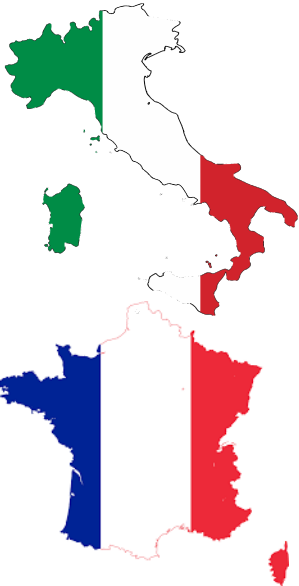


SUSTAINABILITY IN CONSTRUCTION:

**Utilization of waste
and non-traditional materials**



**Střední průmyslová škola stavební
a Obchodní akademie Kladno**



ISIS ITN-ITG-IPS-ITC Riposto



**Lycée Polyvalent Le Garros,
Auch**



**Stredná priemyselná škola stavebná
Dušana Samuela Jurkoviča, Trnava**

The Sustainability in Construction project was focused on developing students' green thinking by making them acquainted with possibilities of reusing old construction materials and using non-traditional substances for construction. As there is a finite number of resources on our planet on one hand and growing number of populations on another, sustainability in construction makes sure that the resources are used in an effective way.

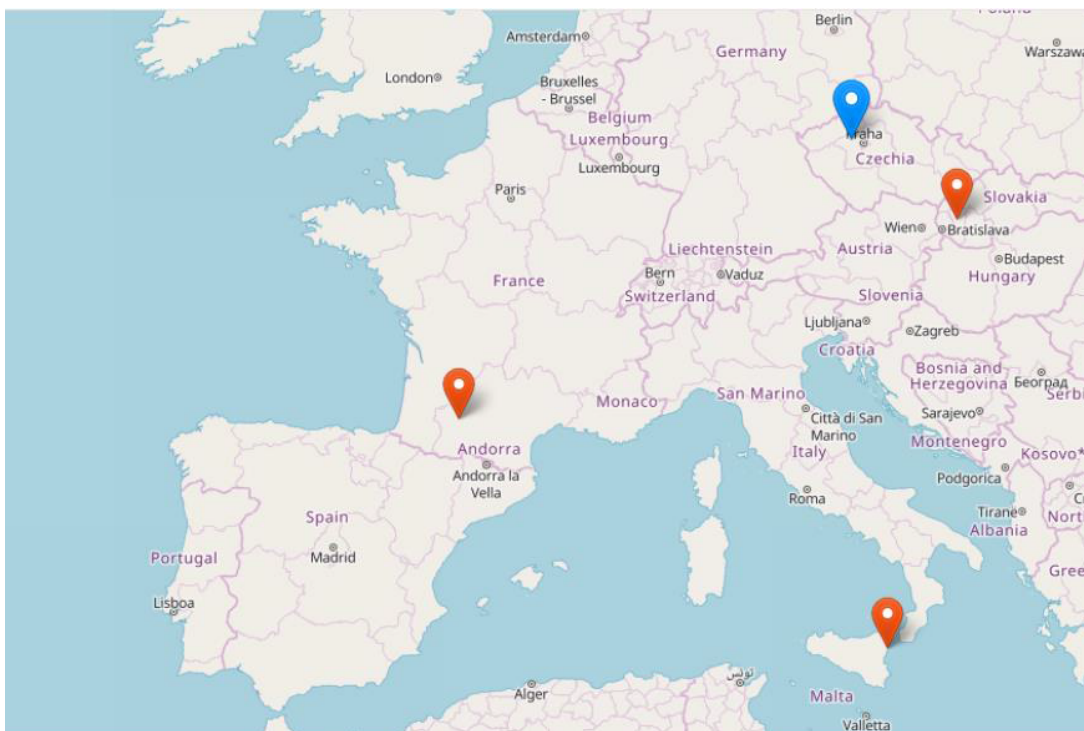
4 participating schools:

Stredni prumyslova skola stavebni a Obchodni akademie Kladno (Czech Republic),

Stredna priemyselna skola stavebna D.S.Jurkovicova Trnava (Slovakia),

ISIS ITN-ITG-IPS-ITC Riposto (Italy) and

Lycee Polyvalent Le Garros Auch (France)




4 international meetings:


December 2021 – Kladno, Czech Republic


April 2022 – Riposto, Italy


October 2022 – Auch, France

March 2023 – Trnava, Slovakia

 One of the most important objectives was to raise students' and public's awareness of possible changes that would help save resources, and support their green skills. Another goal was to develop students' competences relating to green skills and sustainability, because these are both present and future-oriented topics focused on people's and planet's needs. The students would become real bearers of changes in the field of saving resources, finding new ways of using waste, and spreading their ideas further. The project has also contributed to their professional skills development, because they focused on the branch of construction that is spreading very quickly throughout the world. As they had a chance to cooperate with local companies dealing with waste recycling and producing building materials, they could get acquainted with the real-work environment. This has helped develop their work skills and gave them a sort of practical training for their future job.

 The students dealt with utilization of waste and non-traditional materials by testing various waste and searched for more ideas concerning their utilization in construction. They proceeded to heat testing comparing different materials (recycled and more classical materials) in order to make a performance analysis (comparative tables) of the different possible solutions.

 The students' learning motivation was developed by new learning strategies they were provided, encouraging their problem-solving skills, and offering them with reasonable assignments and effective feedback. It was a real challenge for the students, because they got involved in authentic work and meaningful activities, as they became part of the research themselves.

 One of the tasks students had to deal with was to create case studies on non-traditional and waste materials used in construction in their countries. Those worksheets were later developed in an exhibition organized by SPSS a OA Kladno accessible to the public. Some of the companies focused on processing such materials were also visited during the international meetings in the four countries.

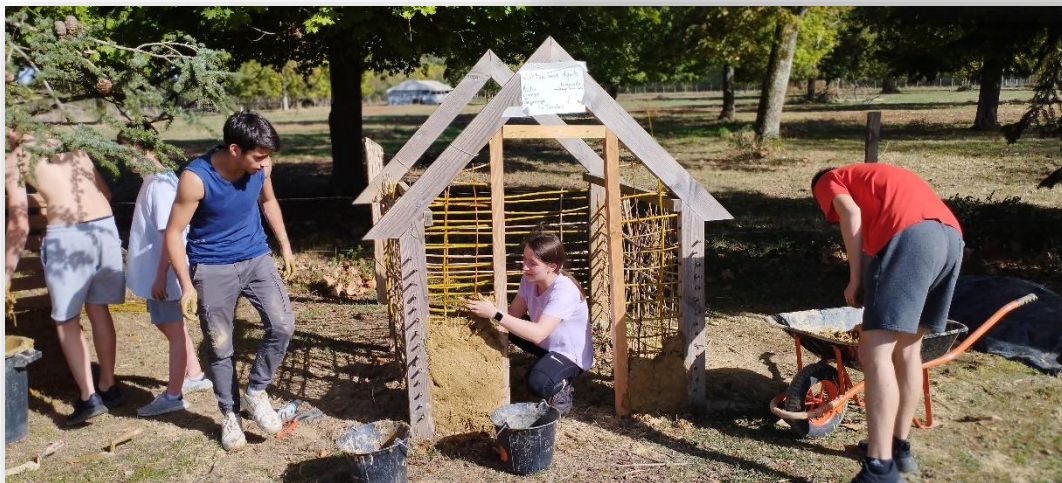
CZECH REPUBLIC – December 2021



ITALY / SICILY - April 2022



FRANCE - October 2022



SLOVAKIA - March 2023



Czech Republic



Bamboo



Advantages:

It is the fastest growing plant.

