

polyurethane is  
performing

technologies, methods and industry's experiences  
of flexible polyurethane foam

n° 02 - 2021



Schultz Chair, recycled polyurethane sofa

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## Introduction

“Polyurethane is performing” is a new editorial series that intends to explore the multiple approaches that the flexible polyurethane foam industry is taking to the developing to respond to the growing need to have compatible processes with environmental balances.

The concept of eco-sustainability in the field of polyurethane foam includes a very wide and varied range of actions: from chemical recycling to treatments post-consumption mechanically based, from energy enhancement through combustion up to the organization of integrated processes that manage the passage of the product at the end of its life, from the delivery centers up to the areas where the materials are separated and reprocessed.

Without forgetting the importance of transforming the polyurethane recycled into new products capable of combining aesthetics and functionality, enhancing the often also the intrinsic charm of a recycled material not ‘to be hidden’ but to value.

Each issue of “Polyurethane is performing” will present focuses on several experiences, in Italy as well as abroad, as a testimony of an industrial reality made of large numbers and globalized but constantly dynamic and attentive to promote new forms of circular economy.

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## Profilo

## Poliuretano è

Poliuretano è represents an innovative and unique project of its kind, born in Italy 15 years ago by the will of some of the most important Italian companies in the production' sector of flexible polyurethane foam. Over the years to companies producers have also supported the project with a number of companies protagonists at international level in the production of additives and related raw materials to the production of flexible polyurethane.

Poliuretano è has carved out in recent years its own authoritativeness and a precise identity in the world of communication, production and design. Initially developed as a project oriented to improve the knowledge of the flexible polyurethane foam at the distribution operators, Poliuretano è has progressively widened its range of action, involving in a way more and more companies producing industrial products in polyurethane, from furniture to packaging.

Poliuretano è promotes a wide range of initiatives for the dissemination of culture on the polyurethane material, which include the organization of exhibitions and themed presentations, conferences dedicated to deepen the different themes related to polyurethane, training meetings with retailers and the publication of research and documentation on the subject.

[www.poliuretano-e.it](http://www.poliuretano-e.it)

Polyurethane é is promoted by the following leading companies in the polyurethane sector flexible foam:

Promoters - Flexible polyurethane foam manufacturers



[www.cires.it](http://www.cires.it)



[www.nir-spa.it](http://www.nir-spa.it)



[www.olmogiuseppespa.com](http://www.olmogiuseppespa.com)



[www.orsafoam.it](http://www.orsafoam.it)



[www.pelma.it](http://www.pelma.it)



[www.sip-srl.it](http://www.sip-srl.it)

Supporters - Manufacturers of raw materials and additives



[www.covestro.com](http://www.covestro.com)



[www.evonik.com](http://www.evonik.com)



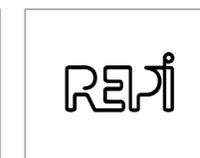
[www.borsodchem-group.com](http://www.borsodchem-group.com)



[www.dow.com](http://www.dow.com)



[www.huntsman.com](http://www.huntsman.com)



[www.repi.com](http://www.repi.com)



[www.shell.com](http://www.shell.com)

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# 1.

## Technologies for the mechanical recycling of flexible polyurethane foam



## Rebound Flexible Foam

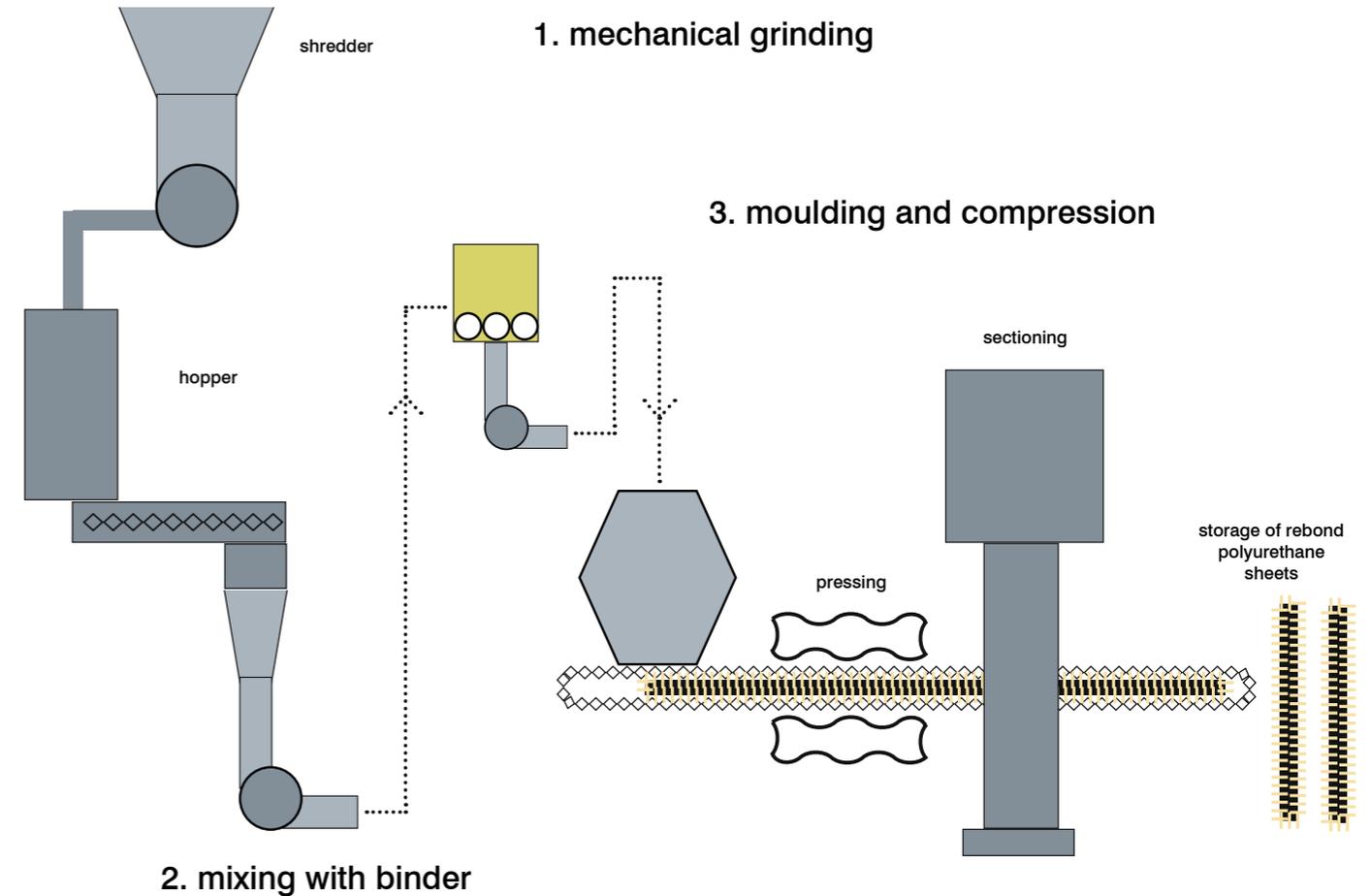
**Polyurethane is crushed and reassembled using special binders, creating new semi-finished products that can be used in a wide range of industrial sectors.**

