

THE RESPONSIBLE USE OF RUBBER GRANULATE MADE FROM CAR TYRES AS INFILL FOR ARTIFICIAL GRASS SYSTEMS; QUESTIONS AND ANSWERS BASED ON INDEPENDENT RESEARCH

Introduction

In the last few years, the tyre sector has had in-depth, long-term laboratory and field research carried out into the environmental and health aspects of rubber infill made from car tyres that is used in artificial grass surfaces. This research was carried out in close consultation with the artificial grass sector, the Dutch Ministries of Infrastructure and the Environment (I&M) and Health, Welfare and Sport (VWS) and the Netherlands National Institute for Public Health and the Environment (RIVM). Furthermore, research into potential health risks associated with rubber infill for the workers laying and maintaining artificial grass surfaces was carried out on behalf of the Branchevereniging Sport en Cultuurtechniek (BSNC - Trade Association for Sport and Agricultural Engineering).

The conclusion that can be drawn from all the research (2007-2014) is that it is safe to use rubber granulate made from recycled car tyres from private cars and commercial vehicles as infill for artificial grass football pitches. There are no health or environmental risks. Using infill made from recycled car tyres helps reduce the use of raw materials by completing raw material cycles as well as reducing greenhouse gas emissions.

VACO and RecyBEM hope that this document will give the market a clear and up-to-date picture of the situation as it stands in 2014 and that it answers any remaining questions.

Health aspects

Based on the research and literature studies carried out, the SGS INTRON researchers have concluded that there is no significant health risk for athletes or spectators when sport is played on an artificial grass surface where rubber granulate made from recycled car tyres has been used as infill.

What is this conclusion based on?

1. In 2007, INTRON performed an extensive literature study and a field study in cooperation with Industox, under the auspices of, amongst others, the RIVM and the Dutch Ministry of Health, Welfare and Sport. To assess the health risks, it is important to not only look at the chemical substances that are present in the rubber, but also at the actual bioavailability of these substances for people. When assessing the risks of these substances, the researchers used internationally accepted limits. In the research, exposure via swallowing, inhalation and skin contact was investigated.

Swallowing

The concentration of heavy metals in rubber granulate meets the European toy standard. The researchers, therefore, conclude that the metals in rubber granulate do not cause a health risk in the case of swallowing or contact with the skin. Canadian and Norwegian scientific studies confirm the conclusion that swallowing rubber granulate does not present a health risk.

Inhalation

According to foreign literature, there is no health risk associated with inhalation for either indoor or outdoor use of rubber granulate in sports pitches. In the autumn of 2006, the Dutch Municipal Health Service (GGD) Gelderland Midden and the RIVM performed an air quality investigation on an artificial grass surface with car tyre granulate infill. The measured levels of fine particulate matter, polycyclic aromatic hydrocarbons (PAHs), heavy metals, volatile organic hydrocarbons and nitrosamines did not exceed the health limits.

Skin contact

Research shows that skin contact with rubber does not present a health risk. Exposure to substances which can migrate from the rubber granulate to the skin (e.g. PAHs) has been investigated in experimental research by INTRON and Industox. The researchers came to the conclusion that the absorption of PAHs when playing sport on an artificial grass surface for an exposure scenario with relatively long-lasting and intensive skin contact with rubber granulate cannot be determined unambiguously. If absorption through the skin did take place, then it was extremely small compared to absorption from other sources (for example, the living environment and food). Danish and Canadian scientific studies confirm this result.

2. In 2009 and 2012, Industox and Kempeneers Milieu investigated, on behalf of the BSNC, the effect of exposure to rubber granulate and dust (rubber and sand) on workers who lay and maintain artificial grass surfaces. The conclusion was that the workers are not subjected to significant health risks associated with the rubber infill during maintenance. When a surface is laid, the exposure to dust and quartz during spreading the rubber infill and sand can be sufficiently reduced by taking practical precautions. The BSNC has drawn up a checklist for this.

This research was performed just once. How do I know for certain that the infill in my artificial grass is also safe?

What must I, as a local council or building contractor, pay attention to when laying a new artificial grass surface?

