

WHITEPAPER

CEYES RPR[®]

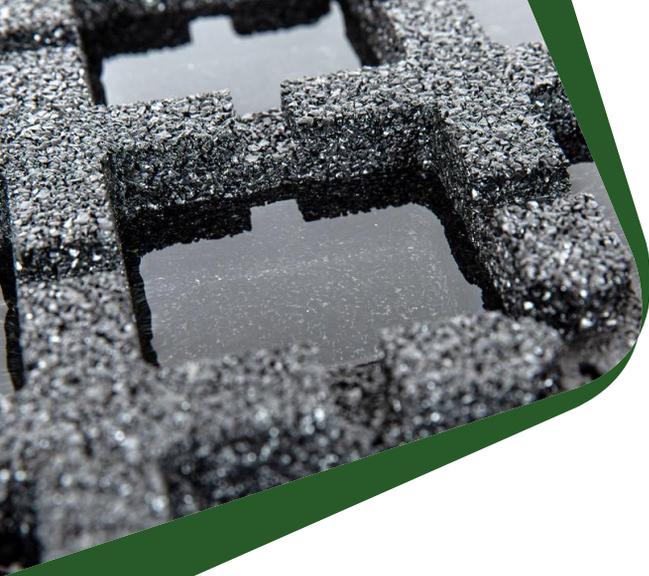
STORM WATER RETENTION PANELS

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Circular Experts



RPR[®] Retention Panel Rubber

- 1.0 CEYES introduction
- 2.0 Closed Loop Innovation
- 3.0 CEYES Trade-In-Program™
- 4.0 Technical data CEYES RPR 60 panels
 - 4.1 LCA Life Cycle Assessment
 - 4.2 Environmental cost indicator
 - 4.3 Water drainage capacity
 - 4.4 Noise reduction
 - 4.5 Total cost of ownership
- 5.0 LEED ratings
- 6.0 Unique Selling Propositions



1.0 CEYES introduction

CEYES's MISSION is to revolutionize tire recycling in the Circular Economy, through the innovative CEYES manufacturing HUB's. Making rubber Circular for at least 100 years.



We have specialized independent knowledge and effective solutions for the production of re-cycled and up-cycled rubber for, inter alia, decision makers, starting entrepreneurs and companies.

This is a whole new approach, small-scale industries in the Circular Economy. These CEYES HUB's are circular, compact, mobile, efficient, effective, economical, 100% recyclable and create less CO₂ emissions compared to a factory building.

They are ideal in C40 megacities and especially attractive in a radius of 150 km from the city. In this day and age, it is no longer justified to cover large distances, together with its forthcoming high CO₂ emissions.

CEYES has designed a new water retaining system for the roof, the RPR[®] panel, made out of waste rubber granules used in synthetic turf. The design aim to reduce the CO₂ footprint of the average market product, made of waste HPDE, polyethylene and polypropylene.

CEYES uses recycled tires rubber granulate from worn artificial grass fields while increasing the lifespan of the retaining system and reducing the kg CO₂-eq/m²



2.0 Closed Loop Innovation

The lifespan of an artificial grass field is around ten to twelve years, after which the entire field must be renewed. The old artificial grass mat can be recycled. The rubber grain remains as residual material. The grain is still usable, but due to the loss of elastic properties, it is not always for artificial grass pitches.

CEYES developed the circular RPR-stormwater retention panel that can serve as the basis for a green roof and for infrastructure. The panel made entirely from rubber granules has both drainage and a retention reduction. After a rain shower, about 20 liters of water remain in the panel. If it is dry, the water evaporates and provides a cooling effect on a summer's day.

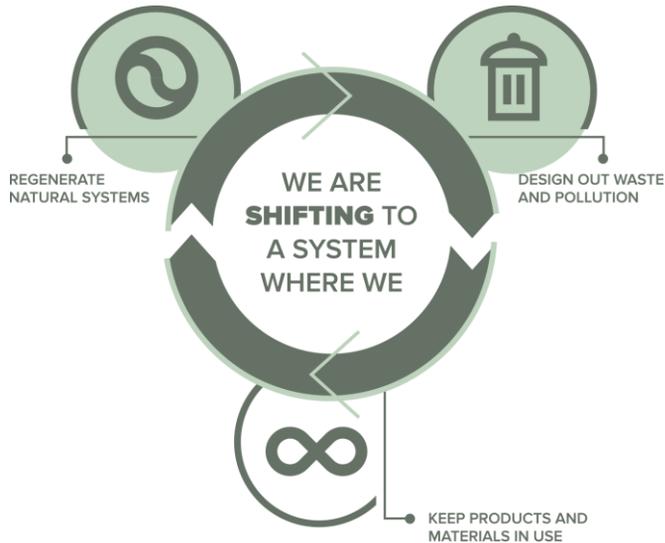
Green roofs absorb CO₂, which compensates. The production of a CEYES RPR 60 panel with rubber granules requires only 8,58 kg of CO₂ per m², while the balance between production and absorption of CO₂ is only four to eight years. With a lifespan of 100+ years, the CEYES RPR panel is a very environmentally friendly solution and the panel itself is 100% recyclable again.

