“No Dig” renovation and installation of systems using polyolefin pipes
Why use “No Dig” technology with polyolefin pipes?

In many of the major cities of the world, the underground pipeline systems are in poor condition and in need of renovation. Reduced rainfall is forcing water companies from London to Beijing to replace their water systems in order to reduce leakage. To dig up these pipelines and replace them would be prohibitively expensive and would create major disruption to city life. One solution is to use “No Dig” technologies to line the old pipes or completely replace them without bringing the city to a standstill.

The simplest technique is “slip lining”, which is to line old pressure or non-pressure pipes with a continuous length of welded PE or PP pipe. After cleaning and inspecting the bore of the old pipe, a smaller diameter liner pipe is simply pulled or pushed through the old pipeline into position. Although the cross section of the new pipe will be smaller than the old one, the loss in flow area is compensated by a much lower friction loss. It is common practice to fill the annular gap between the two pipes by injecting cement or similar material to reduce the risk of gas tracking or the ingress of groundwater.

When the flow capacity of the water pipeline is critical, “close fit” lining can be used where the PE liner forms a snug fit with the bore of the old pipe. This technique can also be used to solve water quality problems where thinner non-structural PE pipes may be used. In this method, the liner pipe is first reduced in size by mechanical means, and after insertion, it is reverted by the application of heat and/or pressure. The diameter of the liner pipe may be reduced, by drawing it through rollers (“Rolldown”) or a smaller die (“Swagelining”). Other methods reduce the cross sectional area, by folding the pipe into a “C” or “U” shape before insertion into the old pipe.

It is also possible to renovate pipelines using “pipe bursting”, where a larger diameter PE pipe than the original pipe is used. In this technique, a hydraulic pipe cracker is drawn through the old pipe, which progressively breaks open the pipe, allowing a new larger diameter PE pipe to be drawn through. As the external surface of the PE pipe tends to get damaged from the broken shards of the old pipe, multilayer pipes with outer layers of high stress crack resistant PE, such as BorSafe HE3490-LS-H, are often used.

It is also possible to install new pipes using “No Dig” techniques, such as “ploughing”, “moling” or “drilling”. In rural areas, continuous lengths of welded PE pipe can be ploughed into the ground using a specially modified plough. Using this technique, pipe can be installed at very high rates of up to 2km per day. Moling or drilling can be used to install PE pipes under obstacles, such as rivers, lakes, railway lines or roadways. Since the PE pipe is passing through unknown soil conditions and may be damaged, it is advisable to use pipe with outer layers of high stress crack resistant PE material, such as BorSafe HE3490-LS-H.

The use of “No Dig” installation techniques using PE and PP pipes provide many benefits including:

- Reduced disruption to the environment
- Reduced installation time
- Improvement in water quality and flow
- Major cost savings of up to 60% project cost, compared to replacement (refer to fig 5).
Some examples of Polyolefin pipes in “No Dig” installations from around the world

**Thames Water, London**
In London, Thames Water are using polyethylene pipes to reduce the water leakage from their old cast iron mains. They chose to use PE, because of the overall cost savings and the benefits of using “No Dig” techniques. They are currently achieving over 60% of the work using “No Dig” techniques, reducing the cost and disruption to the city. They started this project in 2007, and in the first year, they saved over 800 million litres of water.

**Sharjah, Middle East**
In Sharjah in the Middle East, the seven steel water supply pipelines under Sharjah Creek were heavily corroded and leaking. A local contractor, APS from Dubai, inserted PE pipes into the old pipelines to eliminate the leakage. At the same time, to cope with the increasing population, an additional 800mm PE pipeline was also laid across the creek. This pipeline was laid into a sub-sea trench and weighted down with concrete blocks.

**Beijing, China**
China’s capital city Beijing is facing a serious water shortage, which has been made worse by successive years of drought. Much of the water network was installed in the 1950’s and the old iron and concrete pipes are now heavily corroded, and with the ever increasing traffic loads in the city, bursts occur at regular intervals. A number of relining projects have been carried out, where the PE pipe is folded into a “U” shape and then strapped in position so it can be drawn through an old main. Once in position, the pipe can be pressurised to break the holding straps and then it will reform and form a snug fitting liner to the inside of the old main.

**Bethnal Green, London**
In Bethnal Green in London, a 595mm SDR 33 PE pipe was used to reline an old 24 inch cast iron gas main. Once on site, the pipe was welded into continuous lengths and fed through the forming unit to produce the shape shown in the photograph. At the exit from the forming machine, an automatic strapping unit fixed polyester straps at regular intervals along the pipe to keep the pipe in shape. The winch cable was connected to the front end of the liner pipe and the pipe pulled into position. Once the liner pipe was in place, the winch cable was de-coupled and the pipe ends prepared for reversion. Reversion was carried out using cold water at a pressure of 2 bar. As the pipe reformed, the restraining straps break and remain trapped between the liner pipe and the cast iron host pipe.
Read these case stories where polyolefin pipes have been used in “No Dig” installations around the world
• Reducing leakage rates
• Saving considerable project costs
• Saving traffic congestion
• Providing long term sustainable solutions
Materials for Pipeline Renovations

PE Grades

BorSafe HE3490-LS
This is a PE100 pressure pipe compound providing an excellent balance of production and end use properties. It is a high output material which is ideal for producing liner pipes for renovating gas, water and sewage systems.

