

Hostalen 4731 B

Introducing a new PE-RT Type II material



About LyondellBasell

LyondellBasell Industries is one of the world's largest polymers, petrochemicals and fuels companies. We are the global leader in polyolefins technology, production and marketing; a pioneer in propylene oxide and derivatives; and a significant producer of fuels and refined products, including bio-fuels.

Headquartered in The Netherlands, LyondellBasell in 2007 had combined annual revenues of more than \$40 billion and has approximately 17,000 employees worldwide. Our vertically integrated facilities, broad product portfolio, manufacturing flexibility, superior technology base and reputation for operational excellence allow us to deliver exceptional value to our customers across the petrochemical chain – from refining through to advanced product applications.

LyondellBasell is dedicated to ongoing research and development programs that meet the ever-changing requirements of our diverse customers, including the creation of new catalysts, processes and products. Our materials are used in virtually every market to manufacture countless goods and products that enhance quality of life for people around the world. From fresh food packaging, clean fuels and durable textiles to medical applications, construction materials and automotive parts, the uses for LyondellBasell materials are almost unlimited.

At LyondellBasell, we clearly recognize the importance of being a responsible corporate citizen in our communities. We are committed to operating our businesses with the highest principles of integrity, ethics and corporate responsibility, as well as the highest standards of health, safety and environmental performance.



Adding value for customers

Customers in the pipe markets, including pipe coating of steel pipes, are served by a dedicated team and by focused products benefiting from

- High market reputation
- Experience
- Quality of products, services and people
- Leadership in technology and innovation
- Global presence of the Business Unit Pipe, Industrial Sheet and Pipe Coating with sales and technical service teams in Europe, North America and Asia/Pacific



Experience and long term commitment

Over the past four decades, HDPE products for hot water pipe applications have been steadily replacing traditional materials such as copper. It all began more than 35 years ago with high molecular weight HDPE for cross-linked pipes.

Since that time, the LyondellBasell Industries Group and its predecessor companies have been the leading suppliers of materials used in the manufacture of hot water pipes. Well-known materials include PE-X, PP-R and PB-1. With *Hostalen 4731 B*, LyondellBasell has closed the gap for PE-RT Type II materials, and now offers the full range of materials.

Since they were first introduced around twenty-five years ago, Raised-Temperature Polyethylene Resins (PE-RT) have been selected by customers for use in multi-layer heating and plumbing pipes and underfloor heating systems. The ability to withstand a designed stress level over several decades at elevated temperatures is critical to their performance.

Hostalen 4731 B resin is a new-generation PE-RT resin, produced using LyondellBasell's Advanced Cascade Process. Using three reactors in cascade, the process enables fine-tuning of the properties balance that is required for grades used in demanding applications such as pressure pipes for hot water. Catalysts and compounding technologies used in the *Hostalen* process enable us to provide customers with the high-performance materials they depend upon to meet challenging application needs.

During the development of *Hostalen 4731 B* resin, LyondellBasell combined its 50 years experience as a supplier to the HDPE pressure pipe market and the more than 35 year track record of serving customers with materials used in hot water pipe applications. The outcome is a material with excellent behavior in terms of long-term creep performance and thermal stability.

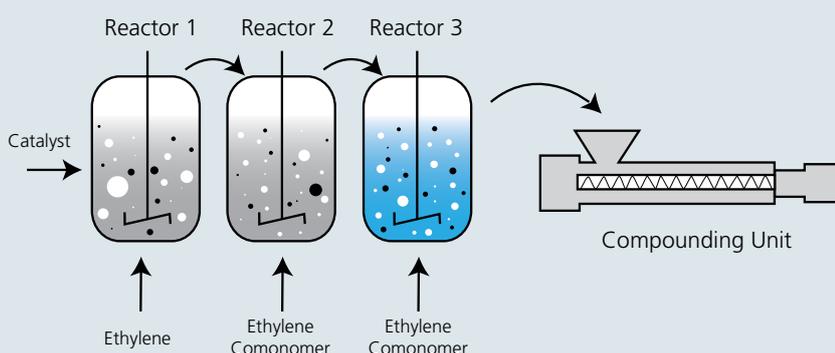
Potential Customer Applications

A possible application area for *Hostalen 4731 B* resin is underfloor heating pipes, either as solid-wall pipe or as the PE component of aluminium-composite pipes. *Hostalen 4731 B* resin can be considered for use in aluminium metal composite pipes with a typical operating temperature of up to 70°C. The material has the potential to be used for the inliner as well as for the outer layer.

