

Queo™

Enabling innovation with plastomers and elastomers

Together we can



Keep Discovering

 BOREALIS

بروج
Borouge

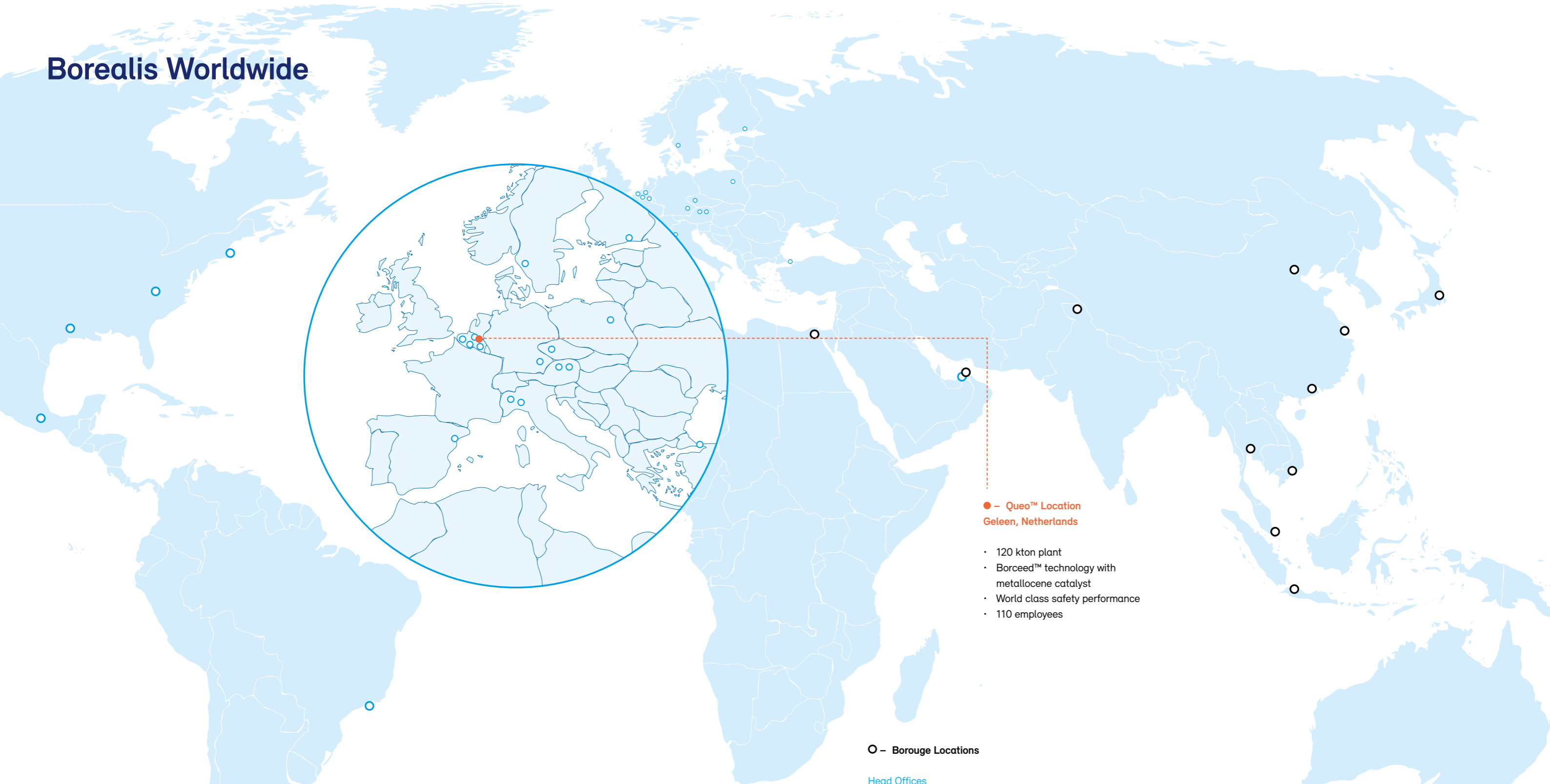




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Borealis Worldwide



○ – Borealis Locations

Head Office
 Borealis AG
 Trabrennstraße 6-8
 A-1020 Vienna, Austria
 Tel.: +43 1 22 400 000
 Fax: +43 1 22 400 333
 www.borealisgroup.com
 info@borealisgroup.com

Customer Service Centres

Austria, Belgium, Brazil, Finland, Türkiye, United States

Production Plants

Austria, Belgium, Brazil, Finland, Germany, Italy, Sweden, The Netherlands, United States

Innovation Centres

Austria, Brazil, Finland, Sweden

Sales Offices/Representative Office

Austria, Belgium, Brazil, Czech Republic, Italy, Mexico, Poland, Spain, Türkiye, United States

○ – Borouge Locations

Head Offices
 Singapore, UAE

Innovation/Application Centres
 China, UAE

Production Plants
 China, UAE

Sales Offices/Representative Offices
 China, Egypt, India, Indonesia, Japan, Singapore, Thailand, UAE, Vietnam

Logistics Hubs
 China, Malaysia, Singapore, UAE

**● – Queo™ Location
 Geleen, Netherlands**

- 120 kton plant
- Borceed™ technology with metallocene catalyst
- World class safety performance
- 110 employees

The purpose of this visualization is of representational nature only. Though it was prepared with the greatest possible attention to detail, simplified illustrations may have been applied.

POP and POE Markets

Around the world, polyolefin plastomers (POP) and polyolefin elastomers (POE) markets are exhibiting robust growth. Demand continues to rise for polymer solutions that fulfil sophisticated sealing, flexibility, toughness, compatibility and processability requirements.

The range of applications continues to expand, particularly in the areas of automotive thermoplastic olefins (TPOs), wire and cable, and consumer packaging. Increasingly, these innovative polymer solutions are replacing conventional polymers such as polyvinyl chloride (PVC),

ethylene propylene diene (EPDM), ethylene vinyl acetate (EVA), linear low density polyethylene (LLDPE) and thermoplastic vulcanizate (TPV).

Our Queo™ products encompass a range of low density ethylene copolymers made possible by combining metallocene catalyst technology with our solution polymerization process. More efficient and consistent comonomer incorporation enables our products to offer the best of both worlds, combining the performance characteristics of elastomers with the processing advantages of a thermoplastic.

A unique Borealis offer – Together we can



Borealis believes in Value Creation through Innovation and providing proven solutions. To this end we are working with our customers and partners to develop attractive polyolefin plastomer and elastomer solutions that fulfil demanding sealing, flexibility, toughness, compatibility and processing requirements.

Leading innovator and reliable partner

Borealis is a leading innovator with a track record of over 50 years in the polyolefins industry. In plastomers, Borealis is a European market leader with more than 20 years of experience in producing high-quality polyolefin plastomers based on proprietary technology. Since 2014 Borealis Plastomers has been developing a portfolio of elastomers to complement the existing offer. These products have become available commercially in 2016.

to serve customers with short response times, excellent service levels, security of supply, flexible planning and rapid delivery of innovative solutions tailored to customers' needs.

Extensive technological knowledge

Borealis is a leading global provider of innovative polyolefin solutions with decades of experience. Building on its proprietary Borstar®, Borlink™ and Borceed™ technologies, Borealis is committed to advancing the properties and applications of polyolefins, with a strong focus on industries such as automotive, wire and cable, and high-end consumer packaging.

A team dedicated to customers

Borealis Plastomers has a dedicated team of around 100 employees based in Geleen, the Netherlands. Our clear customer focus allows us

About Queo™

Embedded in the Borealis Plastomers product family since March of 2013, Queo™ is a key brand in our ongoing drive to be a global provider of innovative solutions in polyolefins.

Queo™ is closing the gap between thermoplastic products and rubbers

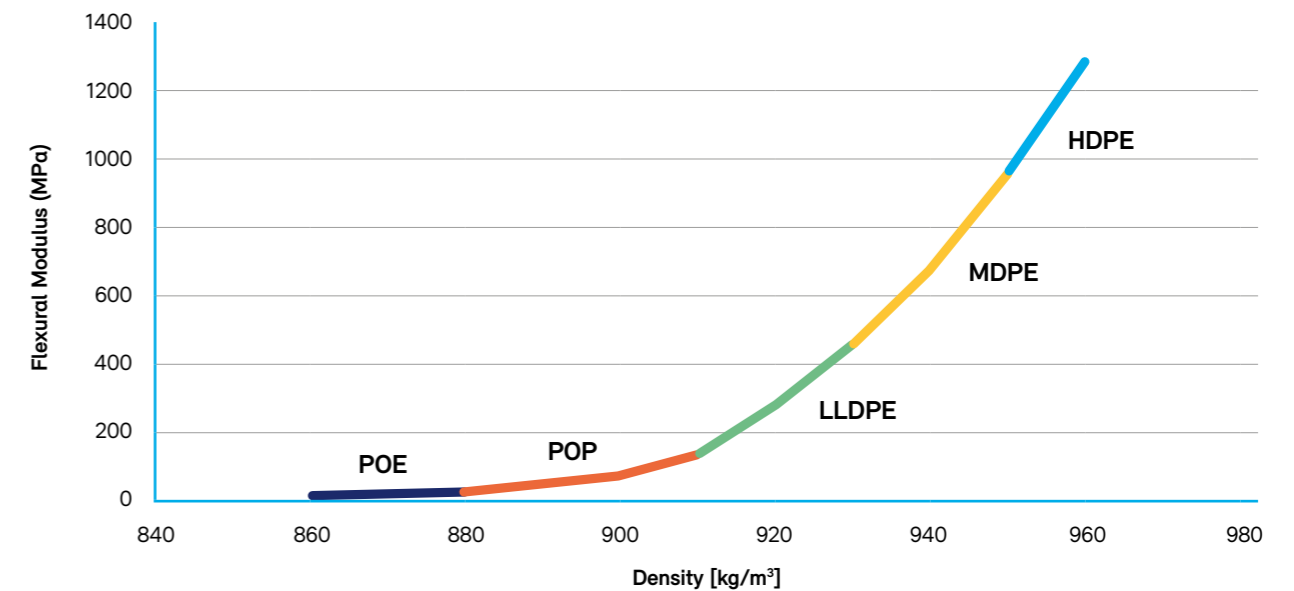
Queo plastomers and elastomers close the gap between classic thermoplastic products and rubbers, exhibiting both plastomeric and elastomeric properties. This is achieved through efficient and uniform incorporation of octene as comonomer and by using a specialised metallocene catalyst.

		Polyolefin Elastomers (POE)		Polyolefin Plastomers (POP)			
Density (kg/cm ³)	ISO1183	860	870	880	890	900	910
DSC Peak melting point (°C)	ISO11357	40	60	75	85	95	105
Flexural modulus (MPa)	ISO178	5	10	20	40	70	130

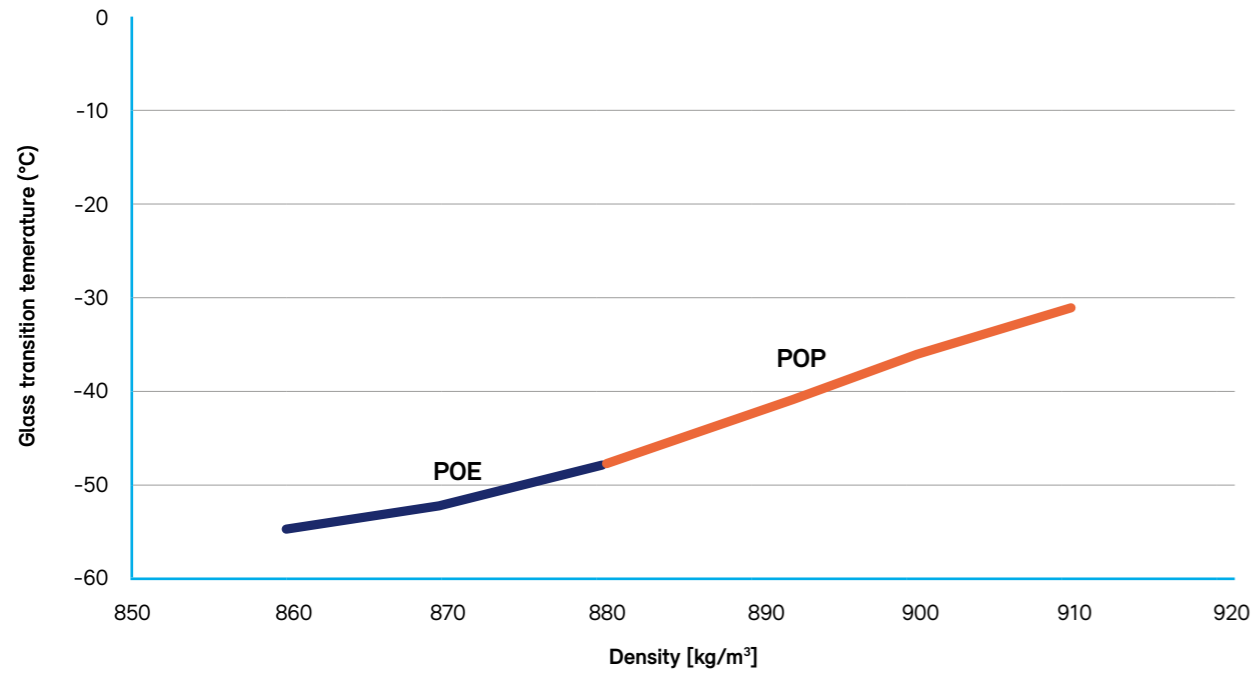
By incorporating increasing amounts of octene comonomers into the ethylene backbone structure, Borealis is able to supply Queo solutions that provide our customers with significant benefits:

- Reduced crystallinity
- Improved flexibility and low-temperature impact
- Decreased density
- Lower Seal Initiation Temperatures

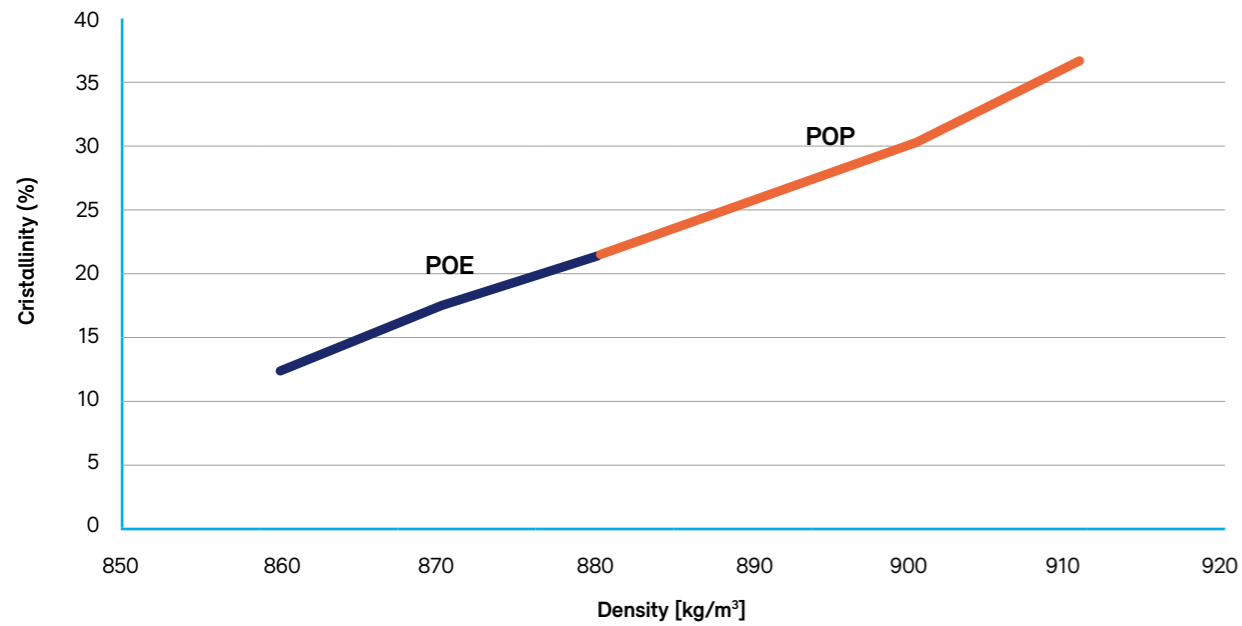
Flexural Modulus vs. Density for the whole PE range from HDPE to POE



Glass transition temperature vs. Density for POP and POE



Crystallinity vs. Density for POP and POE



Queo™ is multitasked

Derived from the Latin "I can", the name Queo™ symbolizes the brand's key strength as an enabler. Designed on the basis of our core competencies, Queo's unique product performance and balanced property profile offer new opportunities when it comes to enhancing an existing product range or expanding into new markets.

Flexible: Queo has a highly amorphous structure, resulting in outstanding flexibility, good optical properties and very low temperature impact resistance.

Tough: A narrow molecular weight distribution and uniform comonomer incorporation make Queo exceptionally tough.

Competent: Queo offers best-in-class sealing performance with lower peak melting points, narrow melting ranges and excellent seal through contamination.

Team player: Queo is highly compatible with other polyolefins, allowing tailor-made blends to meet specific requirements.

Queo™ portfolio – Plastomers

Portfolio

The Borealis Queo™ polyolefin plastomers product family offers a unique combination of flexibility (20–100 MPa), high mechanical strength (tensile strength, tear and puncture resistance), state-of-the-art sealing performances (low seal initiation temperatures and seal through contamination), and high clarity.

Their properties make Queo plastomers suitable for a large variety of applications, including flexible and rigid specialty and high performance packaging, soft flexible mouldings, specialty compounds for a vast number of end uses like wires and cables, and automotive acoustics insulation.

Application Highlights

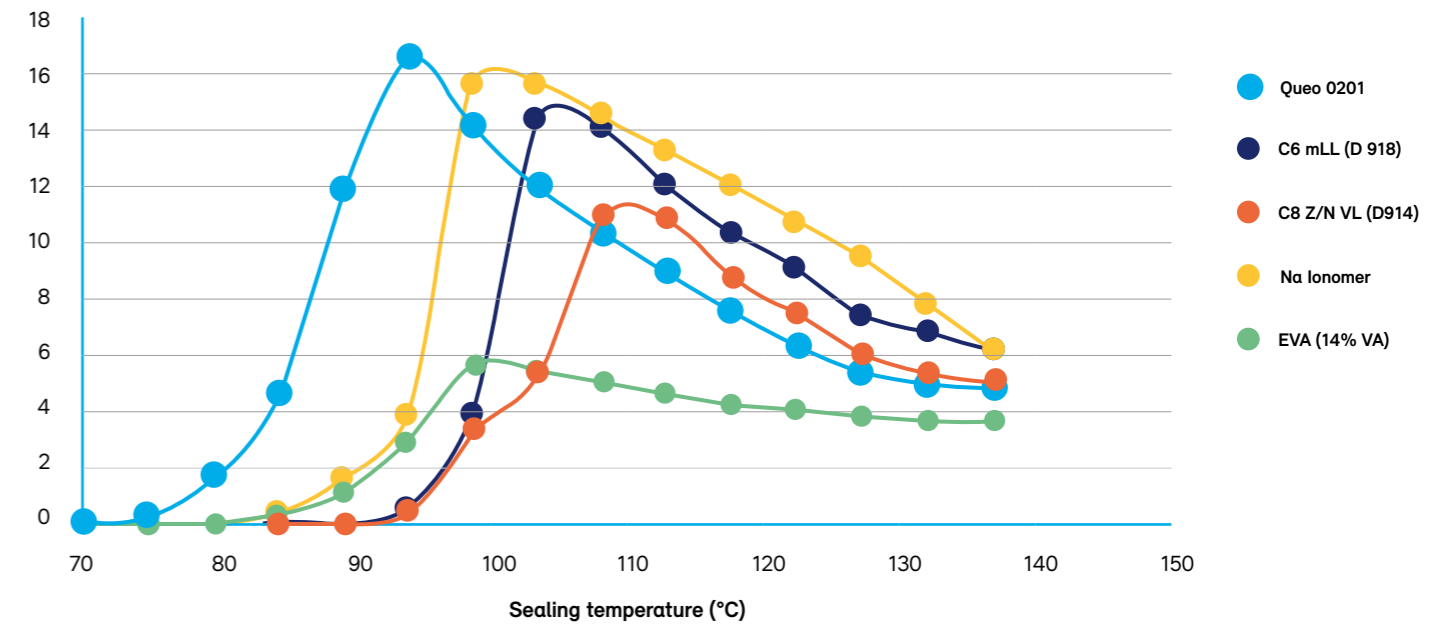
Flexible packaging

Superior seal performance

Queo plastomers provide a combination of low seal initiation temperature with high hot tack and seal strength over a broad temperature window, outperforming conventional sealing polymers such as metallocene linear low density (mLLDPE), very low density polyethylene (VLDPE), EVA and Ionomers. This translates into customer benefits such as increased line speed and reduced wastage.

Hot-tack strength

(Mono-blown film data – N/30 mm)



As Queo™'s superior sealing performance often exceeds actual packaging requirements, blending and downgauging are efficient measures to balance performance against cost. By blending with LDPE, extrudability improves, and downgauging above 20% has been demonstrated in a variety of applications. Equally important to outstanding seal performance is the excellent seal through contamination offered by Queo plastomers for both powder and liquid contaminants. Here, Queo plastomers again outperform all conventional sealing materials and offer the customer reduced downtime on the packaging line as well as minimal wastage.

Outstanding optical properties

Queo plastomers can also contribute to enhanced packaging appearance and esthetics. The low haze value of film produced with Queo can improve product visibility and facilitate outstanding graphics, thus contributing to easier product differentiation among consumers, e.g. in retail environments.

Excellent purity

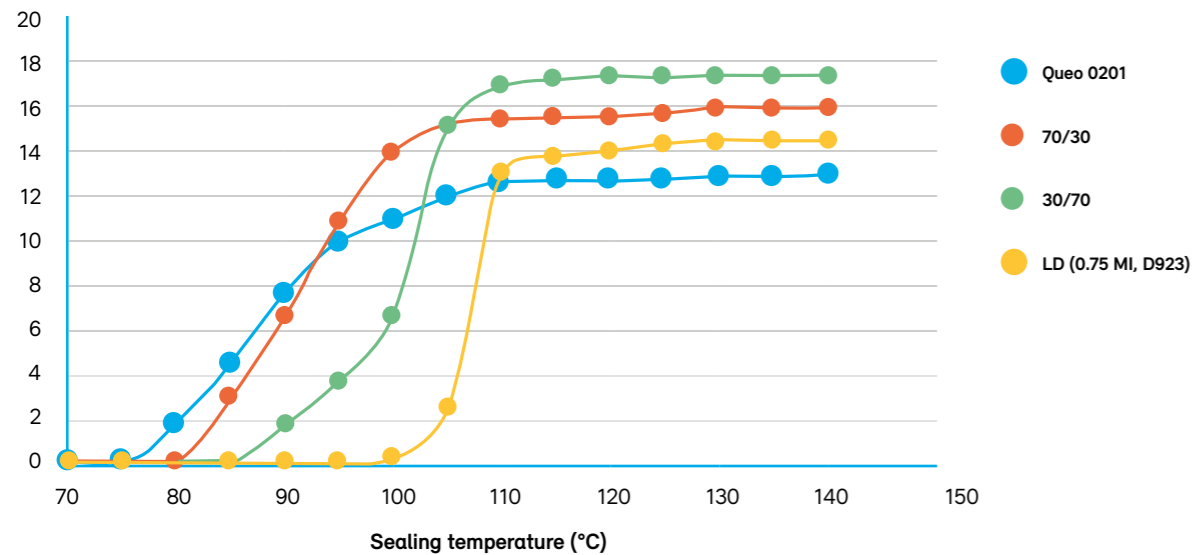
Queo plastomers contain low levels of extractables, contributing to reduced die build-up and smoke generation during processing on the one hand, and excellent organoleptics on the other.

Exceptional toughness

Driven by the improved mechanical properties of metallocene-based products, Queo plastomers exhibit top performance when it comes to overall toughness. For this reason, Queo plastomers are the material of choice for high-strength freezer films, meat packaging and pouches. Even in minority blends, the improvements are of such significance that cost-effective downgauging can still be achieved.

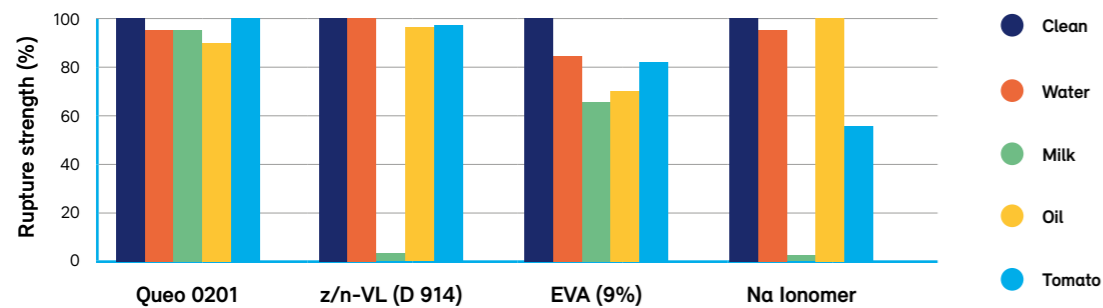
Seal strength of Queo™/LDPE blends

(Mono-blown film data – N/30 mm)



Seal integrity of VFFS bags

(25µ seal/tie/15µ PA blown film) Clean seal rupture strength = 100%



Rigid packaging and housewares

The flexibility and exceptional mechanical properties of Queo plastomers are not only exploited in flexible packaging, but are also used in rigid packaging to improve low temperature impact resistance. When Queo is used as a blend partner with random PP copolymer, clarity and haze level can also be maintained. What is more, low flex fatigue, excellent chemical resistance and organoleptics make Queo the material of choice when the aim is to improve performance of caps, closures and seals. Haptics, soft touch and aesthetics are additional arguments for using Queo in rigid packaging and housewares such as toys and cosmetics packaging.

Halogen Free Flame Retardant compounds

Queo plastomers are an ideal blend partner for thermoplastic HFFR formulations, because they have a high acceptance for flame-retardant fillers like magnesium and aluminium hydroxides. Supplied in free flowing pellets for continuous compounding, Queo plastomers can be processed on conventional plastics equipment at comparable line speeds. HFFR compounds containing Queo plastomers have a low density, resulting in a combination of weight savings and lower costs per

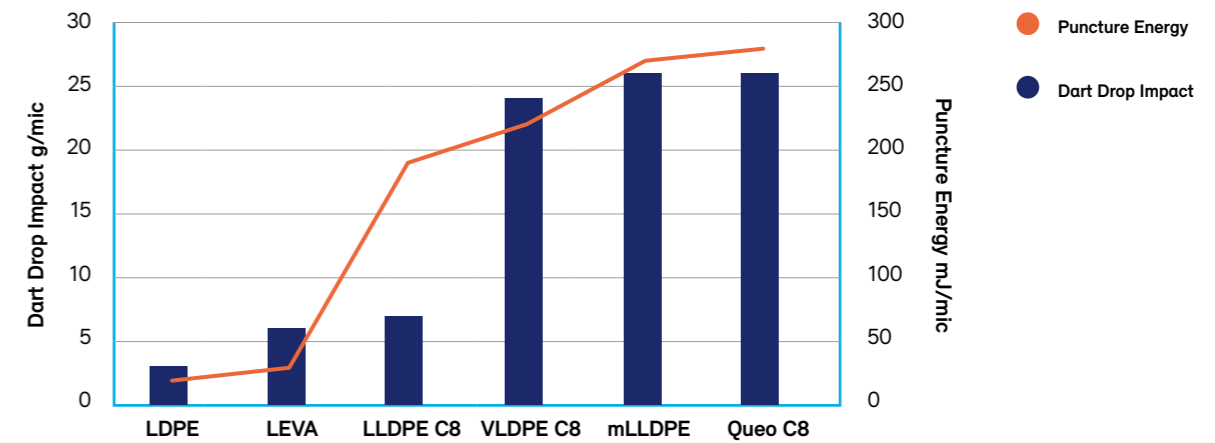
volume. Nevertheless, Queo plastomers ensure thermal and mechanical versatility, and provide a flexibility comparable to that of conventional PVC and EPDM. Queo plastomers are cross-linkable by using Silane or Peroxide technology, and will outperform EVA on key mechanical characteristics in thermoplastic HFFR formulations. The flexibility and thermal performance (Hot Knife Test) of HFFR compounds can be influenced by selecting a specific Queo density and melt index.

Sound deadening sheets

Queo plastomers are very suitable as the base polymer for automotive sound deadening sheets because they provide high flexibility and exceptional mechanical properties including puncture resistance, elongation at break, as well as tear and tensile strength. Since they are easy to process and available in different Melt Flow Rate in the form of non-stick, free flowing pellets, Queo plastomers enable fast and continuous compounding. They can be processed in various ways such as calendar, flat die extrusion, injection moulding and others. Queo plastomers can also be blended with PE for cost efficiency, or with high levels of recycled materials to reduce the carbon footprint of sound deadening sheets.

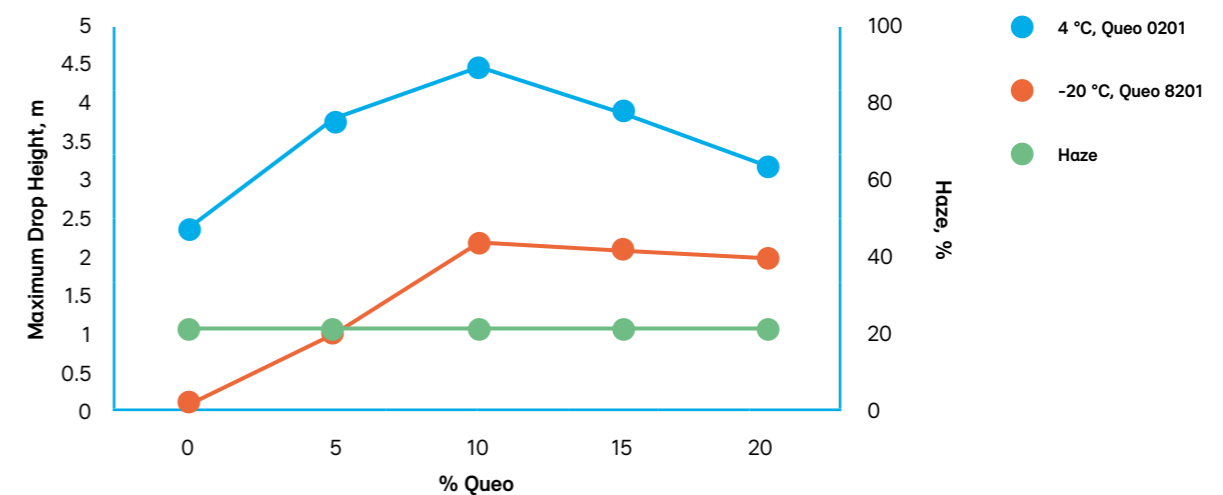
Mechanical Properties

Dart impact strength vs. Puncture energy



Queo/PP Blends

Impact improvement and optics



Queo™ portfolio – Elastomers

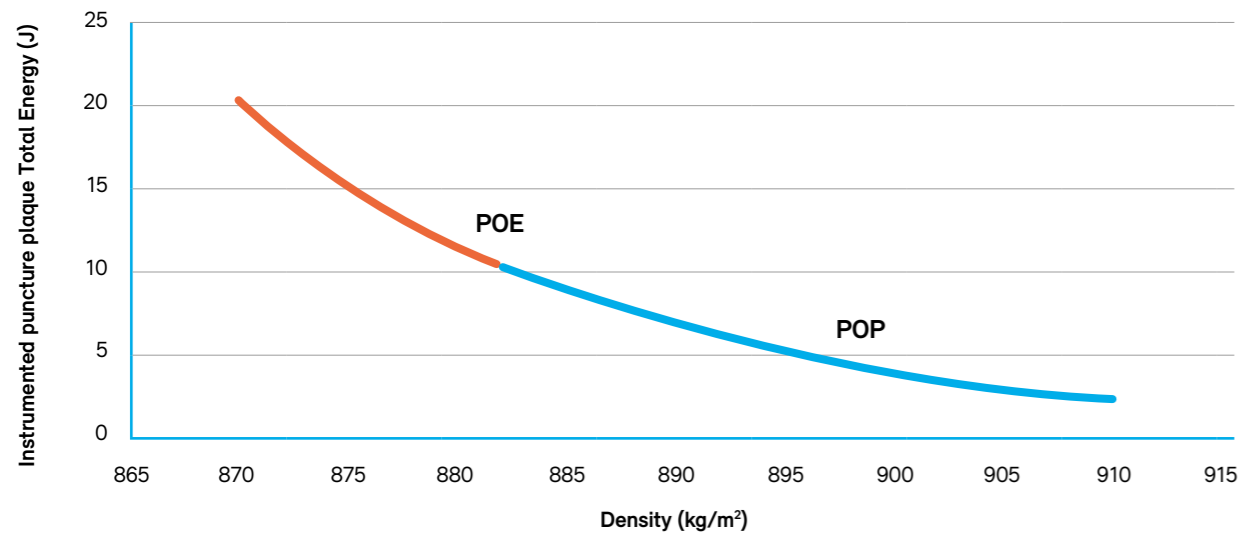
Portfolio

Whereas Queo™ polyolefin plastomers are mainly aimed at applications requiring good to moderate flexibility combined with higher thermal properties and high mechanical strengths, Queo polyolefin elastomers are targeted at applications for which very high flexibility (<20 MPa) and improved low temperature performance (glass transition -55 °C) are key requirements.

The increased product performance of Queo polyolefin elastomers compared to polyolefin plastomers, makes these products the material of choice for application such as interior and exterior car parts, adhesives, cable compounds, grafted polymers and highly resilient surfaces.

Borealis' latest development is Queo 6201LA-P polyolefin elastomer. This product has opened up new markets for very soft applications in Automotive and Construction TPO, EPDM profile and Cable manufacturing, EPDM / TPV replacement and grafting. Advantages of this new product are: outstanding low temperature impact, highly amorphous structure, excellent polymer modifier, processing on plastic and rubber equipment, high filler and oil acceptance, EPDM like flexibility, compatible with PE, PP and EPDM.

Impact Strength with Queo at -40 °C



Application Highlights

Thermoplastic Polyolefins

Queo elastomers are highly flexible and therefore very suitable to improve the impact performance of the semicrystalline polyolefin – often PP – in thermoplastic polyolefins. Queo elastomers can be melt-blended with PP, for instance in a twin screw mixer, to create a TPO with the desired characteristics.

Queo elastomers fulfil the main requirements of lowtemperature impact strength, lightweighting potential, mechanical strength, filler acceptance, good dispersion, low extractables migration and elasticity.

Queo metallocene based ethylene alpha olefin elastomers have some unique characteristics that make them ideal as impact modifiers for PP based TPOs. Their controlled, high comonomer incorporation results in low crystalline, highly amorphous polymers. In addition, the glass transition temperature of Queo elastomers is around -55 °C.

TPO applications

- Interior and exterior car parts
- Appliances and housewares
- Furniture
- Recreational goods
- Crates and containers

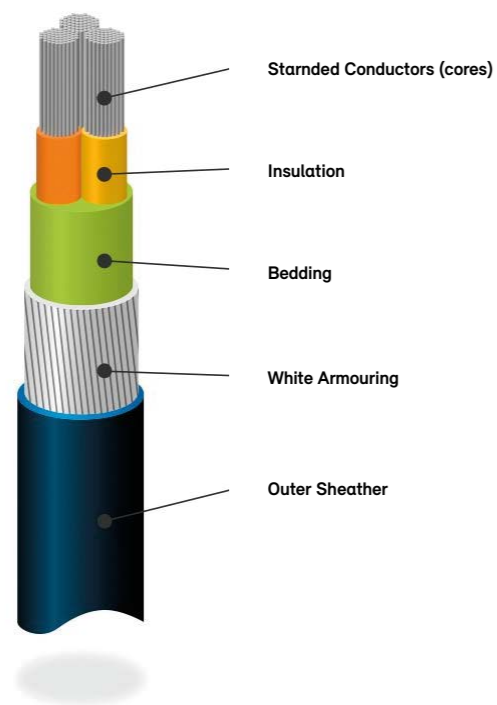
Hot Melt Adhesives

An adhesive typically consists of several different components to create the required combination of mechanical, wetting, viscous and adhesive properties. Queo elastomers can easily be combined with these different components without affecting their performance. Queo elastomers are very flexible with a low crystallinity and have a sharp melting point for fast application. They also have a lower density which allows more adhesive to be made per unit of resin and provide the advantages of lower filter plugging. On top of that, Queo elastomers are resistant to oxidative degeneration, translating into colour retention of the finished product, as well as more consistent sealing characteristics.

Adhesive applications

- Glue
- Sticky tape
- Hygiene products
- Book binding





Cable bedding compounds

A compound of roughly 80% calcium carbonate and 20% Queo™ elastomer is excellent for encasing the conductors in a cable and to make that cable round. At the same time, this compound also provides a protective layer between the cable core and the jacketing. Queo elastomers are robust, have a high filler acceptance and exhibit improved filler dispersion. Furthermore, high flexibility and strong mechanical properties, including tear and tensile strength and elongation at break, make Queo elastomers very suitable for cable bedding compounds. There are Queo elastomers with different Melt Flow Rate to facilitate the extrusion of specific cable types. Fast and continuous compounding is crucial in these processes, so Queo elastomers are ideal as they come in the form of free flowing pellets.

Other examples of elastomers applications

- Grafted polymers
- High resilient flooring
- Industrial film

Borceed™ technology

Queo products are based on Borceed™, a proprietary Borealis technology that enables flexible materials that exhibit both plastic and elastomeric properties. Plastomers and elastomers made possible by Borceed are complementary to other Borealis proprietary technologies that target the similar markets and customers, such as Borstar® and Borlink™.

Queo polyolefin elastomers are made using a combination of Borceed solution polymerization technology and a specialty metallocene catalyst, which allows higher amounts of octene comonomer to be integrated in the ethylene backbone structure. As a result, Queo copolymers have a lower density and are very flexible with outstanding low temperature impact performance.

The Borceed technology is a Borealis proprietary solution originally developed and marketed by DSM under the name Compact. When Borealis acquired the Dutch plastomers production site in Geleen from DSM and ExxonMobil Chemical, ownership of the Compact technology also transferred.

To complete the integration of Compact into the Borealis technology portfolio, it was given the new brand name Borceed. This name was chosen to represent the idea of proceeding towards new heights and exceeding expectations. Moving forward, Borealis is committed to developing and improving Borceed further, paving the way for further Queo plastomer and elastomer developments.



Queo™ grades

Product name	Density [kg/m ³] ISO 1183	MFR (190°C/2.16 kg) [g/10 min] ISO 1133	Melting Temperature [°C] ISO 11357	Flexural Modulus [MPa] ISO 178	Tensile Strength [MPa] ISO 527	Hardness [Shore A] ISO 868	Hardness [Shore D] ISO 868	Additives*	Main applications
Queo 6201LA-P	862	1	40	4	-	61	16	low AO, talcum dusted	TPO
Queo 6800LA	868	0,5	55	8	6	74	22	low AO	TPO
Queo 7001LA	870	1	58	8	7	74	21	low AO	TPO
Queo 7007LA	870	6,6	60	8	6	71	20	low AO	TPO
Queo 8201LA	883	1,1	75	23	23	85	32	low AO	Compounds, Film
Queo 8203	883	3	74	24	22	85	30	AO	Compounds, Film
Queo 8210LA	883	10	73	24	13	84	28	low AO	Compounds, Film, Moulding
Queo 8230	883	30	76	22	7	83	25	low AO	TPO, Compounds, Adhesives
Queo 0201	902	1,1	97	72	36	>90	41	AO	Film, Compounds, Moulding
Queo 0201FX	902	1,1	95	68	33	-	-	AO, slip & AntiBlock	Film
Queo 0203	902	3	96	72	31	>90	43	AO	Film, Compounds
Queo 0210LA	902	10	96	65	16	>90	38	low AO	Film, Compounds, Moulding
Queo 0219	902	19	97	63	13	>90	38	AO	Film, Compounds, Moulding
Queo 0230	902	30	97	65	11	>90	38	low AO	Compounds, Adhesives
Queo 1007	910	6,6	105	118	17	>90	43	AO	Film, Compounds, Moulding

Contact:



www.borealisgroup.com/contact

More info:



www.borealisgroup.com/industries/solutions-for-polymers

Borealis AG

Trabrennstraße 6-8, A-1020 Vienna, Austria

Tel +43 1 22 400 000, Fax +43 1 22 400 333

borealisgroup.com

Borouge Pte Ltd

1 George Street 18-01 · Singapore 049145

Tel +65 6275 4100 · Fax +65 6377 1233

borouge.com

About Borealis Borealis is one of the world's leading providers of advanced and sustainable polyolefin solutions. In Europe, Borealis is also an innovative leader in polyolefins recycling and a major producer of base chemicals. We leverage our polymer expertise and decades of experience to offer value-adding, innovative and circular material solutions for key industries such as consumer products, energy, healthcare, infrastructure and mobility.

With operations in over 120 countries and head offices in Vienna, Austria, Borealis employs around 6,000 people. In 2022, we generated a net profit of EUR 2.1 billion. OMV, the Austria-based international oil and gas company, owns 75% of our shares. The Abu Dhabi National Oil Company (ADNOC), based in the United Arab Emirates (UAE), owns the remaining 25%.

In re-inventing essentials for sustainable living, we build on our commitment to safety, our people, innovation and technology, and performance excellence. We are accelerating the transformation to a circular economy of polyolefins and expanding our geographical footprint to better serve our customers around the globe. Our operations are augmented by two important joint ventures: Borouge (with ADNOC, headquartered in the UAE); and Baystar™ (with TotalEnergies, based in the US).

www.borealisgroup.com | www.borealiseverminds.com

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