Matteo Codogna - Dipartimento dei Materiali - Politecnico di Milano

One of the most interesting processes for recycling polyurethane is called Rebound and consists in recomposing, by subjecting them to pressure, polyurethane foam particles using a binder that is generally also of polyurethane origin. The particles are mainly obtained from the by-products of flexible polyurethane, properly ground, they have the advantage over recycled polyurethane particles that they are clean and selected for use at source, resulting in a multi-coloured appearance of the finished recombined product.

The binder is a mixture of polyol and isocyanate which have not fully reacted and are still able to have not fully reacted and are still able to chemically bind to the foam. The process involves distributing the binder evenly over the foam particles in a mixer and then transferring the mixture to the next forming stage.

The production of semi-finished products is carried out according to batch or continuous processes. In the first case, the mixture is placed in a mould, usually in the shape of a parallelepiped, and injected with steam to make the binder react; the formed block is then extracted and left to cool and dry. In the second case, the mixture is compressed between two inclined, continuously moving conveyors to the desired density and then steam is injected into the final section, again to make the binder react.



The quality of re-agglomerated foams depends on a number of factors, including first and foremost the characteristics of the flexible foam waste and, in particular, its density and shape. In addition, the type of binder and the amount used in relation to the amount of foam play a key role.

The semi-finished product resulting from this recycling process can be treated in the same way as conventional polyurethane and can therefore be shaped, cut, coated and laminated with other materials or different types of foam.

The agglomerates produced by this method have special technical and physical properties that make them ideal for a variety of related applications. In particular, they offer high sound absorption properties that allow them to be used for soundproofing rooms or interiors of transport vehicles. They also have a good energy absorption capacity, which makes them ideal for the production of gymnastic mats and sports floors.

Finally, they have a low thermal conductivity index, which makes agglomerate panels suitable for insulating buildings. The volume of foam processed using this technology is estimated at 20,000 tonnes per year for Europe and 200 million pounds, or 90,000 tonnes, for the North American market.



# 2.

**Applying recycled polyurethane foam in a variety of sectors industry**



## Mats for animal husbandry

**Cubicle mats, mainly used in loose housing, provide strength and softness at the same time, improving the resting conditions and productivity of the animals.**

Alessandro Vita - Politecnico di Milano

One of the strategic objectives of the livestock sector is to promote best practices for farm animal welfare by combining the use of innovative solutions with logistical and production requirements. A healthy animal, living in a comfortable and stress-free environment, produces more and produces better. That is why the industry is constantly developing state-of-the-art solutions that improve the welfare of dairy cows, heifers, buffalo, horses, pigs and poultry. Among the most innovative applications in the livestock sector, flexible polyurethane foam cattle pads are a solution that combines improved animal welfare with higher animal productivity. The mats are made from mechanically recycled polyurethane foam waste according to the Rebound method, which involves shredding, mixing and then recompacting the foam. The advantages of using mattresses are many for the health and well-being of the animal: first of all, the recycled polyurethane sheet provides a soft and restful support that makes it more comfortable for the animal to lie on the ground; in addition, the mattress significantly reduces the pressure on the animal's knee up mats made of recycled polyurethane increase the well-being and productivity of cattle on the farm by 84%, thus reducing possible trauma and joint pain for the animal. In addition, the polyurethane padding is complemented by a special cover that protects the foam material while allowing dirt to slide off the outside of the bunk, keeping it dry, clean and hygienic.



I materassini in poliuretano riciclato aumentano il benessere e la produttività dei bovini in allevamento

The combination of these elements makes the recycled polyurethane foam mattress unique because it ensures a total anti-abrasive effect on the hocks, increasing the animal's resting time. In addition, the mattress makes the lift safe and eliminates the risk of slipping as the coated surface has a better grip. The zootechnical mattress is economically advantageous, as its investment pays for itself in a short time, on average in one year, thanks to increased milk production, milk quality and lower running costs, as it no longer requires straw or sawdust.

