Call for evidence on the use of recycled rubber granules used as infill material in synthetic turf

Background document

1 Introduction

On 1 June 2016 the European Commission requested ECHA to make a preliminary evaluation if recycled rubber granules used as infill material in synthetic turf may pose a risk to human health[1]. Based on this evaluation the Commission will consider whether there is a risk to human health that is not adequately controlled and needs to be addressed at an EU level.

This call for evidence is to:

- Gather information on the composition of the infill material, especially recycled rubber, used in synthetic turfs;
- Gather information on imports of recycled rubber granules and
- Complement the information collected so far.

In this background document there is no information on the risks of the infill material, as this topic is still under evaluation.

European Tyre and Rubber Manufacturers Association (ETRMA), European Synthetic Turf Organisation (ESTO) and a few other stakeholders have been contacted to gather the initial information and a short summary of the information is presented here.

Stakeholders from Europe and outside Europe are welcome to provide relevant information.

2 Overview of different rubber infill types and uses

According to European Tyre and Rubber Manufacturers Association (ETRMA, 2016), the most commonly used elastomeric infill material in sports fields is end-of-life tyres rubber which is styrene-butadiene rubber (SBR). The origin of the styrene butadiene rubber can also be from other rubber materials than tyres.

In some countries rubber granules from end-of-life tyres (ELT) is used in over 95 % of all fields, e.g. in UK, Ireland and France (ESTO, 2016). SBR rubber granules can also be coated with polyurethane based coatings (ETRMA, 2016).

Other materials, such as ethylene propylene diene monomer (EPDM) and thermolastic elastomer (TPE), can be used as infill material as well.

According to industry (ETRMA, 2016) ethylene propylene diene monomer (EPDM) and thermoplastic polymer (TPE) used as infill material can be recycled rubber or virgin material. For example UniRubber Sp, produces infill material from recycled EPDM and virgin EPDM infill material (UniRubber, 2016). UniRubber Sp (2016)

[1] https://echa.europa.eu/documents/10162/13641/echa_rest_proposals_rubber_granules_en.pdf

provided information that the origin of the recycled rubber in SBR, EPDM and TPE rubber granules is mainly from mats, belts, sleeves, spouts and gaskets, not from tyres. They sell the infill material mainly to Poland, Lithuania, Estonia and Latvia. Some refill material is sold to Finland.

According to ETRA (European Tyre Recycling Association) 39%[2] of recycled tyre rubber are being directed to sports surfaces (type of surfaces not specified).

Table 1 (Annex 1) describes the infill demand for artificial turf globally in 2015.

Table 2 (Annex 1) describes the ELT granules/powder market outlets based on the consolidated data from 4 ELT management companies in Portugal, France, Italy and Spain. Based on this information it appears that the share of ELT granules/powder used in synthetic turf (including infill) is decreasing in these countries.

3 Number and types of fields with synthetic turf in Europe

European Synthetic Turf Organisation (ESTO, 2016) states in its Market Report Vision 2020, that there are over 13 000 synthetic turf football fields within Europe and over 47000 minipitches used for football. Data from the major synthetic turf manufacturers and the ELT granulators operating in EU indicate that around 1200 – 1400 new football fields (including the replacement of old fields) are installed every year in Europe (see **Figure 1** (Annex 2)). According to ESTO the number of fields is expected to grow, e.g. by 2020 the number of football fields with synthetic turf is expected to be about 21 000 and the number of minipitches around 72 000.

Football is by far the largest sports' user of long pile[3] synthetic turf fields (see example of synthetic turf in **Figure 2** (Annex 2)). Other sports using this type of surface are:

- rugby,
- gaelic sports,
- lacrosse and
- american football.

Based on industry estimates (ETRMA, 2016), the quantity of ELT rubber infill that is used on European sport fields is about 80000 to 130000 tonnes per year. In Europe ELT-derived rubber infill is the most common form of infill used.

It is estimated that around 10-15% each year of total sales of synthetic turf sports surfaces are for short pile[4] fields (non-ELT infill surfaces) in Europe. These are used for a range of sports such as hockey, tennis, cricket and multi-sport activities.

[2] http://www.recyclingtodayglobal.com/article/etra-takes-stance-on-crumb-rubber-infill/

[3] long pile: typically around 110-120 tonnes of infill material on a full size football field

[4] short pile: infill quantity can be as low as 40 tonnes

In 2015 EPDM represented 0.3 % of the infill material used in synthetic turf globally, while TPE represented 1 %. It is not known what is the share of recycled EPDM and TPA in whole Europe.

