

NEW DEVELOPMENTS IN HIGH PERFORMANCE BIO-BASED PEBAX® THERMOPLASTIC ELASTOMERS

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CERDATO

Lille, 16/03/2021



ARKEMA
INNOVATIVE CHEMISTRY

✦ ARKEMA & ARKEMA R&D

✦ PEBAX® & main characteristics

✦ New developments

- Sport shoes
- Breathable membranes
- 3DP by SLS

✦ Conclusions & Perspectives



A UNIQUE & INNOVATIVE
POSITIONING IN THE
SPECIALTY CHEMICALS
MARKET COMBINING AN
**ADVANCED
MATERIALS
AND ADHESIVES**
OFFERING TO ADDRESS THE
**KEY ECOLOGY
AND ENERGY
CHALLENGES**
OF TODAY'S WORLD

20,000
talents

11,000
in Europe

4,000
in North America

5,000
in Asia and RoW



>
10,000
customers

Collaborations
with the largest
global brands

**WOMEN AND MEN
AT THE HEART
OF OUR
DEVELOPMENT**

2000
new hires
every year



€8.8 bn
sales

Presence in
55 countries

136 plants
15 R&D
centers



OUR DNA: “INNOVATIVE CHEMISTRY”

**TOP 100
GLOBAL
INNOVATORS**
Clarivate
Analytics

**FOR THE 7TH CONSECUTIVE YEAR:
ARKEMA IN THE TOP 100 GLOBAL
INNOVATORS**

- ❖ **244** patents filed in 2018
- ❖ **1,600** researchers, **60** R&D partnerships
- ❖ **~3%** of Group sales allocated to R&D
- ❖ **1** incubator for breakthrough innovations

UNITED NATIONS PROGRAM : 17 SDG

SUSTAINABLE DEVELOPMENT GOALS



<https://www.unglobalcompact.org/sdgs>



6 RESEARCH PLATFORMS DEDICATED TO SUSTAINABLE DEVELOPMENT



New energies

Materials to develop solar and wind power, electric batteries

e.g. Kynar®, Elium®



Biosourced materials

Solutions to replace fossil resources as raw materials

e.g. Rilsan®, Pebax®, Rnew®



Water treatment

Materials for drinking water filtration

e.g. Kynar®



Home efficiency and insulation

Solutions to reduce energy consumption of buildings

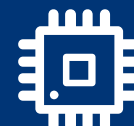
e.g. Bostik®



Lightweight materials

Materials for composites and 3D Printing

e.g. Sartomer®, Kepstan®, Rilsan®



Consumer electronics

Solutions to bring electronics within everyone's reach

e.g. Piezotech

✦ ARKEMA & ARKEMA R&D

✦ **PEBAX® & main characteristics**

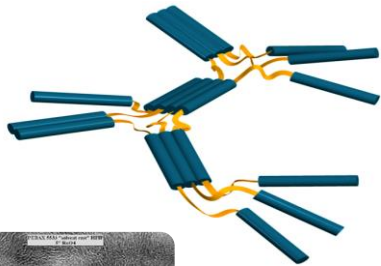
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Technical Polymers – Pebax® elastomers

A powerful chemistry (Thermoplastic Elastomers)



 Polyether
(Soft phase)

 Polyamide
(hard phase)



Lightweight & soft touch



Fatigue resistance



Impact resistance



Chemical
resistance



Consistent performance at
high and low temperature



Easy processing

Additional features



Bio-based grades

PEBAX®
RNEW
by ARKEMA



Breathable



Antistatic
properties



Foams



Ski Boots



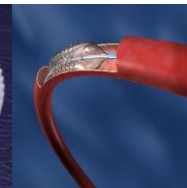
Footwear



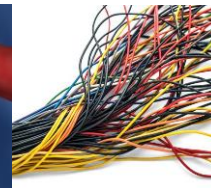
Cons. Electronics



Gears & Belts



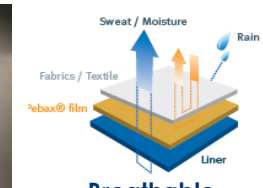
Catheters



Wire & Cables



Antistatic
materials



Breathable
Membranes

A Unique & Integrated Bio-based Supply Chain



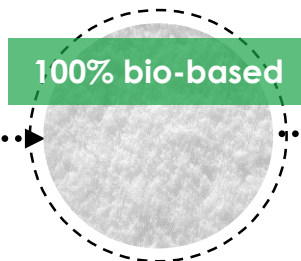
CASTOR PLANT



CASTOR SEEDS



CASTOR OIL



100% bio-based

AMINO 11



POLYMERIZATION

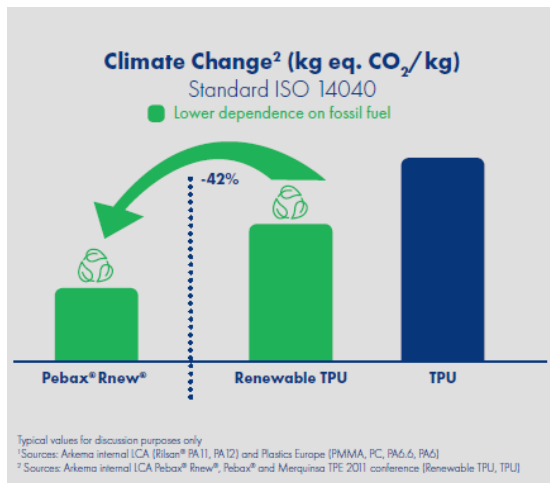
No Food Competition

From Semi-arid to sub-tropical

Non GMO

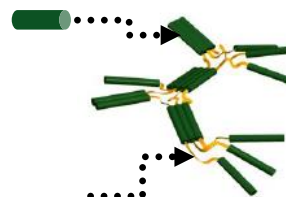
From Annual to Short Cycle Crop Rotation

