pebax®

Polyether Block Amides

Lightness

Mechanical

Electrical Conductivity

Outstanding Properties

Selective Molecule Diffusion

Touch Feeling

ARKEMA

What is Pebax® ?

Pebax® is a block copolymer which offers the widest range of performances (mechanical, chemical, processing) among the thermoplastic elastomers (TPE).

Pebax® provides the best compromise of characteristics:
- the most versatile processing
- the lightest TPE
- the widest range of flexibility
- the biggest offer of physical and chemical properties.

Pebax® stands for polyether block amide. Pebax® is plasticizer free and belongs to the engineering polymers family. The Pebax® range enables to bridge the gap between thermoplastics and rubbers.

Pebax® can be used pure, as an additive or in blends with other polymers or rubbers.
Pebax® can also be reinforced with various fillers.

Pebax® brings

Physical properties

• Lightness

- Pebax® low density enables to reduce weight without affecting the final properties.

• Mechanical

- Good and consistent behavior at cold temperature
- No mechanical property loss during repeated solicitation and resistance to fatigue (low hysteresis, high energy transfer and no heat build up)
- Excellent spring back and elasticity return
- Accurate dimension stability.

• Electrical Conductivity

- Pebax® provides permanent and instantaneous antistatic properties to major thermoplastic materials.

• Selective Molecule Diffusion

- Pebax® allows a controlled release of active molecules with time (perfumes, insecticide, ...).
- Continuous Pebax® membranes offer adjustable permeation to vapor and gas.

• Touch Feeling

• Outstanding Properties

- Independent of temperature

Chemical properties

Pebax® gives a chemical resistance superior to most TPE's depending on the PA block content.

Regulatory compliances

Some Pebax® grades comply with USP class VI and FDA/ECC regulations.

Versatile processing

- Compatible with all technologies (injection, overmolding, extrusion, rotomolding, foaming, fiber and melt spinning) on standard equipment
- Easy settings
- Decoration
- Recycling.

Applications

Transportation

Cold impact performances, chemical resistance and unique touch feeling make Pebax® a suitable candidate for automotive parts.

Power Transmission

Pebax® provides superior long life behavior for belting and gears in very demanding environment.

Sport and leisure

Outstanding mechanical behavior of Pebax® makes it a material of choice for high performances athletic foot wear components, outsoles, ski boots designs.

Fibers and non woven

Stretch, elasticity, chemical resistance and processability are key features of Pebax® fibers and non woven.

Medical

Intrinsic flexibility, good touch feel, excellent processing, breathable features, sterilization properties and compliances with USP class VI lead Pebax® to various medical usage.

Breathable Membranes

The Pebax® range of breathable grades enable to cover a wide permeation level according to specific market requirements.

Antistatic Agent

Certain Pebax® grades intrinsically disperse electrostatic charges and can be added to large number of thermoplastic matrices to impart permanent antistatic properties regardless of the relative humidity.

Additives for PA6 and 6/6.6 films

Improvement of tear resistance, cold impact, flexibility and touch feeling of PA films can be achieved using dedicated Pebax® grades.

pebax®

A global chemical player, Arkema consists of 3 coherent and related business segments: Vinyl Products, Industrial Chemicals, and Performance Products. Present in over 40 countries with 17,000 employees, Arkema achieved sales of 5.7 billion euros in 2006. With its 6 research centers in France, the United States and Japan, and internationally recognized brands, Arkema holds leadership positions in its principal markets.

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In Medical Applications

ADVANTAGES OF USING PEBAX® IN MEDICAL APPLICATIONS

Pebax® is used a variety of medical applications due of its :

- **BIOCOMPATIBILITY**
  Pebax® SA grades comply with USP class VI*
- **STERILIZABLILITY**
  Pebax® can be sterilized by ethylene oxide process, steam, gamma radiation (up to 10Mrads)
- **OUTSTANDING MECHANICAL PROPERTIES**
  Pebax® offers a wide range of performances: light weight, wide range of flexibility, outstanding physical properties and chemical resistance, and a wide range of processing.*
- **BREATHABILITY**
  Films extruded from breathable Pebax® are thoroughly waterproof while maintaining its permeability to moisture vapor. Because Pebax® films are non-porous, they are used as microbial barrier protection. Due to their nature, they also possess antistatic properties, which are used to prevent dust attraction.

Name of the picture 1
Name of the picture 2

PEBAX® SOLUTIONS

APPLICATIONS	MAIN PROPERTIES	MEDICAL DEVICES	Pebax® SOLUTION
TUBING	•Softness and flexibility •Elastic/shape memory	Angiography and angioplasty catheters	Pebax® 7233SA Pebax® 7033SA Pebax® 6333SA
	•Kinking resistance •Torques transference •Low coefficient of friction •Resistance to pressure	Urology catheters	Pebax® 2533SA Pebax® 3533SA
	•Can be compounded with radiopaque fillers (20-50%) •Can be used in co-extrusion with TPU	Connectors for catheters	Pebax® 3533SA Pebax® MX1205SA
DENTAL FLOSS	•Low coefficient of friction •Sliding effect •Good compromise between strength and softness	Coating of the floss	Pebax® 2533SA
FILMS	•Breathability •Waterproof and barrier protection •Antistatic properties •Washable	•Disposable surgery gowns and gloves, mattress covers, wound dressings •Clean room applications •Medical adhesives (bandage) and transdermal patches •Baby diapers	Pebax® MV3000 Pebax® MH1657 Pebax® MV1074

PEBAX® GRADES HAVE A LOW COEFFICIENT OF FRICTION

	Pebax® 2533	Pebax® 3533	Pebax® 6333	Pebax® 7033
STEEL	0.61	0.61	0.26	0.22
TEFLON	0.51	0.30	0.17	0.14
NYLON 11	1.02	1.00	0.19	0.17
PMMA	1.12	1.11	0.87	0.68
POM			0.70	0.31
Pebax® 6333			0.27	
Pebax® 7033				0.23

Dynamic friction coefficient of Pebax® grades
According to ASTMD 1894 method

BREATHABILITY OF PEBAX® FILMS

Pebax® GRADES	B-Water Method 50% RH - 38°C		E Method 90% RH - 38°C	
	15µm	25µm	15µm	25µm
MV 3000	25000	20000	4000	3300
MV 6100	8000	7000	2200	2000

MVTR ASTM E96 (g/m²/24h) - Thickness of the films: 15µm

** However, we point out that it is the duty of the end user to check, in accordance with professional practice, the reciprocal compatibility of the material and the packaged foodstuffs (respective of Overall and Specific Migration Limits) and also that organoleptic characteristics of the latter remain constant.*
Due to the evolution of regulations or existing specific restrictions, it is necessary before any usage in food contact to request the related certificates from our commercial representatives.

