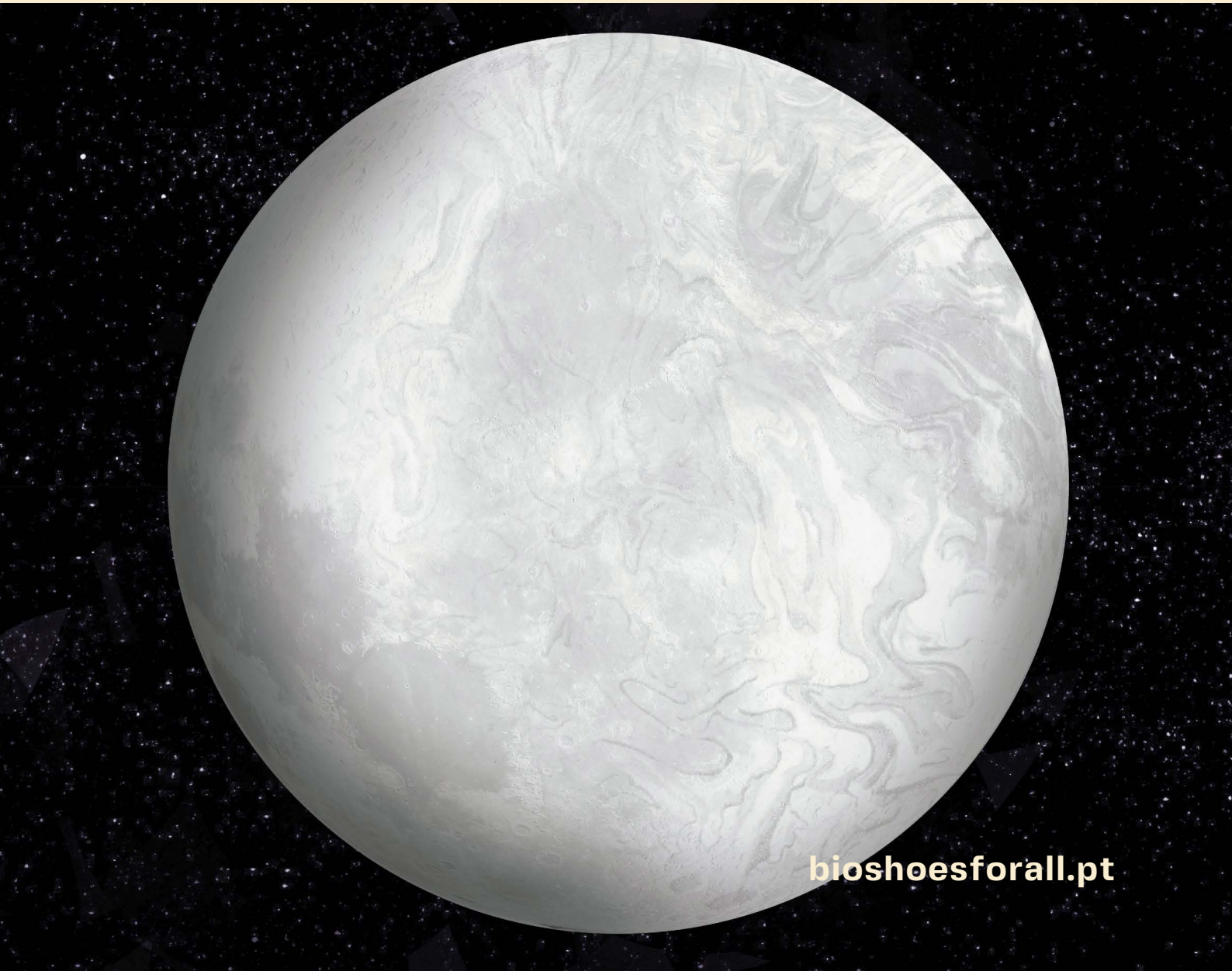
Bio shoes 4all

E-BLAST

N_2 Super Critical Foaming



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Bioeconomia
FUNDO AMBIENTAL
PRR
Plano de Recuperação e Resiliência
REPÚBLICA PORTUGUESA
Financiado pela União Europeia
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ABOUT US

WE ARE TECHNICAL FOOTWEAR SOLE MATES

ALOFT is a Portuguese company specialized in developing and producing soles for technical and performance footwear. From Rubber, Injection, Full Injected Shoes and Rain Boots, to Design, I&D and our own laboratory, we have it all. Backed by a 15.000 square meters self-sufficient plant fully equipped with the latest machinery and automation systems - from initial chemical formulations to finished products and recycling, we're a world-class team with a one-of-a-kind determination: to deliver the best product imaginable.

