LIFE Environmental Governance and Information

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RE-PLAN CITY LIFE

REIevant Audience Plan Leading to Awareness Network for CIrcular Economy Use of Recycled TYre materials in city LIFE

Barriers and Obstacles for Areas of Applications

Working Groups' Analysis

This document has been prepared by the Working Groups of RE-PLAN CITY LIFE Project with aim to help to identify the main barriers and obstacles to the diffusion of Recycled Tyre Marterials (RTMs) and start designing solutions to be implemented during the project.

The WGs are open and every one may contribute to the discussions.

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Rubberised asphalt

Introduction
Rubberised asphalts are technically viable and more sustainable. Experiences and demonstration works have been done in many countries confirming the feasibility and the benefits. However this application is not well spread and implemented as it should be owing to lot of resistances and obstacles.

Application description
Recycled rubber can be used in road asphalts to improve performance and durability. Recycled rubber in powder size can be added to hot bitumen (wet method) and then mixed to aggregates, while rubber granulate can be mixed directly to aggregates. According to the process and the mix design it is possible to emphasize various features obtaining better performances.

Performances
Asphalt is a complex product which has to satisfy higher and higher performance owing to a more demanding market. The use of rubberized asphalt would have the following benefits:

- Reduce Thermal Cracking
- Reduce rutting
- Reduce Reflective Cracking
- Reduce Ice Disbonding
- Reduce Flushing
- Reduce noise up to 3dB
- Increase aging Resistance
- Increase Chip Retention
- Increase Flexibility
- Increase Ravelling
- Improved surface texture.
- Improved fatigue resistance.

Current Market
The first application dates back to the 50's - in the USA - and continues since then, due to the successfully increased performance of rubberized asphalt pavements.
In Europe we are still struggling to go beyond to demonstration works. None the less these works started in the 80's and allowed to develop also in Europe awareness and technical skills in various countries:

- 1981 Belgium
- 1982 France, Austria, Netherlands
- 1983 Italy
- 1986 Germany
- 1999 Portugal
- 2000 Germany, Austria, Greece

Potential Market
The asphalt market is a huge market which could absorb large quantities of recycled rubber:

- ✓ 5-20% rubber powder in the binder (50-200 kg of rubber powder per ton of asphalt mix)
- ✓ EU-27 (2020) 208.3 million tonnes of all asphalt mixes (E.A.P.A.)

- ✓ Europe (2020) 276.9 million tonnes of all asphalt mixes (E.A.P.A.)
- ✓ USA (2020) 370 million tonnes of all asphalt mixes (E.A.P.A.

These data show that even a minor addition of rubber powder in the asphalt mix (50 kg per ton of asphalt mix) in just the 4% of the EU asphalt market would allow to recycle 10% of the annual European post consumer tyre stocks.

Technical development and Know-how

Along the years lot of technical developments have been done allowing the achievement of a solid know-how. Many road construction companies, tyre recycling companies, technicians and laboratories have worked together. Important investments in new equipments have been done and implemented.

All these efforts contributed to create a reliable back-ground able to support the growth of rubberized asphalt throughout Europe.

Companies improved their experience and knowledge. They have become aware of critical aspects, which can now be handled properly, such as, among the others:

- Plant production has a reduction by approx.30%
- Higher asphalt mix production temperatures is required
- Small projects which have larger cost
- Application cost, which is similar to other modified mixes (SBS,ECA etc)
- Paving and compaction equipment, which is the same with normal asphalt mixes
- Paving, that can be performed also during night
- Good control of the temperatures

Technical norms

The use of rubber in bitumen and asphalt has been included in various technical norms throughout Europe. Some of these norms are currently applied.

- ASTM D6114-97 (2002)
- Asphalt Rubber manual (Spain, 2006)
- SABITA (2019) Guidelines for the design and construction of bitumen rubber asphalt wearing courses
- European Technical Assessment ETA 20/0377(22.06.2020)

The most effective norms can be easily extend to other countries and applied.