The basis of a circular economic application of rubber lies in small-scale and local processing; local processing is more environmentally friendly. To prevent large transport distances, CEYES, part of the C40 Cities Climate Leadership Group, wants to install semi-mobile HUB's in large cities.



3.0 CEYES Trade-In-Program

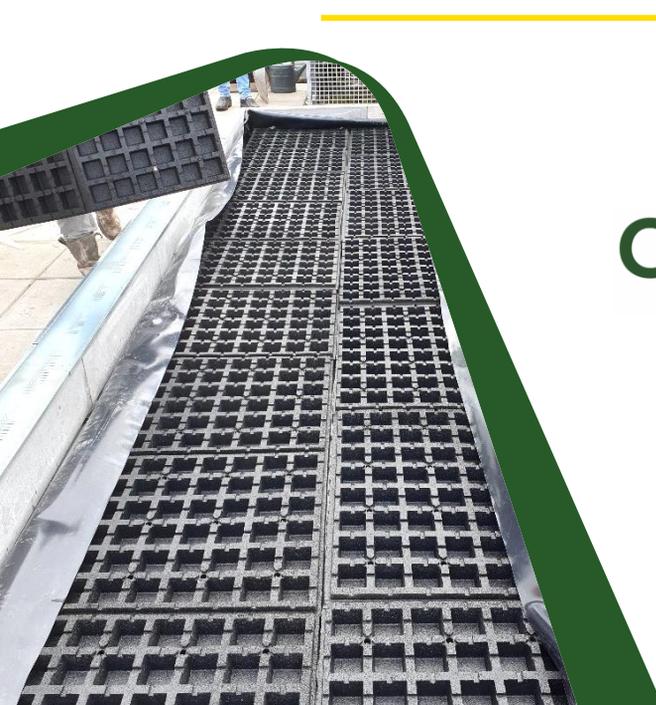
Sustainability is an essential business driver for CEYES and an important part of our product development process.



Through the CEYES Trade-In-Program (TIP) program former buyers of our products can trade-in used products for cash.

As the lifetime of our products under normal usage can reach 50 to 100 years and the materials in the product do not degrade in time, rubber will remain its value overtime and can be re-used and recycled over and over.

After providing information on the products the customer will receive an immediate quote. We expect a guaranteed trade-in price of 50% from the purchase price after 50 years.



ceyes[®] **TRADE-IN**
Circular Experts **PROGRAM**

4.0 Technical data CEYES RPR60 panels

Retention Panels Rubber (RPR), developed for water retention in creating a greenroof, roof terrace, walkway or shock and sound absorbing layers for roads. Products contains SBR granules (made from European Tires and/or Artificial sport fields, temperature bonded with PU-binder. Upper side tubs profiled, bottom side flat with caps.