In comparison to medium density PE-RT Type I grades, the resins' high density creates improved extraction behavior in circulating sanitary pipe systems. This can provide an additional safety factor and can improve the performance of modern plastic pipe systems.

Our customers reported that the flexibility of the aluminium-composite pipes is not negatively impacted by the higher stiffness of *Hostalen 4731B* resin. In addition, customers have reported that pipes made from *Hostalen 4731 B* resin have facilitated installation on construction sites.

Advanced Cascade Process (ACP) for the production of HDPE for heavy-duty pipes Schematic diagram



Courtesy of Maillefer SA/Dreistern

High performance material

Tests carried out at the Bodycote materials testing institute in Sweden confirmed that the new grades can provide high levels of performance for use in hot water applications.

Conducted according to ISO 9080 standards, the tests simulated a 50-year service life at temperatures of 70°C. The results showed the material's excellent hydrostatic strength under such conditions (Fig.1).

The *Hostalen 4731 B* resin fulfils ISO 24033 Type II requirements. This includes the requirements for the application classes 1, 2, 4 and 5 according to ISO 10508 (for details see table 1 and 2).

Fig.2 illustrates that *Hostalen 4731 B* resin exceeds the minimum requirements of PE-RT Type II in the most important application classes by more than 10 percent. On the basis of this excellent performance, it is easy for pipe manufacturers to pass the minimum pressure checkpoint according to pipe standards.

In addition to the minimum requirements of ISO 24033, hoop stress tests on pipes made from *Hostalen 4731 B* resins were conducted for more than 20.000 h at 110°C in order to prove the suitability of the stabilisation package for hot water applications. Here *Hostalen 4731 B* resins outperformed by more than 100 percent in comparison to the minimum requirement, demonstrating the high extraction stability.

The stabilisation package is compliant with most drinking water regulations worldwide and *Hostalen 4731 B* resins meet the food approval regulations of the EU. Detailed information can be found in LyondellBasell's RAPIDS for *Hostalen 4731 B* resins.

Fig.1 – ISO 9080 evaluation

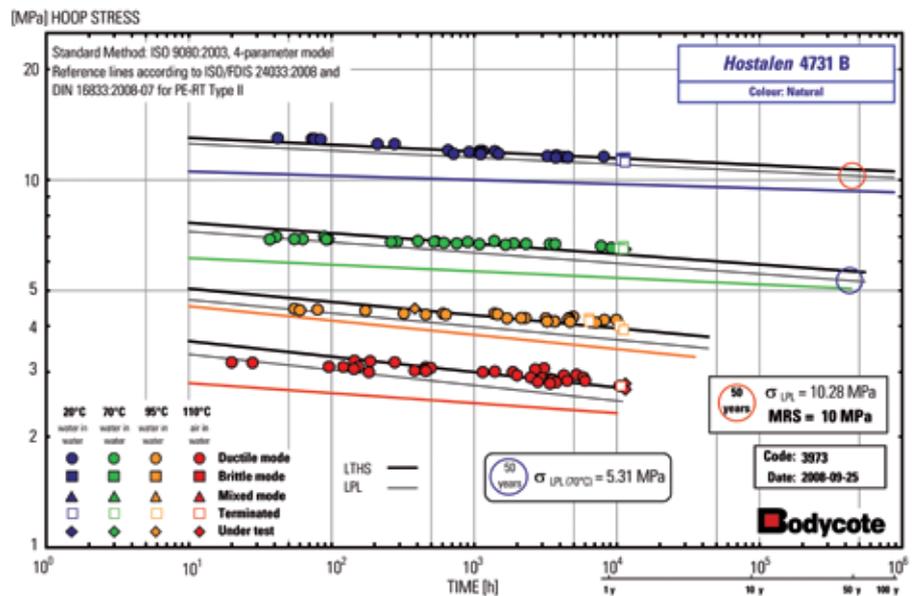
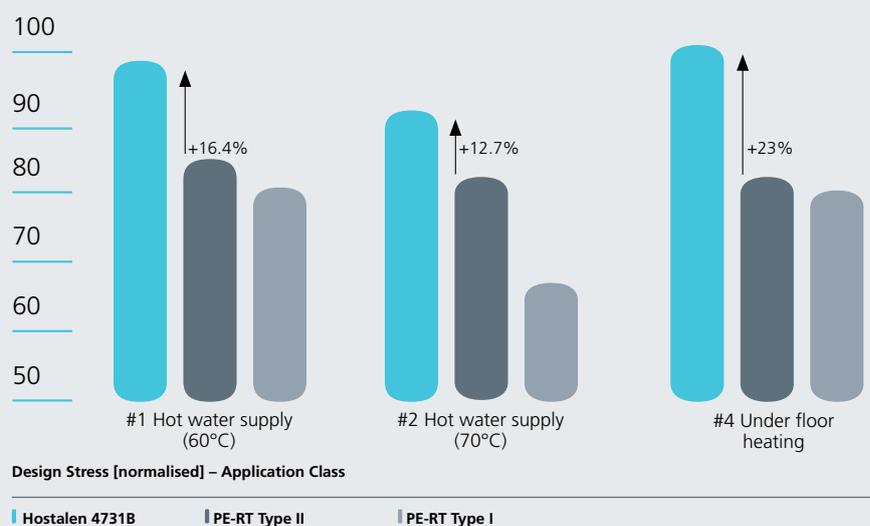