Sustainable Farming



Polyamide 11 block

Polyether block



PEBAX[®]
RNEW
BY ARKEMA

30% to 97% of renewable content (ASTM D6866)

70 years of castor-based innovation and involvement in the **Pragati Sustainable Castor Initiative**

Watch Pragati video on Youtube:



✦ ARKEMA & ARKEMA R&D

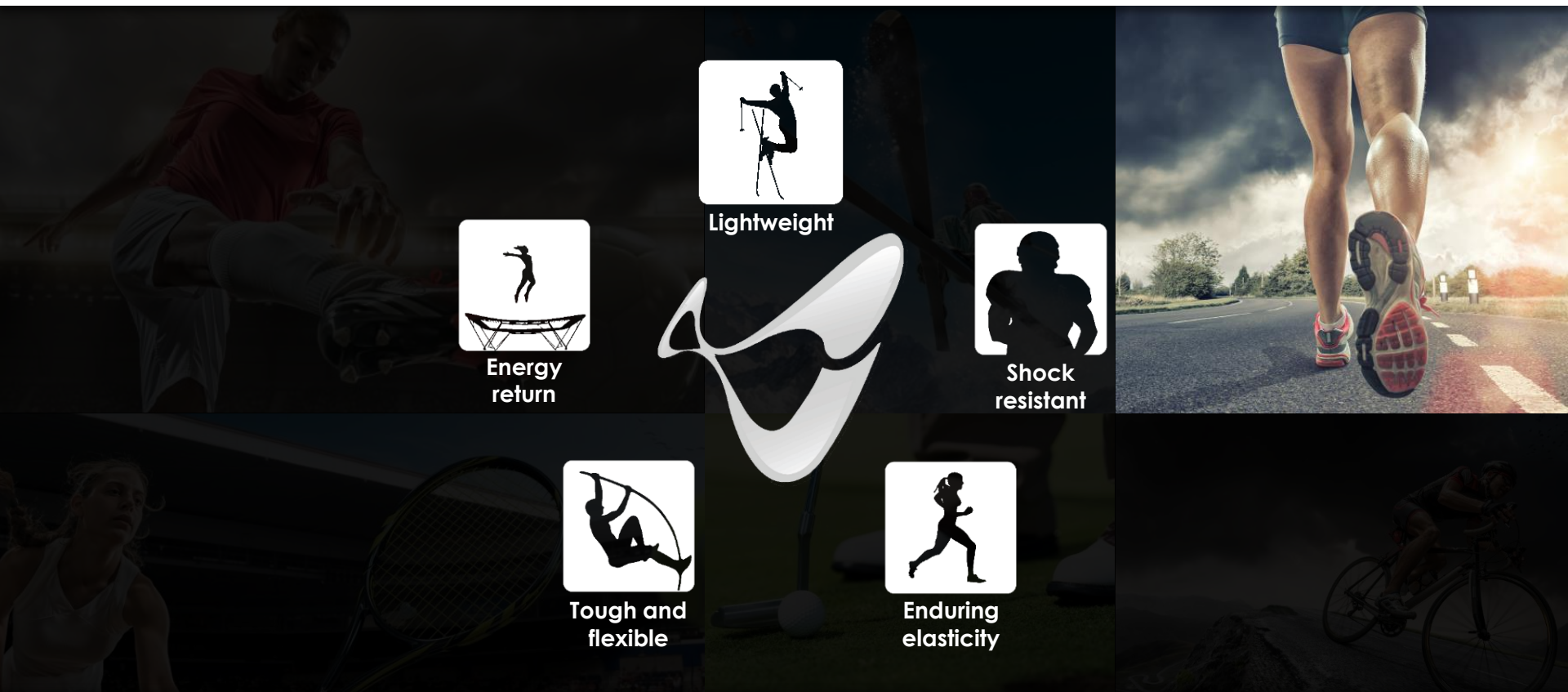
✦ PEBAX® & main characteristics

✦ **New developments**

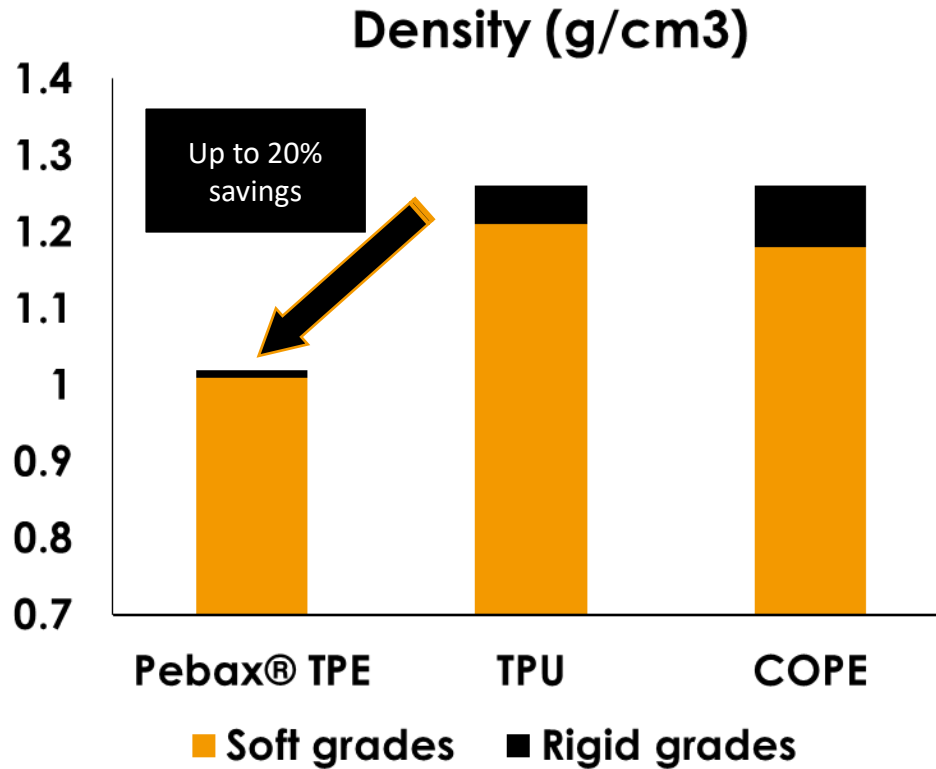
- **Sport shoes**
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✦ Conclusions & Perspectives