Costs

Cost of rubberized asphalts appears to be in line with traditional modified bitumen. The longer duration makes the paving cost cheaper along time.

SWOT Analysis

Strength

Higher performance
Longer duration
Reduced maintenance
Huge, homogeneous market
High replicability

Weakness

Rubberized asphalt could not be included in the public tenders,unless there is an approved national specification
P.A. Technicians need to be trained and assisted
Fake news about technical complexity, results, costs
Some contractors' myths are strong to be overcome:

- We will ruin bitumen storage tanks
- We need special equipment
- Viscosity testing procedure is standard
- Asphalt mix blend design cannot be varied

Opportunities

High TRL of the application
High quantity of tyres that can be recycled
Implementation of GPP satisfying environmental policy
Good practice and strong environmental message easy to be communicated to citizens
Growth of contractors and contribute to modernize public works
Stimulate P.A. to a more positive and motivated approach leading to :

- Re-think
- Re-consider
- Re-engineer
- Re-plan
- Re-cycle

Threatens

Public sector tend to not care about what is "NEW"
Consolidated presence in the market of strong suppliers of traditional products
Conservative approach from both P.A. and contractors
High level of bureaucracy
Lake of motivation of Local Government Officers to take more responsibility, as they are already concerned on many issues, such as:

1. Community Growth
2. Strategic Planning
3. The Budget
4. Community planning issues
5. Increasing citizen engagement

Obstacles and Solutions

In the light of above analysis we can try to identify the main obstacles and propose some solutions to be promote through the project.

Obstacles

The main obstacles may be then summarized as:

- Insufficient awareness of public officers and experience of public technicians
- Public tenders not suitable or not up to date
- Environmental criteria and GPP not yet implemented and applied by the specific P.A.
- No direct reason to use rubberized asphalt instead of common bitumen mix
- Limited trust to materials and products made of or containing recyclates

– Lack of end-user friendly database of good practices and realizations

- The product adds value, but is more expensive than asphalt without rubber
- The use is not indispensable; hence it may not be on the top priorities of the PAs.
- There may not be enough evidence of the benefits? (i.e., the product is used but there is no monitoring of the benefits such as durability increase or crack reduction). Or perhaps there is evidence but the dissemination is not sufficient.

Solutions and advices

How we can approach and propose new materials, new options and new projects:

- Personal contacts
- Integrated documentation for our proposal
- Precise cost analysis
- Media promotional plan
- Low cost – high efficiency proposal
- Financing resources through EU projects
- Turnkey solution
- Accurate mix design
- Appropriate training for contractors and municipalities
- Good paving practices (temperature-controlled asphalt mixing equipment
- Decreased initial cost due to improved paving equipment
- Lower cost due to the high demand for the this pavement
- Demonstration of the better performance (more crack, rut and skid resistant, reduced traffic noise and smoother roads) than conventional asphalt

Steel Fibers for Concrete Reinforcement

Introduction

Producing a ton of portland cement requires about 4 GJ energy, and releases about 1 ton of CO2 into the atmosphere. Portland cement is responsible for about 5% of the global loading of CO2 into the atmosphere.

Concrete components are consumed faster than they can be replenished (resource depletion). The world consumption of aggregates exceeds 40 billion tonnes a year. This is twice the yearly amount of sediment carried by all of the rivers of the world. It is possible to reduce CO2 /kg by substituting the virgin components with recycled materials, such as:

- Rubber granulate and powder in substitution of light weight aggregates
- Steel fibers in substitution of steel or textile fibres in substitution of plastic fibers

After water, concrete is the most widely consumed substance on Earth.

Application description

Steel fibers can be used form concrete reinforcement either in pre-casted elements or on directly on site in different applications, such as industrial concrete pavements or in spray concrete for tunneling.
Recycled steel fibres (RSF) are similar to those industrially manufactured (MSF) and do not corrode in cement-based matrixes
There are several possibilities of substituting the traditional reinforcement of concrete structures with alternative (and more sustainable) materials. Among them, the use of recycled steel fibers from end-of-life tires (RSF) is a feasible solution. In real structures, such as predalle, RSF guarantees not only the same performances of steel rebar but also a reduction of costs, and of the environmental impact as well.

