

Independant Testing, Studies and Reports on the Subject of SBR and any Potential Health and Environmental Impact

Conclusions - What The Experts Say

THERE IS NO SHORTAGE OF INDEPENDANT TESTING, STUDIES AND REPORTS ON THE SUBJECT OF SBR AND ANY POTENTIAL HEALTH AND ENVIRONMENTAL IMPACT

Hundreds of studies have been completed and thousands of pages compiled which detail the exhaustive research readily available on the subject of SBR and the other components of artificial turf infill materials.

Unfortunately, although this is indeed a “fact rich” environment, many have simply jumped on the “scare tactic” bandwagon, reacting and bending to misleading headlines deliberately presented by those with their own agenda to promote.

Those with their own agenda include the manufacturers of alternative infill granulate material and others who provide chemical sprays and treatments. However, the strongest lobby group by far, is the natural grass producers who have been severely impacted by the success of artificial turf.



This natural grass lobby is trying to maintain some \$40+ billion in grass sod, seed, fertilizers, pesticides and equipment sold each year in the US alone. In desperation, however, they have reverted to familiar but deceptive PR tactics, ignoring the facts and creating myths, scares and dangerous headlines to try and reverse the trend toward artificial turf.

In looking for the truth, just look to the research and the reports. The following is a sampling of just some of the conclusions reached by the independent experts who have completed the studies.

What The Experts Say



Tyre waste has no toxic influence on fauna and micro-aquatic organisms.

In the event of ingestion of crumb particles, although it is highly improbable, the particles do not present any toxicity, as the digestive system is not powerful enough to extract the chemical components from the rubber.

Inhaling is practically negligible because crumb rubber does not give off volatile products.

Direct contact with the skin does not present any real danger, even from the point of view of allergy.

Biological tests have shown the absence of genotoxicity.

Laboratoire de Recherches et de Controle du Caoutchouc et des Plastiques - End of Life tyre Crumb Rubber in Sports Floors - Environmental Consequences, 2006 Update

(We have intentionally avoided using documents that could be thought to be too heavily loaded towards one technical opinion. Some bodies (suppliers, rubber industry trade associations, ecological associations, etc.) could be considered biased, and could be tempted to present arguments either for or against lacking in objectivity.)

Independant Testing, Studies and Reports on the Subject of SBR and any Potential Health and Environmental Impact Conclusions - What The Experts Say

Epidemiological studies conducted by the Health Effects Institute, The World Health Organisation and other investigators do not implicate tyre wear particles in ambient air as contributing to human health effects (respiratory and cardiovascular diseases)

FIFA - potential cancer risk from certain granulate infills from artificial turf - July 2006

The available body of research does not substantiate the assumption that cancer resulting from exposure to SBR granulate infills in artificial turf could potentially occur.

Danish Ministry of the Environment

Because tyre rubber is designed to be strong, durable and substantially impermeable, it is unlikely that any losses could occur to air or water in concentrations that would pose serious human or environmental risk. This opinion is supported by the reports and academic studies reviewed, which have shown insignificant effects of such chemicals or release of volatiles and particulates into the atmosphere.



The Use of Recycled Rubber in Sports Surfaces - Sports and Play Construction Association - 2006



No test was clearly genotoxic. No tests performed without microsomal activation demonstrated genotoxic activity. Seven test tests were marginal after activation but did not meet the criteria for genotoxicity and are considered negative.

In all instances except one, the PEEP index was determined to be less than 3, which is considered acceptable by Environment Canada. In the case of the schoolyard material, which was freshly installed and kept in place for three months, the PEEP index was only marginally greater than 3 (3.2). With further aging in place or treatment before installation, this value should drop below 3.

Toxicological Evaluation for the Hazard Assessment of Tire Crumb for Use in Public Playgrounds - Birkholz, Belton and Guidotti - July 2003

All heavy metal levels are in compliance with the standards applicable to toy manufacturing and the risk of harmful effects on sportsmen and women is therefore negligible.

Indoor and outdoor use of rubber infill poses absolutely no risk to sportsmen/sportswomen or other parties concerned through inhalation.

Study from ISA Sport test institute, the NOC/NSF and the KNVB

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De Telegraaf, once again reported a number of factual inaccuracies on the use of SBR rubber in artificial grass fields. The information in the report does not substantiate any of the statements reported in the intended article.

Incorrect Reporting in De Telegraaf on Research Report on Infill Used in Artificial Grass - May 2006

Using the most severe extraction methodology, the nitrosamines found were only slightly above the detection level. These low levels of NDMA and N-MOR represent a worst-case scenario with regard to the product.