A VARIETY OF SPORTS APPLICATIONS



LIGHTWEIGHT



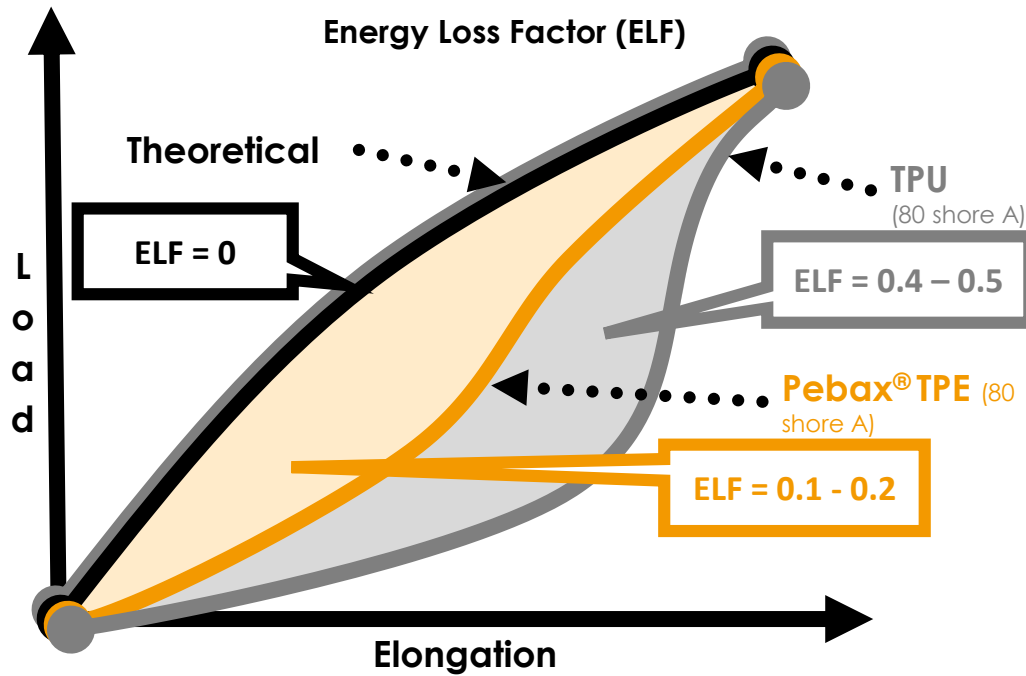
Thinner mold designs

Cut more cost and weight



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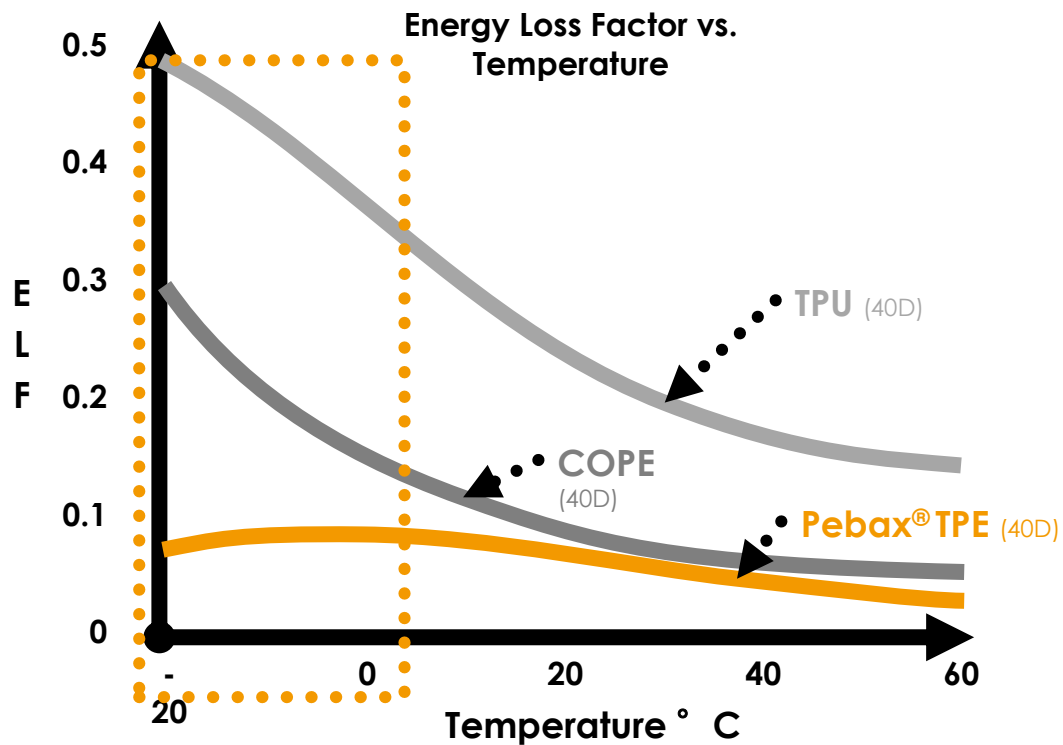
HIGHER ENERGY RETURN FOR ATHLETES