Current Market

The global precast concrete market size was estimated at USD 89.3 billion in 2019 and is expected to grow at a compound annual growth rate (CAGR) of 6.3% from 2020 to 2027, driven by the rising prominence of offsite construction to reduce the material wastage and to increase efficiency. Rapid industrialization and urbanization in emerging economies focus on the development of high-quality infrastructure around the world, emphasis on green building projects are the major factors driving the market. The major impact benefit for the environment by using in concrete RTMs is the contribute to reduce natural resources depletion.

Technical development and Know-how

Along the years lot of technical developments have been done allowing the achievement of a solid know-how. Many road construction companies, tyre recycling companies, technicians and laboratories have worked together. Investments in new equipments have been done and implemented.
All these efforts contributed to create a reliable back-ground able to support the growth of the use of RTMs in concrete applications.

Technical norms

The use of steel fibers for concrete reinforcement is regulated by various technical norms including dosification and testing. All these norms are currently in application.

- Fibres for concrete - Part 1: Steel fibres - Definitions, specifications and conformity (EN 14889-1:2006)

- Test method for metallic fibre concrete - Measuring the fibre content in fresh and hardened concrete (EN 14721:2005+A1:2007)
- Testing sprayed concrete - Part 7: Fibre content of fibre reinforced concrete (EN 14488-7:2006)
- Test method for metallic fibre concrete - Measuring the flexural tensile strength (limit of proportionality (LOP), residual) (EN 14651:2005+A1:2007)
- EAD Fibres for concrete - steel fibres recovered from end-of-life tyres (260010-00-0301)

Costs
Cost of recycled steel fibers appears to be more than 50% cheaper that Manufactures Steel Fibers (MSF).

SWOT Analysis

Strength
Similar performance
Long duration
Huge, homogeneous market
High replicability
Cost effective

Weakness
RSF do not have CE marking
RSF could not be included in the public tenders, unless there is an approved national specification
Technicians need to be trained and assisted

Opportunities
High TRL of the application
High quantity of steel fibers potentially available throughout Europe
Implementation of GPP satisfying environmental policy
Good practice and strong environmental message easy to be communicated to citizens
Growth of contractors and contribute to modernize public works
Stimulate P.A. to a more positive and motivated approach leading to:

- Re-think
- Re-consider
- Re-engineer
- Re-plan
- Re-cycle

Threatens
Public sector tend to not care about what is “NEW”
Consolidated presence in the market of strong suppliers of traditional products
Conservative approach from both P.A. and contractors
High level of bureaucracy

Obstacles and Solutions

In the light of above analysis we can try to identify the main obstacles and propose some solutions to be promote through the project.

Obstacles
The main obstacles may be then summarized as:

- Insufficient awareness of public officers and experience of public technicians
- Public tenders not suitable or not up to date
- Environmental criteria and GPP not yet implemented and applied by the specific P.A.
- Very low number of providers for second life steel fibers (currently not certified)
- Limited trust to recycled materials and products
- Limited information and cases of study proving its benefits

Solutions and advices
How we can approach and propose new materials, new options and new projects:

- Personal contacts
- Integrated documentation for our proposal
- Precise cost analysis
- Low cost – high efficiency proposal
- Turnkey solution

Artificial Turf

Introduction

The use of rubber granulate from tyre recycling as infill material in artificial turf represents one of the most successful case history for Recycled Tyre Materials (RTMs) which has contributed to expand tyre recycling. However success is never forgiven.

Over the past 20 years rumors and ungrounded allegations about soundness and healthiness of infill materials became a constant concern for this specific market threatening, by extension, also other uses of RTMs.

All charges have been faced and addressed, confirming the value of the material and correctness of recyclers and users.

The last threaten is now represented by the inclusion of infill materials in the definition of microplastics, and the consequent ban of infill materials in 6 years which could become the final stroke to the sector.