Tun Abdul Razak Research Centre - 2006

The RIVM has reached the conclusion that PAHs can in fact be released, to a small degree, from rubber granule particles in artificial turf fields, but on the basis of the available data, this does not seem to entail any health risk.



Ministry of Social Housing, Regional Planning and Environmental Administration, The Hague - 2007

Since there is no risk for PAHs, as the most harmful component of PAHs, it seems unlikely that this would be the case for other substances.

PAHs are absorbed in the matrix of the rubber granules and do not leach.

*Dutch National Institute for Public Health & the Environment
Answers to Questions on Harmful Substances in Artificial Turf Fields
Public Health, Social Welfare & Sport*

The concentration of 0.03 ppb means a level of about one million times below the limit recommended in the TUV report. I consider such a margin safe enough.

*Answers to Questions on Harmful Substances in Artificial Turf Fields
Public Health, Social Welfare & Sport - Dr. J.M. Roels - Head of Substances Expertise Centre*

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Conclusions - What The Experts Say

A wide range of PAHs, including the carcinogenic ones, is found in the air -especially in urban air. They originate from various combustion sources (eg; power generation, vehicular traffic, space heating, etc.). Given their widespread availability, human exposure to PAHs cannot be avoided. Some exposure scenarios are:

- inhalation of smoke particles
- ingestion of smoked, charred or char grilled foodstuffs
- skin contact with soot

Exposure does not stop at risks from smokes and chars. As any particulate pollutant once released into the air can be transferred to other materials or media the PAHs carried on smoke can settle on the ground (or vegetation) or be washed into ground waters.

That means that if you go hunting for PAHs (yes, even the carcinogenic ones) you will find them.

PAHs & Other Organics in Tires - Origins and Potential For Release - June 2006



The health risk on children's playgrounds that contained both worn tyres and granulate rubber was insignificant.

Danish Ministry of the Environment



Regarding the potential for Zinc leaching, away from trench, Zn levels rapidly decay to background levels

Tire shreds placed above or below water table have a negligible impact on water quality.

Rubber - Its Implications to Environmental Health (Hydrocarbon Rubbers) - Brian G Willoughby

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Conclusions - What The Experts Say

N-Nitrosamines figure prominently in concerns over cancer risks from rubber, although they have the potential to be formed whenever protein-containing material is roasted in a current of air.

Beer, whisky and bacon contain carcinogenic N-nitrosamines. Unlike the carcinogenic PAHs, N-nitrosamines are volatile. They can be formed during vulcanisation and released from the rubber (12 different ones are regulated for the German rubber industry).

Over the last twenty years, the tyre industry has responded to worldwide concerns and effected large reductions in N-nitrosamine levels. Quite possibly they are now completely undetectable.

That may be the case for tyres – but is it so for EPDM? N-Nitrosamines can be particularly difficult to eradicate from EPDM.

PAHs & Other Organics in Tires - Origins and Potential For Release - June 2006



From an ecotoxicological viewpoint, the results obtained show that the nature of the percolates likely to infiltrate into the ground underlying the artificial turf sports surface proves to be without impact on the aquatic environment.

Environmental and health assessment of the use of elastomer granulates (virgin and from used tyres) as infill in third-generation artificial turf - General conclusions - Dr Robert Moretto ADEME / ALIAPUR 2007

It can be concluded that rubber tires contain PAHs originating from certain oils used in tire manufacturing, but there is clear scientific evidence that any release into the environment is negligible relative to other PAH sources.

The European Commission's Scientific Committee on Toxicity, Ecotoxicity and the Environment



One of the earliest studies of airborne PAH in tyre factories (started in 1973) quickly found that the results made little sense without comparative measurements on the outside air. Studies, over the remainder of that decade, in both the UK and USA, found that:

- no carcinogenic PAH was present in tyre factories in excess over ambient air levels

PAHs & Other Organics in Tires - Origins and Potential For Release - June 2006

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The effects of motorway runoff on the water quality, sediment quality, and biota of small streams were investigated over a 12-month period. Downstream of motorway runoff discharges there was an increase in the sediment concentrations of total hydrocarbons, aromatic hydrocarbons, and heavy metals and an increase in the water concentrations of heavy metals and selected anions. Hydrocarbon contamination of sediments was positively correlated with potential contaminant loading (i.e., length of road drained/stream size).

The dominant PAHs in contaminated sediment at this site were phenanthrene, pyrene, and fluoranthene, whereas the dominant metals were zinc, cadmium, chromium, and lead. Differences between the station upstream and downstream of discharges in the diversity and composition of the macro invertebrate assemblages were detected in four out of the seven streams surveyed.

