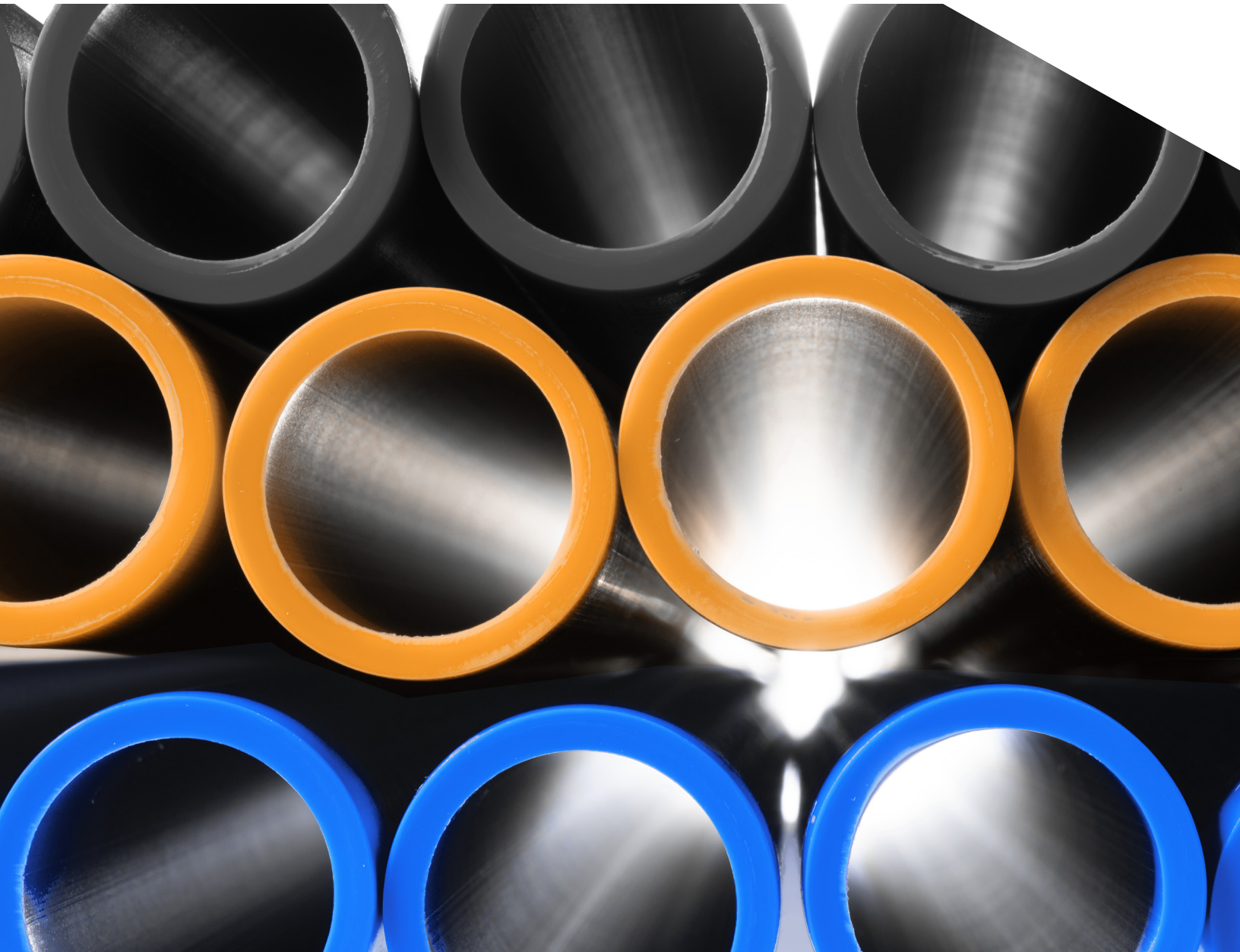
LyondellBasell

Value-based polyolefin solutions used in pipe and industrial applications



About LyondellBasell

LyondellBasell manufactures products and develop technologies that improve the quality of life for people around the world. Our products are the basic building blocks used to manufacture countless everyday goods such as personal care products, fresh food packaging, lightweight plastics, high-strength construction materials, automotive components, biofuels, durable textiles, medical applications and many others. With the help of LyondellBasell materials, thousands of products are made safer, stronger, more affordable and more reliable.

Adding value for customers.

Customers in the pipe industry, including steel pipe coating companies, are served by a dedicated team of LyondellBasell experts which offers benefits that deliver a competitive advantage:

- Strong market reputation
- 50 years of experience
- Quality products, services and people
- Leadership in technology and innovation
- Global infrastructure, building and construction business unit, with sales and technical service teams in Europe, North America and Asia-Pacific

Sustainable water management

Water scarcity concerns are on the rise across the world. With our broad portfolio of polyolefins used in piping systems, LyondellBasell can contribute to making nature's water cycle more efficient. Piping systems made from polyolefins can provide sustainable and reliable water management solutions for generations to come.

Water shortages arise when there is a mismatch between where water is available and where populations dwell. For example, India and China combined comprise 36% of the world's population, but only 9% of the earth's water supply. During the past 50 years to 2020, growing populations, urbanization and changing lifestyles increased domestic water consumption by 600%, according to the World Resources Institute. Whilst 60% of the world's population live in regions that are facing high or extremely high levels of water stress.

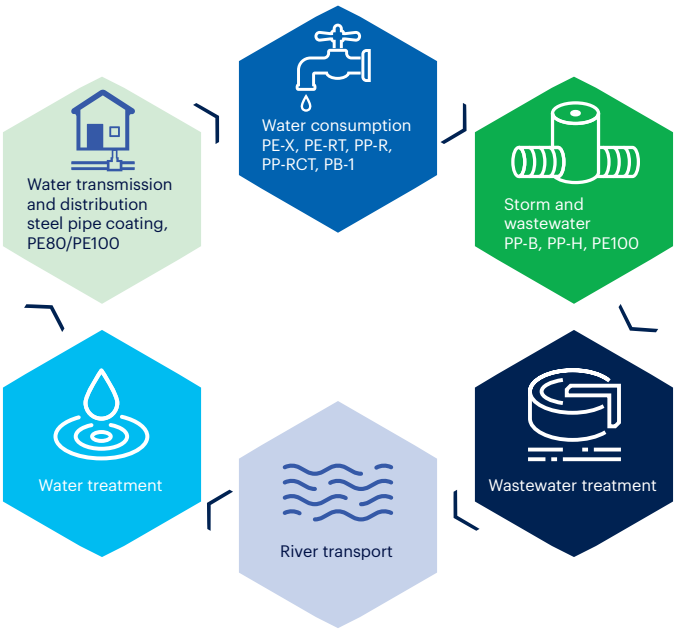
Benefits of LyondellBasell resins

In the water cycle water moves from natural sources to water treatment, distribution, consumption, disposal, wastewater treatment, and then back to nature. Within the water distribution, consumption and disposal sections, piping systems produced using polyolefins contribute to making the water circle more efficient.

Water transmission systems use high-pressure pipes made from steel, which are protected from corrosion with top-coat materials such as LyondellBasell *Lupolen* 4552 D black.

Medium-pressure HDPE pipes produced using the company's *Hostalen CRP* 100 product family can be fully welded, providing water tight systems that are designed to prevent infiltration and exfiltration. Leakage rates are considerably lower than pipes produced with traditional materials such as steel or ductile iron. Pipes made from HDPE can help transport water to households more efficiently than those produced with other materials.

In the disposal of storm and waste water, *Hostalen* PP resins are the materials of choice for today's sanitation systems. Push-fit jointing systems enable fast and economical installation. Chambers and pipes made from PP materials are light,
and can be handled safely and easily during installation. Polypropylene based pipes transport water back to wastewater treatment plants, preventing infiltration and exfiltration. All of the polyolefin solutions described above exhibit extensive durability, reliability and sustainability, with an expected service life of at least 50 years.



HDPE used in pressure pipe applications

The LyondellBasell experience and reputation for technology and innovation in the development and production of grades used in the pipe sector spans more than 60 years. Since the production of the first *Hostalen* HDPE pipe grades in 1955, the range of products has been expanded and upgraded to encompass a complete portfolio of polyolefin grades used by customers in pipe systems.

Hostalen HDPE grades are produced using a low-pressure slurry process plant, based on the latest-generation LyondellBasell *Hostalen* Advanced Cascade Process (ACP) technology.

LyondellBasell HDPE resins used by customers in pipe systems combine high pressure resistance, toughness and a good balance of flexibility and stiffness at a wide range of operating temperatures, enabling their use in both pressure and non-pressure applications.

Our *Hostalen* CRP 100 black, blue and orange grades are PE100 industry benchmarks that have an extensive track record in a wide range of applications across the world.

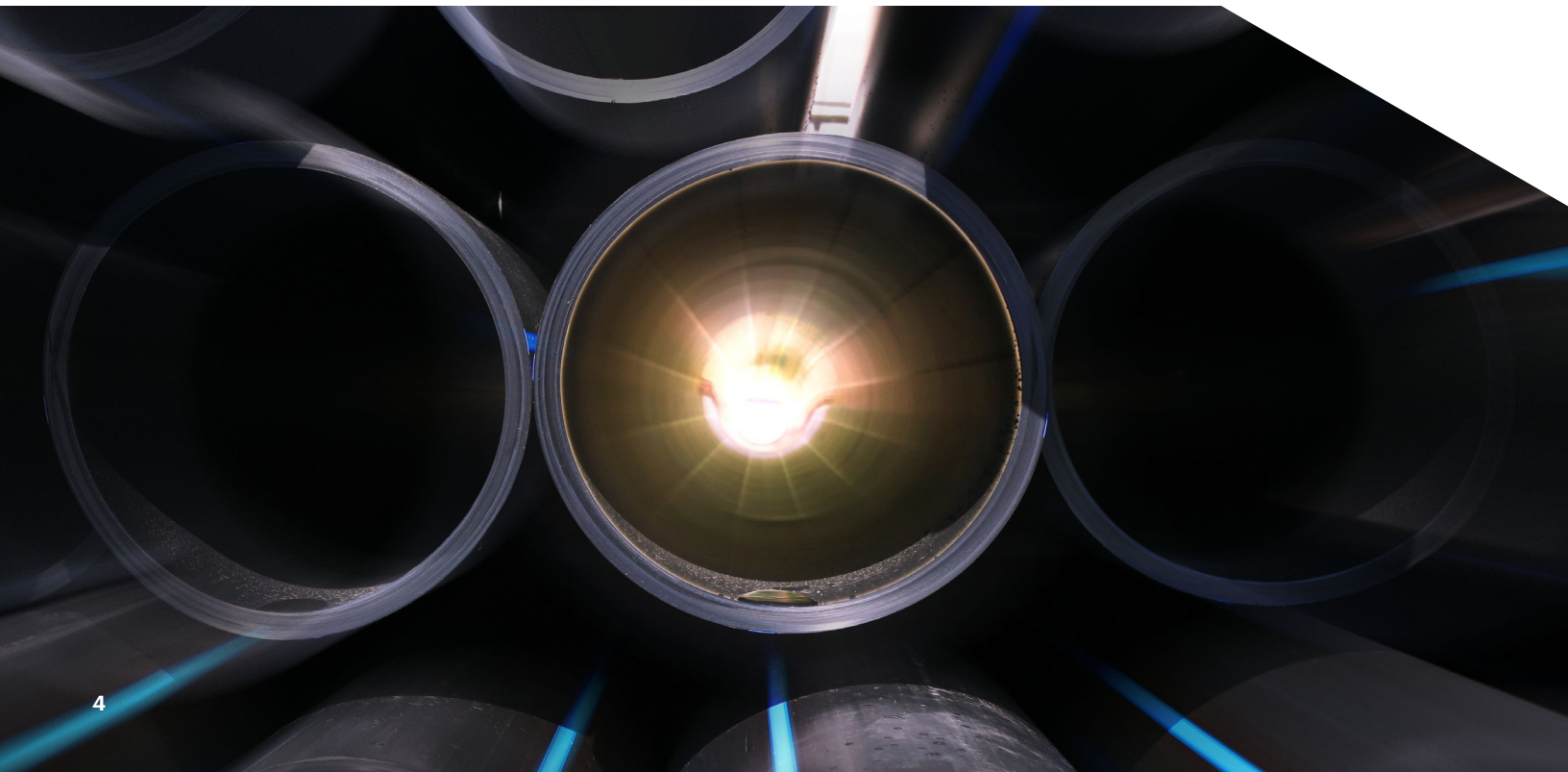
Compared to standard grades, *Hostalen* CRP 100 RESIST CR black, blue and orange demonstrate high resistance to stress cracking (slow crack growth) under demanding installation conditions and are certified as PE100-RC materials.

Hostalen CRP 100 XL black has been developed to allow the extrusion of large diameter pipes with high wall thickness.

Hostalen CRP 100 RT Black is a specialist grade for both pressure and non-pressure applications where pipes and conduits are exposed to higher long term operational temperatures. These include industrial applications and high voltage cable conduits

Hostalen CRP 100 RCD Black has been developed for applications where water networks are exposed to higher than usual levels of chlorine disinfectants, which can attack the inner pipe surface, particularly at higher operational temperatures.

Hostalen GM 5010 T3 black is a PE 80 grade that exhibits a very good balance of properties.



Heating and plumbing applications

Today, LyondellBasell offers a wide range of PE-X, PE-RT, PP-R, PP-RCT and PB-1 products used in heating and plumbing applications.

LyondellBasell offers a range of *Lupolen* grades used in all PE-Xa and PE-Xc cross-linking techniques.

- *Lupolen* 5261 Z Q456 for PE-Xa
- *Lupolen* 5261 Z Q456 B for PE-Xa
- *Lupolen* 5461 B Q471 for PE-Xa
- *Lupolen* 5461 B Q471 B for PE-Xa
- *Lupolen* 4261 A Q416 for PE-Xc

Cross-linking takes place during or after production, leading to extremely high stress crack resistance and extending operational temperatures up to 95°C. The first two grades listed above are for use with the Engel extrusion process, whilst the next two are designed for use on 'Fast PE-X' extrusion lines.

PE-X pipes are used in plumbing applications; industrial and domestic surface heating and cooling; radiator connections; district heating and antifreeze systems. PE-X is also used for the transport of chemicals and industrial slurries at elevated temperatures and where high abrasion resistance is needed.

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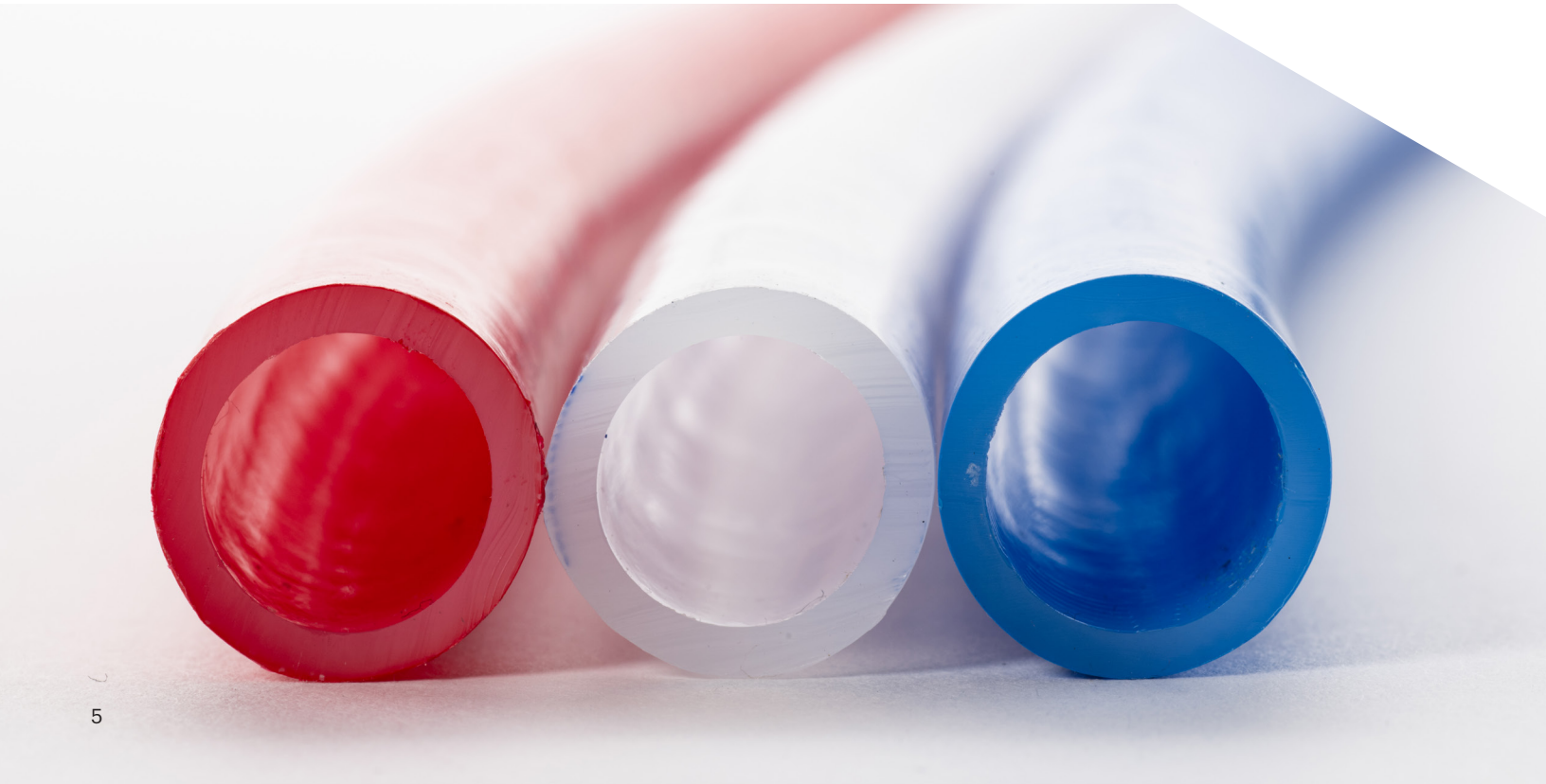
PE-RT Type II material

Hostalen 4731 B is a PE-RT resin that meets the Type II classification given in ISO 24003 and is used as part of aluminum metal composite pipes, underfloor heating and industrial systems. The grade has outstanding resistance to chlorine disinfectants at high temperatures. Pipes produced using the grade and tested in accordance with ASTM 2023 comfortably met the Class 5 requirements of ASTM F2796.

Where a more flexible material with a glossy finish is required, LyondellBasell can offer *Hostalen* 4131 B, which thanks to the latest catalyst technology, is also a PE-RT Type II grade.



Heating and plumbing applications

Plexar tie-layer resins used in multi-layer pipe applications

Multi-layer pipe applications based on PE-X or PE-RT that contain aluminum or ethylene vinyl alcohol copolymer (EVOH) barrier layers also require high performance adhesive layers. Our *Plexar* resins are LLDPE-based, tie-layer adhesives grafted with maleic anhydride.

- *Plexar* PX3216 used in the adhesive layer between the inner layer and the aluminum layer of a metal composite pipe
- *Plexar* PX5335 used in EVOH, multi-layer pipe applications

Polypropylene random copolymers (PP-R and PP-RCT)

Hostalen PP H5416 random copolymer (PP-R) grade is well-established in the field of piping systems for heating and plumbing.

Our advanced PP-R resins, *Hostalen* XN112-I and *Hostalen* XN125-P are classified as PP-RCT, pushing the bar of excellence higher in terms of strength and pressure resistance, through an advanced polymerization process and use of a Hexene comonomer.

Akoalit and *Akoafloor*, polybutene-1 (PB-1) used in heating, cooling and plumbing applications

PB-1 features the excellent properties of polyolefins – light weight, weldability, chemical resistance and low-noise transmission – while PB-1 exhibits an unmatched creep resistance over a wide temperature range translating in a significantly lower material consumption per meter pipe. The highest flexibility unlocks for pipe networks with fewer joints or (costly) fittings, allowing faster installation, which is known to be by far the highest cost component of an installed pipe system.

Akoalit PB-1 resins are used for the production of flexible pressure pipes and fittings for hot and cold drinking water distribution networks.

Akoafloor PB-1 resins are typically used in applications that do not require potable water certifications, such as surface heating and cooling, radiator connections and district heating pipe systems.

Akoaflex polybutene-1 (PB-1) used for flexible hoses in potable water applications

Akoaflex PB-1 is a novel polyolefin portfolio offering outstanding flexibility for potable water applications such as shower hoses and pressurized armoured connections hoses. *Akoaflex* grades do not contain plasticisers and have obtained drinking water certifications, addressing legislative requirements for hot and cold drinking water. *Akoaflex* grades are available in different flexibilities and are excellent substitute grades for less sustainable incumbent materials.

Wastewater management

Rapid urbanization and accelerating industrialization are causing increased water pollution and corresponding environmental threats. Modern wastewater systems made from polyolefins can provide solutions for sewage, stormwater run-off and rainwater infiltration systems.

PP-B materials are used in storm and wastewater pipe networks, including manholes, chambers and storm water boxes., whilst HDPE materials are ideal for small diameter corrugated pipes and conduits.

Customers in this specialist application select LyondellBasell *Hostalen* PP copolymer grades, that demostrate high levels of stiffness and resistance to deformation compared to traditional PP grades.

Other benefits include light weight, which facilitates easy and fast installation on construction sites, a very smooth inner surface which helps prevent build up of deposits and a very high level of resistance to corrosion and chemical attack.

Taken together these properties make *Hostalen* PP copolymer grades the ideal material for durable low maintenance gravity flow networks.

- *Hostalen* PP H2464
- *Hostalen* PP H2483 (PP-HM)
- *Hostalen* PP H2493 (PP-HM)

Hostalen PP H2483 and *Hostalen* PP H2493 are classified as PP-High Modulus (PP-HM) grades according to the European Standards EN 1852 and EN 13476.

Soil sealing, where the ground is covered by impermeable materials, such as concrete and tarmac, increases the storm water shock load on drainage systems. This can be reduced by using rainwater infiltration systems produced using PP-B and HDPE.

HDPE is also used in gravity pipes for sewage and drainage applications. Our *Hostalen* CRP 100 grades are ideal for the manufacture of structured wall large diameter pipes, manholes and chambers that are formed using spiral winding techniques. HS ACP 5831 Agri is a high stiffness natural HDPE material developed for the manufacturer of small diameter corrugated land drains, gravity pipes and cable ducts.

Industrial applications

High molecular weight HDPE and PP are used in construction applications such as storage tanks for chemicals. LyondellBasell materials are used by customers in the extrusion of sheets and rods, and in compression-molded applications. Ultra high molecular weight (UHMW) PE material exhibit excellent abrasion resistance and toughness, which makes it the ideal choice for durable parts.

PP used in industrial applications, heating, cooling systems and plumbing

The *Hostalen* PP range includes a variety of PP families:.

- PP-H (Homopolymer)
- PP-B (Block – Copolymer)
- PP-R (Random – Copolymer)

Hostalen PP H2150 *Hostalen* PP H1022 and *Hostalen* PP H5416 are the preferred resins used by customers for industrial pipes, sheets and fittings. They offer a combination of high stiffness and good impact resistance at sub-zero temperatures and are selected by customers for industrial applications and pipe systems.

UHMW-PE used in industrial applications
Manufacturers predominantly produce semi-finished products in the form of sheets, bars, rods and a variety of ram-extruded profiles which are then machined to produce the final products.

Lupolen UHM 5000 is a UHMW PE1000 material which has outstanding abrasion resistance and is produced using LyondellBasell's latest-generation catalyst.

The polymer is supplied in a coarse particle-size powder form that is ideal for the production of natural compression-molded sheets. During the filling and closing of the press molds, the dust formation is considerably lower than the more common, fine UHMW-PE granules.

For applications where high abrasion resistance is sufficient, *Lupolen* 5261Z Q 456, which is classified as a high molecular weight PE500 material, can be used.

Where gravity pipes, ducts and conduits face high operating temperatures and require excellent heat aging resistance, consider CRP 100 RC-HT, a natural HDPE grade that also has outstanding environmental stress crack resistance.

Polyolefin systems used in steel pipe coating

LyondellBasell offers a wide range of PE and PP products used in anti-corrosion coating, mechanical protection and thermal insulation coating applications for oil, gas and water transportation pipelines.

In three-layer steel pipe coating, customers apply apply our *Lupolen* 4552 D Black PE top-coat using our *Lucalen* G3710E PE adhesive to achieve outstanding protection from impact, ageing and corrosion, even at high operating temperatures of up to 85°C.

Lupolen 4552D Black is a multimodal PE product used by customers due to its outstanding environmental stress crack resistance (ESCR), superior impact resistance and excellent processability, even at high coating speeds.

Lucalen G3710E is a grafted PE adhesive resin, available in pellet form, that customers use due to its superior adhesion, processability and wide application window.

Lucalen A2910M is a low density PE adhesive with high thermal stability. Due to its acrylic acid/acrylate copolymer content this grade offers excellent adhesion to polar materials (e.g. epoxy resin, steel and aluminium). It is designed to be used in 2-layer anticorrosion coatings together with wire and cable applications. It is available in pellet form.

Our PP-based coating products are widely used in pipelines that transport hot liquids, with elevated operating temperatures from 85°C up to 140°C. *Moplen* Coat EP/60 BIANCO is a well-established white top-coat resin with excellent thermal ageing resistance and UV-protection. It is applied by customers with the grafted adhesive resins *Hifax* EPR/60 BIANCO or *Hifax* EP2 015/60 on pipelines with very high service temperatures.

LyondellBasell also offers *Hifax* products for use in the coating of field joints, using flame spray and injection moulding techniques, together with thermal insulation coatings for offshore, deepwater pipeline projects.

Main product portfolio

Typical customer applications

Typical application	Material	Grade
Drinking water distribution Gas distribution Other pressurized media (sewage, chemicals)	HDPE (PE100)	*Hostalen* CRP 100 black *Hostalen* CRP 100 blue *Hostalen* CRP 100 orange *Hostalen* CRP 100 RT black (elevated temperatures) *Hostalen* CRP 100 XL black (high wall thickness)
	HDPE (PE100-RC)	*Hostalen* CRP 100 RESIST CR black *Hostalen* CRP 100 RESIST CR W blue *Hostalen* CRP 100 RESIST CR orange *Hostalen* CRP 100 RCD black (disinfectant resistant and elevated temperatures)
	HDPE (PE80)	*Hostalen* GM 5010 T3 black
Transport of media in explosion-proof areas	HDPE	*Hostalen* GM 9310 C black
Gravity sewage	PP-B	*Hostalen* PP H2464
	PP-B, PP-HM	*Hostalen* PP H2483
	PP-B, PP-HM	*Hostalen* PP H2493
	HDPE (PE100)	*Hostalen* CRP 100 black
	HDPE	*Hostalen* ACP 5831 Agri
Heating and plumbing District heating Surface heating and cooling Radiator connection	HDPE (used in PE-Xa)	*Lupolen* 5261Z Q456 *Lupolen* 5261Z Q456 B (lower viscosity) *Lupolen* 5461B Q471 *Lupolen* 5461B Q471 B (lower viscosity)

Main product portfolio

Typical customer applications

Typical application	Material	Grade
Heating and plumbing District heating Surface heating and cooling Radiator connection (continued)	HDPE (used in PE-Xc)	*Lupolen* 4261A Q416
	PE-RT Type I	*Hostalen* 3531 B
	PE-RT Type II	*Hostalen* 4731 B *Hostalen* 4131 B (higher flexibility)
	PP-R	*Hostalen* PP H5416
	PP-RCT	*Hostalen* XN112-I *Hostalen* XN125-P
	PB-1, copolymer*	*Akoafloor* PB R 509
	PB-1, homopolymer*	*Akoalit* PB 4267 grey *Akoalit* PB 4268 white *Akoafloor* PB 4235-1 ivory *Akoalit* DKG 300
Tie-layer resins used in multilayer pipes in heating and plumbing.	PE	*Plexar* PX3216 *Plexar* PX5335
Industrial pipes, sheets, rods, profiles, in-house soil and waste pipes	UHMW-PE	*Lupolen* UHM 5000
	HMW-PE	*Lupolen* 5261Z Q456
	HDPE	*Hostalen* CRP 100 RC-HT
	PP-H	*Hostalen* PP H2150
	PP-B	*Hostalen* PP H1022
	PP-R	*Hostalen* PP H5416
Steel pipe coating, top-coat	HDPE	*Lupolen* 4552D Black
	PP	*Moplen* Coat EP/60 BIANCO *Moplen* Coat EPR/60 BIANCO

* PB-1 is not sold for pipe applications in North America.

Main product portfolio

Typical customer applications

Typical application	Material	Grade
Steel pipe coating, top-coat	HDPE	*Lupolen* 4552D Black
	PE	*Moplen* Coat EP/60 BIANCO
		Moplen Coat EPR/60 BIANCO
Steel pipe multilayer thermal insulation coating for deep water applications	PP	*Moplen* EP340K
		Moplen EP240H
		Moplen EP310D HP
Adhesives used in steel pipe coating	PE	*Lucalen* G3710E (pellets)
		Lucalen A2910M (pellets)
	PP	*Hifax* EPR 60/BIANCO (pellets and powder)
		Hifax EP2 015/60 (pellets and powder)
		Hifax EP2A53 (pellets)
		Hifax EP5 10/60 BIANCO (powder)
Steel pipe field joint coating	PP	*Hifax* EPR 60/M BIANCO (powder
		Hifax EP5 10/60M BIANCO (powder)
		Hifax CA197J WHITE (pellets)
Flexible tubing	PB-1	*Akoaflex* MR05 P40
		Akoaflex MR05 B40

About us

We are LyondellBasell (LYB) – a leader in the global chemical industry creating solutions for everyday sustainable living. Through advanced technology and focused investments, we are enabling a circular and low carbon economy. Across all we do, we aim to unlock value for our customers, investors and society. As one of the world's largest producers of polymers and a leader in polyolefin technologies, we develop, manufacture and market high-quality and innovative products for applications ranging from sustainable transportation and food safety to clean water and quality healthcare. For more information, please visit www.lyb.com or follow @LyondellBasell on LinkedIn.

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