Link: [www.orsafoamrebound.it](http://www.orsafoamrebound.it)



Recycled polyurethane mats increase welfare and productivity of cattle on the farm

## Soundproofing buildings with polyurethane

**Semi-finished products made of recycled flexible polyurethane foam are an excellent insulator to protect floors and walls of the house from noise.**

Alessandro Vita - Politecnico di Milano

Sound-absorbing panels made of polyurethane agglomerate are designed to absorb airborne sound and are used for acoustic insulation of walls, floors and ceilings. The panels are generally made as semi-rigid sheets that are easy to apply and are produced using only expanded polyurethane agglomerate from industrial processing waste or as multi-material sandwiches consisting of an outer coating of various materials and an inner polyurethane layer. The use of these types of panels is a viable alternative to protect against noise generated in the home or workplace or noise pollution from outside the building. Semi-finished products for acoustic insulation are generally available either as continuous sheets in the form of rolls or as panels of predefined dimensions: their ease of installation and use also lies in the fact that they can be easily sectioned and therefore adapted to different building configurations. The time required to install the material is generally short, making this solution one of the most popular ways to create a noise barrier. In addition, thanks to their molecular structure, they also offer ideal thermal insulation, allowing considerable energy savings on heating and air conditioning. In terms of application, recycled polyurethane foam panels are suitable for insertion into the cavities created to insulate a building. The relatively low weight of the slabs, especially with regard to thinner thicknesses, means that they can also be used in false ceilings.

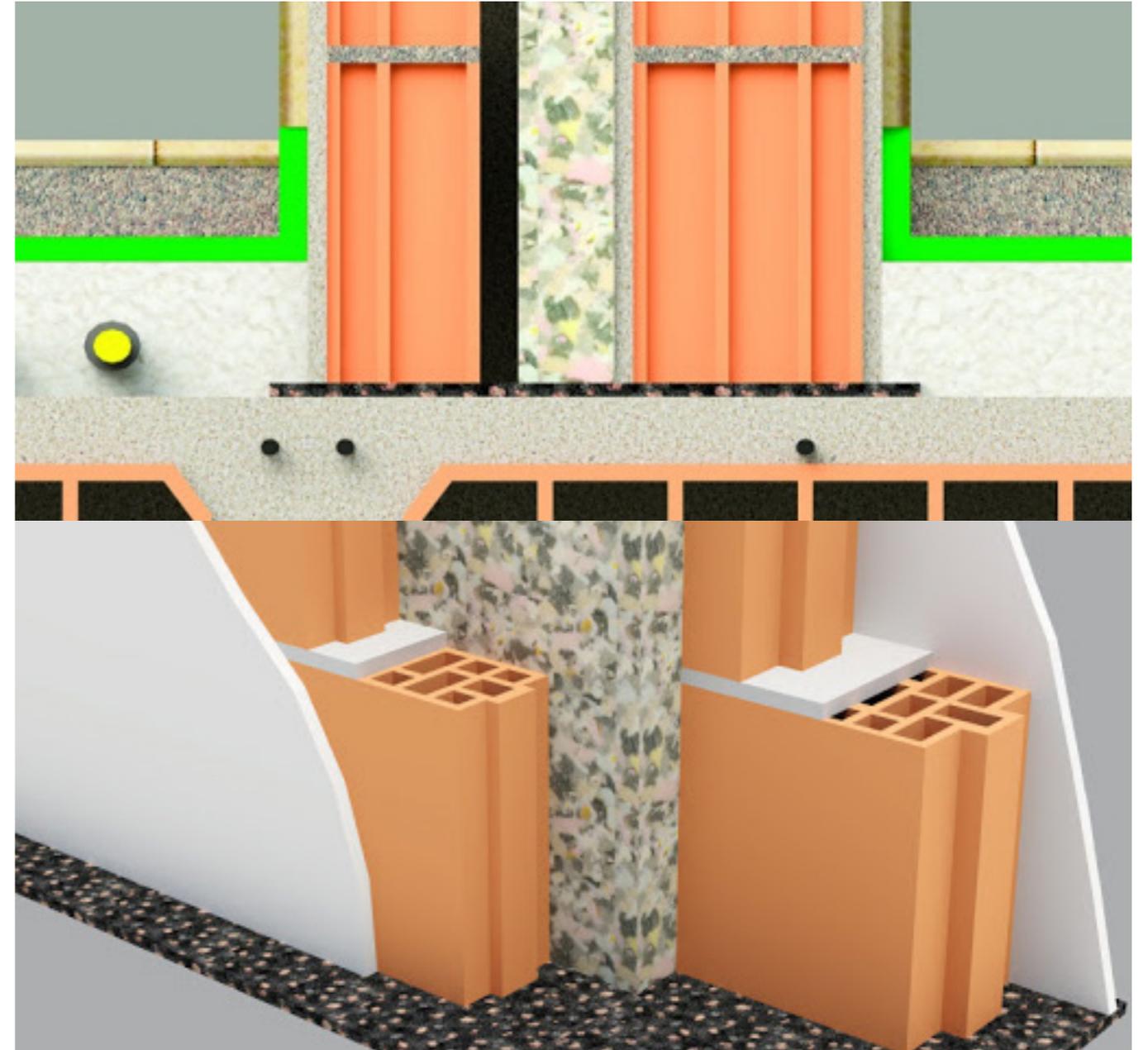


Recycled polyurethane insulation boards are easy to install, mouldable and adaptable to different building shapes.

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The possibility of stapling, gluing and fixing the panels with screws and metal profiles provides the installer with numerous alternative solutions for applying polyurethane panels.

Link: [www.orsafoamrebound.it](http://www.orsafoamrebound.it)



Building insulation through the insertion of recycled polyurethane panels yta the walls of the building