According to ESTO, in Germany it is estimated that 50% of all fields built use EPDM or TPE and that similar infills have significant usage in Scandinavia (whether these are recycled or virgin material is not known). It is to be noted that competent authorities from Finland and Sweden stated that rubber infill material used in their countries is mainly SBR.

Based on information received from some Member States, **Table 3** (Annex 1) describes the amount of fields, type of fields and the tonnages of rubber infill used per year on the field.

In addition ESTO (2016) provided information that around 30 gaelic sports fields are built each year in Ireland.

ESTO estimates that over 95% of all synthetic turf installations are currently located outdoors.

4 Overview of the rubber crumb manufacturing process

Rubber crumb is the name given to any material derived by reducing scrap tyres or other rubber into uniform granules with the inherent reinforcing materials such as steel and fiber removed along with any other type of inert contaminants such as dust, glass, or rock. Rubber crumb is mainly manufactured from two feedstocks:

- scrap tyre rubber and
- tyre buffings (a byproduct of tyre retreading)

Scrap tyre rubber comes from different types of tyres (ETRMA, 2016):

- passenger car tyres (including e.g. trailers, caravans), which represent about 70 percent of the total weight of EU 28 scrap tyres;
- truck and bus tyres, which constitute about 16 – 20 percent of the total weight of EU 28 scrap tyres;
- other tyres, which account for less than 10 percent of the total weight of EU 28 scrap tyres

There are several processes for manufacturing crumb rubber. The two most common methods are ambient grinding and cryogenic processing.

Cryogenic rubber is stated to be the cleanest and highest grade of recycled rubber granule.[5] Ambient rubber differs from cryogenic rubber in its grinding phase, where it is processed through a high powered rubber cracker mill at ambient temperature.

Different crumb rubber market segments have different crumb rubber size requirements. Within a specific rubber crumb market, each application has its own requirements in terms of particle size and purity (the accepted level of maximum moisture content is about 1 percent by weight). In **Table 4** (Annex 1) are indicated

[5] http://www.cityofsanmateo.org/DocumentCenter/View/44200

the characteristics of all size reduced tyre materials as indicated in the Publicly Available Specification, PAS 107:2012[6] for the manufacture and storage of size reduced tyre materials.

In **Table 5** (Annex 1) are reported examples of material categories and applications.

5 Imported rubber crumb

According to ETRMA (2016) in the most important international trade classifications (HS[7] and SITC[8]), tyre-related rubber goods is declared mainly under the HS code[9] 4004.00.

Under the HS code 4004.04 approximately 35000 tonnes are imported in EU per year over the last three years. However, it seems that it is not possible to estimate how much of this is recycled rubber granules.

According to ESTO (2016) most ELT, that is recycled to produce rubber infill, is sourced locally (or regionally) due to economic need to minimise transportation costs.

ESTO assumes that some ELT is imported from the Ukraine and Russia and may be used in some eastern European counries.

6 Composition of the rubber granules

ECHA is still gathering information on the composition of the recycled rubber granules (especially SBR). Scientific literature provides some information on the composition of the rubber granules. In addition several studies describe substances that can migrate from the rubber granules and some studies have analysed e.g. substances in the air above the fields. However the origin of the rubber infill material is not normally described in details.

The US Federal Action Plan on recycled tire crumb used on playing fields and playgrounds[10] was launched in February 2016 and in their Research programme they have summarised substances referred to in different literature surveys.

Some information received from ETRMA and ESTO on the composition of the rubber granules are described in **Table 6** and **Table 7** (Annex 1).

The composition of the carbon black is also under investigation, to assess if it may change significantly from one supplier to another.

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[6] http://tyrerecovery.org.uk/wp-content/uploads/2012/11/pas-107-2012-88.pdf

[7] http://www.foreign-trade.com/reference/hscode.htm

[8] http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=14

[9] Harmonised System code to classify and define internationally traded goods with the following description: 'Waste, paring, and scrap of unhardened rubber and powders and granulates obtained therefrom'

[10] https://www.epa.gov/chemical-research/federal-research-recycled-tire-crumb-used-playing-fields

ANNEX - 1

Table 1: Infill demand for artificial turf globally in 2015 (thousand tonnes per year) (source: AMI consulting – 2010 & 2016 Annual report on Artificial turf market – Received via ETRMA, 2016)