Marketable benefit to consumers

Tell emotional stories

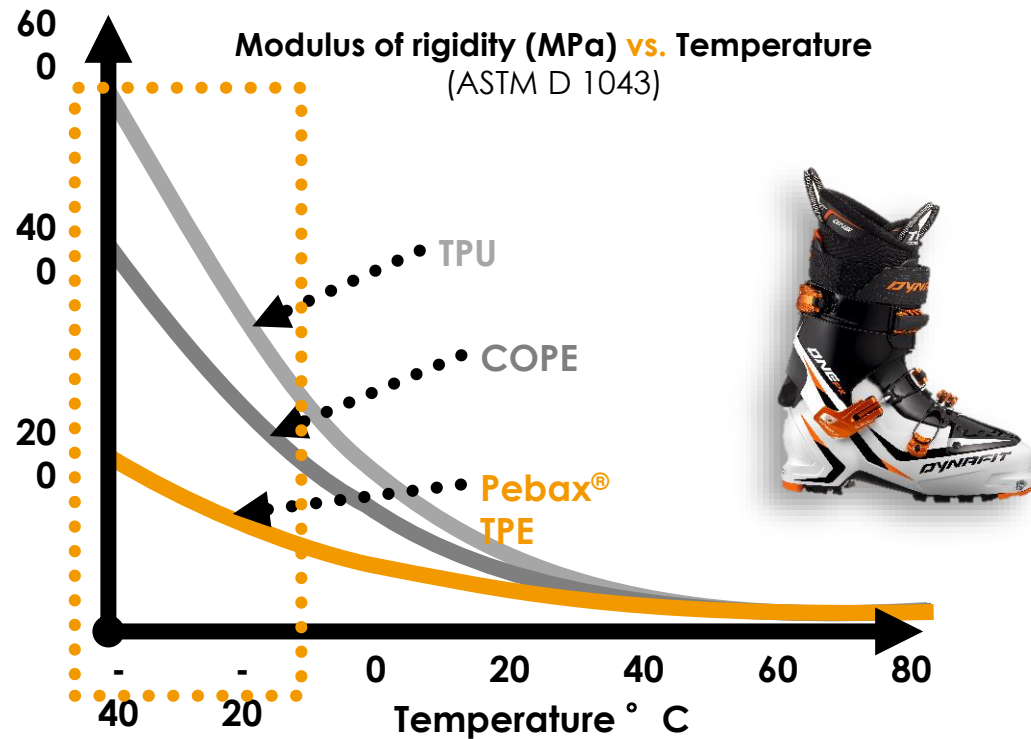
HIGHER ENERGY RETURN FOR ATHLETES



Sustained performance at low T

No energy compromise

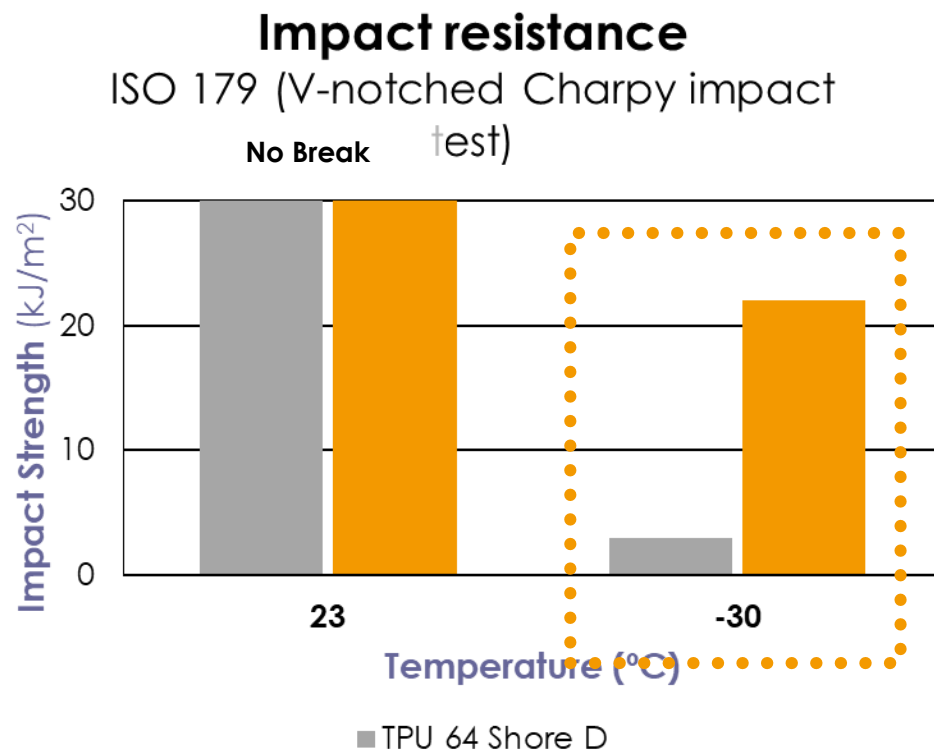
TOUGHNESS AND FLEXIBILITY



Sustained flexibility at low T

Avoid cold stiffening

SHOCK RESISTANT



Sustained strength at low T

Avoid brittleness in the cold



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PEBAX® & RILSAN® Materials BENEFITS for Sport BY TECHNOLOGY



PEBAX®
RNEW
BY ARKEMA



INJECTION

- Lightness
- Snappiness
- Impact resistance
- Durability
- Stability
- Low T° performance
- Wide Stiffness range

30~100% Biobased

FOAMS

- Lightness
- Highest Resiliency
- Recyclable (no crosslinking)



30~50% Biobased

FOAM	TPU	PEBAX® RNEW BY ARKEMA
Thickness (mm)	10	10
Hardness Asker C	40-45	45
Rebound ISO 8307	50%	70%
Density	0,24	0,15



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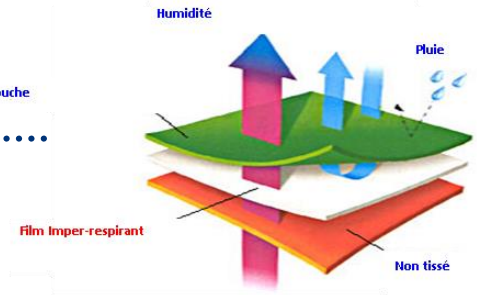
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Needs For Breathable Films In Various Market