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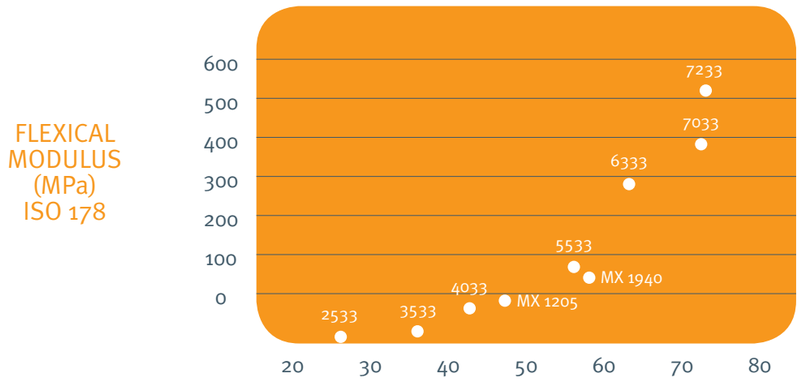
For Sport Equipment

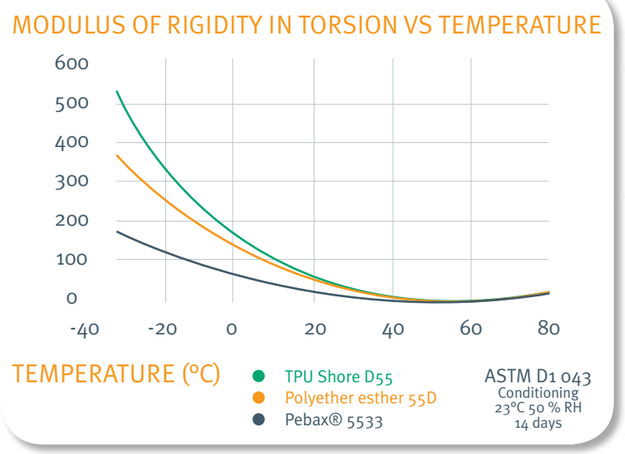
GREAT FLEXIBILITY : FROM RIGID POLYAMIDE TO SOFT RUBBER

Maximum strength where you need support, flexibility where you need movement.
Pebax® grades can be combined within a single component to provide stiffness at one end, flexibility at the other.



PERFORMANCE AT EXTREME LOW TEMPERATURES

Unlike toes and fingers, Pebax® does not stiffen in cold weather.
Snow shoe deckings made with Pebax® retains their mechanical properties (strength and impact resistance) and resilience under frigid conditions (-40°C).



Unbeatable flex - fatigue resistance with Ross Flex machine

- Withstand more than 280,000 cycles down to –20°C for all Pebax® grades

LIGHTEST THERMOPLASTIC FOR SHOES

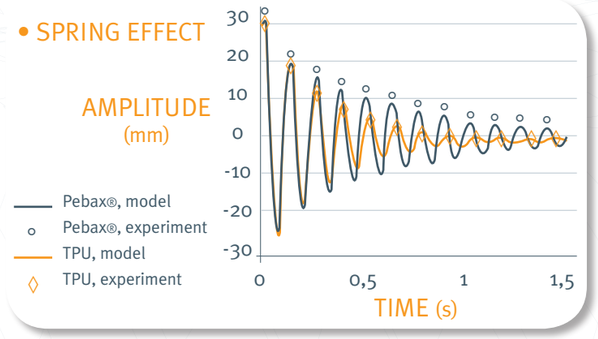
Pebax® has a very low density that allows the design of lighter parts.
Pebax® is ideal for outsoles, offering resilience to repeated stress, along with resistance to distortion and deformation.
Choosing and using Pebax®, will save 20% weight on the plastic components.

POLYMER TYPE	Pebax®	POLYESTER ELASTOMERS (COPE)	THERMOPLASTIC URETHANES (TPU)
SOFT GRADES	1,01	1,18 - 1,20	1,21 - 1,25
RIGID GRADES	1,02	1,22 - 1,26	1,25 - 1,26

EXCEPTIONAL DYNAMIC PROPERTIES

Pebax® has the lowest energy loss factor of all thermoplastic elastomers, which means Pebax® has the best energy return and an unbeatable flex fatigue resistance (resistance to solicitations and preservation of properties).