PEOPLE VOTE WITH THEIR FEET!

Times surprise and challenge us. What was perceived as OK yesterday, today it's a no way! This applies to all aspects of our lives and footwear is no exception. Designing locally but producing far way and shipping goods across the Planet proved to be a good solution for many years but has now shown it's limitations. Consumers started to walk away from this concept, step by step. It's time to change the way we walk the Industry. At ALOFT, we believe technology, digitalization and new materials are here to help us. With E-BLAST®, the gap between people and their shoes has never been narrower, more reliable and greener.

WHAT IS E-BLAST® TECHNOLOGY BRINGING TO THE GAME?

	FIRST MACHINE PRODUCING PHYSICALLY EXPANDED POLYMER FOR FOOTWEAR IN EUROPE.
	VERY LOW DENSITY PRODUCTS.
	LITTLE TO NO HUMAN INTERVENTION.
	NO USE OF HARMFUL CHEMICALS.
	LOW POWER CONSUMPTION AND REDUCED CARBON FOOTPRINT.
	100% RECYCLABLE MATERIALS WITH ENHANCED MECHANICAL PROPERTIES.

PLAIN AND SIMPLE OUR MISSION

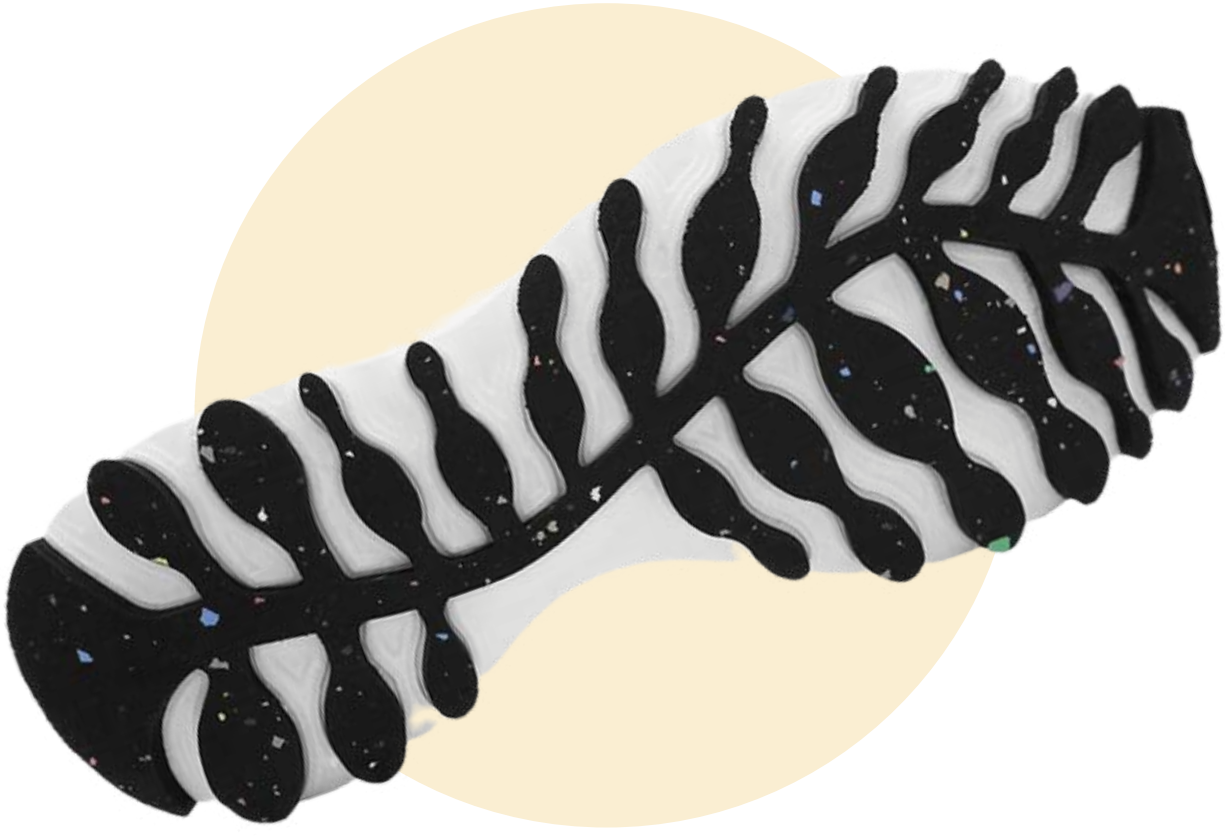
Reduce C02 emissions - adopting processes that require fewer resources/raw materials and consequently generate less waste.

