

Challenges for *Hostalen* HDPE

Pressure pipe applications in alpine regions



Two projects in the upper alpine regions show how pipes made from *Hostalen* HDPE are also capable of meeting extraordinary challenges. Precisely when it comes to laying and installing pipes in confined spaces or in areas where the natural environment must be protected. As to be seen in the Springwater supply system for the Blattenheid Water Supply Association, Switzerland, the relatively low weight of HDPE pipes and the considerably reduced number of required welding operations together make for rapid construction progress. This advantage really comes into its own in a region where the summer period is relatively short. In the case of the artificial snow plant in the skiing region at Jungfrauojoch, HDPE pipes offer unexpected advantages, too: leakage currents in the ground remain uninfluenced and cause no damage to the pipes.

Challenges for *Hostalen* HDPE: Pressure pipe applications in alpine regions

1. Blattenheid: A New Springwater Supply System

The Blattenheid Water Supply Association (WGB) in Uttingen, Switzerland, has been founded in 1913 and serves today 19 communities totalling around 20,000 inhabitants. After its many years of reliable service, the supply system, made out of clay, began to pose a number of problems. Some of the clay pipes were defective and the tunnel was in danger of collapsing through age. Moreover, the filter layers had been adversely affected by erosion in the wake of thunderstorms. For these reasons the association decided to build a new water supply system and at the same time to extend its scope to include a number of additional springs.

The entire project consisted in the cutting of a new, man-sized, 143 m long tunnel. For environmental reasons, only the entrance to the pump room was to be visible,

the rest of the project was to be out of sight underground.

The water from each of the various springs is trapped by a dam at the point where it enters the tunnel and is then fed through separate pipes to the pump room.

There were four main reasons to decide in favour of polyethylene:

- In the extremely confined space of the pipeline tunnel and the pump room, HDPE pipes are easy to handle due to their light weight.
- They are also impact resistant and will therefore not sustain damage during laying.
- Relatively long lengths of pipe could be laid in the tunnel; this would reduce both the time and costs required for the pipe connections, which in the case of HDPE are generally welded.
- Welding ensures a reliable, absolutely

watertight and completely maintenance-free connection of the HDPE pipes over a very long period.

- In the pump room, too, ease of handling is essential for welding the pipes together and installing shut-off valves and other pipeline equipment, such as pumps and gauges.
- HDPE pipes retain their excellent impact resistance even at water temperatures of below 5°C.

For this project, the firm of Gawaplast AG, Neuhausen/Switzerland, a specialist in plastic pipeline systems, decided to use the pipes in multimodal *Hostalen* CRP 100 Black, the third-generation pipe material produced by LyondellBasell. The pipes were produced by HakaGerodur, Benken, Switzerland and the pipelines were laid by LöWi GmbH, Wimmis,



The entrance to the pump room is the only visible part of the Blattenheid springwater supply system



Installations in the pump room: left: Flow rate gauge, middle: Shut-off valve installed in pipeline, right: Overall view

Switzerland, which was subcontractor from the prime contractor Frutiger, Thun, Switzerland.

Four collecting points were built in the tunnel, some of them being fed from several springs and rated for maximum intakes of between 4 and 8 m³ per minute. The water trapped by the dams at the collecting points was fed to the pump house through 106 metres of HDPE pipe of 280 mm diameter and 76 metres of HDPE pipe of 355 mm diameter. Altogether 23 pipe fittings and 70 pipe welds were needed for the laying of the pipes.

The installation work in the pump room was technically the most demanding. The incoming water is first of all tested for turbidity, which may be excessive in certain weather conditions and thus necessitate rejection of the water before it is mixed with the water from other collecting points. It is at this stage that the total yield and flow rate of the water from each collecting point are measured. For this purpose, the pump

room alone was additionally equipped with 50 metres of HDPE pipe of 280 mm diameter plus additional pipes of 280, 315, 355 and 400 mm diameter totalling 30 metres in length. For reasons of hygiene, the water chamber in the pump room was almost completely lined with welded sheets of blue-pigmented HDPE.

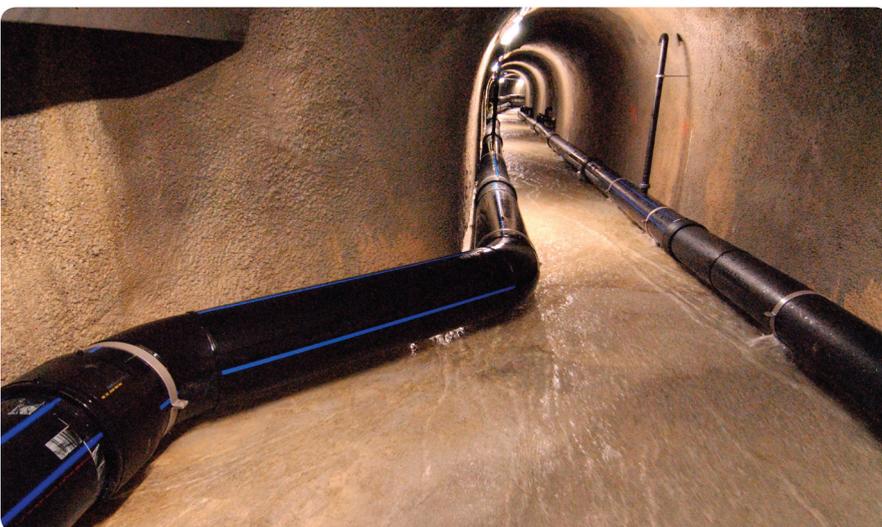
The 43 metre long valley pipeline leading from the pump room was built with 400 mm diameter HDPE pipe, necessitating 11 pipe fittings and 35 pipe welds. Connected to the valley pipeline is a pressure pipeline that transports the water to a hydraulic power station located 570 metres lower down.