• SPRING EFFECT



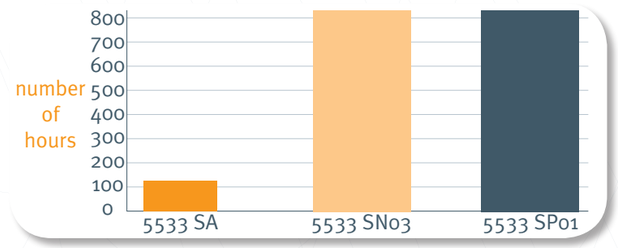
• ENERGY RETURN

LONG-TERM UV RESISTANCE

By utilizing a UV additives selection based on automotive requirement, the performance of Pebax® grades is excpetionnal in two ways:

- Their life
- Their consistency of color during aging

NUMBER OF HOURS WITHOUT SURFACE DAMAGE FOLLOWING UV IRRADIATION UNDER SEPAP 12-24 ACCELERATED TEST



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High Performance Material for Power Transmission

ADVANTAGES OF USING PEBAX®

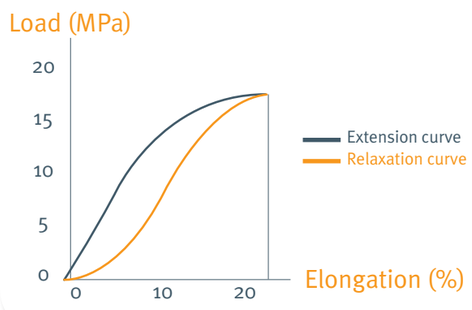
Thanks to its copolymer structure composed of rigid Polyamide blocks and soft Polyether blocks, Pebax® grades show outstanding dynamic properties and flexural fatigue resistance. The very low hysteresis and thus great energy return of the 33 series grades, even at low temperatures, make Pebax® a material of choice for high performance power transmission belts and silent gears.

Pebax® MAIN PROPERTIES		APPLICATION	Pebax® SOLUTION
LOW HYSTERESIS	•Low energy dissipated and heat build-up •High level of power transmitted	Belting/ Silent gears	Pebax® 33 series : 25 to 55 ShD grades
EXCELLENT FLEX FATIGUE RESISTANCE	•Low relaxation	Belting/ Silent gears	Pebax® 33 series : 25 to 55 ShD grades
	•Creep resistance		Pebax® 33 series : 40 to 70 ShD grades
LOW VIBRATION AND NOISE : LOW DENSITY		Belting/ Silent gears	Pebax® 33 series
EXCELLENT PROCESSABILITY	•Easy and strong Splicing	Belting	Pebax® 33 series
	•Very precise injection molding of small parts	Silent gears	
CHEMICAL RESISTANCE		Belting/ Silent gears	Pebax® 33 series : 40 to 70 ShD grades
DIMENSIONAL STABILITY	•Low shrinkage •Low water, oil and grease absorption	Silent gears	Pebax® 33 series : 40 to 70 ShD grades
WEAR RESISTANCE LOW COEFF OF FRICTION		Silent gears	Pebax® 33 series : 60 to 70 ShD grades

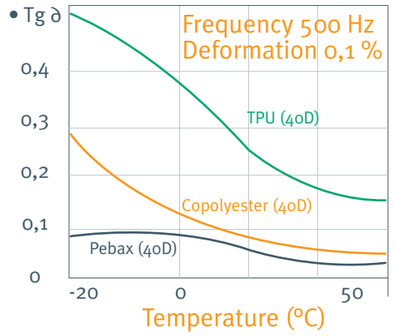
PEBAX® : A GREAT ENERGY RETURN FOR AN OPTIMUM POWER TRANSMISSION

Hysteresis is defined as the energy lost during a cyclic mechanical stress of a material and is a function of the modulus and the loss factor, tan ∂. The particular microstructure of Pebax® resins contributes to its lower hysteresis and tan ∂ when compared to other thermoplastic elastomers, as shown in the graph below:

HYSTERESIS



CYCLIC COMPRESSION TEST



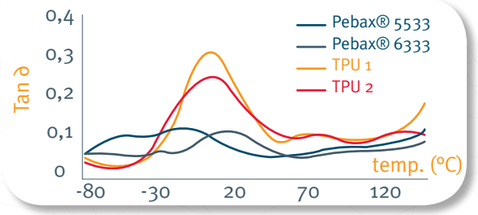
For industrial belts and silent gears the lower hysteresis and better energy return of Pebax® translates into higher speed and frequencies of use and subsequent energy savings through better power transmission and low heat build up.

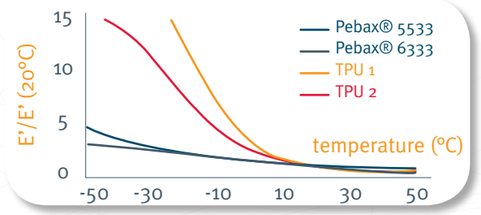
CONSISTENCY OF PEBAX® DYNAMIC PROPERTIES AT LOW TEMPERATURE

Thanks to the low glass transition temperature of its polyether phase, the tan ∂ of Pebax® remains low even in sub-zero environments. This allows Pebax® to maintain its flexibility and display almost no increase of its elastic modulus compared to other materials at sub-zero temperatures.

EVOLUTION OF TAN ∂, ELASTIC MODULUS E' WITH TEMPERATURE

Consistency of Pebax® Dynamical Properties

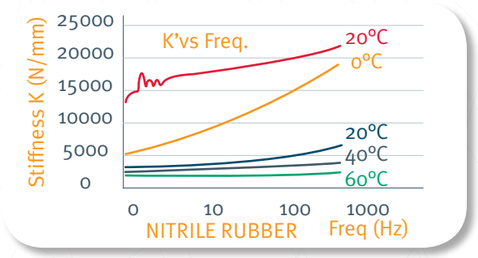


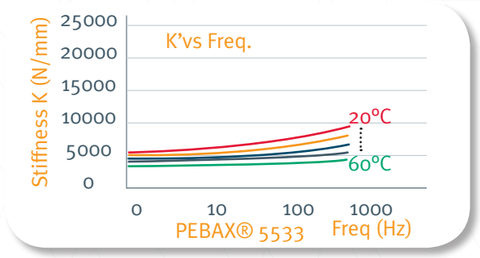


This consistency of the flexibility and dynamic properties of Pebax® at low temperatures is also valid at high frequencies. As shown in the comparative graph below, there is very little influence of temperature and frequency on Pebax® stiffness.

EVOLUTION OF STIFFNESS K WITH TEMPERATURE AND FREQUENCY

Consistency of Pebax® Properties





PEBAX® DYNAMIC PROPERTIES REDUCES NOISE AND VIBRATIONS

The excellent dynamic properties of Pebax® give rise to superior damping properties of vibrations and noise even at high frequencies.