Facilitate logistics and eliminate long supply chains by producing in Europe.

Eradicate toxicity – SCF N2 TPU technology doesn't require toxic chemicals, it uses Nitrogen an inert gas which represents 78% of the air content we breath.

Reduce Human Labor dependency – advanced processes associated with automation, eliminating stages like washing or drying allowing an increased competitiveness in terms of pricing and respect for the workers.

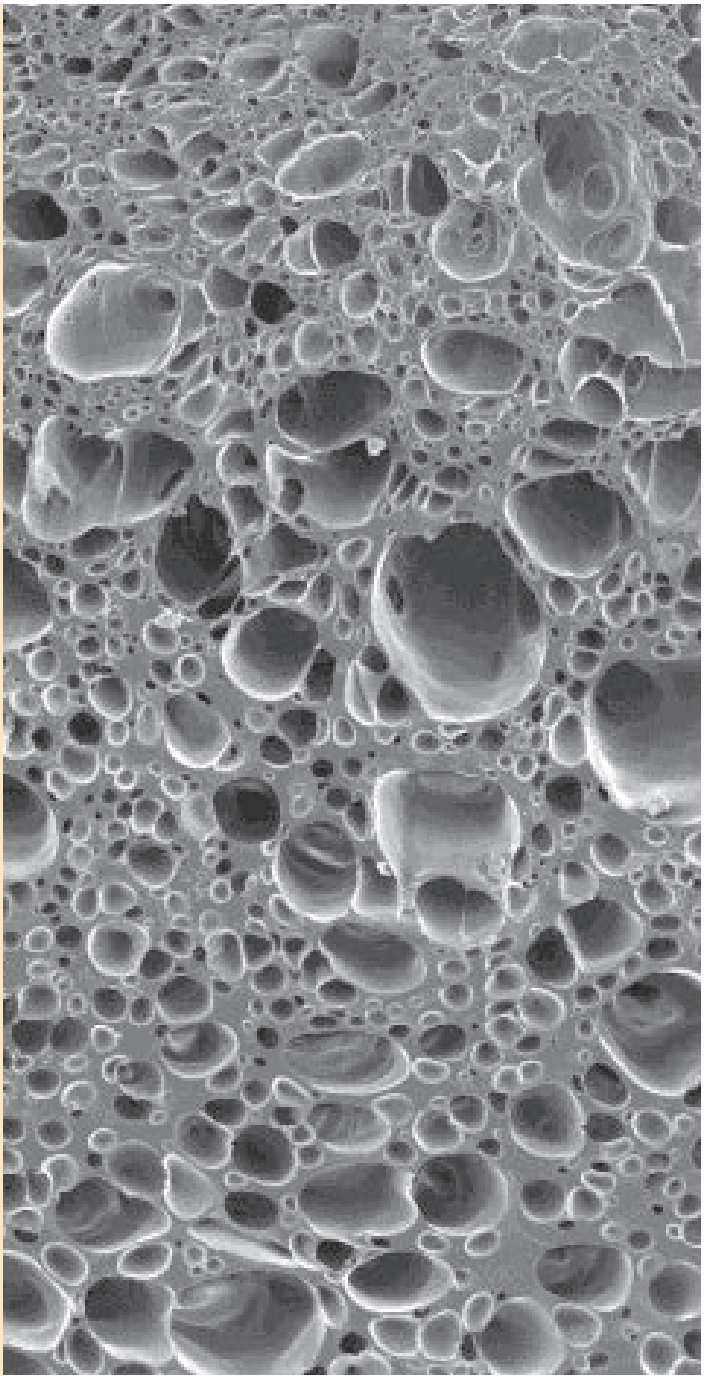
Recyclability – Physical foaming of TPU is clean, environmentally friendly, and fully recyclable, without compromising mechanical properties and performance.



