially water-permeable pavements.

Water-permeable pavements consist of the paving stone surface and the two sub-base layers below. Pre-investigations show that evaporation can be influenced by the complete sub-base. Therefore, the first step was to investigate which materials are used for sub-base construction. All in all, 27 materials were collected from throughout Germany and these materials were then tested (in terms of physical and hydraulic attributes) in the soil-mechanics laboratory of the University of Muenster.

For their street construction useability, and having regard to evaporation, a selection of appropriate materials were built into a test field. The test field consisted of seven hexagonal areas each about 10 m^2 large, which are placed in a honeycomb manner. The evaporation measurements are carried out with a WERNER tunnel-evaporation gauge (TUV) which is able to detect the actual evaporation rate. Its functional principle also allows a direct comparison between the middle reference area and one outer area of the test field. Every measuring period lasts one week and after that the TUV is moved to between the next outer area and the reference area. So the TUV rotates over the whole test field and every measuring area is covered by a measurement. In addition, a Hellman rain-gauge near the test field enables the measurement of a direct precipitation-evaporation ratio. Since the start of the measurements in July 2008, the first results collected showed that measureable differences in evaporation rates could be detected after a few measuring periods, i.e. the differences are up to 32% between the reference area and one outer area.

In July 2009, the six outer measuring areas of the test field will be replaced and, based on the actual results collected, the sub-base layers will be replaced by an evaporation-optimized sub-base. The new outer measuring areas will only differ in terms of a different paving-stone surface. These paving stones are actually under developement and under laboratory testing (i.e. permeability, porosity, capillary water and evaporationrates), and so they will be evaporation-opimized. The open-air test in the test field is to assure and compare the evaporation rates.

As a final result, the evaporation-optimized and water-permeable pavement and the knowledge of its exact drainage ratio will allow city planners or architects to build water-permeable streets with due regard to the respective area-specific conditions. This new developed pavement is an approximation to the water balance of a natural soil. In

this way, the danger of flooding can be further reduced in urban areas.