PEBAX® EXCELLENT PROCESSABILITY

Pebax® can be easily transformed through extrusion or injection molding. Its excellent processability allows for the realization of very precise and very small parts such as silent gears for watches.
In belting, Pebax® processability and rheological properties simplify production procedures and allow for the production of thermally welded "seamless belts" with very high joint strength.

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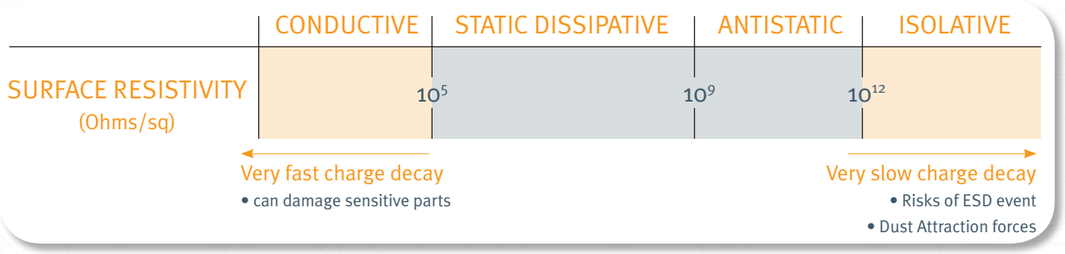
Permanent Antistatic Additive

SOLVING STATIC CHARGE PROBLEMS WITH ANTISTATIC PEBAX®

Very fast charge decay can damage sensitive electronic components while very slow charge decay can create dust attraction forces and uncontrolled Electrostatic Discharge (ESD events). Pebax® used as a permanent antistatic additive produces the best compromise to solve static issues while allowing for the parts to protect in a safe environment.



ADVANTAGES OF USING PEBAX®

Pebax® grades MV1074 and MH1657 are inherently antistatic polymers. Dry blended or compounded with an isolative polymer, Pebax® lowers the surface resistivity of the antistatic domain (Surface Restivity= 10^9 to 10^{12} Ohms/sq).

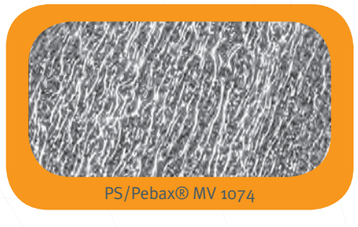
KEY PROPERTY	Pebax® SOLUTION
Immediate and Permanent Antistatic Effect	MV 1074, MH1657
Humidity Independant	MV 1074, MH 1657
Maintain Colorability of the Matrix	MV 1074, MH1657
Maintain the Physical Properties of the Matrix	MV 1074, MH 1657
No Sloughing, Offgassing or Blooming	MV 1074, MH 1657

	Surface Resistivity (Ohms/sq) ASTM D257	Charge Decay time (s) MIL B-81705	Melting point (°C)	USP Class VI approval (*)	Food approval (*)
Pebax® MV 1074 SA	3x10⁹	‹1	158	yes	yes
Pebax® MH 1657	1x10⁹	‹1	204	no	no

** However, we point out that it is the duty of the end user to check, in accordance with professional practice, the reciprocal compatibility of the material and the packed foodstuffs (respect of Overall and Specific Migration Limits) and also that organoleptic characteristics of the latter remain constant. Due to evolution of regulations or existing specific restrictions, it is necessary before any usage in food contact to request the related certificates from our commercial representatives*

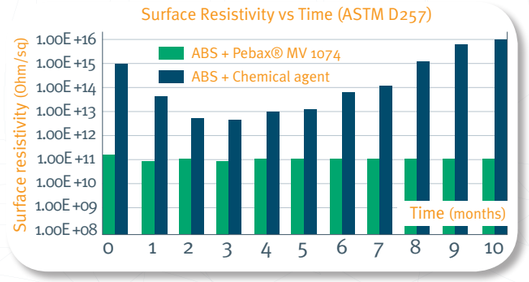
ANTISTATIC PEBAX® : A CONDUCTIVE NETWORK WITHIN THE HOST MATRIX

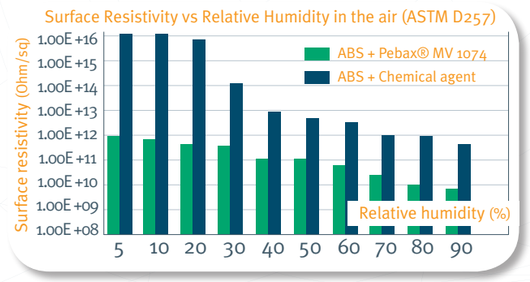
Charge movement can occur by a combination of the large scale molecular motion of the low Tg from the polyether phase and by charge transfer along the Pebax® backbone.
Antistatic Pebax® forms a 3D ionic conductive network within the host matrix which allows to dissipate charges:


PS/Pebax® MV 1074

PERMANENT ANTISTATIC PEBAX® vs TEMPORARY CHEMICAL ANTISTATS

The graphs illustrated below show the evolution of surface resistivity in ABS matrix with Pebax® compared to chemical antistats. Addition of Antistatic Pebax® results in immediate and permanent antistatic properties nearly independent from atmospheric relative humidity:





ANTISTATIC PEBAX® vs CONDUCTIVE FILLERS

Contrary to carbon black, Antistatic Pebax® maintains the physical properties of the host matrix, retains its (host matrix) colorability, and does not create carbon dust.