However, there was no evidence of an effect on either the diversity or abundance of epilithic algae. The diversity of the aquatic hyphomycete assemblage was only affected at the most impacted site. Reductions in the macroinvertebrate diversity were associated with reductions in the processing of leaf litter and a change from an assemblage based on benthic algae and coarse particulate organic matter to one dependent upon fine particulate organic matter.



*The Effects of Motorway Runoff on Freshwater Ecosystems
Cranfield Centre for Ecochemistry - Cranfield University*

A reduction of the concentration of PAHs in tyres will insignificantly reduce the overall concentration of PAHs in the environment.

The European Commission's Scientific Committee on Toxicity, Ecotoxicity and the Environment

It also has been demonstrated that the risk of rubber workers developing skin cancer from exposure to highly aromatic oils contained in rubber is non-existent.

2003 Environmental Health and Safety Report - Goodyear Tire and Rubber

Polycyclic aromatic hydrocarbons (PAHs) are formed during incomplete combustion. Domestic wood burning and road traffic are the major sources of PAHs in Sweden.

Cancer Risk Assessment, Indicators & Guidelines for Polycyclic Aromatic Hydrocarbons in the Ambient Air

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Conclusions - What The Experts Say

The rubber granulate meets the Building Materials Decree requirements regarding chemical composition and the leaching out of substances.

The rubber granulate meets the standards set for heavy metals and the Toys Decree.

No health risks are posed by breathing in or brief skin contact.

No studies showing that rubber granulate poses a risk to health and the environment were unearthed.

The use of rubber granulate in playgrounds forms no relevant risk to children or the environment.

Prolonged daily skin contact with rubber tyres does not pose any relevant health risk.

RUBBER GRANULATE FROM RECYCLED CAR TYRES IS SAFE FOR PEOPLE AND THE ENVIRONMENT - VACO - June 2006

Danish Technology Institute 2005, Commissioned by the Danish Ministry of the Environment



Serious Blunder With Artificial Turf - Scattered rubber granules safe for sports after all.

Poisonous nitrosamine vapours floating above artificial turf pitches have probably never existed. According to the State Institute for Public Health (RIVM), artificial turf pitches sprinkled with rubber granules are in fact not damaging for health, as had been previously assumed.

by Jouke Schaafsma, ARNHEM - 2007

There is no risk for the health playing on artificial grass fields that are filled with rubber particles.

The environment aspects have also been examined. Representatives of the Ministries of VROM and Health, Welfare and Sport, the association Dutch municipalities, ISA sport and the player trade union VVCS also participated in the advisory commission beside the constituents.

*KNVB and combined Netherlands Olympic Committee and Dutch Sports Federation NOC*NSF - March 2007*

Tire Crumb Rubber Used in Artificial Turf Fields - March 2007

Independant Testing, Studies and Reports on the Subject of SBR and any Potential Health and Environmental Impact

Conclusions - What The Experts Say

PAHs can in fact be released to a limited extent from rubber granule particles, but based on the available data, this does not lead to a health risk. There is no health risk for DEHP from oral exposure either.

*Dutch National Institute for Public Health & the Environment - Answers to Questions on Harmful Substances in Artificial Turf Fields
Public Health, Social Welfare & Sport*

It is accepted that the vast majority of PAHs in the environment derive from the incomplete combustion of fossil fuels in particular diesel exhausts from truck and car emissions.

The University of Dortmund Institute for Environmental Research



The aliphatic oils used in EPDM and other rubbers are a more prolific source of volatiles from hot rubber.

PAHs & Other Organics in Tires - Origins and Potential For Release - June 2006



Epidemiological studies conducted by the Health Effects Institute, The World Health Organisation and other investigators do not implicate tyre wear particles in ambient air as contributing to human health effects (respiratory and cardiovascular diseases).

Tyre debris is found in diffuse roadside soils, but the published studies present no evidence for ecotoxic effects in or from roadside soil.

In general tyre abradate is a much finer particulate than are the granules used as infill materials in Football Turf. The finer the particulates the greater the surface area and higher potential for chemicals to leach out of the rubber. The majority of the studies have been on these higher surface area particles and have concluded they are currently acceptable.

The larger granules used in Football Turf will therefore have even less potential for emissions.

A study undertaken by the Danish Ministry of the Environment concluded that the health risk on children's playgrounds that contained both worn tyres and granulate rubber was insignificant.

*FQC - Infill Health Statement 2007
Evaluation of the environmental impact on water:*

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Conclusions - What The Experts Say

All of the physicochemical results (42 parameters analyzed) obtained on the percolates from the 32.5-m² pilots leads to the observation of a release kinetic for potentially polluting substances comparable to the course of time irrespective of the type of granulate used (7 percolate samples analyzed at one year).