## Low-Emission Antiscorching

### REPI unveils new Low-Emission Antiscorching for polyurethane applications

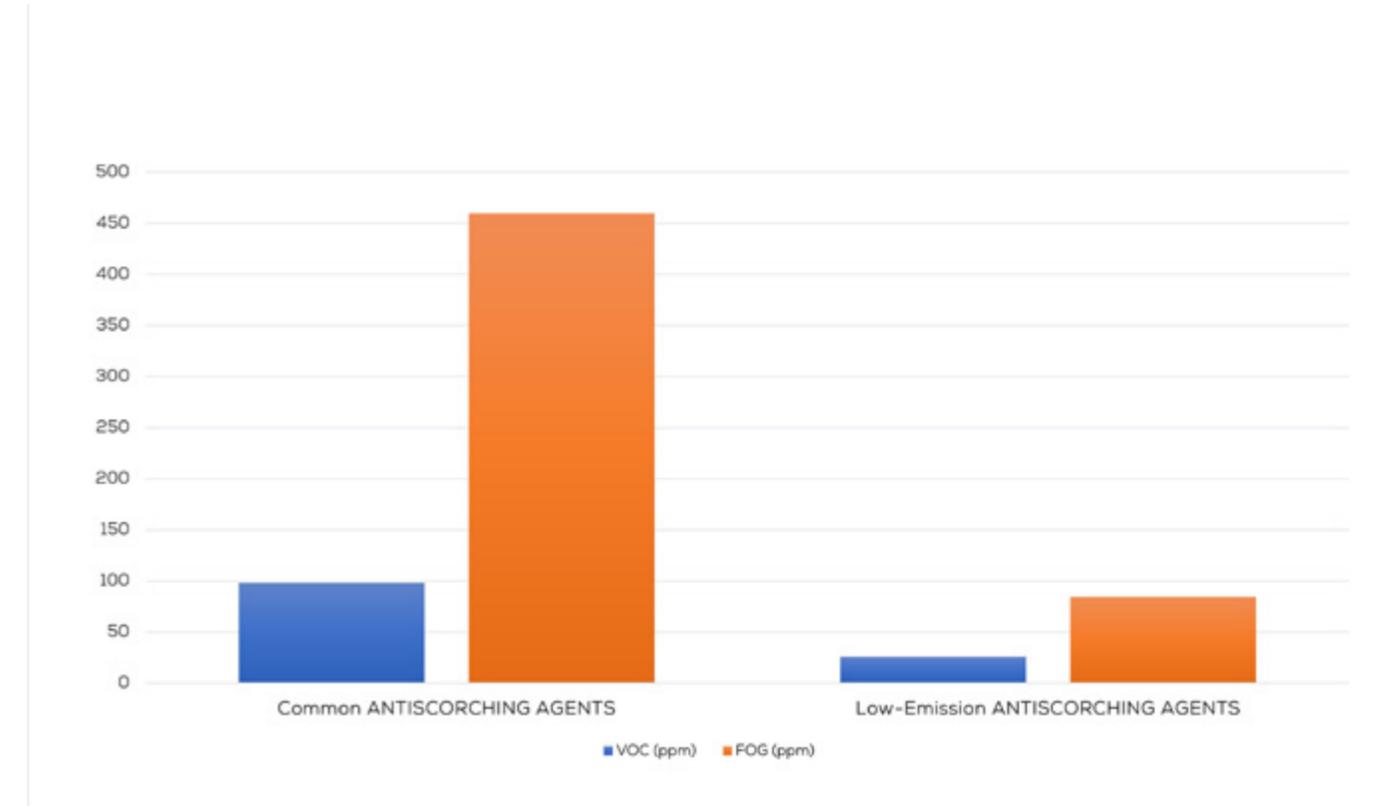
Lucia Buffoni - REPI

Additives in polyurethanes are widely implemented to improve aesthetics, especially to cover inhomogeneities of product, that may occur; they are as well used as performance aids, to improve heat and fire resistance, to reduce oxidation and protect from aging, these being common threats to physical properties of PU.

REPI provides Antiscorching Additive named AO REPITAN, a liquid blend of selected antioxidants and process stabilisers designed to improve PU foam heat resistance and polyol storage stability adding a strong protection against oxidation. As a result, effectiveness of PU foams is enhanced and its discoloration when exposed to NOx and light consistently minimized.

AO REPITAN is normally indicated to stabilize polyol used in flexible, rigid and semirigid PU foams for bedding, furniture and automotive applications, it can be used in combination with UV stabilisers and White Foam stabilisers to further enhance final product properties.

In a context of increasingly stringent regulations and standards set by industries, additives are under the magnifying lens, required to boost the performance of polyurethane parts and reduce their side-impact on people and environment.



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The push for lower emissions is at the basis of REPI's upgraded formulation of Antiscorching. The new Low-AO REPITAN enriches the Program providing improved performance.

Low-AO REPITAN helps manufacturers meet strict fogging and emission limits for polyether and polyester foams, cutting them dramatically.

Research and innovation are key to unveil business growth and to cope with unexpected emergencies and crisis, something that we are exactly experiencing right now. REPI, as a world leader in colour and additive solutions for polyurethanes, works tirelessly specializing in specialty additives that meet the needs of its Partners, putting its know-how and capabilities at their service.

Link: [www.repi.com](http://www.repi.com)



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New Low-Emission formulations are recommended when extra low VOC emissions and Fogging properties are required.

# 3.

**Creative solutions for giving new shape to recycled polyurethane recycled foam**



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## Foam-It by Sara Regal Alonso

**A collection of objects created from the innovative reuse of polyurethane foam waste**

Alessandro Vita - Politecnico di Milano

Sara Regal Alonso, a Spanish designer with professional experience in London, has developed a series of projects investigating the potential of recycled materials in the field of design. Regal develops an intuitive and experimental approach to the focused on the intrinsic qualities of recycled materials and the opportunities offered by mass production, with a strong sensitivity to colour trends and the surface appearance of the products. Foam-it is a seating system for public spaces made of shaped blocks of recycled polyurethane foam, obtained through the mechanical recycling process called Rebound. Through close collaboration with a Swiss company specialising in the mechanical recycling of polyurethane, Sara Regal Alonso has developed an extensive collection of products designed to be combined in multiple configurations. Each recycled polyurethane module has through-holes in the sides to allow the different components to be combined in various configurations, either as seats with backrests or as double-sided benches. Foam-it represents an innovative solution to give new life to recycled polyurethane, through a project that perfectly combines aesthetics and functionality: the potential of this seating system extends to a variety of areas, from public waiting areas to temporary events that require an area to be furnished with easily removable and configurable seating. In addition to the aesthetic and tactile richness of regenerated polyurethane foam and its intrinsic flexibility as a system, the project is a perfect example of a circular product that can be recovered