1. It is important that you are certain that your infill is only made from car tyre rubber. We recommend that you request a statement from the infill producer stating that only car tyre rubber is used.
2. When laying artificial grass surfaces, the building contractor must take the precautions (checklist) specified by the BSNC to prevent the formation of dust from sand and rubber as much as possible. As a building contractor, project manager or local council, you can make sure that the BSNC checklist is actually used.
3. The building contractor can ask the infill supplier for an independent test of the (fine) particulate matter concentration in the rubber infill in accordance with EN 15051. The lowest obtainable (fine) particulate matter concentration (very low) helps to further reduce the exposure of workers to rubber dust.
4. For the regular maintenance of artificial grass surfaces, measures to prevent the formation of dust are not necessary. However, it is recommended to regularly clean the filters of cabins and machines using an industrial vacuum cleaner and/or to replace disposable filters regularly. It is a good idea for workers to wear an FFP3 dust mask when doing so, in order to reduce exposure to dust as much as possible.

Environmental aspects

Rubber granulate made from car tyres used as infill in artificial grass surfaces is safe for the environment.

What is this conclusion based on?

1. The results of the laboratory and field research (2007-2009) confirm that the leaching of zinc from rubber granulate made from car tyres does not have a significant environmental impact on the soil, groundwater or surface water, provided that an underlay of lava pellets and/or sand is used under the artificial grass system.
2. The zinc concentration in the drainage water of five existing artificial grass surfaces was monitored between 2008 and 2012. For all the fields, including the fields which were 10 years old, the zinc concentration in the drainage water was less than the zinc concentration in the rainwater.
3. In 2013, the underlays of four artificial grass surfaces which were between 6 and 10 years old were investigated. The zinc leaching of the 6-year-old to 10-year-old infill was determined and compared to infill which was 1 year old. The zinc concentration and the remaining adsorption capacity of the drainage layers were also determined. The conclusions are:
 - After a period of 6 to 10 years, the zinc leaching had not increased compared to infill which was 1 year old.
 - The capacity of the lava and sand underlay to absorb zinc is greater than was previously calculated in 2009. The conclusion from 2009 that the absorption capacity for zinc of the drainage layer is sufficient for at least 280 years has, therefore, been confirmed.
 - From an environmental point of view (zinc leaching and remaining absorption capacity), the lava and sand underlays can be reused if the artificial grass surfaces are renovated.

This research was performed on other artificial grass surfaces. How can I be sure that the infill made from car tyres used in my surface is safe for the environment? What must I, as a local council or building contractor, pay attention to when laying a new artificial grass surface?

1. Rubber infill made from recycled car tyres is not a stony material and, therefore, does not fall under the formal criteria of the Dutch Soil Quality Decree (Besluit bodemkwaliteit). A test in accordance with protocol AP04 of the Dutch Soil Quality Decree is, therefore, not applicable.
2. Infill made from car tyres does, however, fall under the duty of care under the Dutch Soil Protection Act. The duty of care guidelines given below have been agreed by VACO and RecyBEM with the Dutch Ministry of Infrastructure and the Environment. If these guidelines are followed, you can be assured that your artificial grass system is not harmful to the environment and that you meet the duty of care principle.

Duty of care when laying an artificial grass system

- a. It is important that you are certain (and can prove) that your infill is only made from car tyre rubber. We recommend that you request a statement from the infill producer stating that only car tyre rubber is used.
- b. Ensure there is a suitable, draining underlay under your artificial grass surface. The underlay must be made of sand (minimum thickness of 40 cm) or sand and lava (together a minimum thickness of 40 cm), possibly with a drainage system at the bottom of the underlay. The sand must meet the requirements for foundation drainage sand or substructure drainage sand as specified in the NOC*NSF standards for underlays of artificial grass surfaces. The lava must not contain any SBR and must also meet the NOC*NSF standards.
- c. Fit a recognisable separation between the drainage sand and the underlying soil. When renovating or removing the artificial grass surface, the drainage sand can then be easily disposed of separately.
- d. When using mineral underlay materials other than sand and lava, the pH value of the underlay material must be at least 6.5. Moreover, the alternative underlay materials must demonstrably meet the requirements for building materials or for soil, function class background value, from the Dutch Soil Quality Decree. The adsorption coefficient of the substructure material for zinc must also have been determined. For a layer thickness of 40 cm, it must be at least equal to $K_d = 50$ l/kg for the natural pH of the substructure material.