	SBR*	EPDM	TPE	Coated sand/SBR	Other	Total
Contact sport	1265.0	4.7	12.9	3.4	9.1	1286.0
Non-contact sport	2.0	0.0	0.0	0.0	0.0	2.0
Leisure/DIY	3.6	0.0	0.0	0.1	0.2	3.7
Landskaping	0.8	0.0	0.0	0.0	0.0	0.8
Total	**1271.4**	**4.7**	**13.0**	**3.5**	**9.3**	**1292.5**

* SBR: tyre recycled rubber is often referred to as styrene butadiene rubber (SBR) in the artificial turf market

Table 2: Market outlets of ELT granules and powder in 2011 and 2014 in France, Italy, Portugal and Spain (ETRMA, 2016)

Use	Percentage (2011)	Percentage (2014)
Asphalt and road paving	4 %	1 %
Sport and children playground	23 %	24 %
Moulded objects	21 %	24 %
Synthetic turf (including infill)	43 %	30 %
Other uses	2 %	5 %
Undetermined (export, trader)	7 %	16 %

Table 3: Synthetic turf fields in some Member States

Member State	Amount of fields with synthetic turf	Infill material	Amount of rubber granules per year or field	Remarks
Finland	39 (indoors/ football) Around 250 (outdoors/football)	Commonly made from styrene butadiene rubber (SBR)	45-113 tonnes per field (average size of field is 7 500 sqm) (note: amount depends on the layer)	Year 2013
Norway	Around 800 football pitches Outdoor fields/sport/running tracks: 125 large and 256 smaller pitches based on rubber granules	90 % of football pitches, 80 % of outdoor fields (etc)	Outdoor fields/sport/running tracks: around 5 900 tons are in use. Football pitches: 85 000 tonnes in use. Around 5 tons used as refill.	
Sweden	1191 football fields (676 for teams of 11 players, 210 for 5, 7 or 9 players and 350 small football fields)	Estimation that 90 % of the infill material consists of SBR rubber.	New fields: estimation of 2550 tons (SBR). Old fieds: estimation of 1520 tons (SBR) by Sweco and 2070-3510 tons (SBR) by IVL	Year 2015. Total area estimated to be 6 117 600 m^2. Every year around 100 fields with synthetic turf built.
United Kingdom	Over 5 000 artificial grass pitches (AGPs). Around 2750 3G pitches (latest development of AGPs).			

Table 4 Characteristics of all size reduced tyre material and material category codes - source PAS 107:2012 (note: % refer to the proportion by length of the exposed materials)

Material Category	Size range (maximum dimension), mm		Other characteristics	Code
	Minimum	Maximum		
Rough Cuts	300	None	Exposed wire and textiles [1]	RX
Clean Cuts	300	None	Less than 5% exposed wire and textiles [2]	CX
Rough Shred	50	300	Exposed wire and textiles	RS
Clean Shred	50	300	Less than 5% exposed wire and textiles	CS
Rough Chips	10	50	Exposed wire and textiles	RC
Clean Chips	10	50	No exposed wire. Less than 5% exposed textiles	CC
Granulate	0.5	10	Free from exposed wire and less than 5% exposed textiles	G
Powder	0	1.0	Free from exposed wire and textiles	P
Fine Powder	0	0.5	Free from exposed wire and textiles	FP

[1] All exposed wire and textiles shall be firmly attached to the body of the rubber fragments.
[2] Upon visual inspection.

Table 5 Examples of material categories and applications (source PAS 107:2012)

Material category	Application
Cuts, Shred and Chips	Co-combustion with other fuels in the manufacture of cement and lime products
Cuts, Shred and Chips	Generation of energy by incineration
Shred and Chips	As the leachate drainage layer in the construction of landfill cells
Chips	Clean cut, as the surface for equestrian ménages and pathways
Chips, Granulate and Powder	Resin-bound as a shock absorbing layer for sports tracks and children's playgrounds
Granulate and Powder	Moulded products such as tiles, street furniture and level crossing platforms
Granulate and Powder	In rubber modified bitumen for road surfacing and repair
Granulate and Powder	Carpet underlay and floor tiles
Granulate	Various horticultural applications such as mulching and soil amelioration
Granulate	As a filler, with sand, in artificial turf for sports pitches
Granulate	As aggregate replacement in construction products such as building blocks
Powder	In industrial adhesives and sealants and in new and retreaded tyres

Table 6- Elemental composition of ELT derived rubber fraction (Aliapur, information received via ETRMA, 2016)