Its weight - also used in construction of multi-level houses as scaffolding.

Absorbs a large amount of carbon dioxide.

Usable after 3 days of planting.

Disadvantages:

- Expensive realisation
- Little experience



Interesting facts:

Some species are used as knives or machetes.

From a total of 1500 types of bamboo there are only a few suitable for construction, e. g., *Dendrocalamus* or *Guadua*

Utilisation in the Czech Republic:

- Whole houses
- Instead of steel as scaffolding
- Reinforcement



Resources:

<https://www.drevostavitel.cz/clanek/misto-smrku-bambus>
<https://www.svet-bydleni.cz/bambus-je-opomijeny-prirodni-material>
<https://living.iprima.cz/design/hiddenout-bali-alena-lhotakova-bambus-dum-netradicni-stavebni-material>
<https://www.youtube.com/watch?v=6nhZrClQ3s>
<https://www.ireceptar.cz/zahrada/pestovani-bambusu-na-zahrade.html>
<https://living.iprima.cz/design/hiddenout-bali-alena-lhotakova-bambus-dum-netradicni-stavebni-material>

Foamglas



Advantages:

Frost resistance, shape stable, not smelly.

Resistant to mechanical strain and it is considered an ecologically clean material.

Disadvantages:

Expensive and heavy production.

Use:

Foamglas is used as thermal insulation.



Interesting facts:

Made from recycled glass.

Foamglas board can transfer a load on a four-storey building.

Production:

Glass is crushed into particles between 10 and 90 micrometres.

This meal is compressed warmly with carbon powder.





5

Foamglas in the Czech Republic

Foamglas is produced in the Czech Republic by Refaglass company.

Refaglass foamglas has won numerous awards for excellent ecological, economic and technical characteristics.

Refaglass says that foamglas is used to isolate base plate, this insulation is 10% cheaper than other materials.

Foamglas saves around 15% on energy per year.



6



7

Refaglass says that they see in their product a material of the future.

- 1 AUTOR NEUVEDEN. bestor.ee [online]. [cit. 16.3.2021]. Dostupný na WWW: <https://bestor.ee/wp-content/uploads/2020/01/27-HL.jpg>
 2AUTOR NEUVEDEN. Refaglass [online]. [cit. 18.3.2021]. Dostupný na WWW: <https://www.refaglass.cz/fotografie/?detail=73>
 3 AUTOR NEUVEDEN. Refaglass [online]. [cit. 19.3.2021]. Dostupný na WWW: <https://www.refaglass.cz/fotografie/?detail=73>
 4 AUTOR NEUVEDEN. foamglas.com [online]. [cit. 16.3.2021]. Dostupný na WWW: <https://www.foamglas.com/cs-cz/co-je-owens-corning-foamglas/nas-vyrobek>
 5 AUTOR NEUVEDEN. foamglas.com [online]. [cit. 16.3.2021]. Dostupný na WWW: <https://www.foamglas.com/-/media/project/foamglas/public/shared/ft-perinsul3.jpg?w=1000&hash=8B1E051EDBD125F066095DABCCDB0D59>
 6 AUTOR NEUVEDEN. foamglas.com [online]. [cit. 16.3.2021]. Dostupný na WWW: <https://www.foamglas.com/cs-cz/poradenske-centrum/protection-areas/corrosion>
 7 AUTOR NEUVEDEN. Refaglass [online]. [cit. 19.3.2021]. Dostupný na WWW: <https://www.refaglass.cz/fotografie/?detail=72>

Pallets



Advantages:

- easy availability
- light
- reusable

Disadvantages:

- easy to rot
- sensitive to moisture and mould

Usability of pallets:

They are mostly used for simple structures and furniture.

Exceptionally as the main building materials.



In the Czech Republic:

They are used as furniture, such as beds, tables, chairs, benches or couches.

They can be also used to build garden houses or vertical gardens.

Resources:

<https://www.drevoastavby.cz/drevostavby-archiv/zajimavosti/2104-palety-multifunkcni-stavebni-material>
https://www.drevoastavby.cz/drevostavby-archiv/zajimavosti/4668-drevena-modulova-komora-anebo-dum-z-palet-nic-neni-nemozne?utm_source=www.seznam.cz&utm_medium=sekce-z-internetu&fbclid=IwAR2vj13rN-GNYvL-6aXSnohOFzIqB8HekxUoF4rkPIWyiUnNUfZLejaZcHM
https://www.youtube.com/watch?v=kIZAXxYt98o&ab_channel=BlauelLaguneTV
<https://www.drevoastavby.cz/archiv-aktualit/172-nabytek-doplňky-zahrada/2187-palety-v-zahrade-jako-doma>

Examples of pallet buildings around the world:



Pavilion in Oberstdorf

18 metres long, 8 metres wide, and 6 metres high.

Palletø in Denmark



Diamond-like structure in Florence

Pallet House in Vienna



Resources:

<https://www.drevoastavby.cz/drevostavby-archiv/zajimavosti/2104-palety-multifunkcni-stavebni-material>
https://www.drevoastavby.cz/drevostavby-archiv/zajimavosti/4668-drevena-modulova-komora-anebo-dum-z-palet-nic-neni-nemozne?utm_source=www.seznam.cz&utm_medium=sekce-z-internetu&fbclid=IwAR2vj13rN-GNYvL-6aXSnohOFzIqB8HekxUoF4rkPIWyiUnNUfZLejaZcHM
https://www.youtube.com/watch?v=kIZAXxYt98o&ab_channel=BlauelLaguneTV
<https://www.drevoastavby.cz/archiv-aktualit/172-nabytek-doplňky-zahrada/2187-palety-v-zahrade-jako-doma>

Plastics



Benefits:

The material is not attacked by mould or wood-destroying insects. Light weight. Frost resistance. Impact-defiance. It can be used in humid environments. Possibility to recycle.

Assortment of recycled plastic products:

- fences
- boards
- terraces
- roofing
- plastic transport pallets
- plastic cable troughs



Roofing:

It is used for sloping or step roofs.

It is designed for new buildings and reconstructions.

Its other advantage is the resistance to biological degradation or weather.

Utilisation in the Czech Republic:

Mostly used for terrace boards.

It is suitable for humid environments where its properties do not change. You can also lay boards according to the installation instructions yourself. The length of the grooved terrace board including dilation is 1500 mm.

Straw

Advantages:

- easy to obtain
- cheap
- lightweight building material
- environmentally friendly

Disadvantages:

- easily flammable
- inclinable to moisture

Types of straw products:

Free package:

It weighs 90 - 150 kg / m³, it is available only in a certain part of the year, it is placed on the building by hand and its main use is: exterior insulation, filling of horizontal structures and filling of wall structure.