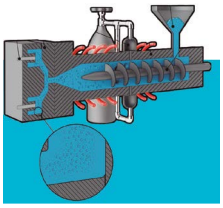
INTRODUCING E-BLAST®

This process is based on MuCell® - Microcellular Foaming Technology for the Injection Moulding Industry, nvented at MIT. It was initially developed for the automotive industry aiming for low weight thermoplastic parts with greater mechanical properties. It rapidly gained attention in many other areas of application, such as now, in the footwear industry.

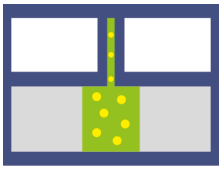
BUT HOW DOES IT WORK? - The MuCell® process involves the highly controlled use of gas in its supercritical state to create microcellular voids in the parts. The voids are created as a result of homogeneous nucleation that occurs when a single-phase solution of polymer and gas passes through the injection gate into the mould.



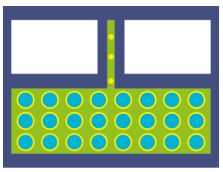
E-BLAST®
PROCESS STEPS



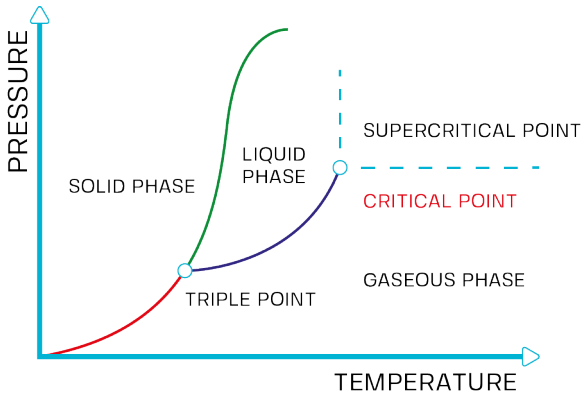
An inert gas (nitrogen) in a Supercritical Fluid state is introduced into the molten polymer inside the Injection Barrel.



The Gas Saturated thermoplastic is injected on the pre-pressurized mold cavity, in a volume of approximately one-third of the cavity volume.



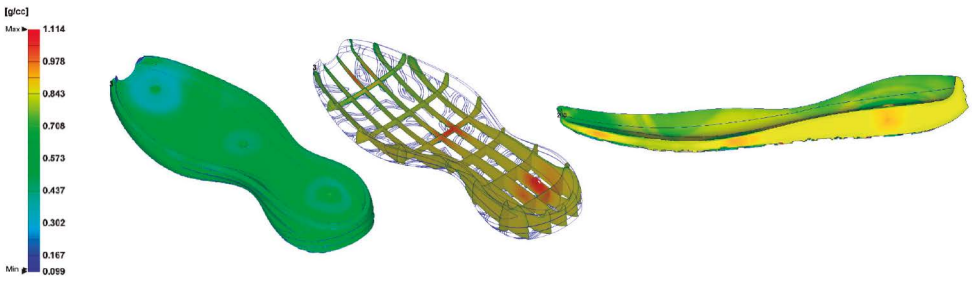
The pressure inside the mould is released abruptly, causing a physical phenomenon where the gas and thermoplastic expand from a super critical state and occupies the full available volume inside the mould cavity. This process creates microscopic gas bubbles dispersed inside the material allowing for the reduction of weight but still keeping an impressive mechanical performance since the gas bubbles act like springs. The Impact Absorption and Rebound are unique.



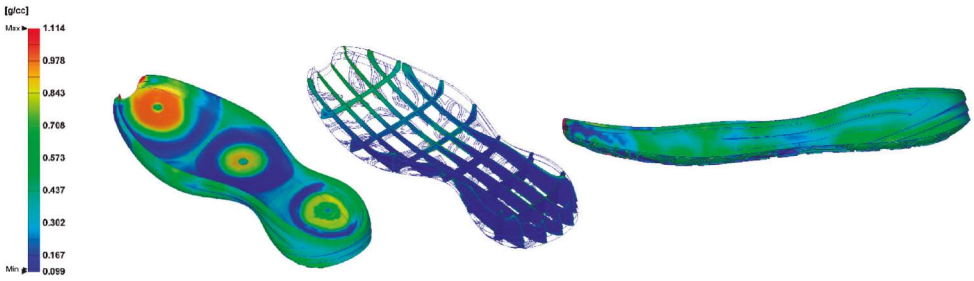
E-BLAST® PROPERTIES

In partnership with the local expertise center on Polymer engineering PIEP and using simulation algorithms, ALOFT projected a simulation of particle size and density distribution on the injected product, idealizing a product that has the most uniform and homogeneous distribution of particles and density. This allows for a fast iteration on mould design and part geometry modification still on the design bench. Injection point dimension and positioning, gas counter pressure and additives to be used can be tested and simulated without a single pair being injected, further decreasing the carbon footprint in the process. Lab testing the first samples allows to retro feeding the software with real data, further increasing the accuracy for future predictions. Making it right from the start.