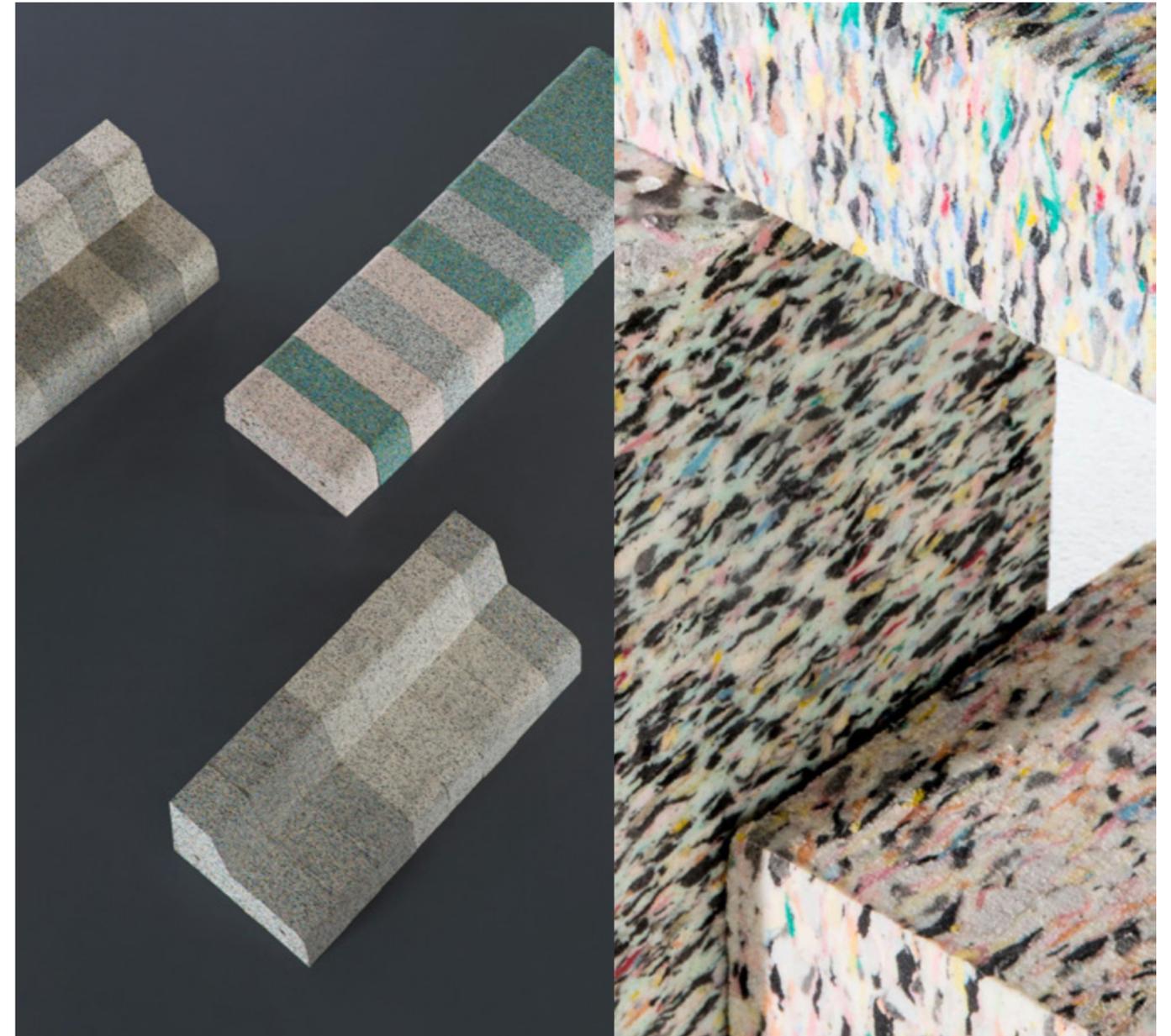
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Components that make up the Foam-It public space seating programme

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at the end of its life. In fact, once deteriorated, Foam-It seats lend themselves to being entirely shredded and recycled, creating new semi-finished products that can be used for a variety of purposes, from the thermal insulation of buildings to the flooring for sports facilities. The aim of my project is to show the intrinsic potential of recycled polyurethane and its particular material beauty through a concrete application that responds to precise functional needs and constitutes a new point of reference for the world of design and industrial production”.

Link: [www.sararegal.com](http://www.sararegal.com)



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The seating elements are modular and can be combined in multiple configurations.

## Industrial Craft by Charlotte Kidger

**A collection of objects for the home that was born from the innovative reuse of polyurethane foam processing waste.**

Marco Pardi, Dipartimento Product Design - Politecnico di Milano

International design is increasingly interested in issues related to the valorisation of recycled materials and the use of recycling waste to create innovative end-of-life solutions. London-based designer Charlotte Kidger has recently developed a new collection of multicoloured objects and furniture made from recycled polyurethane foam waste. Kidger's Industrial Craft collection takes advantage of the by-products of computer numerical control (CNC) manufacturing and uses them to create textured tables, stools and a series of vases in a range of cool tones. The finishes remain deliberately raw, openly industrial. It is no coincidence that the name of the collection is both industrial and artisanal. The material is a mix of recycled polyurethane waste (70%) and resin (30%). The resulting composite can be worked like wood and carved into new shapes. As the designer explains, the CNC milling process produces a large volume of excess light polyurethane foam powder. It is a kind of residual polymer that is generally not reused or recycled and therefore the only current disposal route is through incineration or landfill.



The Industrial Craft collection uses a mixture of powders derived from polyurethane processing waste.

