Swiss Ministry of Environment, Traffic, Energy and Communication
Authority of Environment
Section Water

Results of a Field Study on Environmental Compatibility of Synthetic Sports Surfaces

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During the 80ies Environment Authorities criticized Synthetic Surfaces because they contained Mercury. This substance and other dangerous heavy metals – such as Cadmium or Lead – were washed out with rain water and could run off to open waters or the underground. In order to get control of this contamination the guideline "Synthetic Surfaces and Environment" was prepared (ESSM Guideline 105, first edition 1993; 2nd edition 1997).

The method to assess the environmental compatibility of synthetic surfaces recommended in this guideline is not acceptable any longer from today's point of view. Especially, artificial turf surfaces have not been covered by this document. Therefore, in 2004, the Swiss Federal Authority of Sports (BASPO) initiated a committee to scrutinize and adjust the guideline. The committee decided to perform field testing as a basis for the preparation of a new assessment concept. With this test plus additional chemical and physical analyses (leaching tests etc.) it was investigated between November 2005 and May 2007 what types of substances and substance groups were released from the synthetic sports surfaces with rain water under natural weather conditions throughout a year.

The tests were performed with so-called Lysimeters. This facility is normally used for scientific investigations in agricultural research, for determination for wash-pit of nutrients and herbicides from soil. In 10 Lysimeters, different filled and non-filled artificial turf surfaces and synthetic surfaces were installed. Installation was performed on top of a supporting layer (gravel layer + partly covered with permeable asphalt layer) in real scale. The lysimeters have a cross section of 1 m^2 being exposed to weather. They are equipped with devices to sample the water seeped through the sport surface. Thus, it was possible with this long-term well-tried technique to exactly determine the amount of water which seeped through the lysimeters, to collect the rain water amount-proportionally, to analyze and to establish substance balances.

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The following surface systems have been installed and investigated.

Artificial Turf	- Artificial turf filled with EPDM granules (peroxide cured) and quartz sand on top of an elastic layer - Artificial turf filled with truck tire granules and quartz sand - Artificial turf filled with EPDM granules (sulfur cured) and quartz sand on top of an elastic layer - Artificial turf without in-fill
Synthetic Surfaces	- water permeable EPDM surface bound by PUR binder - water permeable surface with spray coat - impermeable sandwich surface
Reference Installations	- gravel layer without any cover - gravel layer with asphalt drain layer - elastic layer of SBR granules bound by PUR binder

The analytic measurements of the water comprised sum parameters as well as organic individual substances which are used in formulation of rubber or substances which can be produced of the various rubber chemicals as a transformation or decomposition during the curing process. The variety of these substances is large. Therefore, a selection had to be applied.

Sum parameters	individual substances
- DOC (diluted organic carbon) - Sum of the solved organic nitrogen compounds	- Anilin - alkylated Phenylendiamine - benzothiazol - cyclohexamin - 16 polycyclic aromatic hydrocarbons PAH - zinc - ammonimum nitrogen - nitrate nitrogen - nitrit nitrogen

In addition to the lysimeter field tests, the zinc content of the various rubber granule products were determined and Differential Scanning Thermo Analyses as well as leaching tests were performed for characterization of the products.

The field tests have shown that the today's micro analytic technique enable to detect even the least traces of organic substances in the water drained from synthetic sports areas. These substances are washed off the surface of the granules by rainwater within a relatively short time. At the end of the 1-year test period the concentrations of the analyzed substances were below the analytic determination limit of 0.2 µg/liter water. This behavior could also be found with leaching tests (i.e. several hour shaking of the granules). The found substances are the same trace substances which are contained in road drainage waters (as a consequence of tire abrasion) and in purified waste water of municipal purification plants.

During the whole test period no enlarged amounts of zinc were released to the aquatic environment.