Revision 1.1 Dated 20-07-2020

Description	Details	According to standard
Artical code and dimensions:	RPR60 0600 0800 - Retention Panel Rubber 60mm x 600mm x 800mm	
Material and colour:	SBR granules from waste tires / black	
Temperature resistant:	- 30° C to 120° C	
Weight:	600mm x 800mm 17kg / 800mm x 1200mm 34kg / 35,9kg p/m ²	
Weight-mass tolerance:	+/- 3%	ISO 9864
Thickness tolerance:	+/- 3%	ISO 9863-1
Length-width tolerance:	+/- 5%	ISO 9863-1
Expansion coefficient:	+/- 0,8%	IHT (In House Tested)
Expansion polytechnic:	per 10°C*m / +/- 0,4mm	IHT
Perforation opening diameter:	17mm (tolerance +/- 2%)	IHT
Perforation opening per m2:	55cm ² (tolerance +/- 10%)	IHT
Compressive strength crush test unfilled:	>1000 kPa	IHT
Compressive strength crush test unfilled:	Pointload 10cm x 10cm >1000 kN/m ²	IHT
Behaviour to fire:	Class E	EN 13501-1
Thermal conductivity:	0,0 S (tolerance 0,001)	IHT
SVHC REACH:	Pass (concentrations: <0,1%)	
Reference service life (RSL):	>75 year.	
CE marking:	Earth, road and water engineering	NEN-EN 14933
Leaching test:	SGS Intron A101410 - R20190063	NEN 7383, NEN 7375:2004,
Life Cycle Assesment (LCA):	SGS Search / EcoChain valid to: 18-03-2024	ISO 14040/44, ISO 14025, ISO 21930 and NEN 8006.
General product properties:	Water- and frost resistant -30°C / suitable for indoor- and outdoor use / sound- and shock absorbing / anti-slip / 100% recyclable / 3 years warranty	



4.1 LCA Life Cycle Assessment

Article	kg CO ₂ / m ²	kg packaging material per m ²
RPR60 0600 0800	8,58	5 grams

Using recycled rubber in molded products, creates a substantially smaller (by a factor up to 20 times) carbon footprint as compared to using virgin plastic resins. (Source: RecycledRubberFacts.org)

4.2 Environmental cost indicator

Article	Unit	MKI value m ²
RPR60 0600 0800	Euro	1,039

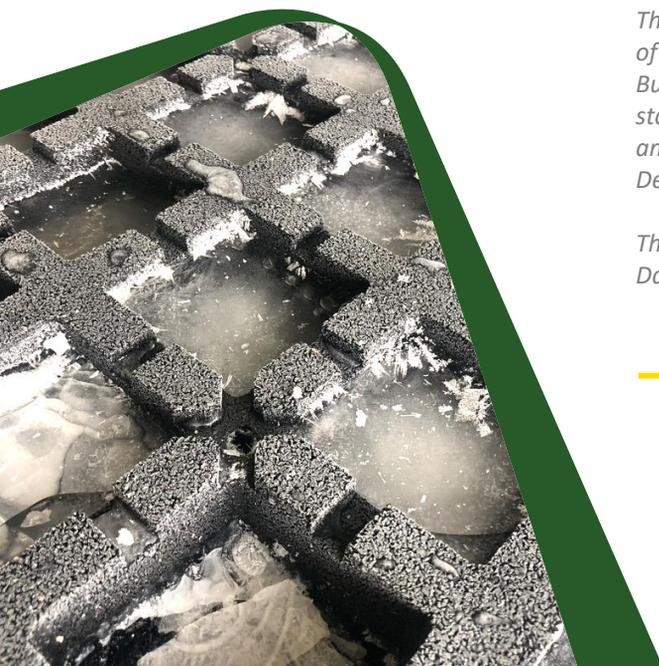
This chapter includes the Cradle to Grave environmental profiles of the RPR retention panels. The results represent the environmental profile in MKI value (Environmental Cost Indicator). The MKI value is an aggregated single score value based on 11 environmental parameters calculated with the method: SBK Determination method, 20-9-2016 (NMD 2.0) 29-9-2017 V3.03 / MKI-SBK single-score. The MKI parameter is a Dutch calculation method and not part of the ISO14040, ISO14044 or EN15804 standards.

4.3 Water draining capacity

Description	Details	Tolerance
No slope	6,3 L/s*m – according ISO 12958	1 L/s*m
2% slope	7,5 L/s*m – according ISO 12958	1 L/s*m
4% slope	20,1 L/s*m - according ISO 12958	1 L/s*m
Water buffering capacity:	20,35 L/m ²	2 L/m ²
Panel fill volume:	27,56 L/m ²	2 L/m ²

4.4 Noise reduction

Description	Details	Tolerance
Contact noise Rw – unfilled	23 dB	+/- 2 dB (IHT)
Surroundings noise Rw - unfilled	15 dB	+/- 2 dB (IHT)



The CEYES RPR rubber retention panels meet the requirements of the Environmental Performance Assessment Method Buildings and civil engineering works”, with underlying standards ISO 14040/44, ISO 14025, ISO 21930 and NEN 8006, and meets the maximum emission values of the Soil Quality Decree for all components.

The results are included in the Dutch National Environmental Database.