CELL DISTRIBUTION



DENSITY DISTRIBUTION



BUT WHY SCF TPU?

Despite our machine and Technology allowing for several types of polymer injection (like Pebax), TPU was a good candidate because:

Excellent processability.

Easily available in compounders in Europe.

Allows direct Overmoulding on compact TPU outsole / expanded TPU midsoles (direct attach).

No warpage, shrinkage or expansion on the injected piece, keeping a 1:1 geometry to the mould shape.

Very good technical performance of the soles and midsoles.

Fully recyclable, time over time.

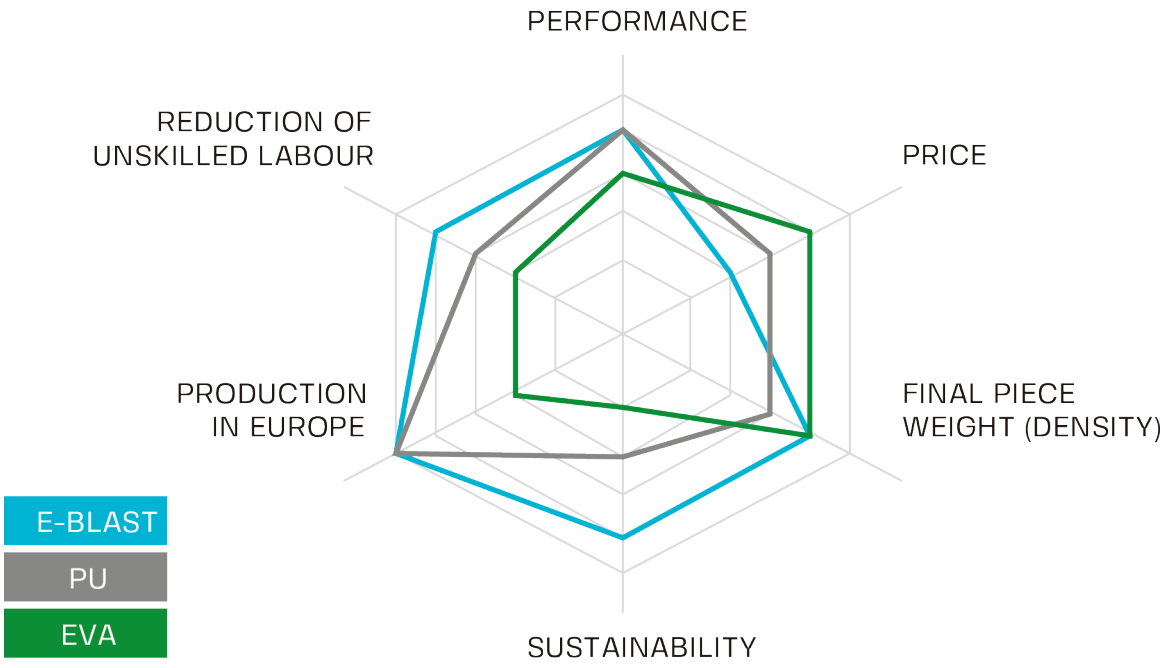
High bio-based content is an option.

Possibility of reincorporating production waste without compromising performance and/or properties.

DIFFERENCE BETWEEN CHEMICAL AND PHYSICAL EXPANSION

Chemical blowing processes use the decomposition of substances to release gases, creating non homogeneous voids in the molten plastic. During this process, harmful toxic chemicals can be added to the composition.

Physical foaming processes: based on the ability of molten polymers to absorb and dissolve inert gases, and after cooling and depressurization, the inert gases are released in the form of micro evenly dispersed bubbles inside the polymetric matrix formation. (E-BLAST)



SCF TPU TECHNICAL DATA

Here are presented some of the values already reached. Being a continuously improving technology it is likely they will continue to improve in the near future.

