DIN 18035-7:2002-06

Sports Grounds Part 7; Synthetic Turf Areas

Determination of Environmental Compatibility

(translation performed by H.J. Kolitzus to serve scientific discussion)
Full German text is available at www.DIN.de)

Table 7 Environmental Requirements (Soil and Ground Water) and Testing of Bound Elastic Supporting Layers, Elastic Layers and Synthetic Turf Layers (including in-fill material of pile layer)

Column	1	2	3	
Row	Parameter (Extract/Eluate)	Requirements	Testing	
			Extract/Eluate produced acc.	Analytic Method
1	DOC (diluted organic bound carbon)	≤ 20 mg/l [a] ≤ 40 mg/l [b]	6.11.2	6.11.5.1
2	EOX (extractable organic bound Halogenes)	≤ 100 mg/kg	6.11.4	6.11.6
3	Lead (Pb)	≤ 0.04 mg/l	6.11.3	6.11.7
4	Cadmium (Cd)	≤ 0.005 mg/l	6.11.3	6.11.7
5	Chromium (Cr) total	≤ 0.05 mg/l [c]	6.11.3	6.11.7
6	Chromium VI (CrVi)	≤ 0.008 mg/l [c]	6.11.3	6.11.7
7	Mercury (Hg)	≤ 0.001 mg/l	6.11.3	6.11.7
8	Zinc (Zn)	≤ 3.0 mg/l [d] or ≤ 0.5 mg/l [d]	6.11.3 or 6.11.2	6.11.7
9	Tin (Sn)	≤ 0.05 mg/l	6.11.3	6.11.7
10	Toxicity (as inhibition of nitrification)	inhibition ≤ 50% [e] or no requirement [e]	6.11.2	6.11.5.2
11	Biological Breakdown (aerobic)	if necessary	6.11.2	for instance: Guideline OECD 301 D
12	Smell	to be described		
13	Exterior Condition	to be described		

[a] without respect to EOX in total Assessment

[b] with respect to EOX in the total assessment

c The standardized methods of spectral photometry (see DIN 38405-24) and ion chromatography (see DIN EN ISO 10304-3) are capable of determination of CrVI of more than 0.05 mg/l only. Thus, total contents of Cr of ≤ 0.008 mg/l only meet this requirement. Is this not the case, the CrVI concentrations of less than 0.008 mg/l have to be proved using non-standardized methods.

[d] The requirement of ≤ 3 mg/l applies to elastic supporting layers, elastic layers and synthetic turf layers. The extract is produced acc. to 6.11.3 in acid environment. Elastic infill materials the Zinc content of which produced from non-acid 48h-extract (produced acc. 6.11.2) exceed 1 mg/l **and/or** the Zinc content of which produced from acid 48h extract (produced acc. 6.11.39) exceed 20 mg/l, do not meet the requirement at all (K.O. criteria). Elastic infill materials the Zinc content of which produced in non-acid 48h extract do not exceed 0.5 mg/l **or** produced in acid 48h extract do not exceed 3 mg/l meet the requirement.
It is emphasized that these requirements can be met reliably by EPDM granules only. When using recycled rubber, there is a risc of exceeding the requirements. This is due to inevitable non-homogenuous character of the raw material.

[e] The requirement of inhibition ≤ 50 % applies to elastic supporting layers, elastic layers and synte^hetic turf layers. The extract is produced in neutral environment acc. 6.11.2. There is no requirement set for elastic infill materials yet. Parallel and alternatively to this test, new test procedures and requirements which are relevant for the assessment of environmental compatibility are being developed.

4.11 Environmental Compatibility

The requirements Testing of Bound Elastic Supporting Layers, Elastic Layers and Synthetic Turf Layers including in-fill material of pile layers are listed in table 7.

The elastifying layers and the synthetic turf layer must be in a condition that hygiene and health of neighbours and users are not endangered by:
a) release of harmful gases and dangerous particles to the air
b) pollutrion or contamination of water and soil
c) in respespect to usage and disposal after use the following must be observed:
    - use of materials with low content of pollutants
    - restriction to as few as possible material types (compound materials)
    - easy separation of individual/various layers
    - priority use of worn-out materials by recycling or combustion rather than dumping

These requirements must be secured by quality monitoring according to section 5.6.

5.6 Quality Monitoring

Identity and continuous quality of the building materials and surface design must be secured by a quality monitoring program according to DIN 18200. The details are left to the monitoring requirements.

If the conditions have changed the suitability of the bound elastic supporting layer, the elastic layer and the synthetic turf must be proved anew. In order to realize changes use table 8 as well as the descriptive properties according to table 9 and the description of components of the surface system in the test report according to section 5.1.2.

For assessment of the environmental compatibility of the elastifying layers and the synthetic surface layer and some parts of the surface system the extraction method is used. The test procedures are described in section 6. Table 7 contains the requirements for the results.