4.5 Total cost of ownership RPR 60

Description	Worst case	Best case
Purchase price m ² : (fictional)	€ 35,00	€ 35,00
Buy back > 40 years: (50% of cost price)	- € 17,50	- € 17,50
Subsidy:	€ 0,00	- € 7,50
Net investment:	€ 17,50	€ 10,00
Net investment p/year/m ² :	€ 0,44	2 L/m ²
Benefits m² p/year		
Roof lifetime extended:	€ 0,62	€ 0,75
Energy savings:	€ 0,38	€ 3,76
Water control:	€ 0,54	€ 0,58
CO ₂ reduction by use of recycle rubber:	€ 0,11	€ 0,15
Reduction of roof damages:	€ 0,06	€ 0,12
Total benefits p/m ²	€ 1,71	€ 5,36
Other benefits		
Health improvement:	< 10%	
Increase value improvement:	> 4 to 8%	
Air cleaning of plants by CO ₂ :	€ 0,05	€ 0,19

4.0 LEED ratings

CEYES RPR meets the stringent criteria required to contribute to point 2 of the 6 LEED rating system categories including MR 4.1 and MR 4.2.



6.0 Unique Selling Propositions

- From synthetic turf sportsfield - recycled rubber - to water retention panel. Reuse of “infrequent” raw material natural rubber. Tires are now still burned on a large scale >50% and dumped >30%, resulting in all CO₂ and environmental problems. Only 20% is processed into new products. CO₂ emissions reduction 2.69 kg of CO₂ per re-used kg of rubber.
- Water buffering 20 liters per m² (RPR 60) and 28 liters with greenery. This allows most storm water floods to be buffered and drained slowly. High investment costs in water management systems are therefore not necessary. Water damage currently costs the government EUR 1.3 billion per year. Water damage from storms costs insurers 90 million a year. A doubling is expected in the next 10 years. The Netherlands has 480,000 utility buildings with 460 million m² of floor space. This is approximately 40% of the total built-up area. 60% is therefore houses that cover an area of 690 million m². Arcadis calculated the water damage in the Netherlands in 2019 at 2.10 per m².
- There is much less damage in storms. Storm damage in the Netherlands averages 165 million a year. The expectation is 103 million to 250 million extra damage from climate change.
- Protection of the roof covering so that the roof lasts longer. Conventional 25 years by RPR panels to 50 years. Roofing costs 45 to 55 euros per m².
- Insulation of the roof (RC value 0.17 higher per mm) with reduced energy use of the building.
- Rubber does not crumble, cannot freeze, no leaching and therefore retains rainwater purity.
- The indestructible nature of the rubber panels enables new circular payment methods, such as pay per m², pay for use.
- Large leasing companies that lease many roof products see good opportunities for leasing projects with green roofs with rubber panels.
- Sustainable buildings receive up to 0.5% lower interest rates on loans from financiers.
- A much better LCA value.

6.0 Unique Selling Propositions

- Extremely low CO₂ production footprint of the panel, which means that when applied, the green roof is CO₂ neutral within 4 to 8 years. Compared to plastics it needs 13 to 32 years. Current price (2020) CO₂ is 44 EUR while 84 EUR is proposed by 2025.
- Long product life and reusability after end of life. Indication 100 years instead of 40 years for plastic material. The Life Cycle Costs of a rubber panel are therefore considerably lower 0.265 than of plastic 0.625 per year. There is much less damage in storms. Storm damage in the Netherlands averages 165 million a year. The expectation is 103 million to 250 million extra damage from climate change.
- Procurement procedures of governments prescribe the purchase of locally acquired, locally produced, lowest CO₂ footprint products.
- Designed and produced in accordance with circular principles.
- Produced locally according to LEED principles. Buildings can collect up to 23 extra LEED points.
- Solar panels can be mounted on RPR panels (using the weight of the rubber panels) to utilize the cooling of the green roof (yield of the solar panel can rise to 12% by cooling).
- Panels applicable in civil engineering solutions, parking roofs, roads, erosion, surface water storage.

The rubber retention product therefore has many advantages that will certainly justify a higher price because of the much lower Cost Of Ownership, but it is suspected that this premium product will only be paid later if the inevitable change in the market will be implemented: the elimination of using polluting plastic materials because we don't want more plastic soup in our seas.

CEYES RPR® contributes to the following UN sustainable development goals



In addition, the product has all the advantages of green roofs:

- Heating in winter and cooling in summer (energy reduction).
- Lowering the Urban Island City Heat.
- Relief from the sewer systems.
- More Biodiversity.