	2015 batches of ELT shreds - Cat A tyres (Passenger Car)				2015 batches of ELT shreds - Cat B tyres (Truck & Bus)			
	Rubber fraction				Rubber fraction			
	μ	min	max		μ	min	max	
Carbon	**78.9**	78.1	79.6	%	**82.6**	82.2	83.3	%
Hydrogen	**7.2**	7.2	7.3	%	**7.6**	7.5	7.6	%
Nitrogen	**0.4**	0.4	0.4	%	**0.4**	0.4	0.4	%
Oxygen	**2.8**	2.6	2.9	%	**2.1**	2.0	2.4	%
Sulfur	**1.7**	1.6	1.8	%	**2.0**	1.9	2.2	%
Chlorine	**180.5**	155.0	212.0	mg/kg	**116.3**	99.0	151.0	mg/kg
Bromium	**309.6**	246.0	378.0	mg/kg	**754.8**	311.0	973.0	mg/kg
Fluorine	**<20**	<20	<20	mg/kg	**<20**	<20	<20	mg/kg
Silicon	**2.7**	2.4	3.0	%	**1.1**	0.6	1.8	%
Zinc	**1.5**	1.5	1.6	%	**1.9**	1.8	2.0	%
Iron	**989.2**	496.0	2310.0	mg/kg	**1286.3**	451.0	2239.0	mg/kg
Aluminium	**736.8**	626.0	876.0	mg/kg	**660.3**	603.0	797.0	mg/kg
Calcium	**3398.6**	2786.0	4144.0	mg/kg	**835.3**	545.0	1020.0	mg/kg
Potassium	**339.4**	305.0	371.0	mg/kg	**492.8**	396.0	656.0	mg/kg
Magnesium	**337.8**	288.0	394.0	mg/kg	**427.3**	359.0	507.0	mg/kg
Sodium	**476.4**	440.0	501.0	mg/kg	**290.8**	235.0	354.0	mg/kg
Phosphorus	**125.0**	118.0	136.0	mg/kg	**207.8**	184.0	233.0	mg/kg
Titanium	**56.4**	42.0	72.0	mg/kg	**42.8**	32.0	69.0	mg/kg
Arsenic	**<3**	<3	<3	mg/kg	**<3**	<3	<3	mg/kg
Baryum	**7.2**	5.0	9.0	mg/kg	**9.3**	6.0	12.0	mg/kg
Beryllium	**<3**	<3	<3	mg/kg	**<3**	<3	<3	mg/kg
Cadmium	**<3**	<3	<3	mg/kg	**<3**	<3	<3	mg/kg
Cobalt	**111.0**	99.0	130.0	mg/kg	**201.8**	169.0	268.0	mg/kg
Chromium	**4.3**	3.0	7.0	mg/kg	**5.5**	3.0	12.0	mg/kg
Copper	**67.8**	47.0	86.0	mg/kg	**66.3**	39.0	111.0	mg/kg
Mercury	**<3**	<3	<3	mg/kg	**<3**	<3	<3	mg/kg
Molybdenum	**<3**	<3	<3	mg/kg	**<3**	<3	<3	mg/kg
Manganese	**7.4**	5.0	14.0	mg/kg	**9.5**	4.0	19.0	mg/kg
Nickel	**3.8**	3.0	6.0	mg/kg	**4.5**	3.0	8.0	mg/kg
Lead	**19.0**	15.0	21.0	mg/kg	**20.5**	11.0	25.0	mg/kg
Selenium	**<3**	<3	<3	mg/kg	**<3**	<3	<3	mg/kg
Thallium	**<3**	<3	<3	mg/kg	**<3**	<3	<3	mg/kg
Vanadium	**<3**	<3	<3	mg/kg	**<3**	<3	<3	mg/kg

Source: Aliapur

Table 7 Example of substances analysed from recycled rubber granules and reported in a safety data sheet (Murfitts Industries Ltd, information received via ESTO, 2016)

