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EXPERT OPINION

Referring: Evaluation of health risks caused by skin contact with
rubber granulates used in synthetic turf pitches

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1 ORDER

As ordered the health risk potential of rubber granulate used in synthetic turf pitches caused by migration of harmful substances and by its direct skin contact to athletes should be evaluated.

This expert opinion is based on existing literature and the currently available knowledge.

2 BACKGROUND (FACTS)

Synthetic turf is defined as sports surface comprising a carpet of tufted, knitted or woven construction whose pile (fibres) is designed to replicate the appearance of natural grass. The non-filled synthetic turf is defined as a synthetic turf surface that does not contain any form of unbound particles within the pile of the carpet and is therefore not matter of concern.

In the case of filled synthetic turf the pile is either totally filled or partly filled with an unbound particulate material which is typically sand, rubber or sand and rubber mixtures. Possible elastomeric filling materials are recycled tyres made of styrene-butadiene-, butadiene-, isoprene- or natural rubber (short SBR, BR, IR or NR) or newly manufactured rubber granulates like EPDM rubber (ethylene-propylene-diene-elastomer). New filling material is being developed, and some alternatives are currently available, including rubber-covered sand and granulates of thermoplastics.

Advantages of recycled tyres are low costs but also the energy economy and the efficient use of resources. A strong disadvantage is that these recycled rubber granulates contain several harmful substances in unknown and varying concentrations. These substances may persist in the environment, they may be bio-accumulative, carcinogenic, reprotoxic or mutagenic. Such substances are for example polycyclic aromatic hydrocarbons (PAHs), phthalates, volatile organic hydrocarbons (VOC), alkyl phenols and metals. For the potential health risk due skin contact especially the exposure to organic components is relevant, because only these substances are able to migrate into the skin. Additionally and especially in case of mixtures with natural rubber recycled granulates contain two different types of allergens. The allergic potential of rubber ingredients is very well evaluated for the use of natural rubber latex (NRL) in gloves. Type I natural rubber latex allergy is an immediate allergic reaction to natural latex proteins and is potentially life threatening. Symptoms are urticaria, fever, asthma and rare but possible anaphylaxis. In many cases symptoms become progressively more severe on repeated exposure. So it is important for sensitised individuals to avoid further contact with these latex proteins.

Nevertheless no comparable cases are reported until now for recycled tyre materials, even though if latex is the basic component. One explanation therefore could be the different curing process for

tyres and that the disruption of proteins is more likely than in case of NBR latex gloves manufacturing.

The second possible reaction is the type IV allergy. In this case people react to the chemicals used in the manufacturing process, mostly accelerators like thiurames, carbamates and mercaptobenzothiazoles. This is a delayed hypersensitivity reaction which occurs 6-8 hours post-exposure. Its main symptom is a red itchy scaly rash, which is often localised to the area of contact, but may also spread to other areas.

Both types of allergic reactions are provoked by direct skin contact or in case of natural latex proteins additionally by inhalation of loaded dust (e.g. in case of powdered gloves). There is no direct relationship between the available concentration of such allergens and the probability of an allergic reaction especially in case of already sensitised individuals. Therefore risk assessment based on end points is difficult. Nevertheless it is very unlikely that substances in the rubber will cause skin irritation to non-sensitized persons.

New synthesized SBR or EPDM filling materials may also contain these hazardous chemicals but the control of quality is much easier and there is the possibility to avoid some of these harmful chemicals.

3 RISK ASSESSMENT

3.1 Risk analysis

Intended use

Synthetic turf pitches are surfaces for sports areas, primarily designed for outdoor use for soccer and hockey trainings, matches and cup tournaments. Typical users are adults, juniors and older children (12-15 years). It is supposed that younger children only play in the presence of training personnel.

Hazard identification

Identified dermal hazards are

- Uptake of hazardous substances (PAHs, PCBs, phthalates, alkyl phenols), which can cause cancer or which are mutagenic or reprotoxic
- Allergic reactions (type I and type IV) caused by latex proteins and accelerators (thiurames, carbamates, benzothiazoles) or aromatic amines

Risk estimation

Two routes for dermal/skin exposure can be identified by the intended use:

- Direct skin contact with the rubber filling material e.g. in case of falls
- Dust/particles released from the rubber granulate can come in contact with bare skin

In both cases legs, thighs, arms and hands can be concerned.

Direct skin contact with the rubber filling material is supposed to be not very frequent as the athletes use to wear shoes and in case of falls the contact time should be short.

The skin exposure by dust and particles was already evaluated by the Norwegian Institute of Public Health and the Radium Hospital (lit. [1]). This exposure study was based on the worst case scenario of an indoor use and 100% skin uptake. The estimated maximum quantity of dust/particles deposited on the skin is 1,0 mg/cm². Under consideration of frequency and duration of trainings and matches the following particle exposure was calculated:

Adults (older than 20 years): 87 mg/kg body weight/day

Junior (16-19 years): 109 mg/kg body weight/day

Older children (12-15 years): 73 mg/kg body weight/day

Children training/matches (7-11 years): 71 mg/kg body weight/day

From the total quantity of chemicals which exist in the form of particles only a limited portion will be available for uptake into the body through the skin. In this Norwegian study it was assumed that the uptake via skin corresponds to the water-leachable amounts. Other tests on migration show especially in the case of the non water-soluble substances as PAHs but also in case of thiurames, carbamates and mercaptobenzthiazoles that they are directly resorbed by the skin (lit. [9], [13]).

3.2 Risk evaluation

The risk acceptability decision is based on the level of severity and the probability or likelihood of occurrence.

