Sport Surfaces

E-book

Cork infills

Bringing back nature to artificial turf systems

AMORIM
CORK COMPOSITES

Cork infills

Content

1. Introduction

In recent decades, artificial turf pitches have multiplied around the world. Lower maintenance costs, resistance to wear and adaptability to different weather conditions make artificial turf pitches an increasingly popular option for sports clubs, schools and councils.

This growth has given rise to questions on the impact of artificial turf systems on the environment and player health and safety, calling for a discussion on the technology and materials used for such infrastructures.

Considering that the type of infill used is one of the main focuses of concern, this guide analyses the benefits of using organic filling materials, such as cork, with the aim of contributing towards choosing the best option for each project.

2. Objective and types of infill

The infill used for artificial turf systems plays a similar role to soil for natural turf, and aims to create turf stability, with the artificial turf maintaining its proper position and creating the conditions for users' performance, comfort and safety.

There are currently recycled rubber-based infills on the market, produced from tires crushed into small granules (SBR - Styrene-Butadiene Rubber), EPDM rubber (*Ethylene Propylene Diene Monomere*), plastic (TPE - *Thermoplastic Elastomer*), sand and organic materials (cork and other plants, such as coconut shell).

Despite the predominance of synthetic fillings, recent years have seen a growing shift to organic options. The main reason behind this stems from lingering doubts about the potential impact of plastic- and rubber-based infills on the environment and people.

For instance, plastic infills (SBR, TPE and EPDM) were recently identified as a potential source of pollution in seas and oceans due to microplastics.

3. Environmental impact - frequently asked questions

3.1 What type of infill is safest for the environment?

Although plastic-and rubber-based infills are considered environmentally safe, cork is a more sustainable option, both environmentally and socially speaking.

Cork is a 100% reusable and recyclable material, and even the smallest residue (cork dust) is used in combined power plants. In fact, over 60% of the energy that Amorim Cork Composites uses is obtained from burning this material, helping to minimize greenhouse gas emissions and reduce the company's carbon footprint.

Cork oak trees help to prevent soil degradation, make soil more productive, regulate the water cycle, control desertification, retain and store carbon dioxide, promote biodiversity and combat climate change.

It is calculated that every year, cork oak forests retain 14 million tons of CO_2, playing an important role in reducing greenhouse gases, a major source of climate change.

3.2 What is the source of the materials used in the different types of infill?

Extensive regulation governs the characteristics of the materials suitable for producing plastic- and rubber-based infills in order to ensure minimal impact on health and the environment from such products.

However, given these are composite materials including chemical elements, there will always be concerns about the possibility of using lower-quality raw materials or materials from unknown sources. Therefore, certified suppliers and companies must always be used.

* FAQ - Frequently asked questions

Unlike other synthetic options, cork infills only use 100%-natural materials obtained from cork bark and, for Amorim Cork Composites, completely free from chemical contamination pursuant to REACH, an EU regulation on the registration, evaluation, authorization and restriction of chemical products.

A quality profile enhanced through the use of cork mainly from forests certified by the *Forest Stewardship Council* (FSC) and/or by the *Program for the Endorsement of Forest Certification Schemes* (PEFC).

3.3 Can the environmental impact of artificial turf systems be minimized?

According to the *Environmental Impact Study on Artificial Football Turf*, conducted by *Eunomia Research & Consulting Ltd* for FIFA (March 2017)[1], three aspects determine the environmental impact of an artificial turf system:

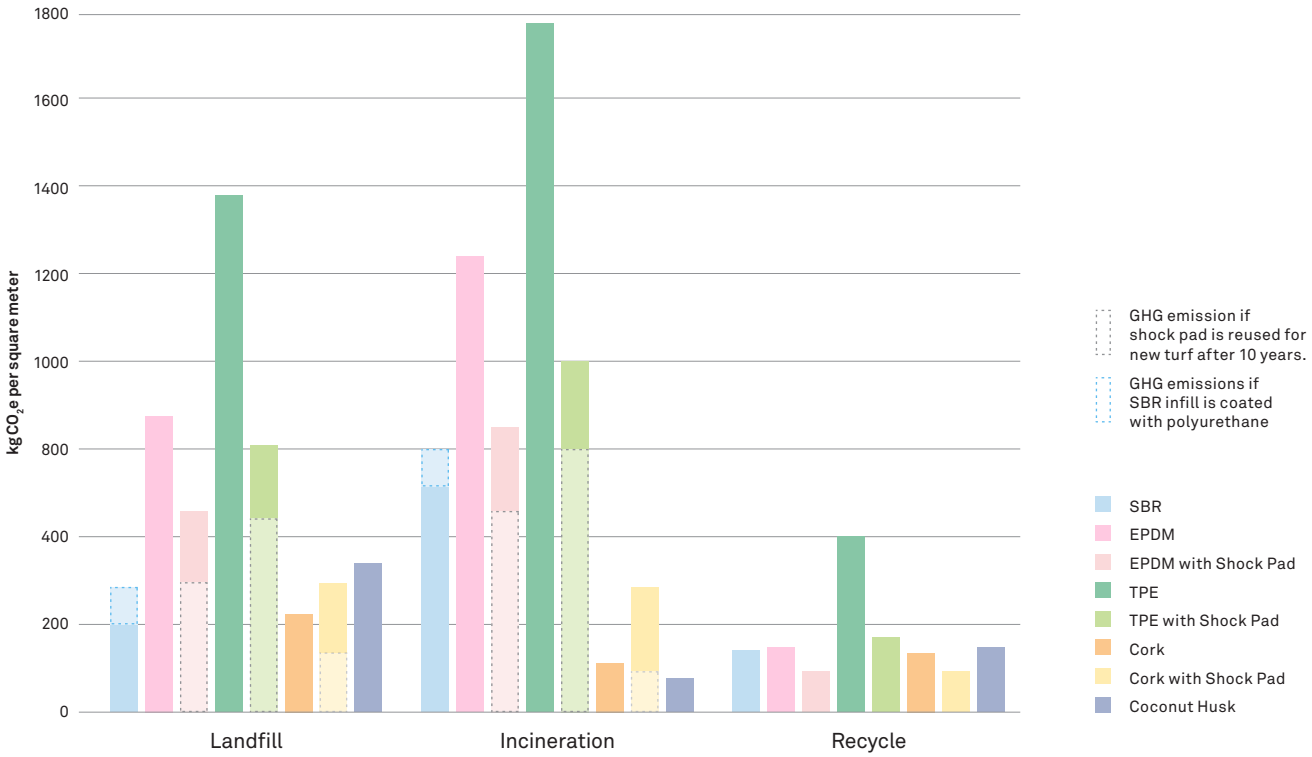
- the infill chosen,
- whether or not a shock pad is applied,
- the type of treatment used at the end of the system's life.

The chart below shows the comparative results between different turf formulas, each containing one of the main types of infill, for the different treatment options.

Among other factors, the study reveals that, irrespective of the type of treatment chosen at the end of the system's life, cork infills are one of the solutions that releases the least amount of CO_2 (kg) per m².

Using cork infills with a shock pad (namely when this is reused after the first 10-year cycle) is one of the most appealing solutions, particularly when the end-of-life treatment is incineration.

Versatility in terms of recycling or reuse that's possible at the end of the system's life is another positive for cork infills. For instance, EPDM rubber is a thermosetting plastic that cannot be reshaped, limiting recycling or reuse options compared to those available for organic materials.



[1] https://football-technology.fifa.com/media/1230/artificial_turf_recycling.pdf

In short, choose cork infills for a solution that's environmentally friendly solution throughout its life cycle. When still part of the tree, cork helps to retain CO_2 and, if removed at a certain time, the tree's retention capacity even increases. During the production process, all waste generated by the cork industry can be reused and, at the end of the system's life, cork releases less CO_2.

4. Health and comfort of users

4.1. Can infills used on artificial turf systems affect users' health?

Thus far, the studies undertaken[2] reveal that the use of turf with artificial infills, specifically SBR rubber, entails no health hazards, and there is no connection between cancer risks and the use of such equipment.

However, given this type of rubber includes elements that are carcinogenic in their natural state (styrene and butadiene), players and the community are often concerned about the risk of oral intake, inhalation or skin contact with rubber particles.

In light of this concern, coated SBR infills have been increasingly used as an alternative that has a lesser environmental impact and is safer for users. However, coated SBR is four times more expensive than traditional SBR, and incineration cannot be used as an end-of-life treatment. Furthermore, as the material wears, the coating disappears, and recycled rubber and its components are again exposed.

For cork used in Amorim Cork Composites infills, these issues are of no concern, as all materials used are 100% free of chemical contamination, pursuant to REACH, and contain no traces of PAHs (Polycyclic Aromatic Hydrocarbons) or phthalates.

The presence of other potentially toxic substances was also measured in the German laboratory Chemisches Laboratorium Dr. Stegemann, finding practically zero values for substances such as cadmium, lead, chromium, mercury, zinc, tin and bioluminescent bacteria (Vibrio fischeri), including in the Daphnia test results.

Test request Phthalates Content as specified in Regulation (EU) 2015/326 amending entry 51 & 52 of Annex XVII of REACH Regulation (EC) No. 1907/2006.
Test method EPA 3550C:2007, EPA 8270D:2014, solvent extraction and quantification by GC-MS.

