BWU 11003

Summary

Research project BWU 11003 deals with characters and water balance of recultivation layers in waste dump surface sealing systems. Optimized recultivation layers with uncompacted soil should minimize the leakage by means of evapotranspiration. In preceding projects on the Leonberg landfill (Landkreis Böblingen) 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 field U the soil installed was not compacted, whereas in field K it was installed in four mechanically compacted single layers. Employing this experimental set-up, the water balances of the two different recultivation layers as well as the most important factors influencing it can be ascertained and compared.

Targets of project BWU 11003 are 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.

The micromorphological observations of soil structure show that since the installation of the recultivation layer about 15 years ago compactions were dissolved to circa 10 cm depth and mineral and organic soil constituents have been mixed by earthworm activities. This layer is characterized by a low penetration resistance, a low bulk density and intensive rooting -signs for a favorable soil structure. Compacted layers in field K can still be identified micromorphologically and due to the penetration resistance. In both fields no signs of a bettering of the soil structure in dense zones can be observed. In less dense areas cavities have persisted, but due to the lack of continuity they may contribute little to soil aeration .

The earthworm population originally existing in the soil material nearly completely died off with the construction of the test fields in the year 2000. Because the resettlement of large areas by earthworms is very slow, earthworms were brought in to foster the populations rehabilitation in spring 2002. Up to 2008 biomasses and until 2009 also abundances of earthworms increased. In 2010 a moderate decline took place. The earthworm population found in 2010 was very rich in species and correspond 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 and in 2014 abundance und biomass died down to a very low level. By now, the differences between Field U and K are very small.

The rooting in the topsoil is actually as well as in previous years more intense in field K than in field U. In the subsoil, a reduced root penetration in compacted layers of the field K opposite to the uncompacted soil in field U was observed in the sampling 2013. In the remaining depth levels of the subsoil the rooting intensities vary strongly and no continuous differences between the fields can be found. It can be concluded that the root penetration of the subsoil in K-field proceeded with a delay of approximately eight years compared to the Ufield.

The results of the vegetation studies show a more rapid growth of the Aspen trees (*Populus tremula*) in the field with uncompacted soil. Today, 14 years after they were planted, these trees have an approximately 20 % higher stem girth. The annual growth rates of the Aspen trees in field U are -with the exception of 2014 -also higher. These results indicate differences in soil characteristics between the test fields, which are relatively fine, but nonetheless important for site conditions. As an explanation for the higher growth rate of the Aspen trees in 2014 in test field K and their reduced growth in field U intermittent water shortage of the better developed trees in the U-field can be presumed. Leaf analyzes did not indicate any differences between the two fields concerning the nutrient supply of the trees. Therefore, nutrient supply may not be considered as a

reason for the different growth rates in 2014.

Comparing the two lysimeter fields' leakage rates in the period 1.6.2003 -31.12.2014 shows an approx. 30 % lower leakage rate from lysimeter field U (uncompacted soil). Because of the vegetation and soil development the initially very high leakage from the two test fields decreased significantly and for the first time in the year 2014 reached a similar level. The relevant specifications of the DepV for "Wasserhaushaltsschichten" could almost be reached in 2010 (64 mm) and for the first time definitely fulfilled in 2011. The leakage from lysimeter field K undercut the limit of 60 mm/a according to DepV for the first time in 2012. The year 2013 with considerable higher leakage rates than in the previous years indicates that the performance of the "Wasserhaushaltsschicht" as a natural component of the surface sealing is partly depending on the weather conditions and not only on sum of precipitation.

The results about soil development and leakage rates lead to the recommendation to favour soil protecting procedures, in particular not stratified installation of recultivation layers with merest compaction possible in the subsoil. This contributes to minimizing leakage rates from recultivation layers in the long term.