Element/PAH Code	Units	Test Method	Results
Benzo(a) Pyrene (BaP) PAH1	mg/kg	AfPS 2014:01 PAK	1.52
Benzo(e) Pyrene (BeP) PAH2	mg/kg	AfPS 2014:01 PAK	2.60
Benzo(a) Anthracene (BaA) PAH3	mg/kg	AfPS 2014:01 PAK	0.527
Chrysene (CHR) PAH4	mg/kg	AfPS 2014:01 PAK	0.825
Benzo(b) Fluoranthene (BbFA) PAH5	mg/kg	AfPS 2014:01 PAK	0.939
Benzo(j) Fluoranthene (BjFA) PAH6	mg/kg	AfPS 2014:01 PAK	0.517
Benzo(k) Fluoranthene (BkFA) PAH7	mg/kg	AfPS 2014:01 PAK	0.178
Dibenzo(a,h) Anthracene (DBAhA) PAH8	mg/kg	AfPS 2014:01 PAK	ND
Indeno 1,2,3 (cd) Pyrene (IcP) PAH9	mg/kg	AfPS 2014:01 PAK	0.863
Benzo(ghi) Perylene (BgP) PAH10	mg/kg	AfPS 2014:01 PAK	1.98
Naphtalene (NAP) PAH11	mg/kg	AfPS 2014:01 PAK	1.43
Acenaphtene (ACP) PAH12	mg/kg	AfPS 2014:01 PAK	ND
Acenaphtylene (ACY) PAH13	mg/kg	AfPS 2014:01 PAK	0.735
Anthracene (ANT) PAH14	mg/kg	AfPS 2014:01 PAK	<0.005
Fluoranthene (FLT) PAH15	mg/kg	AfPS 2014:01 PAK	7.63
Fluorene (FLR) PAH16	mg/kg	AfPS 2014:01 PAK	0.293
Phenanthrene (PHE) PAH17	mg/kg	AfPS 2014:01 PAK	4.65
Pyrene (PYR) PAH18	mg/kg	AfPS 2014:01 PAK	25.5
Aluminium	mg/kg	EN ISO 11885	25.7
Antimony	mg/kg	EN ISO11885	<0.5
Arsenic	mg/kg	EN IOS 11885	<0.5
Barium	mg/kg	EN IOS11885	2.6
Boron	mg/kg	EN IOS 17294-1 & 2	11.5
Cadmium	mg/kg	EN IOS 17294-1 & 2	<0.5
Cobalt	mg/kg	EN IOS 11885	0.7
Copper	mg/kg	EN IOS 11885	39.2
Lead	mg/kg	EN IOS 11885	<0.5
Manganese	mg/kg	EN IOS 11885	2.6
Mercury	mg/kg	EN IOS 17294-1 & 2	<0.5
Nickel	mg/kg	EN IOS 11885	<0.5
Selenium	mg/kg	EN IOS 11885	<0.5
Strontium	mg/kg	EN ISO 17294-1 & 2	0.6
Tin	mg/kg	EN ISO 11885	<0.5
Zinc	mg/kg	EN ISO 11885	491
Chromium III	mg/kg	MF T 90-043	<0.5
Chromium VI	mg/kg	NF T 90-043	<0.004