Surcouche



Medical & Hygiene



Food Packaging



Construction



Textiles



MAIN NEEDS

For good
mechanical
performances



Large range of
breathability
requirement



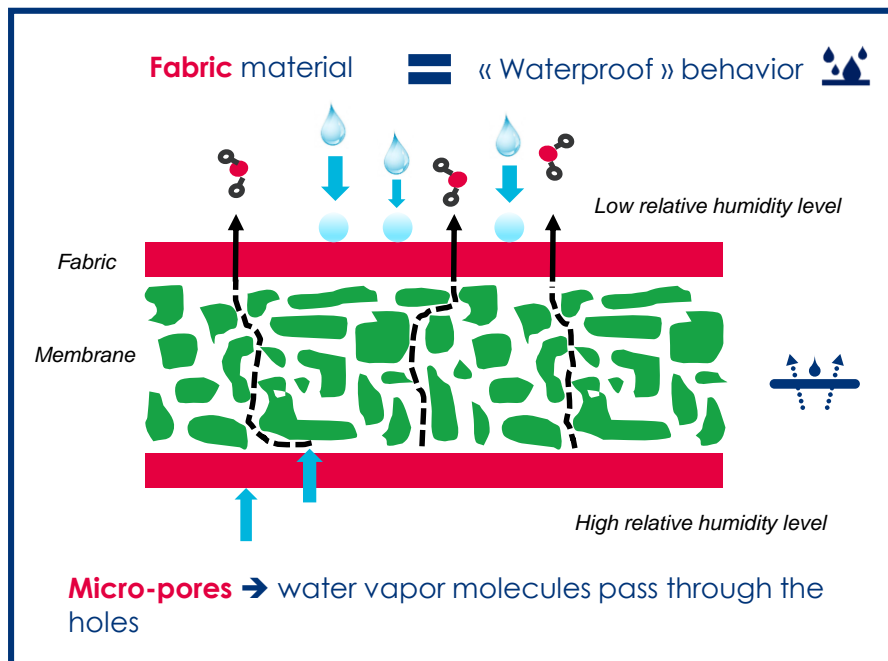
Consistent
performance with
time



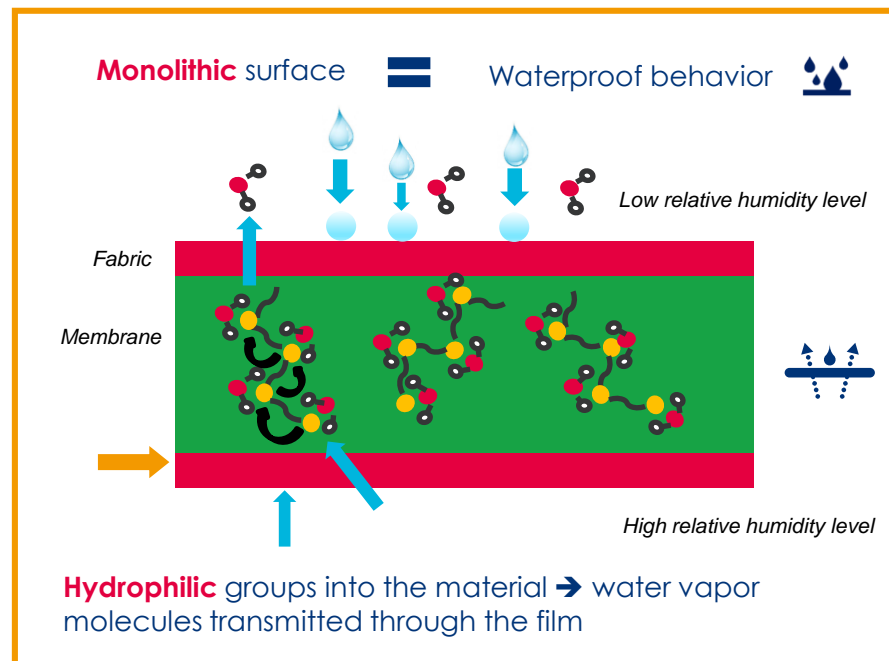
Liquid &
odor barrier

Two Types Of Breathable Film Structure

1st technology Perforated or micro-porous film



2nd technology Monolithic film



Benefits Of Monolithic Films vs. Microporous

1st technology Perforated or micro-porous film



- ❌ Variable performance with time
→ Holes can be plugged
- ❌ Low water-entry pressure
- ❌ Low tear strength