2

Prefabricated panel:

It weighs 90 - 120 kg / m³. It is mounted using a crane and its used as: wall panel, ceiling panel and floor panel.



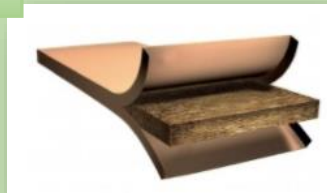
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Pressed plate:

It weighs 380 kg / m³. It is assembled by hand and its used as a separate partition, skeleton cladding, attic cladding.

Modul part:

It weighs 100 kg / m³. It can be mounted manually, but usually a crane is used. It is used as a load-bearing perimeter wall.



2



2

Utilization in the Czech Republic:

There are a number of straw houses and this technology has slowly become established in our construction market. It is especially suitable for its environmental friendliness.

Resources:

1. ŠČUDLA, Miroslav. fa.cvut [online]. [cit. 24.3.2021]. Dostupný na WWW: <https://www.fa.cvut.cz/studium/predmety/ekologie-i/ekologie-i-vyuziti-slamy-v-soucasne-architekture.pdf>
2. ČHYBÍK, Josef. stavba.tzb-info [online]. [cit. 19.3.2021]. Dostupný na WWW: <https://stavba.tzb-info.cz/obalove-konstrukce-nizkoenergetickych-staveb/17721-vyuziti-slamy-v-soudobe-architekture-a-stavitelstvi>
3. GEMBALOVÁ, Alena. homebydleni.cz [online]. [cit. 24.3.2021]. Dostupný na WWW: <https://homebydleni.cz/dum/rekonstrukce-domu/prirodni-zatepleni-zateplete-si-dum-chalupu-slamenymi-baly/>
4. KIERULFOVÁ, Zuzana. abs-portal.cz [online]. [cit. 24.3.2021]. Dostupný na WWW: <https://www.asb-portal.cz/stavebnictvi/strecha/doskova-strecha-bude-i-u-nas-znovu-beznou-krytinou>

Traditional use of rye straw

Thatched roofs protected the houses of poor people from rain and cold. They were not very durable, but cheap and affordable.



4

Today, a modern thatched building means luxury. Cereal straw or more durable reed is used.



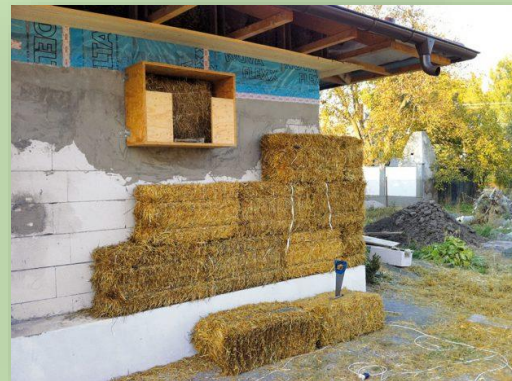
3



4

The straw bale is the cheapest thermal and acoustic insulation.

If the straw is not treated and has a short life, it can be easily replaced.



1



1

Insulation mats and panels are made from straw.

Straw is chemically treated to improve resistance to moisture, rodents and high temperatures. This will extend its life.

Resources:

1. ŠČUDLA, Miroslav. fa.cvut [online]. [cit. 24.3.2021]. Dostupný na WWW: <https://www.fa.cvut.cz/studium/predmety/ekologie-i/ekologie-i-vyuziti-slamy-v-soucasne-architekture.pdf>
2. CHYBÍK, Josef. stavba.tzb-info [online]. [cit. 19.3.2021]. Dostupný na WWW: <https://stavba.tzb-info.cz/obalove-konstrukce-nizkoenergetickych-staveb/17721-vyuziti-slamy-v-soudobe-architekture-a-stavitelstvi>
3. GEMBALOVÁ, Alena. homebydleni.cz [online]. [cit. 24.3.2021]. Dostupný na WWW: <https://homebydleni.cz/dum/rekonstrukce-domu/prirodni-zatepleni-zateplete-si-dum-chalupu-slamenymi-baly/>
4. KIERULFOVÁ, Zuzana. asb-portal.cz [online]. [cit. 24.3.2021]. Dostupný na WWW: <https://www.asb-portal.cz/stavebnictvi/strecha/doskova-strecha-bude-i-u-nas-znovu-beznou-krytinou>

Technical hemp

Today, up to 25,000 100% recyclable products are produced from hemp. Therefore, it also finds use in the construction industry.

Hemp concrete - advantages:

- high thermal and sound insulation
- recyclable
- hardening speed
- cheap



Hemp oil: advantages:

It works as a wood coating.

It protects it from pests, mould and wind. Wood also does not absorb water and has a longer lifespan.



Hemp insulation - advantages:

- great against mould and pests
- thermal insulation properties
- environmentally friendly

Disadvantages:

It does not protect against UV radiation (but there are also hemp lazurizing varnishes that solve this problem).

Utilization in the Czech Republic:

Although there are already hundreds of structures made of hemp concrete in Europe, we are only just beginning to use it timidly.

The first cannabis house in our country is the house of Petr Žáček near Litoměřice.



Resources:

<https://www.asb-portal.cz/stavebnictvi/zatepleni/vyuziti-konopi-ve-stavebnictvi>

<https://casopisroots.cz/konopi-a-jeho-vyuziti-ve-stavebnictvi/>

<http://www.enviweb.cz/85729>

<https://www.ceskestavby.cz/clanky/jak-se-konopi-vyuziva-ve-stavebnictvi-23216.html>

Italy





Etna's volcanic ash

The Reucet project (Recovery and use of Etna volcanic ash) of the University of Catania, funded by the Ministry of the Environment, reveals how waste ash can become a very sustainable resource.



Thanks to this project, everything that comes from the mouth of the Sicilian volcano can be recycled and reused. Leaving the black hole of the waste, bulky, and entering the club of sustainable materials.



ETNA'S ASH

First of all, there is the possibility of using it in concrete, in mortars, in plasters, and also to create the layers under the road and geothermal works. In all these cases, ash replaces polluting materials, innovates the product and guarantees excellent performance both in terms of solidity and safety.





CERAMICS WITH ETNA'ASH

A second line of reuse of Etna ash is that of ceramic products. The researchers found that the characteristics of the ceramics obtained from the ash of Etna are higher than those of conventional ceramics, which in Sicily involve a real production chain, between industry and crafts. And among the performance of ceramics is its lightness: about 20 percent less than other types of ceramics. This means considerable savings in terms of storage, transport and disposal.

RECOVERY OF ETNA'S ASH

But the recovery of Etna ash has an absolute value in terms of horizontal cutting of the costs of collection and disposal of this material. The ash is classified as waste to be disposed of in landfill, with a cost of about EUR 120 per tonne, or in recovery plants, with an expense of EUR 12 per tonne. Then there are the expenses for collecting ashes from public spaces. And instead, thanks to the recycling and reuse identified by researchers at the University of Catania, all these cost items disappear. And the Etna ash from waste becomes a resource. Unfortunately, because of the pandemic, the project has been blocked for the moment. We look forward to its reboot.