- e. It is not permitted to use a system construction that does not contain an absorption layer, where rainwater is directly drained into the surrounding area, for example, by using a non-draining underlay which removes the water horizontally.
- f. When using an underlay which is thinner than 40 cm (but has a minimum thickness of 10 cm), a risk calculation must be used to demonstrate that the layer has sufficient capacity to absorb zinc leaching for at least 30 years.

Duty of care during use of an artificial grass system

- g. Make sure the rubber granulate does not spread outside the playing surface. Prevent the rubber granulate from getting into road gullies and grass verges. Make sure you use good clean-off mats and regularly sweep the paved surface around the artificial grass surface. By using, for example, a raised edge around grass verges outside the artificial grass surface, you prevent rubber granulate from being washed or blown from the paved surface into the flower beds and verges.
- h. Make sure there is no rotting vegetable waste on the artificial grass surface. This prevents the pH value in the drainage layers from changing and keeps the zinc absorption capacity at the desired level.

Duty of care during renovation of an artificial grass system

- i. When replacing the artificial grass surface (on average, after 10 years), check whether the drainage layers still have a compact structure and, if necessary, repair any cracks or irregularities.
- j. When removing the artificial grass surface, prevent the rubber granulate from getting mixed in with the drainage layer. This will ensure that the drainage layer remains suitable for all uses (function classes) in the future.
- k. Check the zinc absorption capacity of the drainage layers after 30 years. The zinc concentration must meet the requirements for the background function class. The absorption capacity for the natural pH value of the underlay material must be equal to $K_d = 50$. If the zinc concentration meets the background function class and the absorption capacity is at least $K_d = 50$, the lava and/or sand can be reused as underlay under the artificial grass surface. If the above is not the case, the lava and/or sand must be removed and replaced. The removed material can, in principle, be reused elsewhere.
- l. The rules for the transport and use of sand and soil apply in the case of reusing the drainage layers elsewhere (outside the facility).

Renovation of an artificial grass system

An increasing number of artificial grass surfaces are reaching the age at which they must be replaced. Many local councils and building contractors do not know what to do with the old infill and drainage layers.

Can I reuse the infill made from car tyres?

In the context of corporate social responsibility, VACO and RecyBEM advocate the reuse of materials and products. From an environmental point of view, there appears to be no objection to the reuse of infill for an artificial grass surface. After all, the leaching of 10-year-old infill is the same as that of 1-year-old infill. However, for the following reasons, VACO and RecyBEM recommend local councils and building contractors not to reuse the infill from old artificial grass surfaces for renovated or newly laid surfaces:

1. All rubber infill (as well as the artificial grass fibres) is made up of polymers, which are subject to ageing due to ozone, ultraviolet light and temperature. This means that both the sport-related properties and the environmental performance of all rubber infill deteriorate in the long term.
2. The results of research into specific rubber properties show that after rubber granulate made from car tyres has been artificially aged to resemble granulate that is 15 years old, it loses viscoelasticity and feels hard to very hard. VACO and RecyBEM recommend taking this into consideration on account of the long-term consequences for the sport-related performance of a renovated artificial grass system.

3. The environmental impact of using new rubber infill made from recycled car tyres has been extensively investigated for a period of use of 15 years as part of the duty of care under the Soil Protection Act. In order to meet this duty of care when reusing infill, we recommend that the reuser of the infill demonstrates, for example, by means of research, that no environmental risk is expected if this period of 15 years is exceeded.

Can I reuse the drainage layers under the artificial grass surface?

1. Yes. The results of research performed by INTRON on four fields that were 6 to 10 years old show that, from an environmental point of view (zinc leaching, zinc concentration and zinc absorption capacity), the lava and sand underlays can be reused without any problems if an artificial grass surface is renovated. However, as a result of the higher concentration of zinc in the top 10 cm of the layer of sand, it is recommended to test the sand against the zinc limits for soil under the Soil Quality Regulation before it is reused.
2. For further information, see the recommendations for "Duty of care for renovation of an artificial grass system" on page 4.