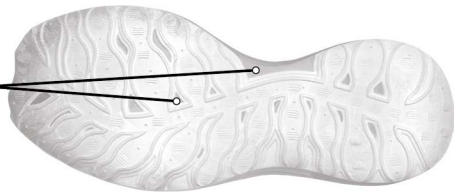
Density [g/cm^3]	0.20
Hardness [Asker C]	51 ± 4
Rebound Resilience [%]	55 - 60
Tensile Strength [Kgf/cm^2]	21 - 25
Elongation [%]	> 350
Tear Strength [Kgf/cm]	12 - 15
Compression set [%]	40 - 55

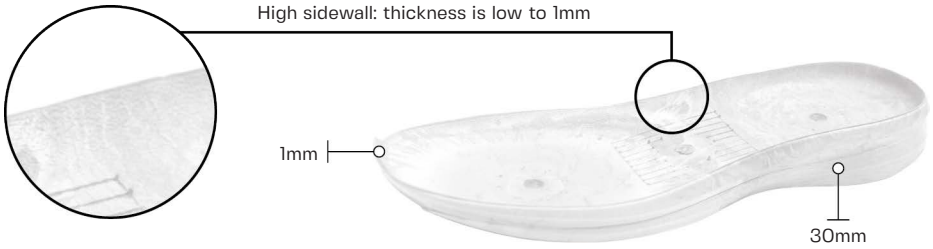
INJECTION CHARACTERISTICS DESIGN GUIDELINES

Size of injection point Ø10mm.

1 to 3 injection points possible per mould / sole design.

Distance between injection points = 80mm.





Thickness change from thin to thick.

Injection Point locations are in line at the center.

All side textures are possible.

Wording on the sidewall is feasible (width: 1mm)

Patterns on sidewall are clear.

Unique signature bursting effect lines on the flat surfaces, unique to the SCF process.

Angles, recesses, and undercuts possible.

OVERMOULDING VS **STOCKFITTING**

SCF N_2 TPU opens the possibility for insert-molding (over-molding). A TPU / rubber outsole is pre-placed in the mold and the injection of the SCF TPU foam occurs over it. It is possible to produce highly complex shapes without stock fitting, all with no shrinkage and achieving tight dimensional tolerances.

EBLAST® MIDSOLE (SCF TPU) + TPU OUTSOLE

Possible to overmould E-BLAST® midsole over compact TPU.

Requires no addition of chemical bonding agents

Compatibility of TPU foam and compact TPU outsole is excellent, creating a perfect bond.

During production of the outsole, scrap level = 0%, since all waste can be reintroduced into the process.

At the end of the life cycle, the outsole is fully recyclable since outsole & midsole are made of the same material.

Bio-based formulations already exist, bio-degradability ones will follow.

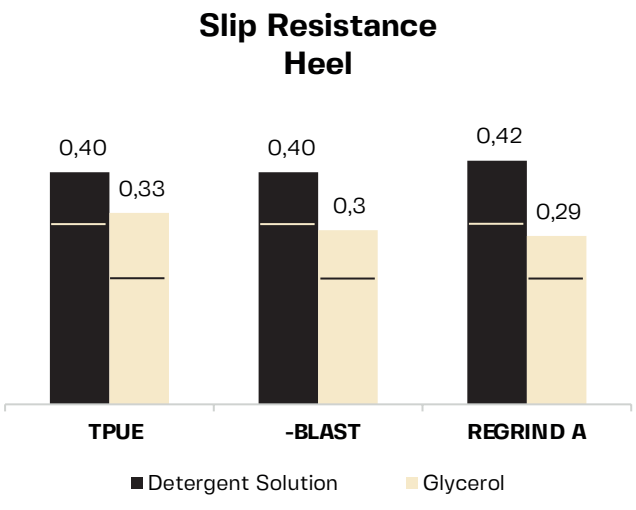
E-BLAST® MIDSOLE (SCF TPU) + RUBBER OUTSOLE

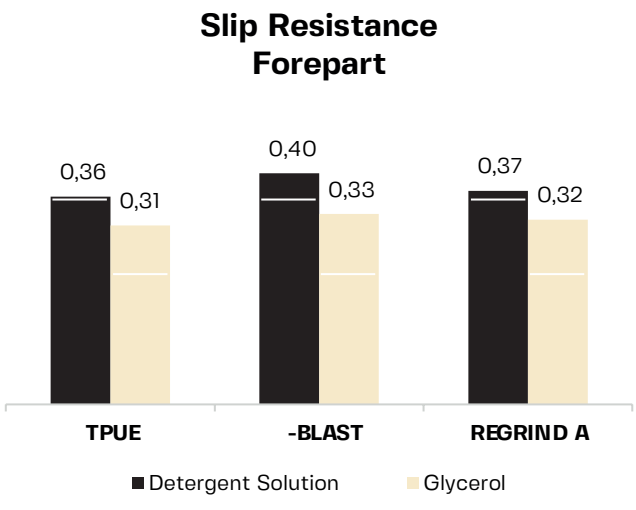
When injecting SCF TPU over rubber outsoles, pre-preparation of the outsoles is required.

