BWU26004

Abstract

Recultivation layers in waste dump surface sealing systems inter alia have to be conducive to the reduction of emissions by keeping away atmospheric water from the disposals. The research project BWU 26004 „Leonberg 2005+ - Wasserhaushalt qualifizierter Rekultivierungsschichten“ dealt with characters and water balance of recultivation layers. The hypothesis was, that an optimized recultivation layer with uncompacted soil should allow an easier and more intensive rooting and a better growth of plants, so that leakage would be reduced by increasing the evapotranspiration (transpiration and interception) of the plant cover.

In the year 2000 on the Leonberg landfill (Landkreis Böblingen, Baden-Wuerttemberg) two large lysimeter fields were constructed and planted with trees. The only difference between these two fields is the manner of the installation of the recultivation layers. In one field the soil installed was not compacted, whereas in the other field the soil was mechanically compacted in three single layers.

Targets of the project were to continue the examinations on the water regime and the development of soil and vegetation to obtain continuous data series from the outset and to maintain the test field facility for long-term operations. The working program includes the collecting of weather data, leakage rates and soil moisture values including backwater levels in the lysimeter fields as well as examinations of the vegetation development, the earthworm population and the soil structure.

Results of the latest examinations of soil characteristics are, that only marginal signs of development of soil structures are recognizably in the subsoil so far. In particular no dissolution of compactions and horizontal orientated structures in the testfield with mechanically compacted soil was detected. The situation at the soil surface is considerably more favorable. After 10 years a topsoil layer of approximat 5 - 10 cm has developped, what is first of all a result of the earthworms’ activities: The small quantity of compost which was dispensed and the litter stemming from the trees were mixed with the mineral soil material. The earthworms successively amend the soil structure, but it will still last many years, until the structure of long standing forests or graslands will be achieved.

In the first years, the bulk densities of the soil in the two test fields featured remarkable differences as expected. In 2008, an examination in one soil profile per test field showed, that in the zone between 0,5 and 1,3 m the uncompacted soil was just as dense as the mechanical compacted soil. This effect may probably be caused by subsidence of the uncompacted soil.

Since the outset, the root penetration of the subsoil was much better in the uncompacted soil. But now it seems, that differences in root penetration decrease as well as the differences of the bulk densities. For the first time in 2008 roots could be discovered in the Field with compacted soil below a depth of 70 cm.

The earthworm population originally existing in the soil material nearly completely died off with the construction of the test fields. Because the resettlement of large areas by earthworms is very slow, earthworms were brought in to foster the populations rehabilitation in spring 2002. Since then biomasses and abundances of earthworms increased. The earthworm population found in 2010 was very rich in species and corresponded to good grassland soils, which suggests very good site conditions in the test fields. In 2011 the population of both test fields drastically decreased because of draught. By now, the differences between Field U and K are very small. In the field with uncompated soil however more middens of anecic earthworms are found. The uncompacted subsoil is a better shelter for these animals.

The measurements of the stem girth of the trees (*Populus tremula*) evidence a different thriftiness in the two test fields. Since 2004 the trees in the field with uncompacted soil show higher growth rates. In 2010 the average stem girth in this field was 568 mm in opposite to 412 mm in the field with compacted soil. Also the average height and the maximum height of the vegetation are different.

Comparing the two lysimeter fields' leakage rates shows increasing differences since 2006. The leakage from the field with compacted soil averages up to 18.4 % of the annual precipitation and the leakage from the field with uncompacted soil however amounts only to circa 11.3%. As one reason for this, the increasing evaporation due to the growth of woody species can be assumed. The leakage rates are affected by the weather, in particular the amount and the seasonal distribution of precipitation. An analogy of seepage rates and soil water content indicates that the generation of leakage does not depend on complete soil water saturation. Already at water contents below field capacity brief discharge events occur, more frequent and with higher leakage rates in the field with compacted soil. This shows the influence of the fast draining secondary pore system on the generation of leakage. Because of these differences between the test fields, it is assumed, that the mechanical compaction of the soil evoked more fast draining fractures.

These results indicate differences in soil characteristics between the test fields, which are relatively fine, but nonetheless important for site conditions. Soil protecting procedures, in particular the installation of recultivation layers with merest compaction possible, should be favoured therefore.