WOOD

Wood is a porous and fibrous structural tissue found in the stems and roots of trees and other woody plants. It is an organic material, and has been an important construction material since humans first began building shelters and boats. Today a wider variety of woods are used. For example, solid wooden doors are often made from poplar or pine-tree, but usually wood will still be found as a supporting material, especially in roof construction or chairs and beds.



Wooden houses respect the principles of bio-architecture, thus the use of wood and other natural materials allow good thermal insulation and a consequent saving in energy consumption. Good insulation also allows you to better manage the balance of internal temperatures in a home. Wooden houses guarantee a cool and comfortable environment even in summer without the need to resort to air conditioning systems thanks to its natural insulating properties.

Disadvantages

First of all, while not a practical disadvantage of wood as a building material, the over-use of wood may lead to ethical and environmental challenges. We can class cut timber as a renewable material, but this invariably involves cutting down trees - which, when not carried out sustainably - has the potential to lead to deforestation.



Low environmental impact

As long as wood is sourced sustainably, its use as a building material has a very low environmental impact. It carries benefits as a completely natural and environmentally friendly material - for instance allowing perfect thermal-acoustic insulation; and being non-toxic. Sustainably-sourced wood of controlled origin is a renewable material, meaning its use as a building material is undoubtedly an ecological choice.

The brick that filters pollution

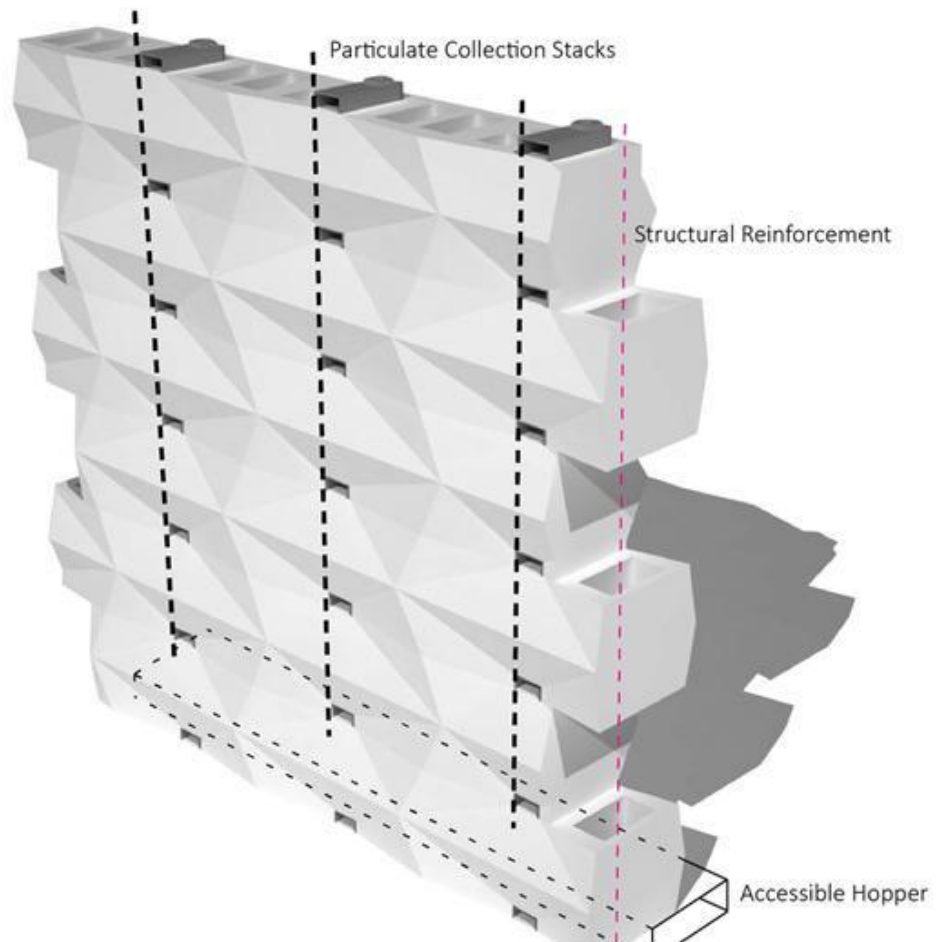
Advantages: This brick has the function of filtering substances such as gases, droplets, benzene particles, carbon monoxide, nitrogen oxide, ozone, heavy metals.

Disadvantages: There are no known disadvantages of this material.

Advantage: The key advantage is that it filters pollution, this helping to mitigate diseases such as cancer and respiratory problems.

Benefit for the environment: Not to use materials that pollute and damage the environment

Air pollution is one of the biggest environmental and health issues facing the world nowadays. It leads to around seven million premature deaths worldwide every year. Living in heavily polluted areas such as cities may take away at least 1-2 years of a typical human life. In Italy, 90,000 people die every year due to air pollution.



RICE WASTE FOR SUSTAINABLE CONSTRUCTION

characteristics of the material:

Rice as a raw waste material in Italy is not lacking. The annual production of rice hovers at around 1 million tonnes. To obtain each tonne of building material, 1.3 tonnes of straw, 200 kilos of husk and 70 kilos of chaff are produced. All of this is possible thanks to a basic mixture consisting of husk, chaff and rice straw that ensures the production of a lightweight, highly thermal, breathable, healthy and 100% made-in-Italy material.

Use of the material in Italian construction:

The uses in buildings range from plasters to screeds, from eco-paint to closing panels or dry coatings, up to a new construction system for the prefabricated envelope. It's high thermal and acoustic performance allows you to regulate the humidity of the internal environments by purifying it from concentrations of pollutants, thanks to its clay-like properties. In Italy, rice straw, another derivative, is used instead to produce insulating panels and to build the roofs of prefabricated wooden buildings. Research has produced a treatment, thanks to an optimal mix of rice straw with wool waste deriving from sheep shearing. This creates a material that is particularly effective as an insulator and heat-

Advantages:

Furthermore, these products are surprisingly easy to install and are suitable for all types of interventions, from renovations to new buildings.

Disadvantages:

it does not last long, as it can be very fragile.

Its benefit for the environment:

As they are completely natural, the products that have reached the end of their life will not have an impact on the environment, as they are bio-compostable and biodegradable.



Name: STRAW

Characteristics: Plant material with low environmental impact.

Use in construction: Used in construction to improve thermal and acoustic comfort and to regulate humidity levels.

Advantages: The thatched house is comfortable because the thickness of the bales (45 centimeters) works as sound insulation and allows for the natural



breathability of the walls. This works well to prevent condensation or mold from forming. Straw compressed in bales contains a very low percentage of oxygen which protects well against fire. The construction also ensures excellent seismic resistance.

Disadvantages: The thatched house is certainly ecological and sustainable, safe in all respects and undoubtedly inexpensive. However, the use of straw does not allow for large planimetric elaborations. Therefore, unfortunately, we will never see a straw skyscraper.