ANNEX – 2

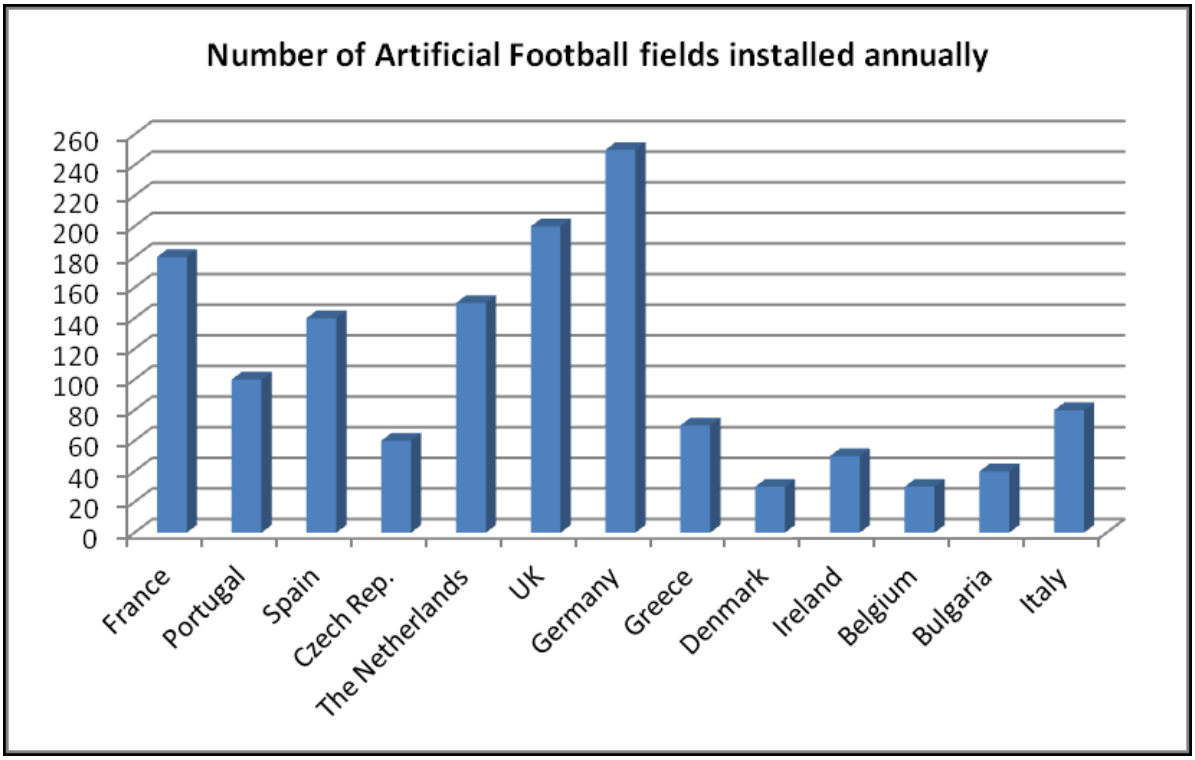

Figure 1 - Number of artificial football fields installed annually

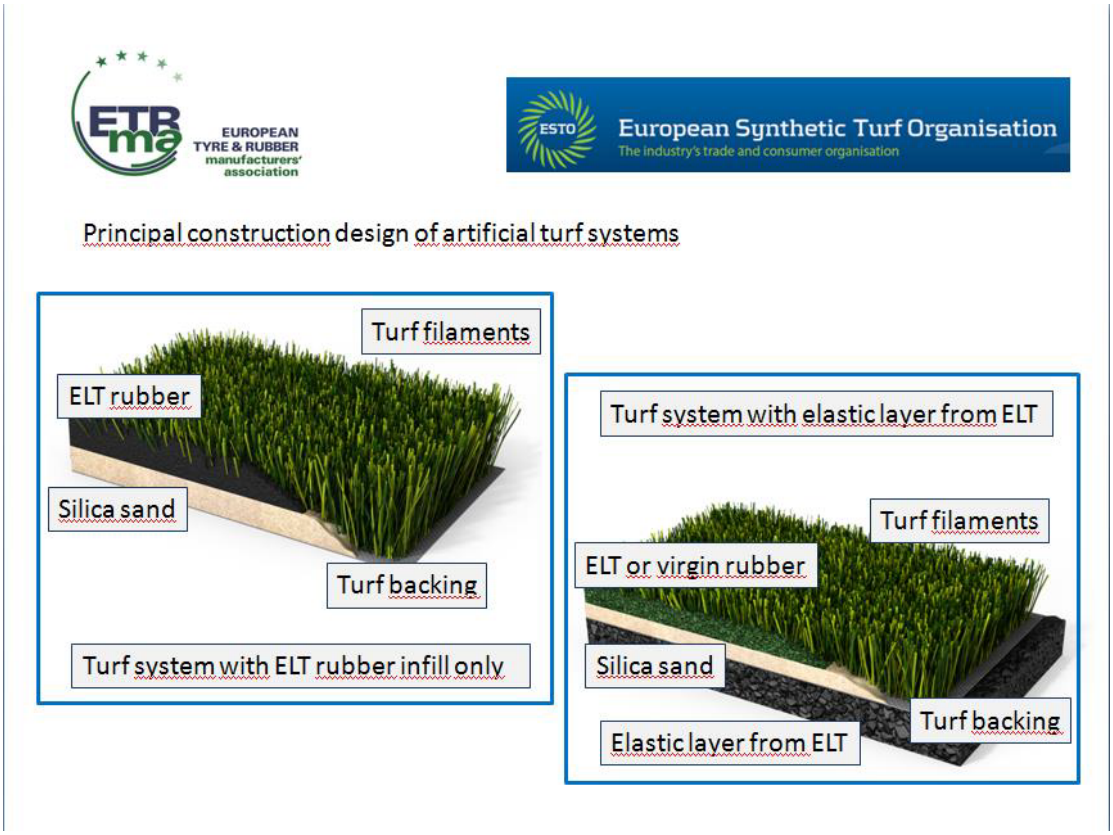

Figure 2 - Examples of artificial turf systems