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The fundamental aim of Charlotte Kidger's project is to provide a creative stimulus for designers and industrialists to see production waste as a new opportunity to create a new generation of applications. "This new composite material offers interesting opportunities for further design applications, as well as finding a permanent solution to the waste stream," said Charlotte Kidger. "With a process that drastically reduces production waste, new sculptural objects are generated that are characterised by a strong focus on durability with the aim of creating a seductive and functional use of the material," he added. The beauty of the process with this composite material is also its intrinsic uniqueness, as each piece is a different result, where imperfection is turned into a valuable factor," says Kidger. "For example, although I can use the same mould to cast multiples of the same shape, each piece will come out slightly different due to the solidification process after casting. These often unexpected revelations can create interesting flaws that add new qualities to the material; represents a borderline approach between craftsmanship and industrial production," he added. The collection was premiered at the London Design Festival as part of the 'Plastic, Beyond the Chipper' exhibition, which celebrates plastic as the material of the year, focusing in particular on the re-use of polymers in the design industry.

Link: [www.charlottekidger.com](http://www.charlottekidger.com)



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Each object is produced by mixing different colours and finishes to create a special material effect.

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# 4.

**Companies tell each other.**

**Technologies, materials and  
research of protagonists  
of the sector**



## The protagonist companies

Leading industrial reality in production of flexible polyurethane foam, the Elm Giuseppe spa constitutes a significant example of Italian entrepreneurship more evolved and dynamic. Born at the end of the years '50 to expand the Group's commitment Elm in the specific field of polyurethanes, increasingly strategic products in many fields applications, has quickly established itself for a business model characterized by precise choices. Production technologies at the cutting edge constantly updated, research of innovative products in performance and reliability, controlled quality and certified, constant commitment to a complete environmental protection. Olmo Giuseppe spa represents a large progress oriented company, the reference guide for your industry for quality flexible expanded polyurethanes.

[www.olmogiuseppespa.com](http://www.olmogiuseppespa.com)



## OlmoSoff, la soluzione confortevole

OlmoSoff sono una serie di schiume microcellulari a cellula aperta di tipo convenzionale.

Schiume altamente innovative con un alto grado tecnologico.

Le caratteristiche primarie sono una eccellente resa elastica, un ottimo comfort, una bassa deformazione, un'alta resistenza alla lacerabilità e alla trazione e una straordinaria traspirabilità.

La gamma spazia da 18 Kg./mc. a 45 Kg./mc. con caratteristiche in prevalenza di bassa portanza.

Adatte sia per il settore dell'arredamento che del bedding.

A catalogo è disponibile anche una versione OlmoSoff viscoelaastico denominato VE50.



## The protagonist companies

The activities of the Rebound Division of ORSA foam S.p.A. is based on the development of technologies for the recovery and valorisation of by-products of industrial processing of flexible polyurethane foams, satisfying diversified applications and needs.

A wide range of innovative products able to achieve excellent performance in the field of comfort while maintaining attention to the environment.

The flexible polyurethane foam agglomerate has excellent flexible polyurethane foam with regard to acoustic insulation and breathability, finding for example use in construction to solve acoustic problems and increase living comfort in buildings and in the automotive sector cars or motor vehicles in general; and in sports footwear, for its breathability and lift in insoles and ski boots.

# ORSA foam



## Rebound, prestazioni ed ecosostenibilità

Thanks to its dual role as a thermal insulation and acoustic insulation, polyurethane agglomerate represents the ideal technical answer in many fields of use:

The Building Industry: Thermal and acoustic insulation against for floors and walls.

Sport: subfloors and gyms with energy absorption function.

Automotive: acoustic insulation of interiors cars, trunks, dashboards and panels;

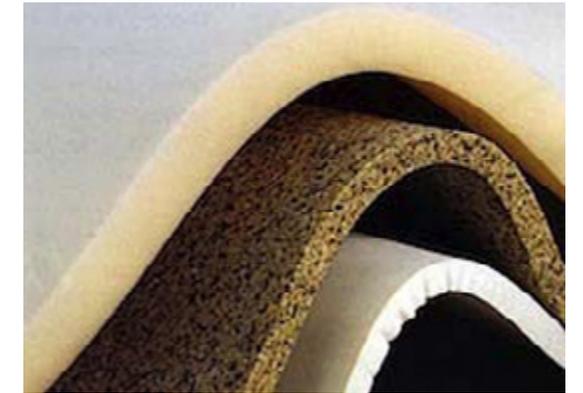
Packaging: thanks to its flexibility and workability, it is possible to create and packaging with excellent protective capabilities.

Animal husbandry: mats for cows' bunks, mainly used for animal welfare.

Industry: acoustic insulation made for particularly noisy machinery.

Footwear: Breathable insulation and protection

[www.orsafoam.it](http://www.orsafoam.it)



## The protagonist companies

Pelma spa was founded in 1962 and from the very beginning aimed to build an image of itself modern and dynamic to the point of making your own name synonymous with quality and reliability. A “Question of Form ... and Substance”. This is the philosophy that characterizes the products Pelma spa and that allowed us to improve research and service. Our commitment led us to the realization of a dream: Pelma spa is now capable of to face the complexities of the market thanks to the professional preparation of men and women who together believed to a challenge. Pelma spa is our way of designing the future by living the today without forgetting the past. The company is aware that only the right conjugation between human resources and technology will ensure that you look at the future with confidence and security.

[www.pelma.it](http://www.pelma.it)

# PELMA



## Thermofresh, the thermal polyurethane

Thermofresh is a family of flexible polyurethanes foams characterised by an innovative formulation and production technology, which brings thermal and hygienic benefits, giving the polyurethane product unique features.

Thermofresh, compared to a conventional non-thermal polyurethane, has the ability absorb heat by melting the PCM microcapsules contained inside, thus keeping the temperature constant for a long time.

Thermofresh is not colder than other polyurethane; Thermofresh, by absorbing the heat emanating from a body in contact with the material, has the ability to maintain constant temperature in the range of normal use (between 28 and 35°C), for a significantly longer than a non polyurethane that is not Thermofresh.



## The protagonist companies

# CIRES

Cires spa produces polyurethane foam polyester-based and polyether-based. Different physical-mechanical characteristics of the various products allow to space on several sectors: from automotive to insulation, clothing, without omit the padding market for the furniture and the mattress.

