

Laboratory Lysimeter for Testing Leaching

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Hydraulic problems with infiltration and percolation of rainwater on sports grounds are often reported. Sports surface products may contain leachable substances of environmental concern. Substances like Zinc, Benzothiazole, Polycyclic Aromatic Carbons (PAC) are studied (1,2). Studying leaching of artificial turf grass with infill materials or hydraulic behaviour of unbound grounds as well as entire systems raised interest in test methods. Laboratory tests are already standardized and used, e.g. the tank test (EN 12457 (in DIN 18035)) or harmonized European Dynamic Surface Leaching Test (DSLTL) as a material test (CEN TS 16637-2). A simple system test was initiated under umbrella of DIN (CEN TS 16384:2012). However, this system test is still lacking due to the focus on materials of the upper layer.

We installed in a laboratory lysimeter (30 cm diameter, 70 cm heights) the whole system of an artificial sports ground with different probes for continuous measurements. Main interest was in the leaching behaviour of zinc and Benzothiazole used in the EPDM infill. Water samples were taken in 10 cm depths and a suction plate at the bottom (outflow) in 70 cm depth. Zinc was analysed by ICP-MS, Benzothiazole by LC-MS/MS. The irrigation (20 L/m² h) was set to three intervals each 6 h and 18 h drying in-between. The total amount is corresponding to 360 L/m². After the irrigation cycles, the food dye Brilliant Blue was applied continuously to trace the flow paths. The DSLTL developed for construction products has been used for studying leaching of artificial turf, EPDM infill, and shock pad.

The results show zinc release from EPDM infill in small quantities (2.5 g/m² over 64 d) in the DSLTL, but cannot be determined in the leachate of the lab lysimeter. At pH >8.0, zinc is precipitated and immobile in the subsurface material. These results are in line with the former Swiss lysimeter study (3). Benzothiazole was present in DSLTL water samples at high concentrations and leachate concentrations in outflow were also above the proposed acute quality standard for surface and groundwater (0.25 mg/L). Artificial turf and the shock pad did not release zinc and Benzothiazole. Overall, the emission of Benzothiazole in DSLTL is about a factor of 16 higher than in the lab lysimeter. Taking into account the different amounts of water in the lab lysimeter and DSLTL, the specific emissions normalized per litre account for 14 mg/m² L Benzothiazole in DSLTL and 6 mg/m² L Benzothiazole in the lysimeter.

The following conclusion and outlook can be given:

- The lab lysimeter is rapid, reproducible, and realistic due to testing a system under unsaturated conditions. It is applicable also in the field to run a series of system tests at the same site. In such a realistic layered profile, zinc is immobile due to the pH > 8.0.
- The DSLTL (16637-2) is excellent set-up to determine the leaching processes (wash-off, diffusion) and assess the long-term release (e.g. 5 or 30 years). A transfer factor is needed for upscaling the results. The typical pH is not representing the conditions in the field like the tank test or system test (CEN TS 16384:2012). However, test conditions can be adapted (pH, UV, temperature etc.).
- Using the food dye Brilliant Blue is an excellent approach for tracing water flow and transport pathways.

References

- 1) Nilsson, N.H., et al. (2008): Emissions and environmental and health assessment of chemical substances in artificial turf. Report, Danish EPA.
- 2) Wachtendorf, V., et al. (2017): Influence of weathering on the leaching behaviour of zinc
- 3) Müller, E. (2008): Kunststoff- und Kunststoffrasenflächen Verhalten unter natürlichen Witterungsverhältnissen. BASPO Federal Office of Sports, Magglingen, Switzerland