Where can I dispose of the old rubber infill from my artificial grass surface?

1. In the Netherlands, there are a number of specialised companies which recycle artificial grass surfaces and the materials used in them as much as possible.
2. A number of VACO-recognised and RecyBEM-certified infill producers provide a return guarantee with their rubber infill.
3. RecyBEM is currently working with various research institutes and market parties to investigate the recycling possibilities of infill. There are opportunities for used rubber infill in the road construction industry and as a raw material for the rubber industry.

Literature

The following research forms the basis for the information given above.

- INTRON report A833860/R2006031, 'Milieu- en gezondheidsaspecten van instrooirubber', (2007) (Environmental and health aspects of infill rubber)
- INTRON report A924220/R20070368, 'Vervolgonderzoek milieuaspecten instrooirubber', (2008) (Follow-up research into the environmental aspects of infill rubber)
- INTRON report A845090/R20090029, 'Adsorptie van zink uit instrooirubber aan onderlagen', (2009) (Adsorption of zinc from infill rubber to underlays)
- INTRON report A844740/R20090015/UHo/NBe 'Zink in drainagewater onder kunstgrasvelden met SBR, metingen', (2009) (Zinc in drainage water under artificial grass surfaces with SBR, measurements')
- INTRON report A850420/R20100304/RZw/ILa, 'Keuring kunstgrasvelden, uitloging zink in het drainage water en de drainage laag', (2010) (Inspection of artificial grass surfaces, the leaching of zinc in the drainage water and the drainage layer)
- SGS INTRON report A856830/R20110317 'Uitloging van minerale olie uit SBR rubbergranulaat, aanvullend uitloogonderzoek', (2011) (Leaching of mineral oil from SBR rubber granulate, supplementary leaching research)
- SGS INTRON report A86217/R20120010 'Keuring drainagewater kunstgrasvelden', (2012) (Inspection of drainage water from artificial grass surfaces)
- Kempeneers Milieu en Management rapport 'Veroudering van infill, beoordeling van materiaaleigenschappen', (2012) (Ageing of infill, assessment of material properties)
- SGS INTRON report A865780/R20130046c/HCr/ILa 'Zink uitloging uit SBR infill en zinkadsorptie- en concentratie in onderlagen van 6 tot 10 jaar oude kunstgrassystemen', (2013) (Zinc leaching from SBR infill and zinc adsorption and zinc concentration in underlays of 6-year-old to 10-year-old artificial grass systems)

Vereniging VACO

Vereniging VACO is a trade association for the tyre and wheel sector. The association looks after the interests of more than 750 tyre and wheel companies across the entire sector and has an average rate of unionisation of approximately 90 percent. VACO members are active in all areas of the sector: manufacturing, trade, agricultural tyres, industrial tyres, wheels, tyre service, collection, renewing and processing.

Vereniging Band & Milieu (Tyre & Environment Association)

RecyBEM B.V. is the executive body of the Dutch Tyre Management Decree (Besluit Beheer Autobanden). It controls and supervises the collective collection and processing system for tyres from passenger cars and delivery vans. RecyBEM has taken on all the responsibilities and obligations of its members (manufacturers and importers of these tyres) under the decree.

Frequently asked questions about Raw materials - Artificial grass surfaces can be found at:
<http://www.rwsleefomgeving.nl/onderwerpen/bodem-ondergrond/bbk/vragen/bouwstof-kunstgras/>

For more information, please contact:

- Kees van Oostenrijk, RecyBEM B.V. / Vereniging Band & Milieu, telephone: +31 (0)70 444 06 32, e-mail: bem@recybem.nl.
- Arie Verhoef, Vereniging VACO, telephone +31 (0)71 568 69 70, e-mail: a.verhoef@kcleiden.nl.

Interested parties can request the results of all the research and the duty of care document for free via email: vaco@kcleiden.nl.

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