ANTISTATIC PEBAX® CAN BE USED IN WIDE RANGE OF POLYMER MATRICES

Pebax® MV1074 and MH1657 are delivered in pellet form and can be added to a wide range of polymers either by dry blending or compounding. A compatibilizer may be needed depending on the host matrix:

Polymer Matrix	Pebax® Grade	Pebax® Addition Level (wt%)	Compatibilizer	Surface Resistivity (Ohms/sq)
PE	MV 1074 or MH 1657	15 to 25%	Lotader 3210 (3-5%)	10^{11} to 10^{12}
PP	MV 1074	15 to 25%	Orevac CA 100 (3-5%)	10^{11} to 10^{12}
PS or HIPS	MV 1074 or MH 1657	10 to 20%	Lotader AX 8900 (2-3%)	10^{11} to 10^{12}
PVC	MV 1074	10 to 20%		10^{11} to 10^{12}
ABS	MV 1074 or MH 1657	10 to 15%		10^{10} to 10^{11}
ABS/PC	MV 1074 or MH 1657	10 to 20%		10^{10} to 10^{12}
PMMA	MV 1074	10 to 15%		10^{11} to 10^{12}
PBT	MV 1074 or MH 1657	10%		10^{13}
PETG	MV 1074 or MH 1657	10 to 20%		10^{10} to 10^{12}
POM	MV 1074	10%		10^{12}
PA	MV 1074 or MH 1657	10 to 20%		10^{11} to 10^{12}

Addition levels and resistivity values presented in the table above may vary depending on matrix grades and processing. Lotader® and Orevac® are Arkema's Functional polyolefins. *Please consult the following websites for more details: www.lotader.com & www.orevac.com*

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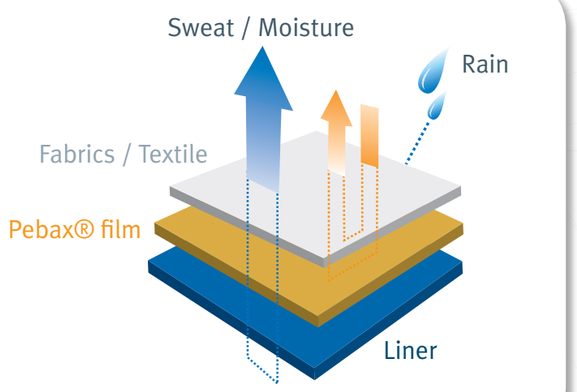
Breathable Film

GENERATE BREATHABLE WATERPROOF MEMBRANES WITH BREATHABLE PEBAX®

The hydrophilic grades of Pebax® when extruded into either a thin film or laminated on to a substrate offers excellent permeability to moisture vapor while remaining waterproof and offering an excellent barrier layer to bacteria. Pebax® can be laminated onto synthetic nonwovens, wovens or any textiles with the help of some functional polyolefins, and does not require any adhesives or bonding agents to adhere with these substrates.



ADVANTAGES OF USING PEBAX®

Pebax®, through its unique copolymer structure offers a perfect combination of mechanical strength, breathability, and ease of processing. Unlike microporous products, the monolithic structure of Pebax® films are a barrier to water and bacteria while exhibiting a high level of **MVTR** (Moisture Vapor Transmission Rate). Each of these advantages make breathable Pebax® a material of choice in many applications such as construction wrapping, food packaging, medical, and sport clothing.

KEY PROPERTY	Pebax® SOLUTION
High MVTR	MV 3000, MV 6100
Water Resistance	MV 3000, MV 6100
Monolothic Barrier to Bacterias and Molds	MV 3000, MV 6100
Tear Resistance	MV 3000, MV 6100
Dry Break Force	MV 3000, MV 6100
UV Resistance	MV 3000 SN 01, MV 6001 SN 01

PEBAX® EASE OF PROCESSING

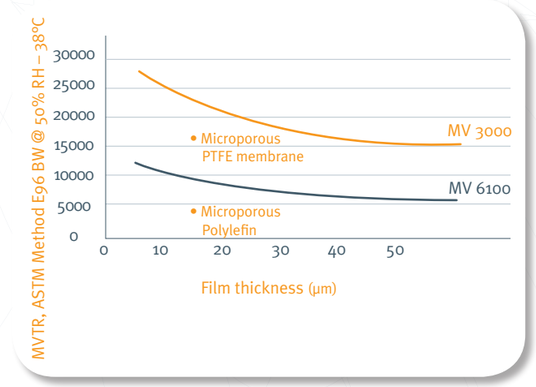
The breathable grades of Pebax® can be extruded into a very thin monolithic film down to 15 microns or laminated on to a wide variety of substrates (wovens, non wovens, textiles...) offering excellent adhesion for structural integrity.
Pebax® can also be used with compatibilizing resins (functional polyolefins) to adjust its breathability to different levels suitable for a wide range of applications and conditions in different parts of the world. Pebax® brings design flexibility to laminators and builders to develop a whole range of products.

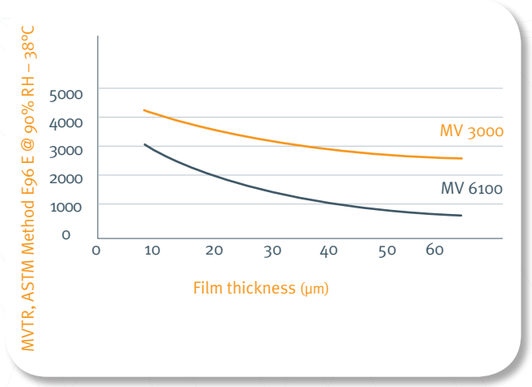
BREATHABLE PEBAX® : THE MATERIAL OF CHOICE FOR MONOLITHIC HOUSEWRAP

The high MVTR of the product allows the monolithic housewrap to breathe easily so the moisture vapor behind it does not turn into condensation that potentially leads to molds and mildews in the walls.
The water resistance of the product allows the housewrap to protect the housing structures from water-related structural failures and formation of agents such as molds and mildews that are major concerns for the health and safety of the residents.
The tear resistance of the product allows the product to be installed around the housewrap without any tearing damages at the jobsite, making it easier for the construction workers to wrap the house in a shorter duration.
The UV resistance of the product allows the builders to wrap the house and then tend to other construction activities not worrying about the damage to the housewrap from the UV rays.