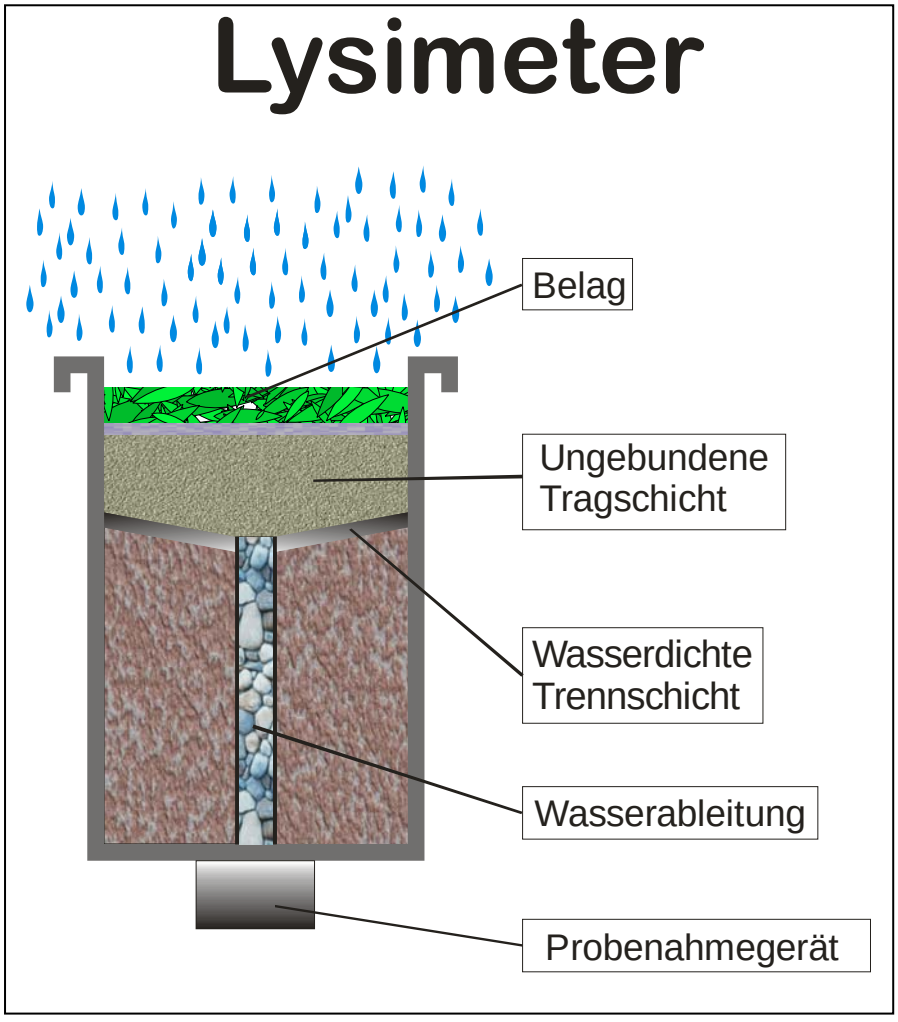
The seeping water of all surface types exhibited the same low ubiquitous PAH traces as the freely (i.e. without sports surface) exposed reference lysimeter equipped with just the gravel layer. No critical amounts of PAH complexes could be found in any seeping water probe.

Conclusion

The field tests and the additional lab tests revealed essential new knowledge of the behavior of synthetic sports surfaces when exposed to natural weather conditions. The following conclusions are drawn:

- rubber granules used as an in-fill of artificial turf or for installation of synthetic surfaces are water insoluble. all granules – independent of being newly manufactured or used tire scrap – release traces which can be analytically verified/detected in the seeping rain water.
- organic substances adhering to the surface of the granules are washed off by rain water within a relatively short time.
- According to today's knowledge there are no hints that synthetic sports surfaces have any detrimental effects to waters when built according to the state of the art. There are no investigations available in respect to long-term behavior of these surfaces.
- From a scientific point of view it is not possible to establish test procedures and requirements since necessary information/basics are missing.

It is the task of further negotiations to find out in which way decision assistance and recommendations should be prepared for practical application i.e. for selection of location, draining off or seeping of rain water and the selection of products/materials for future disposal.




34