- ❌ Poor odor and liquid barrier
- ❌ No virus barrier
- Results in house applications:
 - Waste of heat
 - Inside water condensation: mold issue



2nd technology Monolithic film



Adjustable MVTR
(resin & thickness choices)



No loss of performances in time



Good tear strength



Excellent virus, liquid & odor barrier

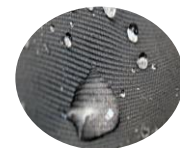


High water-entry pressure

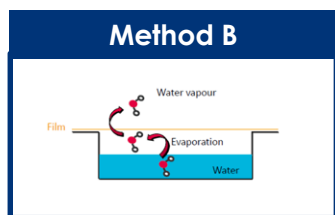
- Better perception on the market
- More sophisticated technology

MVTR: Moisture Vapor Transmission Rate

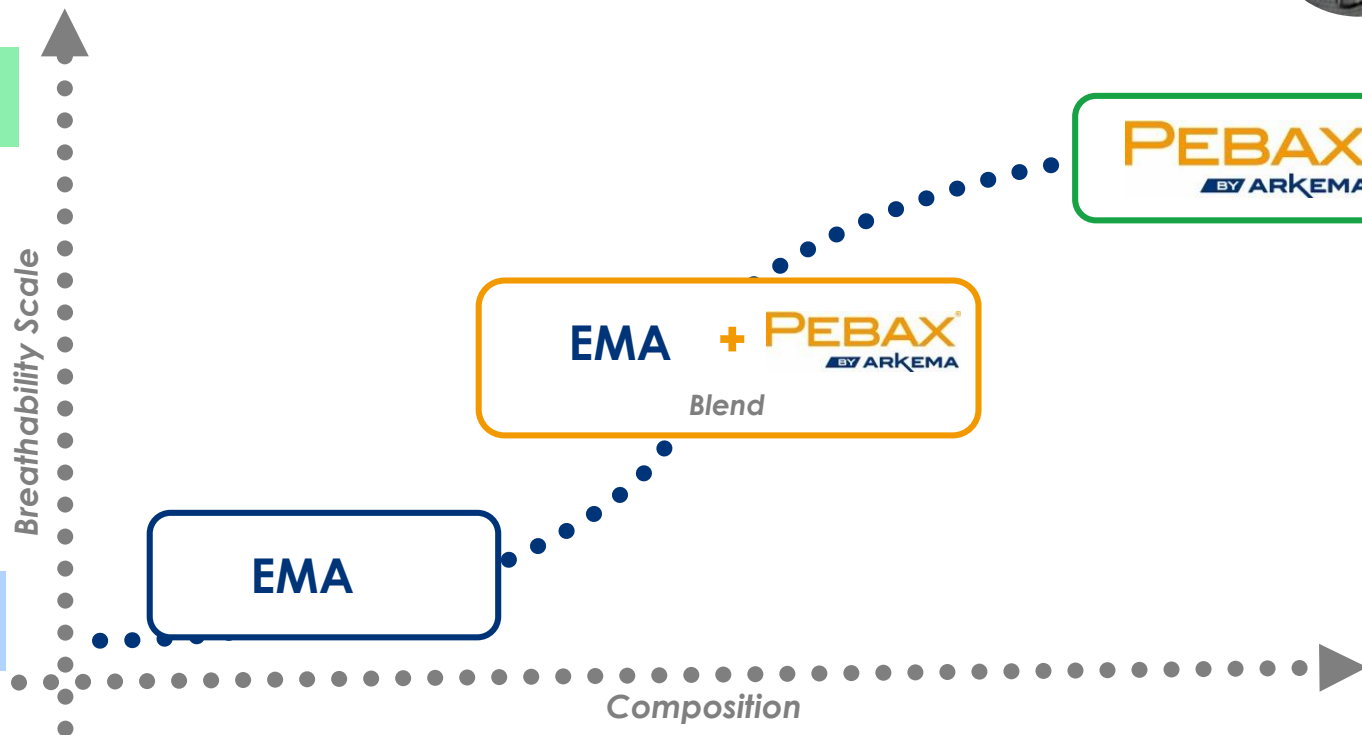
Arkema Offer For Monolithic & Breathable Film