Use in Italy: The haystack is a characteristic pile of straw, built around a central pole to form a cone. This construction is used as a shelter for animals. Haystacks were used in the past, but nowadays have been replaced by mechanized systems in order to reduce costs and increase their practicality of use.



CELLULOSE FOAM

Characteristics:

The plant-based foam consists mainly of cellulose nanocrystals - one of the most abundant natural materials in nature, which in chemistry is identified with a component called nanocellulose.

- Polyvinyl alcohol has been added, another polymer that binds to nano cellulose crystals, and makes the resulting foams more elastic: this has made it possible to create a material that contains a uniform cellular structure and consequently gives excellent results as an insulator.
- Vegetable foam is very light and can support up to 200 times its own weight without changing shape.



Benefit for the environment:

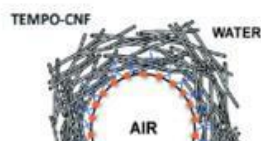
Researchers have also developed a simple and environmentally friendly production process to produce this foam, **using water instead of common harmful solvents.**

Possible applications of cellulose foams:

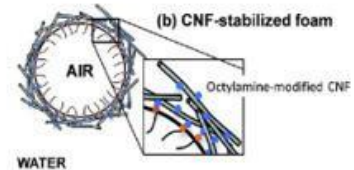
- Heat-insulating and fire-retardant materials;
- Electrical devices and energy storage systems based on nano cellulose;
- Scaffolding for biomedical and pharmaceutical applications.

Unfortunately the ecological polystyrene is a material on which other studies must be done and consequently there are no practical examples in Italy to show you.

(a) Surfactant-stabilized nanocellulose-based wet foam



Nanocellulose-stabilized wet foams



Name: Tyres

The use of recycled materials in construction allows for a more efficient use of raw materials and a reduction in waste. An interesting example is that of recycled rubber, which offers a second life to end-of-life tires (ELTs) and which lends itself to new and interesting applications in the construction field.

Characteristics:

Rubber is elastic, sound-absorbing and has good thermal resistance: thanks to these characteristics it is an excellent material for the production of thermal and acoustic insulation, waterproofing and other materials to absorb vibrations.



Use of the material in Italian construction:

One of the main uses of recycled rubber in construction is in the production of insulation panels and products. With recycled rubber, therefore, it is possible to produce panels, synthetic material for football fields, and mats that can be used for various uses in construction. In Italy for example, they are suitable for the insulation of perimeter walls or internal partitions; they can be used in floors to counteract footfall noise; in roofs they can be inserted between the flooring and the structural part of the floors; or in counter-walls and countertops.

Advantages and disadvantages of the material:

An advantage is that this material allows for a more efficient use of energy thanks to its high calorific value. Unfortunately however, we also have a disadvantage, which is based on the fact that many times this material takes on a black sale. However, the ELT recycling industry in Italy works: it saves money for the country by reducing climate-altering emissions, raw material deficiencies and water consumption.

Benefit for the environment:

According to [Ecopneus](#) data, since 2011 the recycling and recovery of ELTs has made it possible to avoid the production of 3.2 million tonnes of CO₂. If recycled material had not been used, it would have been necessary to use virgin and very often imported materials.

Consequently, emissions of about 380 thousand tonnes of CO₂ are reduced annually, as well as the economic costs of importing. Certainly an important contribution to the growth of the Italian circular economy.



France



THE BAMBOO UNUSUAL MATERIALS

Description

Very robust, light and elastic.
Used in fences, floors, walls and
entire houses



Advantages

It can replace plastics and
metal objects.

Bamboo is compostable.

Hemp concrete



Description

Hemp brick or hemp block is an insulating building material in the mass. This material, sometimes called eco-hybrid, is composed of hemp and aerial and hydraulic lime. It is an alternative to conventional synthetic materials, which are often polluting.

Hemp concrete consists of water, lime and hemp.

Benefits

- Limits ambient humidity and thus improves indoor air quality.
- Acoustic absorption.
- Insulating.
- Increases thermal resistance.
- Permeable to water vapor.
- Resistant to rodents and insects.



Disadvantages

- They are not load-bearing: it is advisable to apply fixing pastes to the load-bearing frames or walls to be lined on a regular basis.
- Protect the hemp bricks from capillary rise.

Additional information

In summer as well as in winter, hemp concrete ensures comfort and therefore energy savings. Hemp concrete can live up to 100 years and the cost is quite high, between 40 and 150 euros per square meter.

PAPER BRICKS

BUILDING MATERIAL

MANUFACTURING

BetR-blok is an American brand that made paper bricks from cement and cellulose from recycled paper and cardboard



ADVENTAGE

The bricks have no problem of solidity, and would even be a very good thermal and acoustic insulator, while having resistance to mold and fire.

DISADVANTAGE

THIS MATERIAL DOES NOT LAST FOR CENTURIES

ADDITIONAL INFORMATION

Paper bricks, an alternative to traditional firewood, are cost-efficient and environmentally friendly. As a low impact resource, paper bricks are very cheap to make and are accessible to anyone with a reliable source of paper.

Paper bricks also encourage the user to recycle products such as newspapers, wood chips and other paper products. There are several advantages to using paper bricks.





RECYCLED COTTON

INTRODUCTION

*Recycled cotton is mainly applied in interior. We will therefore develop these three uses
Your clothes dropped off at a collection point are used at 26 percent to make a raw material for the manufacture of insulation.*

This isolate cost thirty-five euro by meter square Cotton wool offers a high quality of insulation thanks to its minimal thermal conductivity

*this insulation is also very good for sound insulation
It can be applied in two different ways*

WAY 1



In this situation this isolator can be blown to spread it throughout the isolated area.

WAY 2



but it can also be unrolled

Sheep Wool



What is it ?

Sheep wool is an insulating product derived from raw materials.

Sheep wool is made of rolls, semi-rigid and can be used as insulation for buildings: attics, underfloors, ceilings and walls.

Advantages:

- Excellent thermal
- Acoustic insulation
- High resistance
- Healthy insulation

Disadvantages:

- A high price
- A product difficult to find
- A product that attracts moths

Price:

On average, a 60 mm thick sheep wool panel costs 20 to 25 €/m². Sheep wool is generally more expensive than other natural insulating materials.

Sheep Wool



What is it ?

Sheep wool is an insulating product derived from raw materials.

Sheep wool is made of rolls, semi-rigid and can be used as insulation for buildings: attics, underfloors, ceilings and walls.

Advantages:

- Excellent thermal
- Acoustic insulation
- High resistance
- Healthy insulation

Disadvantages:

- A high price
- A product difficult to find
- A product that attracts moths

Price:

On average, a 60 mm thick sheep wool panel costs 20 to 25 €/m². Sheep wool is generally more expensive than other natural insulating materials.

The Straw



**straw is used to
bind clay and
concrete**

**When baled, straw has moderate
insulation characteristics**

**the straw bales are commonly finished
with earthen plaster**

**Straw is an abundant agricultural waste
product, and requires little energy to
bale and transport for construction**

The insulating straw

1 INTRODUCTION

The straw is a material which wasn't used before for construction or renovation. But now, we use it like an insulator, It costs 3 times less than an traditional insulator and we can realise thermal economy.