Fig.2 – Design stress comparison



Technical benefits

LyondellBasell's PE-RT resin provides superior organoleptics, which makes it for our customers the resin of choice for drinking water applications.

Very good stress-cracking behavior of more than 500 h at standard conditions (80°C, 4 MPa, 2% Arkopal, ISO 16770) rounds up the overall superior product properties.

Processability

By using *Hostalen 4731 B* resins, high line speeds with smooth pipe surfaces can be achieved. The high melt strength results in a very good dimension stability of the extruded pipe, which allows our customers to produce thin walled pipes within small tolerances. It can be processed like normal PE80 or PE100 materials. It can open an easy start-up for the production of hot water pipes, because existing machine equipment for HDPE or PP-R can be used. For PE-RT, a crosslinking of the material is not necessary.

Tie layer resins

Multi-layer pipe applications based on PE-RT resins and aluminium or ethylene vinyl alcohol copolymer (EVOH) as barrier layers require high performance adhesive layers. *Plexar* resins are LLDPE-based tie-layer adhesives grafted with maleic anhydride.

LyondellBasell offers the following grades:

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

Availability

After initial adoption by customers in Europe, *Hostalen 4731 B* resins have been commercialized in Asia Pacific markets and are now available worldwide, with the exception of North America.

Table 1 – Classification of service conditions according to ISO 10508

Class	T ₀		T _{max}		T _{mal}		Example of application
	[°C]	time [years]	[°C]	time [years]	[°C]	time [h]	
1	60	49	80	1	95	100	Hot water supply (60°C)
2	70	49	80	1	95	100	Hot water supply (70°C)
4	20 ¹	2.5	70	2.5	100	100	Under-floor heating and low-temperature radiators
	40	20					
	60	25					
5	20 ¹	14	90	1	100	100	High-temperature radiators
	60	25					
	80	10					

¹ Any balancing time required to make the time equal to a service life of 50 years shall be at 20°C (T_{cold})

Table 2 – Resulting design hoop stresses for *Hostalen 4731 B*

Application Class	Design hoop stresses	
	<i>Hostalen 4731 B</i>	ISO/DIS 24033 PE-RT Type II
1	4.09 MPa	3.53
2	3.76 MPa	3.37
4	4.18 MPa	3.38
5	3.27 MPa	2.88

Table 3

Typical Properties	Method	Value Unit
Physical		
Density	ISO 1183	0.947 g/cm ³
Melt flow rate (MFR)	ISO 1133	12.4 g/10 min
(190°C/21.6kg)		0.45 g/10 min
(190°C/5.0kg)		
Staudinger index Jg	ISO 1628	330ml/g
Mechanical		
Tensile Modulus (23°C, v = 1mm/min, Secant)	ISO 527-1, -2	850 MPa
Tensile Stress at Yield (23°C, v = 50 mm/min)	ISO 527-1, -2	22 MPa
Tensile Stress at Yield (23°C, v = 50 mm/min)	ISO 527-1, -2	8%
Maximum elongation TD	EN 638	>350%
FNCT (4.0 MPa, 2% Arkopal N 100, 80°C)	ISO 16770	>500 h
Impact		
Charpy notched impact strength	ISO 868	24 kJ/m ²
(23°C)		8 kJ/m ²
(-30°C)		
Hardness		
Shore hardness (Shore D (3 sec))	ISO 868	59
Thermal		
Vicat softening temperature (VST/B/50 K/h (50 N))	ISO 306	70°C
Oxidation induction time (OIT) (210°C)	EN 728	40 min

Notes: typical properties; not to be considered as specifications

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