The artificial turf pilot without filling granulates used as a control also displayed release rates fairly close to those of the 3 pilots. The concentrations recorded were low for the majority of the compounds and elements searched for. While certain elements displayed slightly higher concentrations at the start of experimentation, these fell very rapidly, thereby indicating a very rapid reduction effect in terms of release rates.

In situ on the football pitch the concentrations and release kinetics are fairly comparable to those observed on the pilots. The chlorides, fluorides and sulphates are even in lower concentrations than in the percolates collected on the pilots, a finding to be linked with the difference in chemical composition of the water that has percolated through the sports surfaces (rain water in situ and drinking water on the pilots).

Environmental and health assessment of the use of elastomer granulates (virgin and from used tyres) as infill in third-generation artificial turf - General conclusions - Dr Robert Moretto ADEME / ALIAPUR 2007



Waste waters in tyre manufacturing plants have been the subject of study, where evidence of some of the lower molecular weight PAHs (non carcinogenic) PAHs can be found. Studies in the field are inevitably confounded by the presence of PAHs from other sources - ie; washed out of the atmosphere.

PAHs & Other Organics in Tires - Origins and Potential For Release - June 2006

The studies to date have concluded that PAHs are not released or at most negligibly released from tyre abradate.

The University of Dortmund Institute for Environmental Research

A Health Risk Evaluation (HRE) conducted by the Institut National de l'Environnement Industriel et des Risques (France) was based on the values of the concentrations of 112 substances identified in the emission chambers and their comparison to the international toxicological reference values (RTV). According to the HRE methodology, a "worst-case scenario" was modeled "small."

Environmental and health assessment of the use of elastomer granulates (virgin and from used tyres) as infill in third-generation artificial turf - General conclusions - Dr Robert Moretto ADEME / ALIAPUR 2007

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On the basis of a comparison with the French and European limit values currently in force, the concentrations of organic compounds, metals and anions from the percolates are without impact on water resources.

Environmental and health assessment of the use of elastomer granulates (virgin and from used tyres) as infill in third-generation artificial turf - General conclusions - Dr Robert Moretto ADEME / ALIAPUR 2007

Emissions tests of Volatile Organic Compounds and aldehydes by elastomer granulate-based sports surfaces conducted by the CSTB (Centre Scientifique et Technique du Bâtiment - France) using the standards in force for the characterization of the emissions in indoor air of construction products (emission chamber) show that:



- Emissions from the artificial turf containing used tyre granulates are relatively low.
- Emissions from the artificial turf containing the EPDM granulates are the most significant.

Environmental and health assessment of the use of elastomer granulates (virgin and from used tyres) as infill in third-generation artificial turf - General conclusions - Dr Robert Moretto ADEME / ALIAPUR 2007



Zinc

With all surface types, Zinc was found in concentrations of 0.009 to 0.003 mg/l. In rainwater, which was also investigated, a concentration of 0.02 mg/l was found.

Polycyclic Aromatic Hydrocarbons

None of the surface systems including the surfaces with recycled granules showed any noticeable PAH concentration. PAHs are ubiquitous substances in the environment and in water. They are present in any street sewage and also in purified sewage from communal sewage purification plants as well as sewage sludge in partly much higher concentrations.

Due to the results of the pre-test it is expected that the DOC concentration will decrease in the course of time.

Swiss Federal Authority of Health July 6, 2006

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This authority was challenged to provide a statement regarding health risk caused by PAH in artificial turf. The issue refers to recycled rubber granules i.e. SBR granules from car tires.

It is considered the question of abraded particles being inhaled as dust and being washed out and ending up in waters and in the subsoil. PAHs can be substances added to softeners of tires, but are also generated by burning processes, from traffic exhaust fumes and heating systems; they also come from tobacco smoking and chimneys.

The estimatable PAH stress is low even in worst case scenarios compared with stress from other sources. The health risk for players and spectators is classified low. Thus, from the health point of view no urgent need of action is seen.

Investigation and Assessment of Synthetic Sports Surfaces in Switzerland Including Athletic and Soccer Facilities - Hans J. Kolitzus, IST Switzerland

Initiated in 2005, this study was conducted with the scientific aim of getting as close as possible to the pitch usage conditions. The results of the evaluation of the environmental impact on the water and of the health risk evaluation (gaseous emissions) on the population groups show:

- comparable behaviour irrespective of the type of filling granulate (virgin TPE and EPDM, used tyre granulates)
- an absence of impact of this type of work on water resources
- no effect worthy of concern on the health associated with the inhalation of VOC and aldehydes emitted by artificial surfaces.