Each product reflects the know-how company that in decades of activity has permission to be always present on the polyurethane market, with a glance constantly focused on innovations in field of raw materials and technology.

[www.cires.it](http://www.cires.it)



## Polyester-based polyurethane

Polyester-based polyurethane is characterized, compared to the basic one polyether, with the following characteristics:

- flame laminability with different types of materials such as fabrics and plastic films;
- more regular and greater cell structure
- resistance to air passage, therefore better sound absorption;
- higher mechanical resistance;
- higher resistance to organic solvents.

It is used in various sectors such as: automotive, clothing, footwear, acoustics, home and personal hygiene, packaging, thermal insulation.



## The protagonist companies

The production site of NordItalia Resine srl (NIR) is located in Campodarsego (PD). NIR is specialized in the industrial production of flexible polyurethane foam, obtained with continuous block technology.

They are present two foam production lines polyurethanes: the 1 Maxfoam line, which uses water as a blowing agent, and the 2 CarDio line, which allows the use of carbon dioxide as an agent auxiliary expander. Flexible polyurethane foam is sold as raw block or can be further processed in sheets and shaped of various sizes.

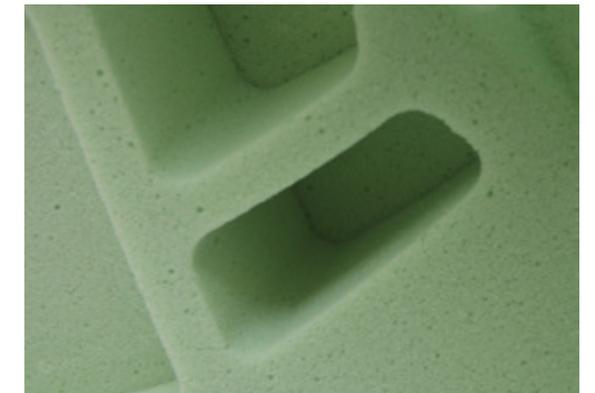
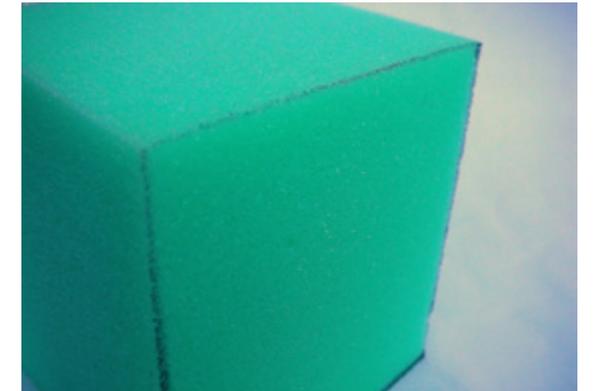
## NORDITALIA resine



## CarDio, use CO2 as auxiliary expander

CarDio technology represents a new generation plant for the production of flexible expanded polyurethanes.

This process allows the production of continuously, introducing the agent expanding CO<sub>2</sub> (carbon dioxide liquid) under high pressure conditions. Unlike traditional technologies, the use of this substance, widely available in nature, allows you to avoid the use of harmful expansion agents for the environment such as CFCs, chlorofluorocarbons, and VOCs, volatile organic compounds. It also allows to reduce the quantity of isocyanate necessary for the process of reaction by lowering the exothermia, i.e. the maximum temperature reached, and in turn reducing the risks of self-combustion.



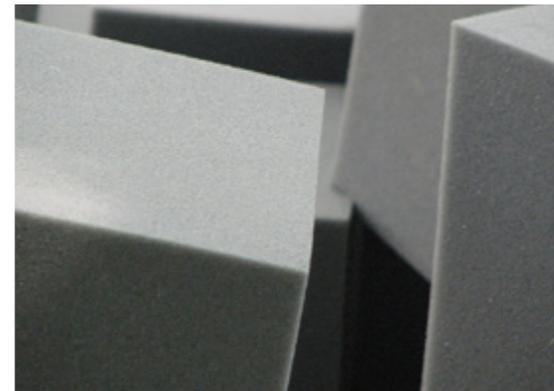
## The protagonist companies



S.I.P South Italy Polyurethanes specializes in the production of polyurethane foam flexible continuous polyether based, with realization of blocks, sheets and rolls.

The factory, located a few kilometers from Matera, occupies an area of 160,000 sqm. of which 27,000 covered.

The activity inside the S.I.P. plant is addressed exclusively to the production and sale of flexible polyurethane foam by continuous block, with different density, formats and colors. The different semi-finished materials are used in multiple fields of application, from furniture to thermal insulation and acoustic, from vehicle interior fittings until packing.



## One Shot Technology

S.I.P South Italy Polyurethanes specializes in the production of polyurethane foam flexible continuous polyether based, with realization of blocks, slabs and rolls.

The basic technology adopted is that of the so-called One Shot system, developed in the USA, with HENNECKE high pressure production QFM with technology: CO<sub>2</sub>, MDI and TDI.

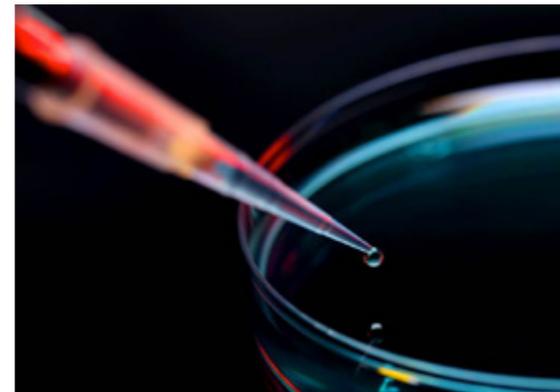
The laboratory is equipped with equipment for the control of the material produced and that purchased from third parties; is able to perform compressive strength tests and sinking, elasticity, deformation permanent, dynamic fatigue, fatigue static, elongation, breaking load, reaction to fire according to regulations Italian and international.