Tested item	CAS No.	Unit	MDL	Result
Dibutylphthalate (DBP)	84-74-2	%	0.005	ND
Benzylbutylphthalate (BBP)	85-68-7	%	0.005	ND
Diethylhexylphthalate (DEHP)	117-81-7	%	0.005	ND
Sum (DBP+BBP+DEHP)	-	%	-	ND
Di-n-octylphthalate (DNOP)	117-84-0	%	0.005	ND
Diisononylphthalate (DINP)	28553-12-0	%	0.005	ND
Diisodecylphthalate (DIDP)	26761-40-0	%	0.005	ND
Sum (DNOP+DINP+DIDP)	-	%	-	ND

MDL = method detection limit
ND = Not detected, less than MDL

[2] https://c.ymcdn.com/sites/www.syntheticturfcouncil.org/resource/resmgr/docs/stc_cri_execsummary2016-0303.pdf

Test request Polycyclic Aromatic Hydrocarbons (PAHs) content as specified in Regulation (EU) 2015/326 amending entry 50 of Annex XVII of REACH Regulation (EC) No. 1907/2006.

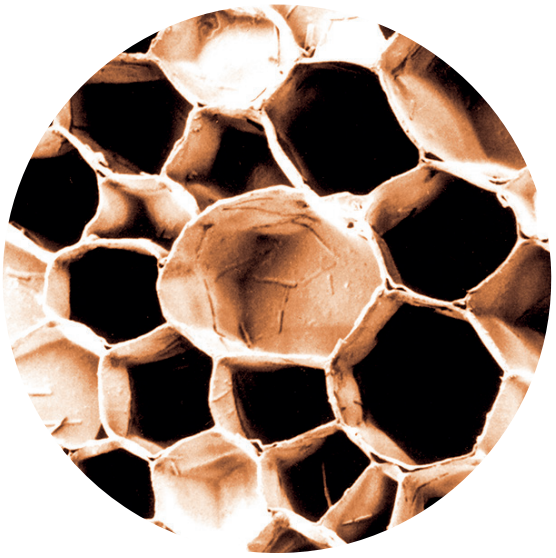
Test method Solvent extraction and quantification by gas chromatography-mass selective detection (GC-MS) with respect to AfPS GS 2014:01 PAK (PAK=PAHs) requirement.

Tested item	CAS No.	Unit	MDL	Result
Benzo(a)anthracene	56-55-3	mg/kg	0.2	ND
Chrysene	218-01-9	mg/kg	0.2	ND
Benzo(b)fluoranthene	205-99-2	mg/kg	0.2	ND
Benzo(j)fluoranthene	205-82-3	mg/kg	0.2	ND
Benzo(k)fluoranthene	207-08-9	mg/kg	0.2	ND
Benzo(a)pyrene	50-32-8	mg/kg	0.2	ND
Dibenzo(a, h)anthracene	53-70-3	mg/kg	0.2	ND
Benzo(e)pyrene	192-97-2	mg/kg	0.2	ND

mg/kg = milligram per kilogram
MDL = method detection limit
ND = Not detected, less than MDL

4.2. Is cork infill turf safe and comfortable for players?

Due to its cellular structure, cork is highly elastic and has a high compressive strength and capacity for recovery. Being made up of millions of closed, hexagonal cells, it can be compressed to as much as 50% of its thickness without losing flexibility and, when decompressed, return to its original size.



These characteristics, together with a natural texture and appearance, make cork infills a non-abrasive solution for players, guaranteeing system performance and reducing wear and tear.

Given that between 10 and 15% of player injuries occur upon impact with the pitch surface, it is important that the pitch not be abrasive or have high or inconsistent temperatures during use.

Cork's unique cellular composition is responsible for its high shock absorption capacity as well as its low thermal conductivity.

Cork's low thermal conductivity requires less pre-match and half-time watering to maintain the ideal turf temperature and ensure the temperature is kept constant during the match, thereby enhancing user comfort and performance.

5. Installation and maintenance of cork infills

5.1 Are cork infills durable?

The durability of cork and its properties are easily understood by considering the material's best-known use: stoppers.

In 2010, 30 bottles of champagne were found in the Baltic Sea, estimated to have been under water for over 200 years. According to specialists, the shipwrecked champagne was in "excellent condition", testimony to the unique ability of cork stoppers to preserve wine and champagne for an indefinite period of time.

This endurance capacity extends to cork infills, which when exposed to aggressive agents such as sunlight, record level 2-resistance in accordance with EN 20105-A02 (change in color after simulating exposure to sunlight).

5.2. Can cork infills be washed away by water?

The infills used in artificial turf systems, irrespective of their typology, can be subject to a phenomenon called buoyancy. During heavy rainfall, a small part of the infill floats and is shifted by rain water. Similarly, in colder countries, it is estimated that 1 to 4% of the infill can be lost during snow clearing operations.