Risk for uptake of hazardous substances

The level of severity depends on the hazard of the substances. The most critical substance groups in rubber materials are PAHs, PCBs, phthalates, and alkyl phenols. In table 1 the correlation between the NOAEL (no adverse effect level) for these substances via oral uptake and the estimated daily uptake from airborne dust (lit. [1], [2]) in case of indoor use is shown. It is assumed that the NOAEL for skin resorption is comparable to the NOAEL for oral uptake as no skin resorption data could be found in the literature.

Table 1: NOAEL in correlation to indoor uptake from airborne dust

Substance group	NOAEL	uptake from airborne dust
PAHs	40000 µg/kg bw/day	0,0038 µg/kg bw/day
PCBs	0,5 µg/kg bw/day	0,000003 µg/kg bw/day
Phthalates	4800 µg/kg bw/day	0,047 µg/kg bw/day
Alkyl phenols	1500 µg/kg bw/day	0,0008 µg/kg bw/day

Skin exposure via dust is only probable in significant amounts in case of indoor use. But also under this circumstances and under the worst case assumption that all available hazardous substances in the dust deposited on the skin (about 1 mg/cm²) are resorbed, the total amounts of substances are very low as shown in table 1.

This assumption is confirmed by an exposure scenario study for professional football player. The maximum average daily uptake was calculated of 0,00012 µg/kg bw benzo[a]pyrene. Benzo[a]pyrene is the most carcinogenic PAH component. The advised limit value for the negligible risk level is 0,001 µg/kg bw. The calculated daily dermal uptake does not exceed this limit value.

The second possible uptake route for hazardous substances is given via direct contact with the filling material. The probability for this is low and the contact time is short as the athletes use to wear shoes and thus direct contact is limited to falls. Based on the expected time of skin contact the following values are recommended in an official information paper (lit. [9]) by TÜV:

Table 2:

Parameter	Skin contact up to 30 sec	Skin contact longer than 30 sec
Benzo[a] pyrene (BAP)	20 mg/kg	1 mg/kg
Sum 16 PAHs (EPA)	200 mg/kg	10 mg/kg

Usual amounts in recycled material are in the range of 10 to 100 mg PAH/kg or 0,1 to 1 mg BAP/kg. Therefore in most cases also this recommendation for products with direct skin contact is fulfilled.

Risk for allergic reactions

There are two different types of possible allergic reactions with rubber components:

Type I natural rubber latex allergy is an immediate allergic reaction to natural latex proteins and is potentially life threatening and therefore very critical. Around 1-6% of the general population is thought to be potentially sensitised to NRL. No data about the real concentrations or migration potential of natural rubber latex allergens in recycled tires are available at the moment. It is also possible that these latex proteins are denaturated or destroyed during the tire curing process in most cases.

Type IV is a delayed hypersensitivity reaction which occurs 6-8 hours post-exposure but is not life threatening. The incidence of this allergic reaction is about 4%. In this case people react to the chemicals used in the manufacturing process, mostly accelerators like thiurames, carbamates and mercaptobenzothiazoles. All rubber materials include such chemicals, though in different amounts. Also the allergic potential depends on the type of accelerators, amongst which the most critical substances are the group of thiurames. In case of new filling materials the accelerators used and its concentrations should be known but are surely not published. The qualitative and quantitative evaluation of these chemicals in recycled material is very difficult and inaccurate.

Due to the low probability of direct skin contact with the filling material, the short contact time and the fact that no related cases of allergic reactions are reported until now, a low risk potential can be evaluated.

In the case of skin exposure via dust, which is probable in case of indoor use, the contact time and thus the risk potential is higher. Due to the missing data about the actual possibility of latex protein allergens in the dust a risk evaluation is not possible at the moment.

4 SUMMARY

The evaluation of health risks by skin contact with rubber granulates used in synthetic turf pitches can be summarised as follows:

Generally the risk evaluation and eventually the acceptability decision are based on the level of severity and the probability or likelihood of occurrence.

In the case of the intended outdoor use of filled synthetic turf pitches only the exposure route via direct skin contact is relevant. The used elastomeric fillings are rubber materials, which contain substances of very high concern as PAHs, PCBs, phthalates, alkyl phenols and well known allergens. Skin uptake of most of these not water-soluble substances is possible via resorption. Therefore the most relevant risk evaluation criterion additionally to the available concentrations of these substances is the time of direct skin contact. Under the assumption that the athletes wear shoes a direct skin contact is not very frequent and only occurs in cases of falls, where legs, thighs, arms and hands can be concerned. Therefore the time duration and thus the risk for the resorption of hazardous substances via direct skin contact is low.

In the case of indoor use additionally the skin exposure via dust released from the rubber granulate has to be taken into consideration. The sources of hazards are the same already described substances but the skin contact with such dust particles is much more intensive and longer than in case of a fall. Available data material and calculations show that the total amounts of these substances are very low and therefore also no health risk is supposed.

Due to the missing data on concentrations of latex proteins in the rubber dust a risk assessment of the allergic potential is not possible at the moment. But it is also very unlikely that substances on the rubber will cause skin irritation to non-sensitized persons.

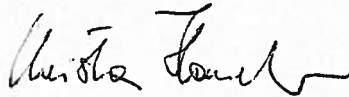
On the basis of knowledge that is currently available, with the exception of a possible allergic potential in case of indoor use, no relevant health risk can be expected by skin contact with rubber as a result of regular training on filled synthetic turf pitches.

5 LITERATURE

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This expert opinion contains 9 pages with 2 tables and no appendices.

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