2 ADVANTAGES

This insulator has a lifecycle of more than 100 years. It is an excellent thermal insulator. It is ecological and biodegradable. It costs 3 times less than a traditional insulator. It is a nice hydro regulator, It guarantees the transfer of water in low quality. It is fire resistance because it does not emit poisonous gas and does not spread flames.

3 DISADVANTAGES

The straw has advantages and disadvantages like : Limited moisture resistance, if the straw is exposed to water during the work the thermal resistant can be deteriorate. The straw can attract rodents.

4 SOMES FACTS

The straw has a lot of advantages. His lifecycle is a big advantage because the others insulator don't have a best lifecycle than the straw.

There are a few solution to isolate his house with straw : isolating by load-bearing walls, isolating by the roof or isolating by the attic.



Tyre

Non traditionnall materials



Description :

Made of rubber, it's a material solid, raincoat and elastic

This waste can use in a construction as a wall, cover roof or foundations

Advantages :

Good thermisulation .

Easy and faster for the construction

The construction blends into the environment



Informations :

The thermal capacity of the tyre is 1200 J/kg.K



Benefical for the environment :

Reuse tyres for the construction allows than them being thrown away and pollutes the oceans

WASTE BRICKS



The process is simple: the waste is washed and dried, then compacted in the form of a brick. And the machine is able to produce a 10 kg brick every 40 seconds, or 150 per-hour.

The advantage of these plastic bricks is that they provide very good thermal and sound insulation.

THIS IDEA IS VERY INTERESTING BECAUSE IT ALONE ALLOWS YOU TO COMBINE TWO PROBLEMS TO MAKE A SOLUTION :



- The pollution of plastic waste in the world is now leading to a catastrophic ecological situation, especially for underwater fauna and flora

- The construction sector is also hyper polluting since it now accounts for 25% of greenhouse gas emissions around the world

De Prada Hugo

Slovakia





USE OF WASTE and NON-TRADITIONAL MATERIALS

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POLYFORM®

Based in:
Slovakia - Podolíneč

Recycled materials:
EPS
EPP



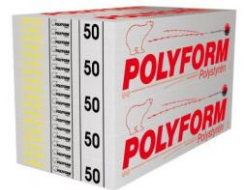
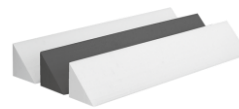
What is EPS?

- EPS (expanded polystyrene), also known as expanded polystyrene is an organic material from the group of foamed plastics
- thanks to its homogeneity, it is easily and efficiently recyclable



- company that specialized in the production and sale of thermal and sound insulation from expanded polystyrene (EPS) for the construction industry
- since January 2006, it has been a member of the HIRSCH Servo Group, which is one of the world leaders in EPS processing and the production of technological equipment for EPS processing

- expanded polystyrene (EPS) is an organic material from the group of foam plastics with a wide range of uses
- in 1949 it was invented by the German physicist from BASF Fritz Šťastný
- expanded polystyrene (EPS) - as a very light product, it provides high benefits
- EPS as an insulating and packaging material offers perfect protection and provides solutions according to customer and environmental requirements
- Its production is characterized by low levels of emissions and pollution



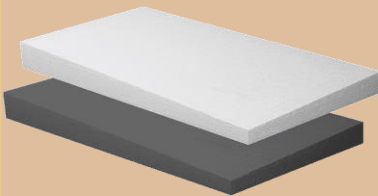
Use of the material:

- facade insulation
- roof insulation
- floor and ceiling insulation
- substructure insulation
- packaging and fittings
- special products
 - o packaging for electronics and home appliances
 - o crates / boxes
 - o thermal and insulation boxes
 - o food packaging

We recycle only clean and dry waste EPS

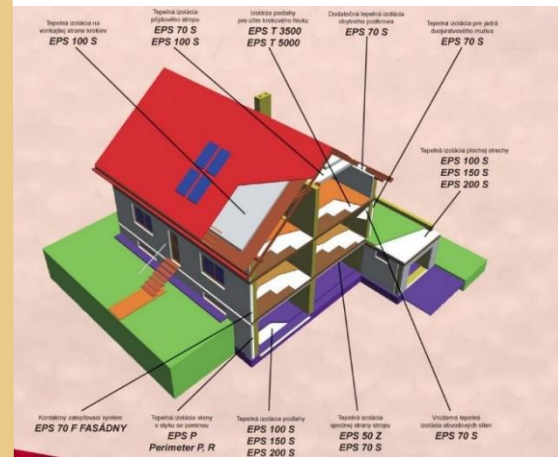
- ✓ Clean packaging of EPS (excluding labels, tapes or other packing materials, such as wood.)
- ✓ Clean construction waste from EPS produced after 2016 (cuttings, residual material without coatings, adhesives and other materials)
- ✓ Pressed and cut fittings made of EPS
- ✓ EPS granulate (e.g., from seat bag fillings...)

- ✗ Fishing boxes made of EPS
- ✗ Contaminated packaging waste from EPS
- ✗ Contaminated construction waste from EPS
- ✗ Food packaging made of EPS (e.g., cups, bowls, coasters...)
- ✗ Packaging and insulating materials made of XPS (e.g., insulating boards, trays for meat and fruit ...)



Thermal insulation boards POLYFORM EPS NSP

- gray expanded polystyrene (EPS) boards have a special NSP stabilizing layer homogeneously applied on the surface, the purpose of which is to prevent significant overheating of the dark polystyrene board by strong sunlight during implementation



Advantages of NSP surface treatment (NEO SUN PROTECT):

- reduces deformation of EPS boards due to solar radiation
- thanks to the content of silica fillers increases the adhesion of the screed layer to EPS
- simplifies the process of making ETICS with gray EPS
- shortens the total



Certification

- for participating in the system of collection, recovery and recycling of packaging waste organized by the producer responsibility organization ENVI - PAK, the company

Based in:
Slovakia - Bratislava

- It's family company which was founded in 1994 in Czech Republic
- since 2006 it has also been operating in Slovakia
- because of their responsibility, system and how they are taking their job seriously they became holders of certificate ISO 9001:2016

Use of ELASTON:

- as a flooring on construction sites
- as a protection of products during transport
- as an anti-noise and anti-vibration insulation or an economically available underlay



GUMEX

flexible partnership

- they specialize in these products and services:
 - industrial hoses and their assembly with fittings
 - sealing profiles, sealing materials and production of seals
 - rubber and plastic industrial flooring and mats
 - conveyor belts and their service and assembly
 - noise insulation and their customization
 - foils for doors and passages and their assembly
 - customization of products

Flat recycled materials:

ELASTON

- material made by mixing rubber granulate and polyurethane glue
- comes in standard dimensions 2000x1000mm and thicknesses according to their offer or your request

- it's a very popular base material for applications in construction, agriculture and logistics



ELASTON-ELTEC GR 650 FS

- the basis of this material is crushed rubber
- very tough single-layer boards made of rubber granulate (crushed rubber from tires joined with polyurethane glue)

density. 650 kg/m³

color. black

measurements:

width x length = 1000 x 2000 MM

thickness = 10, 15, 20, 25, 30, 40, 50 MM

Use of the material:

- in construction
- transport
- for damping noise
- vibration
- possibly loads





ELASTON-ELTEC FS 700

- very tough single-layer boards made of rubber granulate and crushed tires connected with polyurethane glue

density: 700 kg/m³

color: black

measurements:

width x length = 1000 x 2000 MM

thickness = 3, 5, 6, 8, 10, 12, 20, 30 MM



Use of the material:

- in construction
- in industry
- for storing heavy machinery during their anchoring
- vibration damping

Advantages:

the properties of the material don't change even under extreme conditions of maximum effort

- excellent abrasion resistance
- resistant to torsional stress



Bratislava



Žilina



Košice

ELASTON-ELTEC GR 850 FS

- very tough single-layer boards made of rubber granulate (crushed rubber from tires joined with polyurethane glue)

density: 850 kg/m³

color: black (from a thickness of 10 mm it's possible to provide other color versions - green, red-brown = tartan red)

measurements:

width x length = 1000 x 2000 MM

thickness = 4, 6, 8, 10, 15, 18, 20, 25, 30, 40, 50, 60 MM



Use of the material:

- in construction
- in industry
- for noise and vibration damping, loads
- as production floors, protectors and cable lintels

Advantages:

- the properties of the material don't change even under extreme conditions of maximum effort

Recycled plastics
for asphalt roads

Based in:
Slovakia -Zvolen



Benefits for the environment:

- all "MR" products are a blend of carefully selected polymers that are specially designed to:
 - o reduce the quantity of bitumen required in the asphalt mixture
 - o reduce the amount of plastic waste in our seas, landfills or incinerators,
 - o reduce greenhouse gas emissions



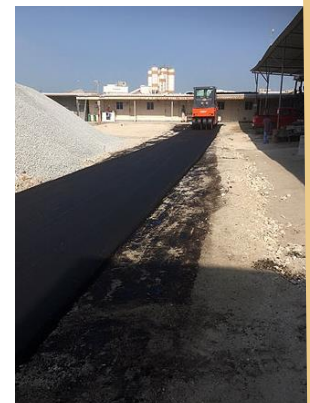
VIKORP

BUILDING TRADE COMPANY

- Viakorp s.r.o. is one of the first companies that recover plastic that would normally end their life in landfill or sea and gives them a new coat
- The company offers several types of plastic ingredients for use in road making from trunk and arterial roads up to motorways.

- A number of tests have been carried out for the use of suitable polymers for road building using UKAS accredited laboratories and universities from all over the UK and around the world

- These roads have undergone vigorous testing
- The results of which have been highly satisfying
- As a result of these tests the following "MR" products have been approved for general use



"MR" Products:

- all of the above can be used to enhance environmental benefits
- each "MR" product is designed to perform a specific task
 - MR6
 - has been designed to reduce the deformation of the top layer caused by the bitumen in hot weather, heavy traffic and/or insufficient binder stiffness
 - MR8
 - doesn't affect the asphalt properties but allows the reduction in fossil fuels through providing a smoother finish that uses plastic waste
 - MR10
 - has been designed to reduce the formation of cracks on asphalt- some of which are caused by low temperatures or inconsistent substrates (dilation in concrete roads)



MR6

- MR6 is a complex arrangement of polyolefin's intended for mixture with bitumen and reduces the risk of asphalt deformation
- the recommended dosage is 6%- 8% of asphalt binder



MR6 advantages:

- increases stiffness
- increases resistance to deformation
- improves moisture resistance
- increases the temperature at which bitumen deformation occurs
- improves fuel resistance properties
- reduces CO2 emissions
- reduces fossil fuel requirements
- reduces plastic waste



Use of the MR6

- parking spaces for heavy transport
- high traffic areas in the cities
- high traffic junctions and runways

CO2 comparison:

Product	MR6	MR8	MR10
Raw ingredient cost CO2e kg/kg material	0,08	0,08	0,08
Blending cost CO2e kg/kg material	0,26	0,04	0,26
Extrusion cost CO2e kg/kg material	NA	NA	0,26
Total cost CO2e kg/kg material	0,34	0,12	0,6
Saving from bitumen reduction CO2e kg/kg	-0,25	-0,25	-0,25
Saving from virgin polymers for PMB CO2e kg/kg	-2,06	NA	-2,06
Total saving CO2e kg/kg	-1,09	-1,09	-1,09
Overall Comparison	-3,06	-1,22	-2,8

*Source of information, ELCD via Ecoinvent, Eurobitume LCI report 2012

FOAM GLASS

- It takes too long for glass to decay.
- This process is expected to take several thousand years, but it's only assumption
- Maybe it won't decay at all...So, there is a need to use it somehow again
- One solution is a foam glass

In Slovakia we have firm ECO Concept which uses glass shards, old bottles, glass from windows, tables etc.



Production of input material:

- waste glass, old bottles, glass shards, it doesn't matter (even quality or color plays no role here)
- next we need mineral activator for granulate or coal dust in the case of boards
- in the end it'll be 100% glass material



- foam glass has variety of uses and it has some really interesting qualities
- its price is lower than other product 's because it's made of rubbish
- But how exactly do we proceed trash to make this product?



Procedure of making foam glass:

1. Material gets cleaned from labels and other remaining pieces.
2. Crushing it into smaller pieces, so they are approximately 10mm in size.
3. Grinding it into a glass flour.
4. The mineral activator or coal dust is added to a whirlpool mixer.
5. In an even layer it's moving forward by a carrier into an electric furnace. Its temperature is around 900°C. Glass flour is changing its form transforming into liquid. This liquid poured together. Mineral activator or coal dust evaporate and ensure even foaming of the material. Thus, its mass increases 15 times.
6. Continual coherent board with a temperature around 300-400°C leaves the furnace. Spontaneous breaking happens.

The final granulate is 3-6cm big.

The outcome is the final product transported in big bags or just freely accessible



So, what qualities does this product have?
Why is it so lucrative?

Structure of foam glass:

- it has a closed-cell structure
- does not bind any water
- it's frost-resistant
- it's light because of its pores



Collection of waste glass:

- people sort their trash into containers; green container = glass
- by recycling it we can save money, energy for the procedure and decrease the carbon intensity of production
- for every used 10% of waste glass, we can save up to 7% of CO2 emissions
- So, for foam glass, it's around 70% less CO2 emissions.