6.11 Effect to Soil and Ground Water

6.11.1 Preparation of Samples

For Extraction/Elution, the samples are cut into pieces of 2 x 2 cm. After this preparation the pieces are extracted/eluted. The pieces of Elastic Layers and Elastic Supporting Layers receive a post-treatment by restoring the binder coverage of the rubber granules which was damaged by the cutting process. The 4 cut sides of the pieces are dipped into binder. For this a Petri tray is filled with 1mm of binder . After this, the pieces are sprayed with water for faster curing of the binder. After a curing time of 24h the pieces are extracted/eluted.

6.11.2 Extraction with water

The extraction process is performed according to DIN 38414-4.

For the determination of the DOC, the toxicity and the Zinc content (only in the case of elastomeric in-fill material), 100g of cut pieces (see section 6.11.1) or granules are added to 1000ml of de-ionized water (sample to water 1:10) and shaked for 24h 'overhead' at room temperature. Then, the received extract is filtered through a glas filter (acid-washed, 0.3 to 1µm) in order to get rid of particles (1^{st} extract 0-24h). The same pieces are treated a second time with 1000ml fresh water for another 24h (2^{nd} extract 24-48h) and filtered as before.

For evaluation/assessement the concentrations of DOC, Zinc and the toxicity of the 2^{nd} extract are used.

6.11.3 Extraction with CO_2 saturated water

For determination of the concentration of heavy metals 100g of sample pieces (see section 6.11.1) are extracted for 24h in a bottle with 1000ml of CO_2-injected de-ionized water (sample to water 1:10; about

50ml CO_2/min). The extract is filtered through a glas filter (acid-washed, 0.3 - 1 µm) (1st extract). The same pieces are then extracted a second time for another 24h (2. extract: 24-48h; socalled acid 48h extract) and filtered. The flasc/bottle is shaked during the extraction process in order to get rid of stuck gas bubbles (probably a shaking table).

For evaluation/assessment the concentrations of heavy metals of the 2nd extract are used.

6.11.4 Extraction with Hexan for subsequent determination of organic Halogen Complexes

6.11.4.1 Soluble shares in Hexan - Soxhlet extraction

Two to four pieces are added to an extraction tube and extracted in a Soxhlet apparatus with n-Hexane for 12h whereas the extraction tube is covered with the solvent over night. Since the material tends to swell considerably and small particles are separated the use of glass wool in the extractor is recommended. The extract is cleared of the solvent by means of a rotation evaporator and dried until constant mass at 105°C in a drying chamber. The final weight is determined (see DIN 38409-1)

6.11.4.2 Organicly bound Halogens of the residue of the Soxhlet extraction

The residue of the Soxhlet extraction is collected with Diisopropylether, final volume 25ml.

In order to dissolve the residue as completely as possible it is treated several times in an ultra-sound bath. The sample may show some sedimentation in the extraction bulb. For the determination of organic halogene complexes the top clear/transparent solution is used only.

6.11.5 Prove of dissolved organic compounds and the toxicity

6.11.5.1 Determination of dissolved organic carbon (DOC)

The determination of DOC is performed with the filtered extract according to DIN EN 1484. The organic carbon in the water may be cleared by blowing off. Adjust sample with concentrated hydrochloric acid to pH=2 to pH=3 and blow off. A pulled out glas pipe is suitable as a blow-off device. Normally, 5 minutes are enough at a gas flow of 200 ml/min. If there should be any precipitation during the acidification the sample should be diluted.

For assessment of the DOC value the 2nd extract is used.

6.11.5.2 Determination of eco-toxicity based on nitrification inhibition

Nitrificants are lively mud micro organisms which convert Ammonium Nitrogene to Nitrate. the 2nd water extracts are mixed according to DIN EN 9509 with lively mud which contains nitrificants after adding buffering salt and a defined amount of Ammonium and ventilated while stirred. Parallel to the extracts a blind value (de-ionized water) and a positive control with Allylthio-urine are determined. After defined time intervalls (for instance 0h, 4h, 7h, 22h, 30h) aliquots are taken, filtered (0.45 mm) and the remaining concentration of Ammonium is determined by means of a photometric procedure.

6.11.6 Prove of the amount of halogen-organic compounds (EOX)

10 ml are broken down in a burning apparatus, for instance according to Wickbold, and the resulting Halogenids dtermined with an automatic tritration device, for instance argento-metricly (see DIN 38409-8)

6.11.7 Prove of heavy metals

The 2nd acid extracts are investigated and assessed.

The quantitative determination of heavy metals is performed by means of plasma-nuclear emission spectrometry (according DIN EN ISO 11885) or by means of nuclear absorption spectrometry (AAS).

The determination of Mercury (Hg) is carried out according to DIN EN 1483.