BREATHABILITY OF PEBAX®

Breathability can be described as the Moisture Vapor Transmission Rate (MVTR) and it represents the amount of water vapor that goes through a film or structure over a period of 24 hours. It is measured per ASTM E96 A/B/BW methods in g/m²/day at 50% or 90% RH and at 23 °C or 38 °C. Depicted in the graphs below, Pebax® grades offer high levels of MVTR under different conditions, surpassing alternative microporous or microperforated technologies.





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Active Molecules Carrier

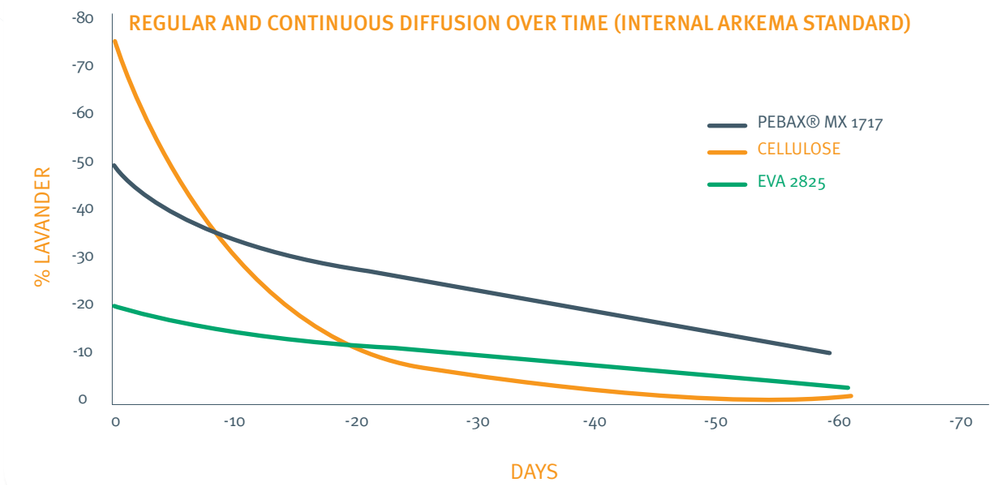
The Pebax® MP1717 structure consists of regular linear chains of rigid polyamide and soft polyether segments. This unique chemical structure allows for, through the polyether phase , the absorption and controlled release of volatile molecules (fragrances, oils, insecticides...)

ADVANTAGES OF USING PEBAX® MX 1717

KEY PROPERTY	Pebax® SOLUTION
High Level of initial absorption of volatile substances	Pebax® MX 1717
Uniform release over time	Pebax® MX 1717
Long lasting affect	Pebax® MX 1717
Consistency of the substances released	Pebax® MX 1717
Ease of the processability and recycling	Pebax® MX 1717

PEBAX® MX 1717 : EXCELLENT ABSORPTION, OPTIMUM DIFFUSION

As depicted in the graph below for the case of lavender perfumes, Pebax® MX1717 exhibits a high level of initial absorption (up to 50%) and a uniform and long lasting release of the fragrance compared to other supports.

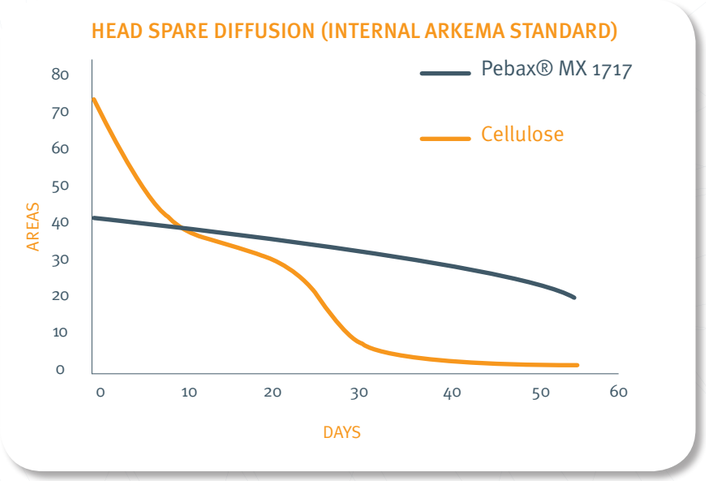


CONSISTENCY OF THE SUBSTANCES RELEASED

The evolution in time of lavender perfume components has been measured by chromatography (Head Space Technology).

The graph below represents the evolution in time of specific peaks corresponding to the olfactory notes of the perfumes.

Contrary to a cellulose support, Pebax® MX1717 does not affect the nature of the perfume and allows for a consistent diffusion at a constant rate over a long period of time.



EASE OF PROCESSABILITY AND RECYCLING

Pebax® MX1717 pellets can be impregnated before transformation through dry-blending with the volatile substances.

-The low melting point (135°C) of Pebax® MX1717 allows for injection molding or extrusion of the polymer without the degradation of these volatile substances.

-Standard conditions of processing and coloration can be applied. To avoid modification of the volatile substances, lower processing temperatures are recommended.

APPLICATIONS

Pebax® MX1717 can be used as a support for oils, perfumes, insecticides, and pheromones (air fresheners, insect repellent devices, etc..).

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Coloration, Welding And Decoration

COLORATION

•BY MASTERBATCHES

Polyamides recommended (instead of polyolefins)
With a similar viscosity to Rilsan® or Pebax®
Compounding always better and sometimes necessary

The rate of incorporation is generally ~3% for thin parts and 0.3% for thick parts

•BY PIGMENT BLENDS

Recommended: preliminary compounding with material to be colored
Careful choice of pigment (to avoid migration phenomena OR processing issue due to presence of organic colorants)

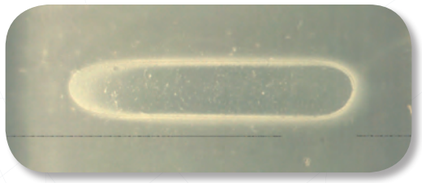
•BY LIQUID COLORANTS

Colorant acts as a lubricant so the flow of material is affected

WELDING

There are many techniques suitable for welding Rilsan® and Pebax®, but, once again, one technique should be specifically studied accordingly:

- Ultrasonic welding technique: for soft grades only (2533, 3533)
- Induction technique
- High frequency technique (due to polarity): Rilsan® and Pebax® (all grades)
- Mirror technique



DECORATION

Techniques suitable for decorating Rilsan® and Pebax® include:
Laser printing
Hot printing
Ink Printing
Clear coat/lacquers
...
In-mold decoration techniques (co-molding, insert-molding, in-mold labeling, ...)

Choice of techniques depend on application, geometry of part, and cost.

SUBLIMATION AND THERMOFORMING

This technology has been developed to meet different requirements for ski applications, and can be applied in other fields with minor changes.
After decoration, the Pebax® film can be thermoformed and stamped to meet the required shape and size. This produces an insert that can be over molded by Pebax® for example, or it produces a film that can be thermobonded on a substrate, such as composites.

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High Performance Additive In PA6, PA6/6.6 Films

ADVANTAGES OF USING PEBAX® MP 1717

Pebax® is a thermoplastic elastomer with a glass transition temperature below –50°C. Added to PA6, Pebax® MP1878 enhances the properties of PA6, especially at low temperatures and low humidity content, at the same time maintaining the transparency of the nylon film and improving its soft touch.

KEY PROPERTY	Pebax® SOLUTION
Improved tear resistance	MP 1878
Improved impact resistance	MP 1878
Faster moisture pick up	MP 1878
Allows for higher stretching ratios	MP 1878
Soft touch	MP 1878
Antistatic	MH 1657

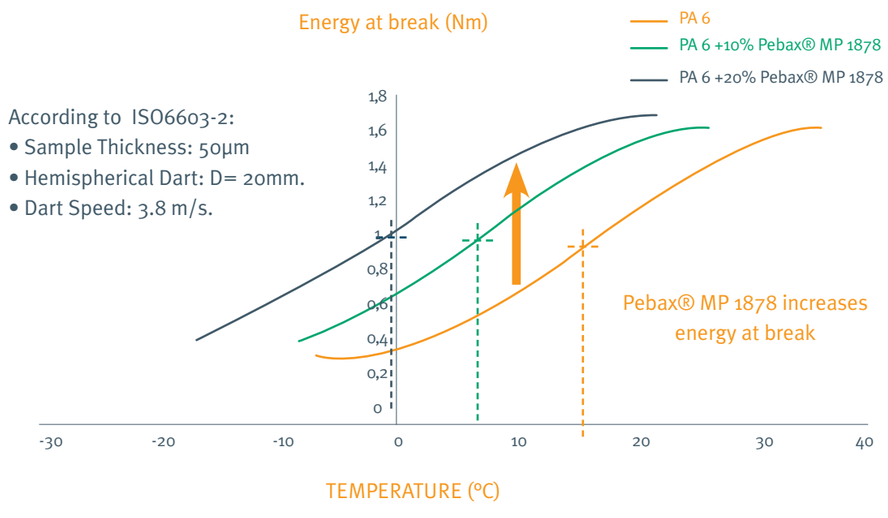
PEBAX® MP 1878 EFFECT ON PA 6 TEAR RESISTANCE

According to ISO 6383/2- ASTM D1922/93 ELMENDORF : Thickness of the film: 50µm.

	PA 6	PA 6 + 10% MP 1878	PA 6 + 15% MP 1878	PA 6 + 20% MP 1878
Parallel to the flow (cN)	60	65	80	90
Perpendicular to the flow	60	70	80	90

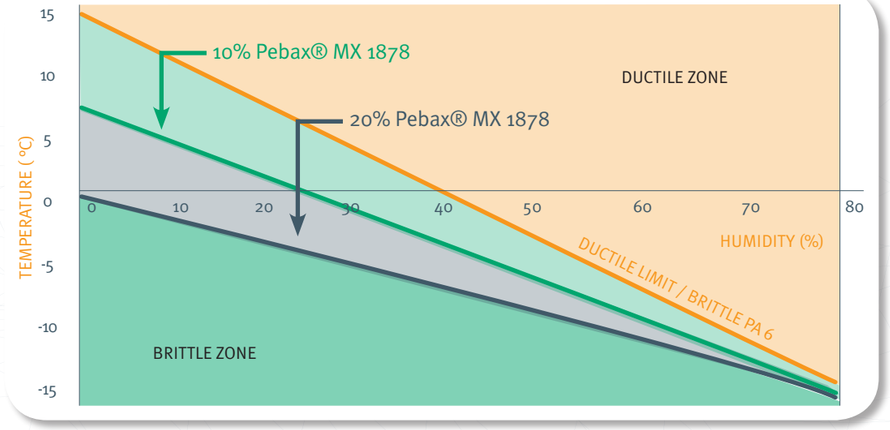
DARTTEST : PEBAX® MP 1878 PUSHES THE LIMITS OF PUNCTURE RESISTANCE OF PA 6 FILMS

Variation of the Energy at Break vs Temperature under dry conditions:



DART TEST : PEBAX® MP 1878 SHIFTS THE DUCTILE/ BRITTLE TRANSITION TO ACHIEVE AN IMPROVED NYLON FILM vs WORKING ENVIRONMENT

The graph below illustrates the evolution of the ductile/brittle limit: The addition of Pebax® MP1878 increases the range of impact resistance of PA 6. This effect is particularly important at low temperature and humidity content.



PEBAX® MP 1878 EFFECT ON PA 6 MOISTURE UPTAKE

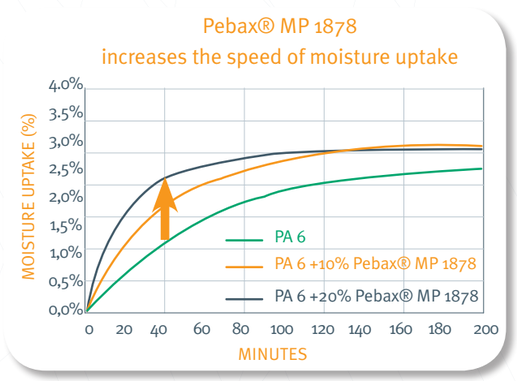
PA6 films are completely dried and then exposed in a 50% humidity atmosphere at 23°C.