Meanwhile the new water supply system has long since passed the crucial test. In May 2006, during extreme weather conditions, the system proved itself capable of handling a total incoming volume of water of 30 m³/min – that is 5 m³/min above its maximum rating of 25 m³/min.

2 Compressed air lines near a world heritage site

The artificial snow plant in the skiing region of Jungfrauoch/Klein Scheidegg comprises the stationary high-pressure snow guns, the underground supply of water and compressed air to the snow guns for generating the artificial snow and the newly built Fallboden Reservoir, in which the necessary water is collected during the summer months. The compressed air for atomizing the water is pumped to the snow guns at a maximum required pressure of 10 bar, and therefore HDPE pipes have been proven as suitable for this application.

The HDPE performance class PE 100 used for the compressed air lines is distinguished by its good creep behaviour and high resistance to slow crack growth, and not least by its very high impact resistance. Pipes manufactured from this material are thus insensitive to the hard knocks they inevitably receive during transport and installation. The contractor decided to lay them directly in their trenches, without any protective conduit.



Shown here are the pipelines laid in the cavern area of the tunnel (N.B.: Depending on the weather conditions, there may at times be more water than the system can cope with. Surplus water, as in this photograph, then flows down through the tunnel and out into a stream)



The Fallboden Reservoir for the supply of water to the snow guns harmonizes perfectly with the landscape at the foot of the north wall of the Eiger

High resistance to rapid crack propagation is an important criteria when it comes to compressed air applications: in tests carried out on pipes in *Hostalen* CRP 100 Black, which is the PE 100 pipe material produced by LyondellBasell, no rapid crack propagation took place in the S4 test at pressures up to 25 bar (test conditions: 110 mm nominal pipe diameter, test carried out at 0°C. Tests performed by: Gastec, Netherlands) [2, 3].

One of the astonishing benefits for the operation of the Jungfrauabahn is the fact that HDPE is not electrically conductive. Ever since it went into service in 1912, this mountain railway has been operating on 1125 V three-phase alternating current. Consequently there is a high occurrence of leakage current (up to 150 A have been measured at times). Non-conductive HDPE pipes – unlike metal pipes – do not influence leakage current and are not subject to electrochemical corrosion.

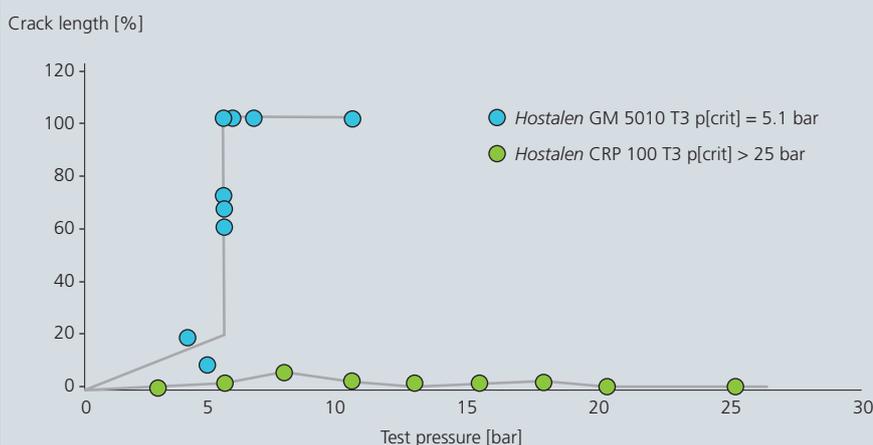
For technical reasons concerning construction work in general and pipe-laying work in particular, a highly important criterion in this UNESCO world heritage region was the very low weight of the pipes made from HDPE. Without any impact on the environment, the pipes can be transported initially by railway and then by helicopter directly to the site. Moreover, even very long lengths of pipe could be easily handled in the trench, an advantage that really came into its own in this alpine region.

Installed are at present 100 snow guns that are supplied with compressed air via a pipeline system possessing a total length of 14 km. The pipes have nominal diameters between 90 and 180 mm and are rated for a maximum nominal pressure of 7 bar. For a standard dimension ratio of 17 (SDR 17), they have a wall thickness from 5.8 to 10.7 mm. The pipes were delivered in lengths of 10 m to an assembly area where they were joined together by electro-fusion socket welding to form sections with a length of 120 m. These

long sections were transported by helicopter and lowered directly into the trench. Then the sections were joined together by electro-fusion socket welding, a process that requires only a negligible amount of equipment.