- >100 US perms
- < 0.02 Sd (m) @ 50 μ m
- 800-1500 MVTR* (g/m².24 h)



- 5-15 US perms
- 0.25-0.50 Sd (m) @ 50 μ m
- 50-100 MVTR* (g/m².24 h)



Polymeric composition controls moisture vapor permeability

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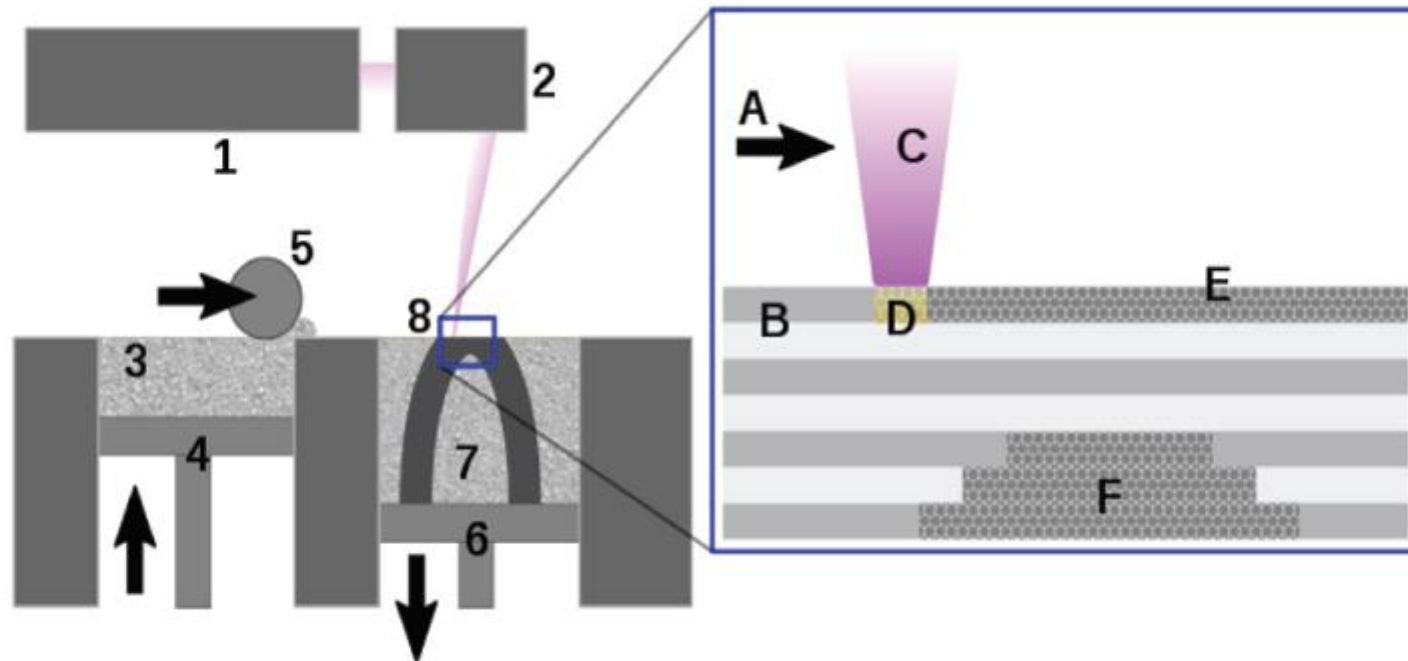


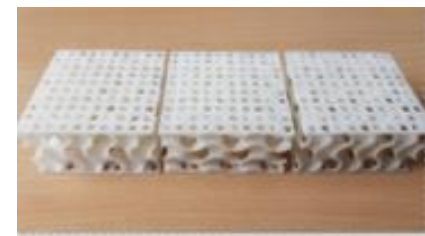
Figure 9 - **Principe du frittage laser de lit de poudre.** 1 et 2 : dispositif laser ; 3 : bac réserve de poudre ; 4 : piston fournisseur ; 5 : rouleau ; 6 : piston de fabrication ; 7 : bac de construction ; 8 : pièce en cours d'impression ; A : direction de déplacement du faisceau laser ; B : particules frittées de la couche en cours ; C : faisceau laser ; D : zone de frittage couche en cours ; E : zone à frittage couche en cours ; F : particules non frittées des couches précédentes.

- Powder Flow at high temperature (MP-20°C) especially for the softest TPE's
 - PSD (d10, d50, d90) + « formulation » of the powder
 - Thermal stability / discoloration of the powder (MP-20, >10 hours)
- Processing window : between T_f and T_c + influence of the cristallinity
- Multiple recycling ability (10% use per job)
- Interactions between laser beam and powder to reduce LS cycle times :
process + formulation
- Mechanical properties of sintered pieces + Anisotropy (Mech. Prop. z axis)
- Depacking ease
- No warpage of the sintered pieces
- No porosity => loss of Mech. Prop.
- Importance of post treatments (mechanical, chemical, coatings, ...)