Created by:
Laura Presalovičová

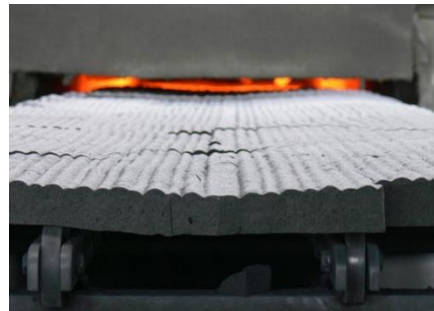
Qualities:

compressive strength

- great compressive strength thanks to 100% glass composition
- it isn't fragile because of its foam structure
- it reaches values 280kN/m² with compaction 1.6:1 depends
- strength of a single grain is 5N/mm²

thermal conductivity

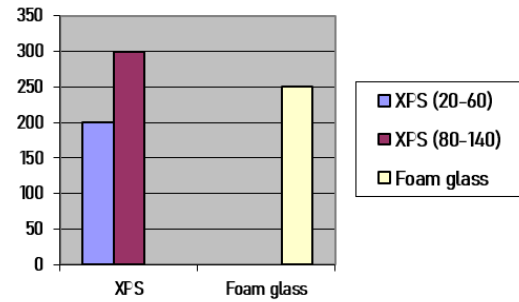
- thanks to its pores has a usable thermal conductivity
- values are 0,08 W/mK in dry state and 0,13W/mK in wet with compaction 1,3:1
- loose sprinkled value is 0,06 W/mK



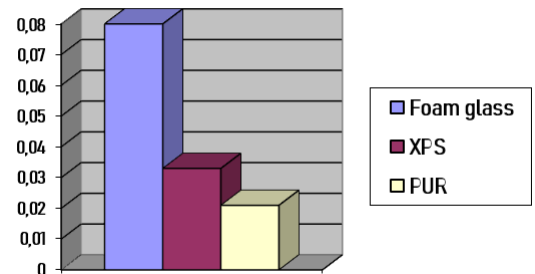
Use of the material:

- under the base plate of any type of buildings
- material that can carry the load and break the thermal bridge
- protects objects from radon accumulation
- insulation of roofs, green roofs and terraces
- to lighten the overloaded ceiling structures of monumental buildings
- outer side insulation of cellars or sub-level storeys
- floor remediation of old buildings
- load-bearing subsoil for parking areas and roads

comparison:



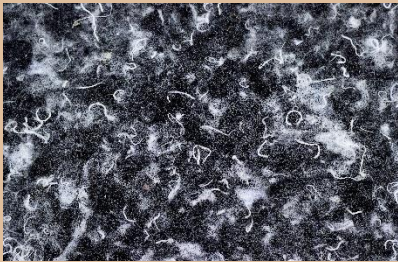
this stat isn't the best, but still usable:



Other properties:

- 100% again recyclable
- inorganic
- resistance against fire (A1), almost every acid, alkalis, ageing, rot, rodents, moisture, frost
- in case of fire it doesn't release any toxic substances or gases
- free air circulation
- with good drainage properties

**“WE BELIEVE
WE CAN
CREATE A BETTER,
SUSTAINABLE
WORLD TOGETHER”**



- Growing amount of textile waste overwhelms our planet just like any other waste

- That is why they consider our role to be not only the processing of textiles, but also encouraging pro-environmental attitude in society by writing articles about the recycling of clothing, publishing in newspapers and proposing changes in legislation, where textiles are not



SK-TeX

- They have been recycling textiles since 1998, currently recycling about 4,500 tonnes of textile waste every year
- They send products to Germany, France, the Czech Republic and Poland
- Their products can be found in your cars, couches and home



The largest benefits of this company:

- Giving textiles a new life - recycle your clothing and change it to car seat upholstery filling, furniture insulation and ECO building insulation
- Supplying all over Europe
- Ecological - they process thousands of tonnes of textile waste every year. Products are fully ecological and easy to decompose

EkosenHMC:

- thermal-acoustic insulation with improved air and step acoustic characteristics

Use of EkosenHMC:

- ceilings and floors
- door insulation
- window expansion profiles of different thicknesses





Prefabricated walls

EkosenHMC:

- acoustic, fireproof and thermal insulation

special treatment:

- mold-resistant
- fire-retarded

Synthetic garneted stock:

1. product: *Acrylic fibres*

material: acrylic based
recycled textile

use of acrylic fibres:

- furniture industry



2. product: *Polyester fibres*

material: polyester based
recycled textile

use of polyester fibres:

- in automotive industry
- constructions
- as a geotextile (litter for cattle)



Floor insulation = Ekosen ATP

- it's a thermal-acoustic insulation of floors and ceilings

material properties:

- *thermal insulation*
- *humidity control* – ability to bind excess vapour from indoor air and release it under elevated temperature
- high compressive strength (category A-D)
- *quick and simple assembly operations*
- *pleasing to the touch*
- *easy manipulation with material*





Based in:
Slovakia - Veľké Lovce

Recycled materials:
EPDM
VKM
PUR...

Results of recycling:
Full-fledged construction product Tetra K board, PUR panel or sound-insulating tape.

Recycling Tetra Paks in Slovakia:
Yellow container = plastics, HDPE films, polystyrene, empty cans

Orange container = only for used TETRA Paks (from milk, juice...)

It depends if you're living in a city or in a village (not every town has orange containers)

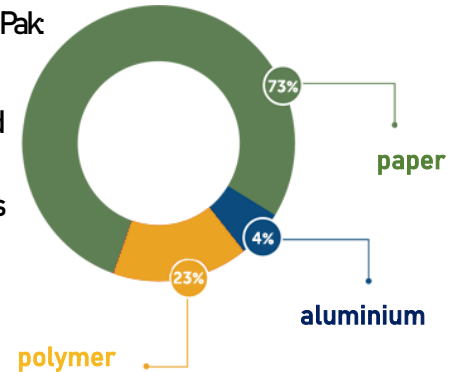


- company deals with the sale and development of technology for waste recovery
- the company's operation has been evaluating secondary raw materials and waste for more than 25 years
- other activities of the company include production, road transport and the production of suction cartons

TETRA K board Standard

- It's a product from Tetra Pak
- the Tetra Pak cubes are grinded and rejoined under high temperature and pressure without using any adhesives
- added isolation in these board is made out of PUR foam from old car seats

Composition of Tetra Pak



Use of the material:

- as a protection of floorboards
- in an attic, office, residential area in general
- in a concreting process
- in a process of building segmented vaults





Benefits for the environment:

- characterized as a recyclable material
- used as an ecological substitute
- environmental friendly
- no added chemicals or adhesives



Advantages:

- low price
- lightweight material
- tough material
- at least 30 minutes of fire resistance
- water resistant (not in every place)
- easy to handle



Disadvantages:

- humid areas are really bad for these boards
- they can't be exposed to a direct stream of water

Declared parameters:

Main qualities	Parameters	Protocol about try-out	Number of laboratory
Coefficient of thermal conductivity	0,146W/m.K	STN 72 7012-1,2	1
Coefficient of steam diffusion	0,00132.10 ⁹ s	STN 73 0862	1
Firmness in bending	≥ 5 MPa	STN EN 310	1
Module of flexibility in bending	≥ 650 MPa	STN EN 310	1
Firmness in pull perpendicularly on surface	≥ 0,05 MPa	STN EN 319	1
Soaking up after dive in water	≤ 25 % after 24 hours	STN EN 317	1
Resistance against pulled screws in axial direction	min. 35N/mm	STN EN 320	1
Density	≥ 850 kg/m ³	STN EN 323	1
width x height x board's thickness	1200 x 2700 x 10 mm		
Accuracy of dimension	width ± 1mm	STN 73 0280	1
	height ± 2mm		
	thickness ± 3mm		
Surface of board	3,24 m ²		
Board's weight on 1m ²	27,54 kg		