Environmental Compatibility of Sports Surfaces

an ISSS Project

History

The problem of health and environmenal relevance of sports surfaces was first addressed in Germany after irritating information was published about harmful components within sports surfaces. In the seventies, it was discovered that mineral surface materials produced from ash contained heavy metals and Arsenic which could contaminate the lungs of the players through dust inhaled from the surface. The University of Aachen developed a concept how much of these substances is tolerable in mineral sports surfaces. Additional fear was realized when Dioxin was discovered as a component in the ashes from particular provenance as Dioxin was commonly associated with the Seveso disaster. Fortunately, a special study showed that the workers of the affected quarry enjoyed the best of health conditions. Still today, however, there are several sports fields on which play is not allowed because the material cannot be replaced by lack of financial means.

Following the subsequent discovery that certain synthetic surfaces were produced using Mercury as a catalyst, which migrated from the surfaces through leaching, Germany and Switzerland concluded that a policy to preclude further reproaches of harmful substances in the synthetic materials was necessary. This concept contained a broad unanimity that heavy metals are the most suspect and therefore most immediate substances to be controlled. DOC (Dissolved Organic Carbon) was included in order to have an overall indicator of organic substances (not indicating harmfulness, only indicating the presence of organic substances of which some might be relevant, but others such as sugar, may not be). If the DOC exceeds certain limits, EOX was added as a parameter to be controlled (Extractable Organic Halogens).

It was also the common conviction that only substances are relevant which are leachable because it were the receiving natural and artificial open waters and the ground water which were endangered by contaminated flowing off water. The method for investigation was taken from the EPA (Environmental Protection Agency) and other acknowledged guidelines.

The process includes that the surface layers are cut into pieces of 2x2 cm and 100g of those pieces are extracted/leached with 1000ml of water for 48 hours (first 24h = 1^{st} extract; second 24h with new water = 2^{nd} extract). The 2^{nd} extract is analysed.

It was agreed to ban Mercury and Cadmium and to reduce Lead and Chromium content. Regarding other heavy metals, there was uncertainty about the relevance in respect to health and environment. In order to collect information about the amounts of leachable heavy metals of the various synthetic surface products, a huge number of surface products was investigated (RAL organization with the Balsam company in Germany; Research Project of the Swiss Federal Ministry of Interior with participation of IST, 1991). From this data a line was drawn to show what 'regular' synthetic surfaces exhibit as a maximum content of heavy metals. The 'requirements' were understood as an empirical approach to establishing guiding figures or benchmarks against which any unusual content of heavy metals could be compared.

Based on this data, the Swiss published a document called "Kunststoffbeläge und Umwelt" (Synthetic Surfaces and Environment) in 1995 and the Germans amended their RAL GZ 941/1 document "Quality Monitoring of Synthetic Surfaces of Outdoor Sports Facilities" with the requirements for environmental compatibility in 1995. The Swiss and the German committees cooperated very closely so that the requirements are nearly identical. The distinctions between the German and the Swiss concept were that the Swiss added requirements for the total content of heavy metals in mg/kg and the Germans added the "Percolation" test. In the latter test, permeable samples were permeated as integral surface systems (i.e. not cut into pieces) in immediate successive steps running by 3 buckets of water (total amount 10lt) and the 3^{rd} extract was analyzed. The "Percolation" test has since been eliminated.

The measurement of total content of heavy metals was introduced due to a specific Swiss need to determine whether worn-out surface material could be disposed of through regular combustion with household waste. These requirements are questioned.

Deviating from internationally recognized leaching procedures (for instance EPA, Swiss Rules for Waste Disposal) it was agreed that the heavy metals are to be determined by leaching in acidified water (CO_2 saturated). This idea was not discussed in detail (neither in Germany nor in Switzerland). The idea behind this detail was to extract as much heavy metal as possible.

Another critical item of the test program is the toxicity test. The Swiss proposed the nitrification inhibition test, which was favored by the EMPA (Swiss Federal Institute for Testing Materials). This test was accepted in both countries without discussion.

While the Swiss document was re-published in 1997 without further development , the Germans started to apply the Environmental Compatibility concept (UVP = Umweltverträglichkeits-Prüfung) to synthetic turf and its components (turf layer, elastic layer, in-fill). Quite surprisingly, the 'requirements' were not adjusted. Notably missing was the consideration of the much higher specific surface area of the rubber in-fill in cm^2/cm^3. Thus, it was natural that the guiding figures seen in bound synthetic surfaces were exceeded, especially in respect to Zinc. This is due to the fact that the rubber granules - different from the same granules in synthetic surfaces - are not covered by PUR binder which hinders the leaching of substances of the granules.

The requirements for synthetic turf were first published as an amendment to the RAL document "Quality Monitoring Program of Synthetic Turf Surfaces" and in 2000 also integrated in the new version of DIN 18035-7 "Sportsgrounds; Synthetic Turf Areas" (ditto in latest version of 2002). As a result of the negotiations of the DIN committee, a double approach to Zinc determination was concluded. While EPDM granules can easily meet the 'old' requirement for Zinc (when re-formulated and produced with a much lower Zinc content), the black rubber granules often have a problem since SBR rubber for car tires requires Zinc as a manufacturing aid.

The RAL concept for Synthetic Surfaces has been integrated into the new edition of DIN 18035-6 "Sportsgrounds; Synthetic Surface Areas" which will be published in early 2004. In this application the amount of EOX and the Nitrification test have to be performed. However, the results do not count for the assessement of the material's Environmental Compatibility. This was decided since the DIN experts recognized and admitted not to be sure of the relevance of these tests.

One outstanding difference must still be mentioned. While in the RAL concept the cut pieces of the synthetic surface undergo the extraction process with no preparation, both of the new DIN standards specify that the cut sides of the pieces for extraction must be dipped into liquid PUR binder in order to seal the cut areas of the elastomeric granules (EPDM and SBR). Extraction in the DIN process is started after the binder has cured.

The UVP concept has been adopted by UEFA for its Artificial Turf Manual and Austria for its updated version of its Synthetic Turf Guideline (OISS) to be published in early 2004.

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