Project report

Seawater for the heat-pump plant

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It is not surprising that people in Helsinki want to feel comfortably warm in the Finnish winter, or that they like to keep cool in the summer. Both these aspirations are now satisfied by a large heat-pump plant, which went into service in June 2006 in Katri Vala Park in the Finnish capital. The seawater required to operate the pump is transported by pipes made from *Hostalen* GM 5010 T3 black resins, a PE 80 pressure pipe material from LyondellBasell.

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The heat-pump plant installed by energy supplier Helsinki Energy is far better than your average combined heat and power plant. In the buildings to which it is connected, it provides both heat and cool air, irrespective of the season. In winter, the plant uses seawater not only to tap the thermal reservoir in the rock under Katri Vala Park but also to recover heat from treated municipal wastewater and for cooling purposes; in summer, the direct connection to the sea is also used to remove excess heat. In this first phase of the project, some 11 100 cubic meters of water per hour are pumped into the plant under pressure; from 2020 – by which time the plant is due to be connected to another Helsinki district – the volume will be increased to around 27 500 cubic meters per hour. The existing pipeline systems would be too small for this.

Choosing the right material is crucial

The new pipeline connecting the seawater intake and distribution point with the heat-pump plant in Suvilahti was constructed from Weholite® pipes (DN/ID 2000 mm) supplied by KWH Pipe Ltd, Vaasa, as was the pipeline from the plant back to the harbour water. The total length of both straight pipelines is representing some 600 meters. For polyethylene pipes of this size being exposed to low pressure, HDPE materials specially optimized for blow molding are often considered. However, since the seawater is pumped, the internal pressure in this pipeline is 1.5 bar, this is why KWH Pipe decided to use the PE 80, multimodal, pressure pipe material *Hostalen* GM 5010 T3 black.

Concrete, GRP and steel pipelines had already been rejected at an earlier planning stage for cost reasons and because of the required service life: the lines have to withstand aggressive seawater for at least 25 to 30 years. In a comparable project carried out by the client, similar HDPE pipes have already been used successfully for over five years.

Laboratory quantities of individual pipe systems made from HDPE by former Hoechst AG in Frankfurt have been subjected to

Pipes produced from multimodal *Hostalen* GM 5010 T3 black resins (PE 80) have high notch and stress-cracking resistance and are therefore also tolerant to pressure loads and mechanical stresses due, for example, to settlement or pipe installation errors. These properties can help ensure a long service life under harsh conditions.

Project in detail	
Facility	Seawater heat-pump plant in Suvilahti, Helsinki
Client	Helsinki Energy
Transported medium	Salt water
Flow rate	0.8 m/s
Pressure	1.5 bar
Length of installed pipeline	600 m
Water intake system	Three parallel Weholite® pipes
Pipe manufacturer	KWH Pipe Ltd, Vaasa
Pipe type	Weholite® DN/ID 2000mm LP
Material	*Hostalen*® GM 5010 T3 black, a class PE 80, multimodal HDPE
Pipe diameter	2.0 m
Length of individual pipes	20 m; plus pipe bends of various lengths
Connection method	Extrusion welding (with *Hostalen*® GM 5010 T3 black)
Special features	Operation under an internal pressure of 1.5 bar. After installation, the pipes were weighted using an economic method that involved injecting concrete into the external, spiral pipe wall "ribs" to prevent the pipeline floating up as a result of groundwater pressure below sea level. The welding method permitted optimum pipe jointing and fast, uncomplicated adaptation of the pipeline route to circumvent obstacles encountered during pipelaying. The long service life of the polyolefin used means that high reliability can be expected.

continuous shelf life tests since October 1956. Up until now, these systems have achieved a service life of over 50 years at 20°C. These test results confirmed that the Arrhenius law is applicable to plastics material.

Based on the Arrhenius law, the international standard ISO 9080 provides extrapolation methods based on scientific predictions regarding the long-term hydrostatic strength of thermoplastic pipe materials.

Modern piping systems, manufactured using multimodal *Hostalen* GM 5010 T3 black resins, are, compared to conventional HDPE materials, more resistant to notches and stress cracking, and tolerant regarding pressure loads and mechanical stresses – with a possible service life of 80 to 100 years.

Fast, economical and safe

In the opinion of the users, the quality of the pipes and material selected not only guarantee the expected long service life but also greatly facilitate pipeline construction. Because of their light weight, the pipes can be easily transported to the installation site at low cost. To ensure that these lightweight, two-meter-diameter pipes would not be displaced by groundwater pressure, even three meters below sea level, the hollow external ribs of the pipe wall were filled with concrete immediately after installation in a very simple and economic process. This allowed the intake section of the pipeline to be laid in the harbour basin far below the water surface, so ensuring the safety of shipping.

In addition, the use of PE 80 pressure pipe material helped considerably to avoid leakage problems. This is because the 20-meter-long individual pipes plus pipe bends of various lengths were not joined by seals but were welded together from the inside with extrusion welding machines.

Easy pipe laying, even under adverse conditions

Pipe jointing from the inside has the additional advantage that it can be carried out in any weather. Tents are therefore unnecessary. During the cold winter of 2006, interruptions due to unfavorable weather conditions were therefore reduced to a minimum. In Helsinki, about two joints per day could be completed; the rate-determining factor for the progress of the project was therefore not extrusion welding but the speed at which the partner companies could excavate the necessary trenches.

At the same time, this jointing method also provided the KWH Pipe engineers with the flexibility they needed to move ahead rapidly with the project. It allowed them, during the actual pipe laying process, to circumvent obstacles that were only revealed after excavation of the trench; in addition, the optimum curve that the pipeline should follow on entering the harbour basin to avoid interference with shipping operations only became clear during the course of the project. This meant that more than a few pipe bend connections had to be designed and executed "on the fly".

Summary

Successful completion of the project to construct a seawater pipeline for the Katri Vala Park heat-pump plant in the spring of 2006 is due to the farsighted planning of the engineers involved and Weholite® pipes supplied by KWH Pipe Ltd, which were produced from the LyondellBasell PE 80, multimodal, pressure pipe material *Hostalen* GM 5010 T3 black. With their flexibility, light weight and adaptable method of connection, these pipes are outstandingly suitable for laying pipelines along difficult routes under challenging conditions. The robust resistance of this pipe material to mechanical stress and its long service life, as demonstrated in the laboratory and many real-life applications, can help ensure that the investment in this large heat-pump plant in Helsinki is secure long-term.

Cover: Large Weholite® pipes (DN/ID 2000 mm) connect the heat-pump plant to the sea. These pipes are produced from the LyondellBasell multimodal PE 80 material *Hostalen* GM 5010 T3 black resins and can be permanently connected from inside by extrusion welding. The welder is therefore protected from outside weather conditions – important for rapid completion of the project in the harsh Finnish winter.

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