These losses can be minimized via artificial turf system optimization, as infill performance depends on the system's performance as a whole.

The different elements that make up the system — (optional) shock pad, secondary backing, primary backing, fibers, stabilization infill and performance infill — must be designed to optimize drainage capacity and consequently reduce infill loss. This refers to, for instance, placing the base on a slope, using a shock pad with high permeability or proper backing drilling.

5.3. Does cork infill smell?

One of the main objections to artificial turf pitches with recycled rubber infill is the bad smell released when exposed to high temperatures. Particularly in the hottest months, the smell can become fairly strong and might even be noticeable in the pitch's vicinity.

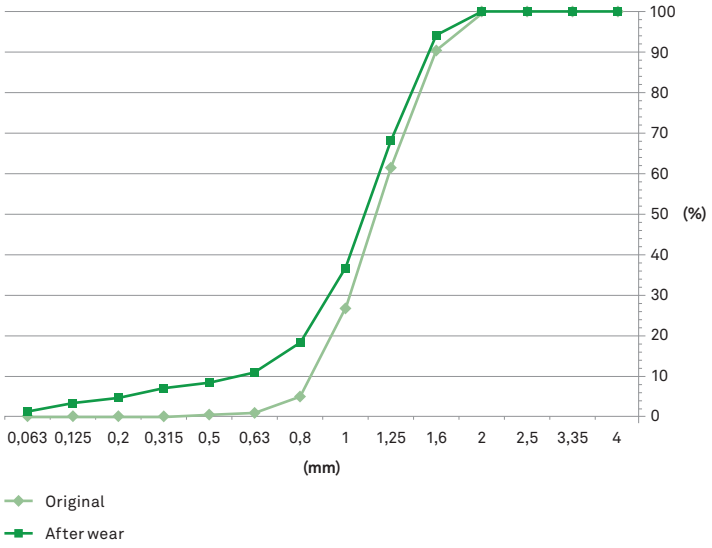
Cork, in addition to heating less and allowing turf temperatures to drop up by to 30%, has a neutral odor.

5.4. Does cork infill limit granulate agglomeration?

When subject to higher temperatures or increased pressure, non-organic infills, particularly EPDM, tend to soften or agglomerate, creating granules.

These agglomerates are hazardous for players and increase the likelihood of injuries. Furthermore, if the performance infill is agglomerated, it loses optimal performance capacity in terms of shock absorption.

Amorim Cork Composites cork infills do not agglomerate and meet all player safety requirements.



EPDM, TPE e Cork infill after an assay of 1 hour at 65ºC and 2N/mm²

5.5 Is cork infill resistant to wear and tear?

Amorim Cork Composites cork infills are cork granulates calibrated in shape and size. Amorim has extensive experience in the grinding process, one of its oldest processes, and therefore the granulates produced have a consistent, spherical shape. This shape results in lower wear and tear during use. More pointed shapes lead to greater wear and tear.

Infills are made up of cork granules that measure between 1 and 2 mm, and after wear tests (as shown in the chart below), less than 10% of particles have diameters of less than 0.65 mm.

5.6 Are cork infills more expensive?

Amorim Cork Composites cork infills have an average density of 190 kg/m³, whereas recycled rubber infills have average densities of 400 kg/m³.

Therefore, the same volume requires twice as much rubber than cork. This is why the per-kilo infill price cannot be directly compared.

In reality, cork infill is the second most competitive among the option available on the market. Additionally, its value proposal is clearly different in terms of environmental and social issues.

5.7 Have organic infills proven themselves?

Having been on the market for longer, synthetic infill use has been studied and documented more than organic alternatives.

However, there are cork infill pitches dating back to 2006, and on the FIFA website for example, there is an extensive list of certified pitches with cork used as the filling method. Cork infill is part of a system, and therefore it is the entire cork infill system that influences performance, not just the infill itself.

6. Conclusion

With regard to the different artificial turf system infill options available on the market, organic infills, specifically cork or cork-based infills such as those offered by Amorim Cork Composites, are an interesting option in terms of environmental impact, player safety and technical quality.

Among other benefits, cork infills can lower general turf maintenance costs, improve safety for sporting activities and enhance player performance and comfort thanks to its neutral odor, more natural appearance and texture than other infills and the fact that it allows the playing surface temperature to be reduced by up to 30% compared to other solutions.

ACC.835 | JUN 2018 | EN

AMORIM CORK COMPOSITES
Rua de Meladas, 260 - P.O. Box 1
4536-902 Mozelos - VFR
Portugal
T. +351 22 747 5300
F. +351 22 747 5301
E. acc@amorim.com

AMORIM CORK COMPOSITES USA
26112 110th Street
Trevor, WI 53179
USA
T. +1 262 862 2311
F. +1 262 862 2500
E. acc@amorim.com

www.amorimcorkcomposites.com