Environmental and health assessment of the use of elastomer granulates (virgin and from used tyres) as infill in third-generation artificial turf - General conclusions - Dr Robert Moretto ADEME / ALIAPUR 2007

Recycled rubber granulate contains many chemical substances which are potentially harmful to health. The concentrations of these substances are however extremely low, they are only leached from the rubber granulate in very small quantities and they are only present in low concentrations in the hall air.

The quantities of this type of substance are consistently lower than in the other types of rubber granulate which are used.

*Artificial turf pitches – an assessment of the health risks for football players
Norwegian Institute of Public Health and the Radium Hospital - Oslo, January 2006*

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Norwegian Institute for Water Research (2005) carried leachate tests on granulate found:

- only two-to-four-ring (non carcinogenic) PAHs in leachate

Log Kow values:

- ca. 3-4 for three-ring
- ca. 4-5 for four-ring
- ca. 6 for five-ring

So five-ring (carcinogenic) PAH is ca. 10⁶ times more likely to partition in an organic phase rather than in water

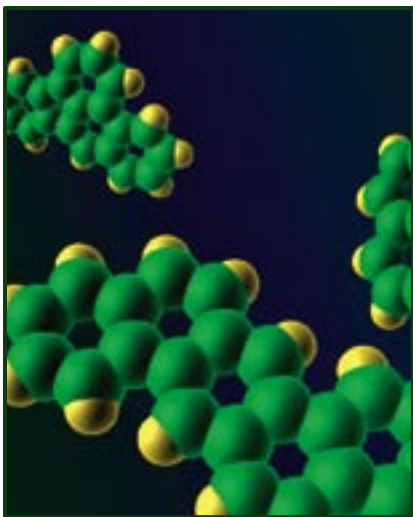
Five-ring PAHs will stay in the vulcanised rubber

Rubber – Its Implications to Environmental Health (Hydrocarbon Rubbers)
- Brian G Willoughby



On the basis of estimated exposure values and the doses / concentrations which can cause harmful effects in humans or in animal experiments, it is concluded that the use of artificial turf halls does not cause any elevated health risk. This applies to children, older children, juniors and adults.

Artificial turf pitches – an assessment of the health risks for football players
Norwegian Institute of Public Health and the Radium Hospital - Oslo, January 2006



As regards allergies, it is concluded that exposure to the low concentrations which were measured does not constitute any elevated risk with respect to the development of contact allergies.

Worst case calculations based on air measurements carried out by NILU and exposure values from the Norwegian Institute of Public Health indicate that training in sports halls does not cause any increased risk of leukemia as a result of benzene exposure or any elevated risk as a result of exposure to polycyclic aromatic hydrocarbons.

Artificial turf pitches – an assessment of the health risks for football players
Norwegian Institute of Public Health and the Radium Hospital - Oslo, January 2006

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BRMA survey of airborne benzo[a]pyrene in ten UK tyre factories found:

- concentrations from zero to 28 ng/m³
- no correlation with process or factory area
- strong correlation with seasons and weather

Nutt (1984) repeated this with simultaneous measurements of inside (tyre factory) and outside air found:

- no excess of B[a]P in factory air

Willoughby (1994) analyzed PAHs from laboratory vulcanizations at up to 200°C found

- only two-to-four ring (non carcinogenic) PAHs in volatiles

Rubber – Its Implications to Environmental Health (Hydrocarbon Rubbers)
- Brian G Willoughby

On the basis of the exposures which have been calculated in connection with the use of indoor halls with artificial turf in which recycled rubber granulate is used, there is no evidence to indicate that the use of such halls causes an elevated health risk.

Artificial turf pitches – an assessment of the health risks for football players
Norwegian Institute of Public Health and the Radium Hospital - Oslo, January 2006



PAHs are already in the environment from combustion processes, transport, power generation, cigarettes, etc.

PAHs are:

- routinely monitored in ambient air
- carried on soot particles and washed out of air by rain
- passed into rivers and lakes - and then into sediments

Nilsson et al (2005) studied PAHs in sand in a children's playground with used tyre components and found:

- distribution of PAHs did not reflect that in tyre rubber
- that the PAHs arose from deposition from the air
- additional risks from PAHs in tyre granulate judged insignificant

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The air studied at the artificial turf football field does not exceed any maximum value established in the European legislation of air environment

- results obtained in the analysis of HAPs and VOCs picked up in the realized samples are similar to the emission generated by traffic in the zone of influence
- no sulphurated hydrogen detected in the air sampled in the installation

IBV - Instituto De Biomechanica De Valencia- Applus Medico Ambiente - 2007