Application description

Rubber from tyres recycling is used in sports facilities, public gardens and other urban areas. In sports facilities it is used particularly in artificial turf football fields as an infill material.

This layer of rubber makes the surface suitable to play as it become soft, durable and not subject to alterations because of the climate and the weather. This performance infill together with the synthetic grass carpet has an excellent shock absorption and gives the football field all the characteristics required by FIFA and UEFA.

In summary for a field we deal with:

- 7,500 square meters of carpet of which between 11 tons and 18 tons of yarn
- 70 tons of sand
- 100 tons of rubber granules
- a total of 200 tons of materials

Recycled rubber is also used in children playgrounds and gardens to create anti-shock surfaces, complying safety norms.

Performances

The synthetic grass soccer field is a system composed of three elements: a carpet of artificial grass that is joined to form a single large carpet on which the sand that forms the stabilizing infill is spread as first layer and then above it as final layer and performance infill the rubber granulates from tyre recycling.

The football field built in this way has the following benefits:

- It is safe for players who would have in many cases a clay surface as alteranative
- It is long-lasting and constant over time

- It resists UV rays and intensive and prolonged use over time
- It allows to achieve optimal results for the constant and performing surface
- the surface is able to pass the tests required by FIFA and UEFA
- almost all elements of the system can be recovered at the end of their life
- it significantly reduces the number of injuries caused by playing on clay (fields with worn out natural grass)
- the performance infill from tyre recycling granulates for the moment is the best
- it is the most commonly used infill material in football fields: more than 80% of fields in Europe use it
- it falls within the limits imposed by ECHA for PAHs
- about 100 tons of rubber granulates equivalent to 30,000 tyres, are used in each field
- on these fields it is possible to play up to 2500 hours / year
- it is excellent for an amateur club that can have up to 20/30 teams
- maintenance, to be done regularly, is much lower than in other types of fields
- the cost of the fields built with recycled rubber granulates is cheaper than the others

The Social Impact

The use of recycled materials in the construction of artificial turf make them more competitive and accessible to a large number of small associations and sport organisations, contributing to spread sports and social activities, either in Europe or in less developed countries, like African nations, who often look at Europe a model.

This aspect are even more important than the environmental benefit, and contribute to build up a modern and sound society.

In a study made by UEFA a few years ago "Social and economic of investing in football" these aspects have been valorized in order to determine their economic impact and the economic returns from investments in sports facilities, in particular football fields.

In the box below you may see the figures referred to some countries.

Social and economic return of investing in football – UEFA SROI model

In addition, and in relation, to the impact on physical activity, there would be considerable consequences from the socio-economic point of view. UEFA has developed an econometric model, the "UEFA GROW SROI model", to prove the benefits of mass participation in football across Europe, in terms of economic value, social and health benefits, based on scientific evidence and insight. With a robust methodology, drawing on the highest quality evidence of football and team sports' impact on a range of economic, social and health conditions it is the first model of its kind to put an overall monetary value on sports participation at the national and international scale.

Using this model we generated a value for current levels of participation across UEFA's 55 member associations[16]. The overall annual lost value from a ban on use of artificial playing surfaces across our members is estimated at €94,669,000,000, with over half of that value being attributable to lost health benefits (see example data in Table 2).