## The protagonist companies

Covestro represents one of the main worldwide producers of raw materials for flexible polyurethane industry over that of systems for polyurethane foams rigid, semi-rigid, flexible and elastomers polyurethanes. Covestro is constantly engaged in the development of technologies advanced for the polyurethanes sector, conceived with an attentive look at the performance and environmental sustainability processes.

[www.covestro.it](http://www.covestro.it)



## The protagonist companies

Evonik Industries is an international leader in the world of chemistry at the service of industrial production.

Evonik products for the polyurethanes sector flexible expanded find application in multiple sectors: from the production of household appliances to transport, from the padding for furniture up to solutions for the packaging, thermal insulation and acoustic to the production of articles for the sport and leisure time.

[www.evonik.com](http://www.evonik.com)



## The protagonist companies

BorsodChem is a leading manufacturer of plastic raw materials and products inorganic chemicals in the European region.

The integration of BorsodChem into the Group Wanhua has transformed the two companies regional into one global society, the third largest producer of isocyanates in the world.

BorsodChem provides high quality products MDI and TDI isocyanates to downstream industries, as the polyurethane foam industry flexible. BorsodChem adheres to most high safety standards and promotes “green chemistry” and responsibility environmental.

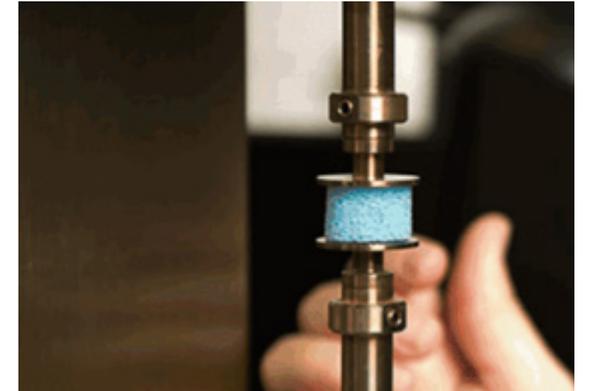
[www.borsodchem-group.com](http://www.borsodchem-group.com)



## The protagonist companies

Passion for innovation inspires and guides Dow's growth strategy by pushing to investing in new cutting-edge technologies in new sectors and new geographical areas. This results in solutions able to respond to major global challenges: in particular, in the field of polyurethane foams, constant collaboration with industries of multiple sectors, has made it possible to create unique solutions to meet specifications performance requirements.

[www.dow.com](http://www.dow.com)



## The protagonist companies

Huntsman's polyurethanes division in Europa produces and markets products MDI and MDI-based systems for production of flexible polyurethane foams used in the production of mattresses, cushions and furniture. Innovative technologies of Huntsman allow manufacturers of foam all over the world to produce a wide variety of high quality foams resilience, viscoelastic and other foams special.

With a constant focus on research and development, Huntsman provides highly differentiated technologies such as recently launched range of foam of RUBIFLEX® Cocoon polyurethane with excellent heat control properties and humidity and pressure distribution.

[www.huntsman.com](http://www.huntsman.com)

# HUNTSMAN

Enriching lives through innovation



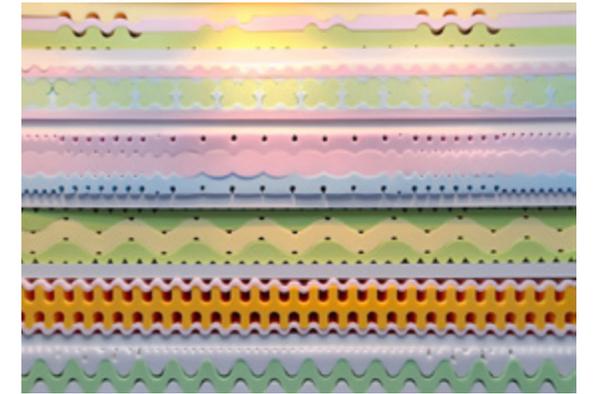
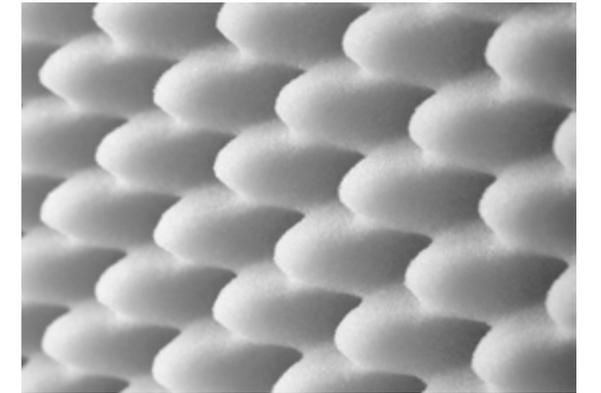
## The protagonist companies

REPI has been producing colours and additives for applications such as flexible, rigid, semi-rigid polyurethane foam, integral skin and polyurethane elastomers for over 45 years.

REPI offers carbon black and pigment dispersions that give the user infinite variations able to give colour and differentiate products with no impact on the properties of the material. The low viscosity liquid formulations are supplied ready to use and offer excellent dispersion and performance. REPI also offers a range of additives for polyurethanes used as both an aesthetic aid and in the performance and protection of the product: to protect against flame, improve the adhesion between sheets and heat resistance, reduce oxidation and protect against aging, key elements to preserve the physical properties of polyurethane.

[www.repi.com](http://www.repi.com)

# REPI



## The protagonist companies

Shell is an energy company that operates in research, production, refining and marketing of raw materials for the polyurethane foam industry flexible.

Shell is present in many Countries cooperating with industrial manufacturers belonging to all the main sectors where the polyurethane foam finds applications.

[www.shell.com](http://www.shell.com)



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## Final notes

The written contributions published in this volume are made exclusively for this edition. In the case of publications of parts of this volume, we request that the source is expressly mentioned.

The illustrations accompanying this volume are edited by Studio Giovanetti, Luca Perani, Karl Rainer.

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