MECHANICAL PROPERTIES

✦ Mechanical properties

Type of material and transformation	Pebax® SLS (XY/Z) by SLS	Pebax® by IM
Tensile Strength at break (ISO 37)	8MPa / 4MPa	30MPa
Young's Modulus (ISO 37)	50MPa / 40MPa	40MPa
Elongation at Break (ISO 37)	500% / 150%	2000%
Rebound	63%	65%
Energy Loss Factor	15%	10-15%
Density of parts	0,98	1,02
Notched Charpy impact -30°C	No break	No break
Biobased content	28%	28%



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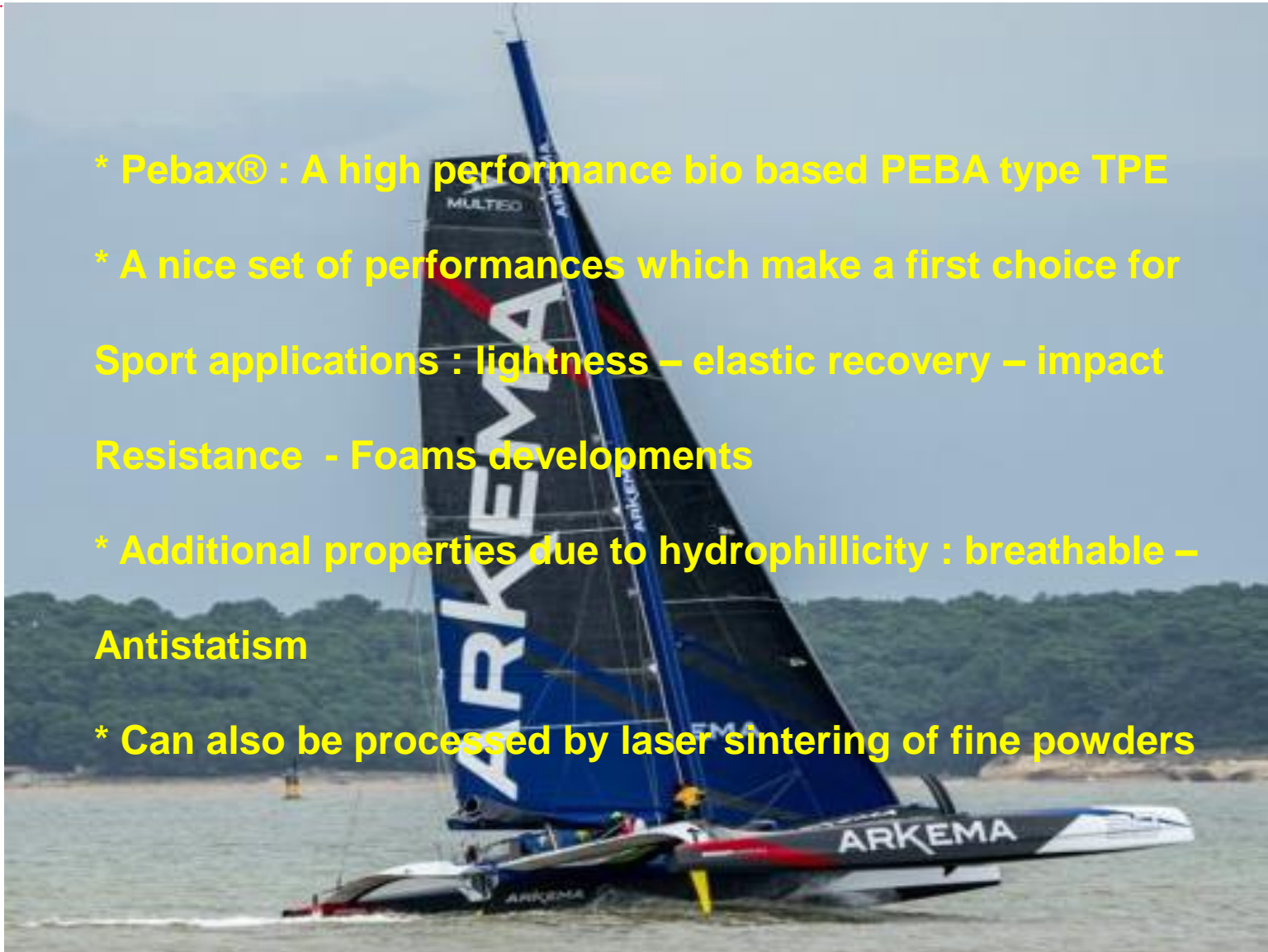
- Foams

- SLS 3DP

✦ Conclusions & Perspectives

NOVEL ARKEMA 4 MULTI 50 – A FLOATING LABORATORY FOR OUR INNOVATIONS

- * Pebax® : A high performance bio based PEBA type TPE
- * A nice set of performances which make a first choice for Sport applications : lightness – elastic recovery – impact Resistance - Foams developments
- * Additional properties due to hydrophilicity : breathable – Antistatism
- * Can also be processed by laser sintering of fine powders



Thank you !

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Jun MOUGNIER & Clio COQUET

Dr. Jean-Jacques FLAT

Specialty Polyamides Global Solution Provider
and NPD Upstream Director



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