Table 2: Sample UEFA GROW SROI Results

Metric	Scotland	Sweden	Germany	Italy	Malta	Latvia	Poland	Romania
Registered players	147,500	432,000	2.25m	1.06m	14,000	90,000	1.03m	219,000
Economic	**€96.1m**	**€244.9m**	**€1.8Bn**	**€742.1m**	**€16.4m**	**€32.1m**	**€424.9m**	**€142m**
- Spending	€34m	€154.3m	€1.15Bn	€606.6m	€8.6m	€20.8m	€465m	€80.2m
- Facilities	€62.1m	€90.5m	€653m	€135.5m	€7.8m	€11.3m	€59.9m	€61.9m
Health	**€144m**	**€1Bn**	**€6.05Bn**	**€1.22Bn**	**€20m**	**€18.4m**	**€466.3m**	**€115.4m**
- CVD	€5.1m	€21.7m	€560m	€56.3m	€564k	€979k	€25.7m	€5.3m
- Diabetes	€2.2m	€4.9m	€131m	€8.7m	€232k	€115k	€7m	€527k
- Cancer	€35k	€178k	€2.9m	€461k	€3k	€11k	€162k	€27k
- Mental health	€8.5m	€10.3m	€495m	€16.7m	€458k	€136k	€6.7m	€2.5m
- Wellbeing	€133m	€1.01Bn	€5Bn	€1.18Bn	€19.4m	€18.4m	€443.4m	€111.4m
- Injury	-€4.8m	-€38.2m	-€168m	-€42.1m	-704k	-€1.3m	-€16.7m	-€4.3m
Social	**€339.6m**	**€672.6m**	**€815.5m**	**€1.05Bn**	**€23.9m**	**€3.4m**	**€62.2m**	**15.5m**
- Crime	€48k	€585k	€5.47m	€370k	€10k	€4k	€92k	€5k
- NEET	€456k	€9.6m	€3.17m	€182.5m	€116k	€1.1m	€1.3m	€224k
- Education	€4.6m	€38.9m	€219m	€55.9m	€460k	€2.2m	€152k	€14m
- Volunteering	€334.4m	€623.5m	€587.6m	€812.7m	€23.2m	N/A	€60.7m	N/A
Total	**€579.7m**	**€1.92Bn**	**€8.67Bn**	**€3.01Bn**	**€60.3m**	**€53.9m**	**€953.4m**	**€272.9m**

[16] After generating a value for current levels of participation across UEFA's 55 member associations the proportion of capacity and different elements of playing time (e.g. training, match play, recreational) that would be lost in the absence of artificial playing surfaces was considered. This lost physical activity was then used to establish a value based on the relevant proportion of the original valuation of football participation in each member association.

Current Market

In Europe there are about 20,000 large fields and an infinite number of playing fields for 5 or 8 players per team of which more than 80% are infilled with recycled rubber granulate. On the other hand, football, and especially youth football, is by far the most practiced sport at all latitudes in all places on the planet.

In 2014, around 43% of the EU population practiced some physical activities at least once a week –or put another way 57% have no participation, so no real attachment.

Even the play ground areas for children and teenagers are now totally built with rubber, especially the surfaces at the base or adjacent to the play tools and almost all of this rubber is composed of recycled rubber granulate, due to its shock absorption characteristics, resistance, durability and non-change over time

Approximately 4.200.000 tonnes of post-consumer tyres are collected each year in the 28 EU Member States and Norway. Of the total, ± 38% undergo some form of material recycling, *(tyres that are processed for energy recovery are not included .*

The total quantity of granulate produced per year is + 640.000 tonnes. Until recently, more than 50% of the granulate produced was used in some aspect of the sport sector, corresponding to +350,000 tonnes, including artificial turf, running tracks, horse tracks, gym and indoor facilities, school sports facilities, among others.

The ban of recycled SBR infill materials, adopted by the Commission, will lead to the collapse of tyre recycling sector with minor benefit for microplastic prevention and major drawback for the environment.

Potential market

Every year in Europe about 1000/1500 new large fields are needed, including new or refurbished fields and a large number of pitches In all EU states, eastern North African countries, the requests for new fields or replacement of fields are increasing.

Especially in countries where the climate is too hot or too cold does not allow for a playing surface with the required characteristics It is difficult to quantify the need for play areas for children and teenagers, but these too are constantly increasing In every municipality, in every city in every country even the smallest, a playground for children is present and normally the surfaces adjacent to the games are built with rubber granulate from tyre recycling both in tiles and cast in place.

Tecnical development and know - how

The soccer fields in synthetic grass was born in America 50/60 years ago and have subsequently developed all over the world and in particular in Europe.