Looking at the entire construction area, there are even more products from LyondellBasell in use. The newly constructed Fallboden Reservoir is entirely lined with 12,200 m² of polyolefin-based barrier sheeting with a thickness of 2.2 mm. The starting material for the highly elastic sheeting was produced from *Hifax* CA 721 GW, manufactured by LyondellBasell using its *Catalloy* process technology.

Installed in and around the reservoir is a comprehensive pipeline network likewise equipped with HDPE pipes. The decisive criteria for the choice of HDPE pipes were, besides their lightness of weight, their good weldability and their resistance to corrosion. The underwater network comprises, for example, an intake shaft and siphon trap located 18 metres below the surface, a 47 m long discharge shaft to the pump station, a return pipeline and an emergency pipeline for completely emptying the reservoir.



The results of the S4 test showed that pipes in *Hostalen* CRP 100 Black retain their stability up to a pressure of 25 bar; no rapid crack propagation takes place (Tests performed by: Gastec, Netherlands) [3]



This *Hostalen* CRP 100 Black pipeline is the first to be manufactured by HakaGerodur for a pressure rating of 40 bar

3. World première: drinking water pipes for 40 bar nominal pressure

The growing popularity of the Jungfrau region with winter sports enthusiasts necessitated also an efficient water supply system for the start house of the famous Lauberhorn ski race. This supply system posed an enormous challenge, for it had to cope with a difference in altitude of 330 metres over a total distance of 2.5 km. Considering the fact that a certain water pressure is required for distributing the water to the various consumer points, it was obvious that the pipeline had to be rated for an initial pressure of 40 bar.

To this end, the Sesselbahn Lauberhorn AG as operators, the firm of Gawaplast as planners of the supply pipeline, the firm of HakaGerodur as manufacturers and layers of the pipes broke completely fresh ground, for it was during this project that HDPE pipes were rated for 40 bar for the first time ever. As the internal pressure in the pipeline drops as the delivery head increases, only the first 1,000 metres of the pipeline had to be rated for 40 bar. The following 700 metres of pipeline were rated for 25 bar and the last 800 metres for 16 bar. All pipes were extruded in *Hostalen* CRP 100 Black, which is distinguished by, among other properties, its outstandingly good creep strength. The 40 bar pipes have an outer diameter of 75 mm and a wall thickness 15.1 mm, i.e. an SDR of 5. In the case of the pipes rated for 25 and 16 bar, the inner diameters both measured 44.8 mm, while the outer diameters were adapted to the respective ratings.

Delivered to an erection site in lengths of 10 metres, the pipes were first joined together by heated tool welding to form 100 metre lengths, which were then transported by helicopter – this is where their lightness of weight comes into its own – to the installation site one after the other and joined together by electro-fusion socket welding. The high quality of the pipes produced using *Hostalen* CRP 100 Black was so convincing for the contractors that they decided to lay the pipes directly into the trench without any special protective or precautionary measures.

These examples show that precisely for applications in alpine regions, HDPE pipes offer a great many additional benefits that cannot be realized with any other material. HDPE pipes

- are light in weight, sturdy and nonetheless relatively flexible, and, thanks to these features,
- can be laid in difficult terrain easily and
- require a minimum of connections, which are also maintenance-free and permanently leakproof, and
- permit rapid construction even in difficult weather conditions.



The quality of the 40 bar HDPE pipes is so convincing that they are laid directly into the trench without any additional precautions

LyondellBasell Industries

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 biofuels. Through research and development, LyondellBasell develops innovative materials and technologies that deliver exceptional customer value and products that improve quality of life for people around the world.

Headquartered in The Netherlands,
LyondellBasell is privately owned by Access Industries.

Dipl.-Ing. Ulrich Schulte
Head of Technical Service & Application Development

Basell Polyolefine GmbH

Industriepark Höchst
Building C 657
D-65926 Frankfurt am Main
Germany

Tel +49 (0) 69 305 65 23
Fax +49 (0) 69 305 8 46 62
Email ulrich.schulte@basell.com

You can find out more about us by
visiting our website at: lyondellbasell.com

Catalloy, *Hifax* and *Hostalen* are trademarks owned or used
by LyondellBasell group companies.

Hifax and *Hostalen* are registered in the U.S. Patent and
Trademark Office.

Before using a LyondellBasell product, customers and other users should make their own independent determination that the product is suitable for the intended use. They should also ensure that they can use the LyondellBasell product safely and legally. (Material Safety Data Sheets are available from LyondellBasell at www.lyondellbasell.com) This document does not constitute a warranty, express or implied, including a warranty of merchantability or fitness for a particular purpose. No one is authorized to make such warranties or assume any liabilities on behalf of LyondellBasell except in writing signed by an authorized LyondellBasell employee. Unless otherwise agreed in writing, the exclusive remedy for all claims is replacement of the product or refund of the purchase price at LyondellBasell's option, and in no event shall LyondellBasell be liable for special, consequential, punitive, or exemplary damages.