In order to recycle the finished product, both components must be detached and recycled separately.

SUSTAINABLE PRODUCTS: E-BLAST® TPU FOAM

Strategies used to reduce materials environmental impact: E-BLAST TPU foam – lightweight & recyclable.





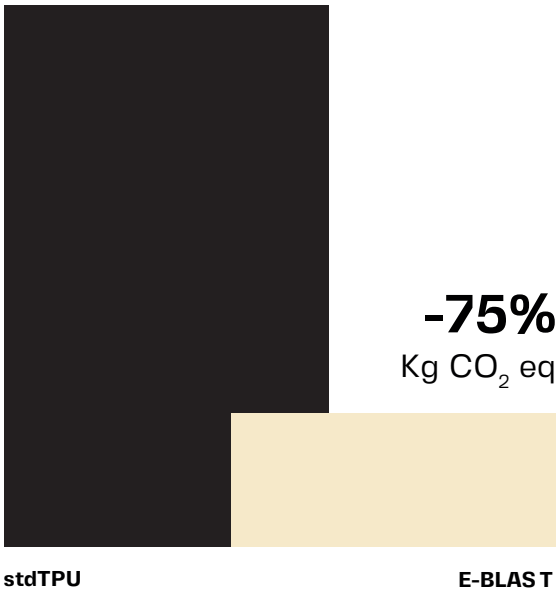
Environmental footprint

Measure and tune products environmental impact throughout its whole life cycle, from the extraction of raw materials, to disposal.

How?

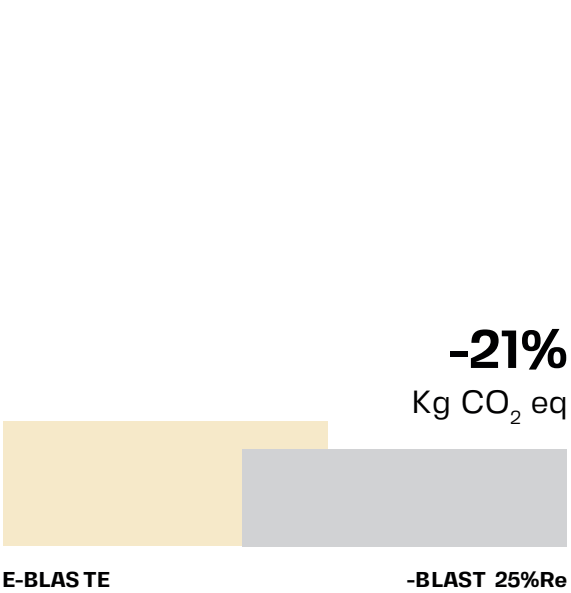
The European Commission proposed the Product Environmental Footprint (PEF) methodology, a standardized LCA.

E-BLAST TPU foam vs standard thermoplastic polyurethane (stdTPU)



E-BLAST/stdTPU: density E-BLAST 0.28 g/cm^3, stdTPU 1.1 g/cm^3 & injection

E-BLAST TPU foam vs E-BLAST 25% regrind/recycling (RE) foam



E-BLAST/E-BLAST 25%RE: density 0.28 g/cm^3 & injection and grinding processes

TEXTURE AND COLOURS

E-BLAST® products have a visual pattern similar to what appears on windows during a frosty day, this is due to the physical expansion of the material which occurs inside the mould at very high speeds. Disguising of this effect by adding mould textures or even remove it completely by applying our most recent 3d film transfer system. Paint / spray can also be used. Still, a lot of our customers prefer to keep it as a distinctive signature of this inovative technology.

When adding pigments, this particular appearance is further highlighted. We are actively working with our partners to develop special color masterbatches, designed specifically for SCF TPU injection with the purpose of improving color homogeneity.