We have gone from a hard and abrasive polypropylene fiber to a subsequent softer and more performing polyethylene fiber which is constantly improving. The research and development of new yarns and new supports is constantly evolving.

Even the infill has gone from sand alone, highly abrasive to a sand system for stabilization to which rubber granulate is added as a performance infill. The sand used as stabilizer must be rounded silica and not calcareous with sharp edges, to allow a longer life of the yarn.

Over the past 20 years, the approved large fields have been built with a performance infill made up of recycled rubber granulate, black or adequately coated with a green polyurethane film.

Also on the performance infill there is an intense research and development activity trying to use organic materials that however hardly reach the performances and conditions of duration of the recycled rubber granulate. In some countries, other elastomers such as EPDM are also used, but this solution is not accessible to everyone owing to higher cost.

The field without performance infill is also being tested, in these cases the quantity of fiber required is much higher because a part of the twisted fibers act as infill. This solution presents some big problems: the non-achievement of the parameters required by the international and national organizations dedicated to sport, the greater quantity of fiber required, the duration over time and the really more expensive maintenance. FIFA has activated a TAG Technical Advisory Group that collects and analyzes all the innovations in this regard to verify, together with accredited laboratories, the practicability and future use of new materials or construction techniques.

Technical norms

The rules and regulations required for the construction or refurbishment of a large synthetic grass pitch are different in the different EU countries. FIFA has prepared a sober and articulated regulation for the construction or replacement of the fields, valid all over the world as FIFA is the highest body in the world as regards football. Below we cite the rules and regulations currently in force for the construction and renovation of a soccer field in synthetic grass, the Italian one being the most restrictive regulation.

Costs

The cost of a large football field of about 7500 square meters varies from between 300,000 € (when they have a more simple design and the use of recycled rubber infill) and up to 600,000 € (more sophisticated design and virgin / organic infill materials).

This data allows us to understand the importance of recycled materials in sport facilities both for the industries / companies connected to these sectors.

Therefore there is an economic relevance to which is added an interesting environmental relevance taking into account the recycled material from the ELTs that can be used (about 30,000 tires per field)

The ban of such use just adopted by the EU Commission it will not only increase the cost of artificial turf pitches while decreasing the quality, but it will have a major negative impact on tyre recycling.

SWOT Analysis

Strength

- Long duration
- High performance
- low costs infill material difficult to be replaced by other material
- constancy over time
- uniformity and standard features of sports surfaces
- maintenance reduction (time and costs)
- use of large quantities of rubber from tyre recycling
- Urban areas improvement
- economic importance of the interventions

Weakness

- The ban of polymeric infill materials that will be implemented in 6 years tend to discourage the use of such product.
- Artificial turf fields contain polymers in the carpet, both in the fiber and in the backing. The wearing of the grass fiber produce microplastics even if they are unintentional microplastics

Opportunities

- Use of a large quantity of recycled tires
- It is a perfect example of recycled materials suitable for GPP
- Environmental minimum criteria should be done quickly and could be a booster for the construction of sports facilities
- The practice of sport increases especially on the weakest segments of the population with consequent reduction of social costs for NHS, Criminality, and youth distress

Threatens

- microplastics issue
- cultural approach, for which a recycled material, even if excellent for its characteristics and performance, being recycled is less attractive. The general idea is that a recycled material must be very cheap, compared to virgin ones.

Obstacles and Solutions

In the light of above analysis we can try to identify the main obstacles and propose some solutions to be promote through the project.

Obstacles

The main obstacles may be then summarized as:

- Insufficient awareness of public officers and experience of public technicians
- Wrong information about microplastics releases and excessive concern about possible risk
- Public tenders not suitable or not up to date
- Environmental criteria and GPP not yet implemented and applied by the specific P.A.

Solutions and advices

- Quantify the environmental and social impact caused by a ban of SBR infill material
- Prepare a position paper to be spread throughout the project
- Involve other organizations such as football association to support recycled rubber
- Think about communications errors and re-think the approach: how propose recycled materials: