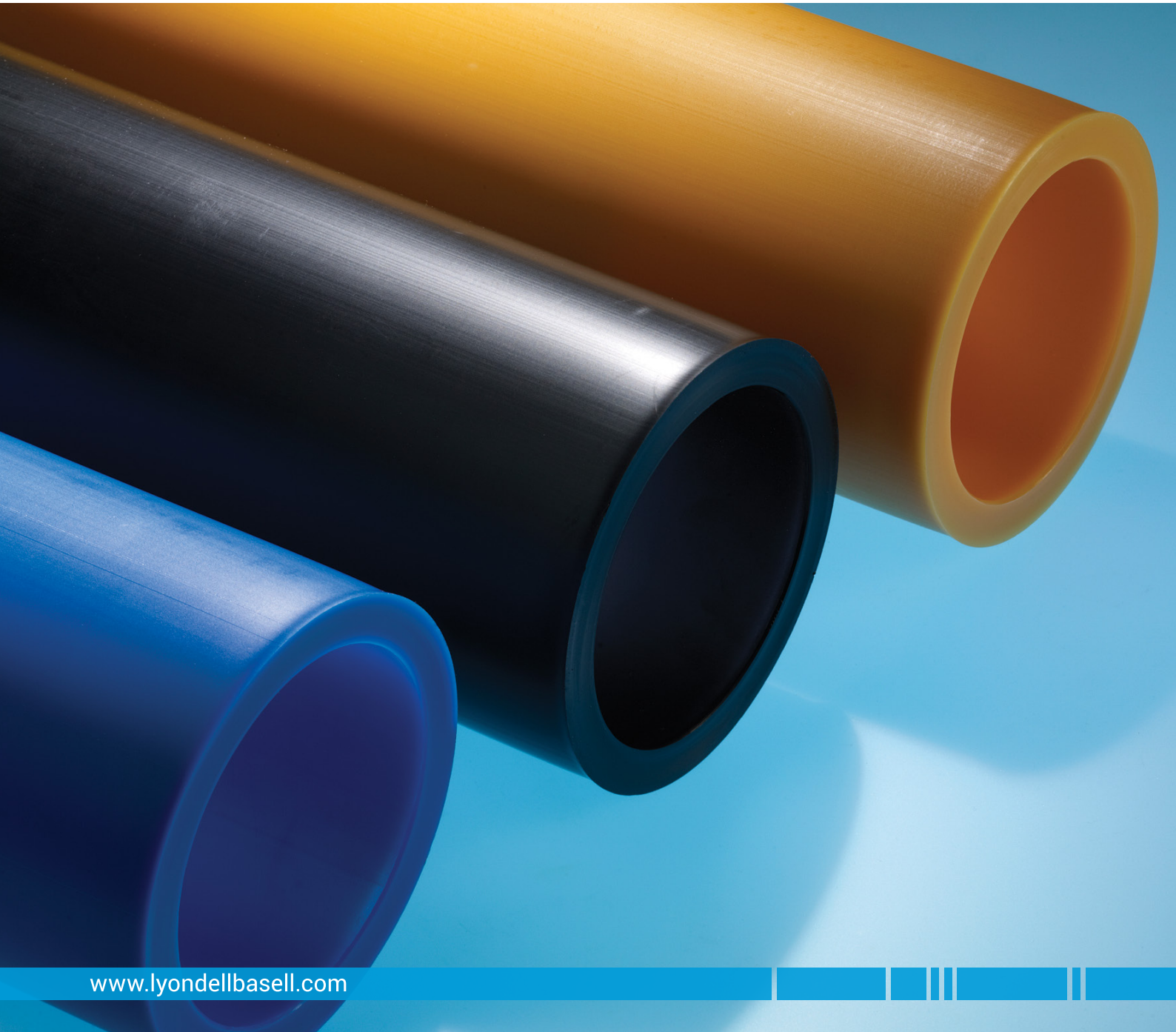
lyondellbasell
Advancing Possible

Value-based polyolefin solutions used in pipe 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 Pipe & Infrastructure 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

The water circle in Fig. 1 illustrates how 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's *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.

Sanitary piping systems made from PE-X, PE-RT, PP-R, PP-RCT and PB-1 ensure safe hot and cold water distribution inside homes and commercial buildings. Plastic pipes also provide better sound dampening performance than those produced using copper and steel, offering improved comfort.

In the disposal of waste water, *Hostalen* PP resins are the materials of choice for today's sanitation systems. Push-fit jointing systems enable fast and economical installation. 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.

Fig. 1 – Water circle – courtesy of Hewing (PE-X), REHAU (PP-B)

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 coating and wire and cable applications. 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 off-shore, deepwater pipeline projects.

Fig. 2 – Steel pipes with HDPE top-coat – courtesy of Socotherm España

Fig. 3 – Steel pipe with PP top-coat

HDPE used in pressure pipe applications

LyondellBasell's 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 used in pressure pipes for drinking water, gas, stormwater wastewater and industrial applications.

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

LyondellBasell's 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.

Fig. 4 – Pipe transport by helicopter

Fig. 5 – Seaoutfall line – courtesy of PLOMYPLAS

Fig. 6 – Extrusion of an 800 mm pipe

Heating and plumbing applications

Over the past four decades, polyolefin products have been steadily replacing traditional materials such as copper in hot water pipe applications. This change began more than 35 years ago, with the development of high molecular weight HDPE for cross-linked pipes. 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 Q 456 for PE-Xa
- *Lupolen* 5261 Z Q 456 B for PE-Xa
- *Lupolen* 5461 B Q 471 for PE-Xa
- *Lupolen* 5461 B Q 471 B for PE-Xa
- *Lupolen* 4261 A Q 416 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.

PE-X pipes are used in plumbing applications; industrial and domestic surface heating and cooling; radiator connections; district heating and anti-freeze systems.

PE-X is also used for the transport of chemicals and industrial slurries at elevated temperatures and where high abrasion resistance is needed. Pipes of up to 630 mm can be extruded.

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 and for underfloor heating 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.

Fig. 7 – Underfloor heating, PE-Xa – courtesy of Schütz

Fig. 8 – Underfloor heating made from *Hostalen* 4731 B – courtesy of Kingbull

Fig. 9 – District heating pipe, PE-Xa – courtesy of Uponor

Heating and plumbing applications

Fig. 10 – Heating distribution system made from PP-R – courtesy of Aquatherm

Fig. 11 – Socket welded PP-R piping system – courtesy of Aquatherm

Fig. 12 – Fittings made from PB-1

Fig. 13 – Underfloor heating made from PB-1 – courtesy of Viega/ Gabo

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 – with a unique combination of outstanding creep resistance and flexibility over a wide temperature range.

Akoalit PB-1 resins are used by LyondellBasell's customers for the production of flexible pressure piping systems for domestic hot and cold drinking water supply, surface heating and cooling, district heating, radiator connections and fittings.

Akoafloor is a PB-1 based copolymer featuring improved flexibility, which makes it the ideal choice for fast installation in surface heating and cooling applications.

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 used in storm water and sewage pipe networks, including manholes and chambers, together with infiltration systems.

Customers in this specialist application select LyondellBasell's *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 causes a loss of soil resources due to the covering of land for housing, roads or other construction work.

HDPE 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.

Fig. 14 – Corrugated pipes made from *Hostalen* PP H2464 – courtesy of PLOMYPLAS

Fig. 15 – 375mm and 400mm orange sewage pipes waiting to be installed

Fig. 16 – Push connection, inline socketing courtesy of PLOMYPLAS

Fig. 17 – Smooth sewage pipe with push fitting courtesy of REHAU

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

Lupolen UHM 5000 is a UHMW PE1000 material 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.

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.

For applications where outstanding abrasion resistance is not required, *Lupolen* 5261Z Q 456, which is classified as a high molecular weight PE500 material can be used.

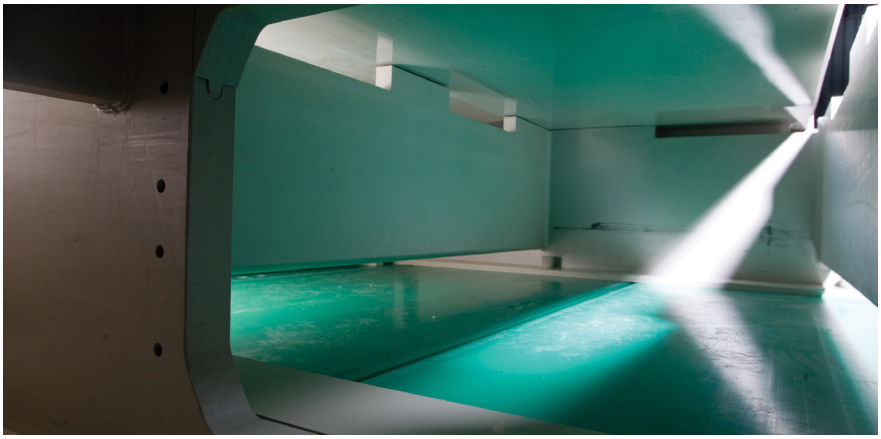


Fig. 18 – Storage tank for pickling of aluminum sheets (UHMW-PE and PP-H 100) courtesy of Steuler

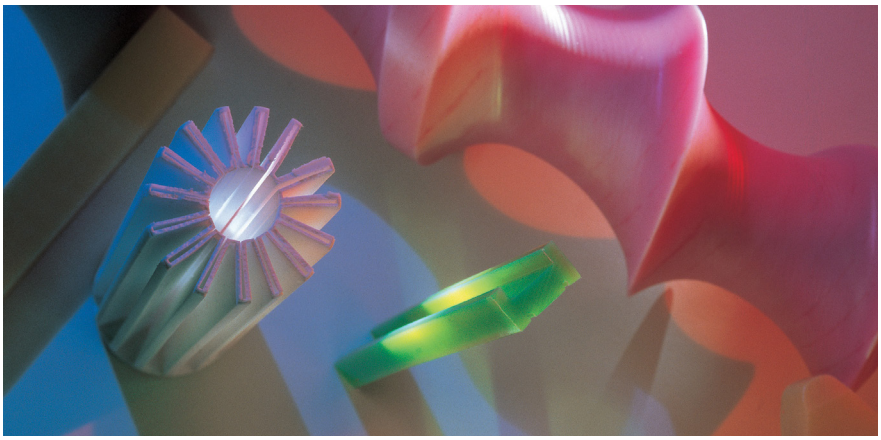


Fig. 19 – Parts made from UHMW-PE

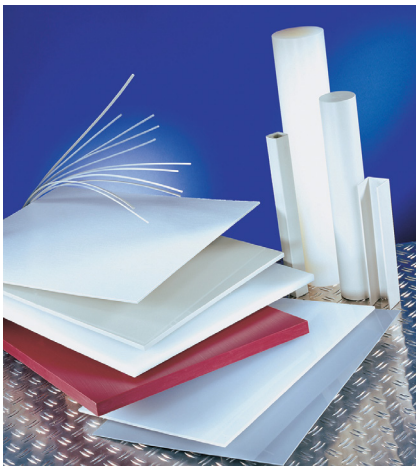


Fig. 20 – Semi-finished products made from PP courtesy of SIMONA

Fig. 21 – Semi-finished products made from HDPE courtesy of SIMONA

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)
	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
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)
	HDPE (used in PE-Xc)	*Lupolen* 4261A Q416
	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 brown
	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

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

Main product portfolio

Typical application	Material	Grade
Industrial pipes, sheets, rods, profiles, in-house soil and waste pipes	UHMW-PE	*Lupolen* UHM 5000
	HMW-PE	*Lupolen* 5261Z Q456
	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
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)

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ABOUT US

LyondellBasell (NYSE: LYB)) is one of the largest plastics, chemicals and refining companies in the world. Driven by its employees around the globe, LyondellBasell produces materials and products that are key to advancing solutions to modern challenges like enhancing food safety through lightweight and flexible packaging, protecting the purity of water supplies through stronger and more versatile pipes, improving the safety, comfort and fuel efficiency of many of the cars and trucks on the road, and ensuring the safe and effective functionality in electronics and appliances. LyondellBasell sells products into more than 100 countries and is the world's largest producer of polypropylene compounds and the largest licensor of polyolefin technologies.

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