Pebax® MP1878 increases the speed of moisture uptake which helps to stabilize the mechanical properties and lowers the dependency on PA6 to the relative humidity of the environment.

Pebax® MP1878 is delivered in sealed packaging, under pellet form, ready to be processed. Because of its superior compatibility with PA6, Pebax® MP1878 can be easily dry blended during the film extrusion process and does not require compatibilization.

Pebax® MP1878 can be used with a variety of PA6 films: oriented BOPA films) and non-oriented (cast or blown fims).

Pebax® MP1878 complies with USP class VI, and European Food Directive EU 2002/72*.



**However, we point out that it is the duty of the end user to check, in accordance with professional practice, the reciprocal compatibility of the material and the packaged foodstuffs (respective of Overall andSpecific Migration Limits) and also that organoleptic characteristics of the latter remain constant.*
Due to the evolution of regulations or existing specific restrictions, it is necessary before any usage in food contact to request the related certificates from our commercial representatives.

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Processing And Handling

LARGE WINDOW OF PROCESS CONDITIONS

Pebax® has been historically documented as having excellent processability in each of the major thermoplastic processing technologies:

- Injection molding
- Extrusion (cast film, blown film, sheet, tube...)
- Assembly process : overmolding and coextrusion

HANDLING RECOMMANDATIONS

- Ready to use products without re-drying for unopened bags
- Bag storage at T ‹ 40-50°C, without high humidity content
- No heated hopper necessary to process Pebax®
- Bring bags into the workshop 24 hours prior to processing (to avoid condensation)
- Do not use granules from bags that have been open for longer than 2 hours.
- During trials, manually close the bags after feeding the hopper to avoid water uptake
- After a one-day trial, reseal the bag before re-using it the next day

DRYING CONDITIONS

Granules exposed to atmospheric conditions for more than 2 hours should be dried before processing (see table below). Place the granules onto a clean flat metallic tray for efficient drying. Arkema highly recommends using vacuum drying ovens because the absence of oxygen allows for higher temperatures and time reduction. Desiccant dryers are also efficient with regularly changed filters. Risk of oxidation is increased with forced-air circulation ovens.

GRADES		RDG 277 / RDG 314	7233 SN 01	7033 SN 01	6333 SN 01	5533 SN 01	4003 SN 01/ MX 1205	3533 SN 01	2533 SN 01
Hot air oven or Vacuum oven	Temperatures (°C)	70-80	70-80	70-80	65-75	65-75	60-70	55-65	55-65
	Duration (h)	6-8	5-7	5-7	4-6	4-6	4-6	4-one night	4-one night

Bag storage conditions: Store away from moisture and heat, and in a ventilated atmosphere
Shelf life: 2 years from the date of delivery

INJECTION RECOMMANDATIONS

- Residence time ‹ 10 min
- 25% ‹ injected volume ‹ 80% of total shot capacity
- 2.2 ‹ compression rate ‹ 2.8
- 18 ‹ L/D ‹ 22
- Correct check-valve
- Depending on the Pebax® grade chosen and on the injection conditions, the shrinkage rate of Pebax® typically varies from 0.5 to 1.5%

EASE OF INJECTION MOLDING

The rheological behavior of Pebax® allows for:

- a wide range of processing temperatures compared to other Thermoplastic Elastomers (especially TPU)
- ability to inject extremely thin parts (down to 0.8 mm)
- Short cycle times
- High recyclability
- Accurate Dimension Control

INJECTION MOLDING CONDITIONS

- MELT TEMPERATURE (°C)

GRADES	RDG 277 / RDG 314	7233 SN 01	7033 SN 01	6333 SN 01	5533 SN 01	4003 SN 01/ MX 1205	3533 SN 01	2533 SN 01
Minimum	240	230	230	230	200	200	180	180
Recommanded	270	260	260	260	240	240	210	210
Maximum	300	290	290	290	270	270	240	240

- MOLD TEMPERATURE (°C)

GRADES	Pebax® filled (RDG 277, RDG 314)	Rigid Pebax® (5533 -» 7233)	Soft Pebax® (2533 -» 4033)
Recommanded	40-60	25-60	10-30

DRY-BLENDING COMPTABILITY

With its extensive hardness range, Pebax® is suitable for a vast majority of applications. It is possible however, to mix various grades of Pebax® in order to achieve specific properties. ARKEMA personnel will be pleased to assist you in selecting the Pebax® blend that will meet your specification criteria.

OVERMOLDING

Insert molding offers a countless combination of possibilities with a variety of materials such as glass, metals, polymers, and textiles.The overmolding technique is widely used to manufacture soles of football and athletic foootwear. Pebax® possesses a wide plasticizing range, which makes it highly suitable for over molding. The adhesion of Pebax® onto inserts can be optimized by adjusting the process parameters. From a general stand point:

- Pebax® can over mold : Pebax®, TPU (preferably Ether type), PVC, leather, coated parts...
- Pebax® can be over molded by: Rilsan® PA 12, Rilsan® PA 11, Rilsan® Clear...

EXTRUSION CONDITIONS OF PEBAX®

Thanks to the rheological properties of Pebax®, many extrusion and coextrusion techniques are available:

- Films down to 10 µm in cast or blown processes
- Sheets
- Tubes

Pebax® can be extruded on conventional equipment. ARKEMA personnel will be pleased to provide specific processing parameters related to Pebax® in technologies such as tube sizing, blown film drawing, or the cooling conditions for sheet calendaring.

Pebax® Grade	Recommanded Temperatures
7033	220°C - 250°C
6333	210°C - 240°C
5533	210°C - 230°C
4033	210°C - 230°C
3533	190°C - 220°C
2533	170°C - 210°C

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