BorSafe HE3490-LS-H
This PE100 pressure pipe compound has exceptional resistance to stress cracking making the pipe less vulnerable to failure due to installation damage. Ideal for the outer layer of a multilayer pipe installed using directional drilling or pipe bursting techniques.

BorSafe HE3490-IM
This is a PE100 compound with improved flow properties, which makes it ideal for the production of injection moulded fittings. The higher flow enables a lower melt temperature to be used which reduces built in stresses (lower scrap rate) and the production cycle time (lower costs).

<table>
<thead>
<tr>
<th>Commercial Reference</th>
<th>Material Type</th>
<th>Colour</th>
<th>Application</th>
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<tbody>
<tr>
<td>BorSafe HE3490-LS</td>
<td>PE100</td>
<td>Black</td>
<td>Extrusion all pipe sizes 63 – 2000mm</td>
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<tr>
<td>BorSafe HE3490-LS-H</td>
<td>PE100 High SCR</td>
<td>Black</td>
<td>Extrusion pipes for demanding conditions</td>
</tr>
<tr>
<td>BorSafe HE3490-IM</td>
<td>PE100 High flow</td>
<td>Black</td>
<td>Injection moulded pressure fittings</td>
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PP Grades

Beta(β) – PP BE60-7032
A unique β nucleated grade with a fine highly crystalline structure which exhibits higher impact strength throughout the complete operational temperature range 0°C to 95°C making it the ideal material for lining industrial drainage pipes which are transporting hazardous fluids.

BE50 and BE50 – 7032
A high stiffness α nucleated polypropylene homopolymer that is ideally suited for the production of non pressure pipes and sheets.

RA 130E-8427
This is a high molecular weight, low melt flow rate polypropylene random material, which is ideal for high temperature industrial pressure and non-pressure pipe systems.

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<td>Grey</td>
<td>Pressure pipes and fittings</td>
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Some useful web sites and references

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<tr>
<td>Borealis</td>
<td><a href="http://www.borealisgroup.com/pipes">www.borealisgroup.com/pipes</a></td>
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<td>PE100+ Association</td>
<td><a href="http://www.pe100plus.net">www.pe100plus.net</a></td>
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<td>The Gulf Plastic Pipes Academy</td>
<td><a href="http://www.yourppa.org">www.yourppa.org</a></td>
</tr>
<tr>
<td>The International Society Trenchless Technology</td>
<td><a href="http://www.istt.com">www.istt.com</a></td>
</tr>
<tr>
<td>Plastics Pipes for Water Supply and Sewage Disposal</td>
<td>Lars-Eric Janson, 2003</td>
</tr>
<tr>
<td>A. Soresina &amp; D. Walton, “New PE pipe material aids renovation of M.P. pipelines in urban environment.”</td>
<td>Plastics Pipes XII, Milan, Italy, 2004</td>
</tr>
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About Borouge

Borouge is a leading provider of innovative plastics solutions. Combining the most advanced technologies with world-class production facilities, Borouge is a unique company that brings together the very best of Europe and the Middle East.

With a heritage of reliable customer partnership and value creation through innovation, Borouge provides plastic solutions that make a real difference to everyday life.

Established in 1998 as a joint venture between the Abu Dhabi National Oil Company (ADNOC), one of the world’s major oil companies, and Borealis, a leading European plastics provider, Borouge is a groundbreaking international partnership at the forefront of next-generation plastics innovation. Together, Borouge and Borealis employ unique Borstar® technology to produce innovative plastics solutions in end-use plastics applications throughout the Middle East, Asia-Pacific and Africa. Borouge’s state-of-the-art petrochemical complex is located at Ruwais, Abu Dhabi in the United Arab Emirates.

Borouge provides a range of differentiated products for high-value infrastructure applications, including water, gas and industrial pipe systems, power and communication cables, advanced packaging and automotive components. The advantages of Borstar are well recognised in the industry and are central to Borouge’s success—the technology facilitates the manufacture of high-performance, high-value plastic products that are vital to modern living. Borouge’s presence in key strategic locations throughout the Middle East, Asia-Pacific and Africa facilitates speed to market, on-time delivery and customer support. Borouge is also the exclusive regional provider of the entire Borealis product line.

To meet ever-increasing market demand, Borouge plans a multi-billion dollar expansion at Ruwais. The project, ‘Borouge 2’, is due to commence production in 2010. This world-scale project will triple existing production capacity to two million tonnes per annum, including, for the first time, polypropylene.

At the forefront of one of the world’s most exciting industries, Borouge empowers its customers to create products that are vital to global development and has a vision of ‘Shaping the Future with Plastics’.

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SALES & MARKETING Singapore (Head Office)
Borouge Pte Ltd 1 George Street #18-01 Singapore 049145
Tel: +65 6275 4100 Fax: +65 6377 1233 Email: info@borouge.com