LIGHT MATERIALS TECHNOLOGIES WHAT ARE THE DIFFERENCES?

EVA	- Industry standard / Proven Ttable Tech.
PU HIGH REBOUND	- Direct Injection Process (DIP) or by pouring.
“POPCORN BOOSTING” TECHNOLOGY	- Expanded particles thermoplastic polyurethane. - Form closed cells around tiny pockets of air.
EBLAST® - N_2 SCF	- Pre-Expanded TPU - Mucell Technology. - Incorporation of SuperCritical Fluid.

	EVA	PU HIGH REBOUND	“POPCORN BOOSTING” TECHNOLOGY	E-BLAST®
PRODUCTION IN EUROPE	IN ASIA: Phylon (Size 1:1) EVA foam pellets OR IN EUROPE: Expansion 1.4 - 1.6 (Injected)	AVAILABLE	IMPOSSIBLE	POSSIBLE (automated process: development of a overmoulding process on rubber or TPU)*
SHIPPING COSTS (AND CO_2 IMPACT)	EUROPE AND ASIA origin (Compact Material)	EUROPE AND ASIA origin (Compact Material)	ASIA origin (Expanded particles = high volume)	EUROPE AND ASIA origin (Compact Material)

*Reduced use of chemicals (no washing / gluing processes)

GOAL: Achieve good performance outsoles at a competitive price in Europe (vacuum process with 0,2mm slacks or printed film).

POSITIVE ECONOMIC AND ENVIRONMENTAL IMPACT

	EVA	PU HIGH REBOUND	"POPCORN BOOSTING" TECHNOLOGY	E-BLAST®
COLOUR	ANY COLOUR Bicolour soles by cold shot + vulcanization = long process (only in Asia)	ANY COLOUR	Only black and white	Only black and white for now (development of pigments in the future)
DESIGN COMPLEXITY	Possibility of having more complex geometries	Possibility of having more complex geometries	LIMITED	Possibility of having more complex geometries
ENVIRONMENTAL FRIENDLY				
LIGHTWEIGHT	0.20 - 0.30 g/cm^3	0.25 - 0.45 g/cm^3	0.20 - 0.30 g/cm^3	0.20 - 0.25 g/cm^3
REBOUND	*37%	*60%	*55%	*55%
ASPECT	ANY ASPECT	ANY ASPECT	PECULIAR APPEAREANCE (Bubbles on the surface)	PECULIAR APPEAREANCE
ABRASION	OK for use one outsoles BUT NOT for performance footwear (quick wear)	Cannot be use in contact with the floor	Cannot be use in contact with the floor	Cannot be use in contact with the floor
CHEMICAL RESISTANCE	NOT GOOD	NOT GOOD	GOOD	GOOD
DUAL-DENSITY	POSSIBLE	POSSIBLE	NOT POSSIBLE	NOT POSSIBLE

*Tests are being carried out at the CTCP (Footwear Technological Center)

ADVANTAGES E-BLAST AT ALOFT

Possible to execute complex geometries with rapid thickness transitions.

Good dimensional stability with no expansion and / or srinkage after injection.

Density of parts adjustable by controlling process parameters.

Direct bonding results E-BLAST®+TPU excellent without using chemical bonding agents.

Low Density (0.20-0,25 g/cm^3).

Possible to use bio-based TPU compounds.

Good chemical resistance and excellent durability.

Injection process allows for overmoulding over TPU/Rubber.

100% recyclable.

High process output with machine with 24 stations.

Suitable for artwork decorations such as mould texture, heat transfer film or paint.

Low environmental impact with reduced CO_2 emissions and low power consumption of the equipment.

CONSTRAINTS
E-BLAST AT ALOFT

Colors (only white or light grey by now) – process and pigment optimization required for other colours.

Particular appearance.

ETPU Not recommended for use in a direct contact with a floor (poor resistance to abrasion).

Not suitable for autoclave or other processes where the material is exposed to high temperatures during prolonged periods.

Low Density (0.20-0,25 g/cm^3).

THE NEW E-BLASTER INJECTION MACHINE

This physical foaming injection rotary machine is revolutionizing footwear production by its efficiency, high level of automatization and reduced carbon emissions.

ALOFT'S E-BLASTER has 24 stations, works with two injectors and will produce 500.000 to 600.000 pairs per year, depending on product complexity. Due to the high level of automatization of the machine, only 1 operator is needed to operate the full process.

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