Whitepaper 6

Future proofing the DHC network

In the District Heating and Cooling Symposium 2010 in Tallinn Thermaflex presented 5 papers[1] pointing towards the benefits of flexible pipe systems as well as tailored prefabricated solutions over the entire network lifetime, exemplified by the pre-insulated piping system Flexalen 600. Since that time Thermaflex achieved a global acceptance of the introduced solutions as they have been successfully implemented in numerous District Heating and Cooling network applications all over the world. This formed the basis for further developments since 2010. Production facilities have been up-scaled to meet an increasing demand. The cooperation of R&D with key stakeholders focused on responding to their challenges with new and improved solutions driven by a strong vision:

Minimize the waste of energy & Maximize the use of renewables

We develop and produce smart solutions for thermal energy distribution, using state of the art flexible pre-insulated pipe systems and pre-fabricated branches. We connect different internal components or between buildings and resources, be that in residential areas, offices, hotels, public buildings and industries.

[1] In cooperation with Liandon, Thermaflex published 5 papers at the '12th International Symposium on District Heating and Cooling, September 5th to September 7th, 2010, Tallinn, Estonia' (click for link):

Paper 1: Verification of heatloss measurements, *J.T. van Wijnkoop*$_1$, *E. van der Ven*$_2$, $_1$ Liandon B.V, $_2$ Thermaflex International Holding B.V. (click for link)

Paper 2: Heat loss of flexible plastic pipe systems, analysis and optimization, *EJ.H.M. van der Ven* $_1$, *R.J. van Arendonk* $_2$, $_1$ Thermaflex International Holding B.V , $_2$ Liandon B.V. (click for link)

Paper 3: Comparison of competitive (semi) flexible piping systems, *I.M. Smits*$_1$, *J. Korsman*$_1$, *J.T. van Wijnkoop*$_1$ *and E.J.H.M. van der Ven*$_2$, $_1$ Liandon B.V., $_2$ Thermaflex International Holding B.V. (click for link)

Paper 4: Heat loss analysis and optimization of a flexible piping system, *J. Korsman*$_1$, *I.M. Smits*$_1$ *and E.J.H.M. van der Ven*$_2$, $_1$ Liandon B.V., $_2$ Thermaflex International Holding B.V. (click for link)

Paper 5: Paper 5 New economical connection solution for flexible piping systems, *C. Engel, GJ. Baars,* Thermaflex International Holding B.V. (click for link)

Introduction

The original pillars for technological development have been preserved: lower (total) investment per house connection, durability, moisture resistance and system implementation reliability.

In order to meet current and anticipate future stakeholder needs, Thermaflex drove innovation further with focus on: network design, speed and quality of installation, environmental impact, efficiency, sustainability and logistics. New tailor made solutions address key requests, like minimal disturbance to the existing environment and speed and safety of installation.

Co-creation of success stories

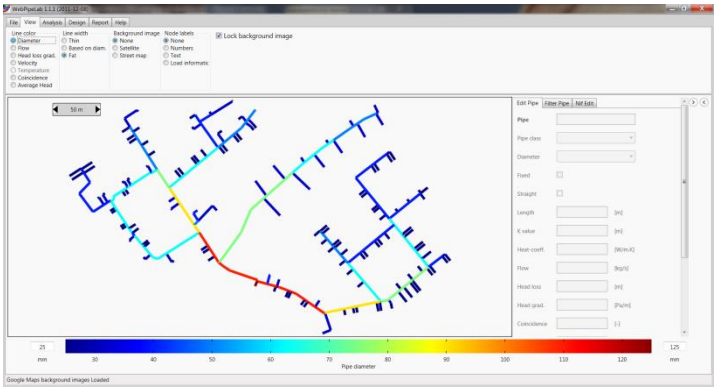

Figure 1: 'Flextools' network optimization program

An important cornerstone of successful project realization and future operation of a DHC grid is an optimized network design. This can be achieved through active support in Network Design, creating tailored network solutions to the specific project challenges and the respective customers' needs. Intensified cooperation and interaction in the project preparation phase with all key stakeholders - consultants, contractors, municipalities and operators – enables co-creation for the best solutions, based on common interests preventing undesired failure costs and contract variations. Holding these qualities, Thermaflex has produced significant results with customers for various applications in Cooling, Heating, domestic Hot & Cold water and Renewables[2].

A World Record!

Taking the most challenging parts of the network installations - branches and connections- as much as possible out of the field (with all its unpredictable external influences) and prefabricating these on the 100% controlled factory floor, proved to be highly beneficial for many stakeholders. The prefabricated house connection, called Flexalink, reduces the connections on site with minimum 70%, compared to the traditional way.

Building upon this success Thermaflex took another huge step in successful connecting houses, by developing the concept of a Street in a Day, with Flexanet, a network on coil that is made-to-order.

[2] Cf. Whitepaper 7: "Engineering functionality"

In just one day, a complete street can be connected to a (renewable) district heating setup, mitigating 2 key barriers in network realisation: minimizing disturbance for daily life and preventing installation and operation risks. This solution clearly contributes to the comfort and economics of District Heating. Successful pilots have been realised in Hengelo (Heating, retrofit) and Terborg (Heating and Cooling, New construction), the Netherlands where 10 and 9 houses, respectively, were connected in 1.5 hrs. The next pilot will be completed in Wörgl, Austria in October '14.

Figure 2: Hengelo, NL: 10 houses connected to the heating grid (2 lines) in 1,5 hrs

Figure 3: Alkmaar, NL: 6 houses connected to District Heating in 1,5 hrs

In our long-time cooperation with Stadsverwarming Purmerend and Warmtenet Hengelo, but also in smaller scale DH configurations, we have successfully implemented pre-fabricated network parts for both renovation and newly built networks. 15,000 Flexalinks have already been used to connect end-users to a thermal Grid, each one tailored to the specific situation and customer needs.

Lifetime & environmental impact

Using carefully chosen materials and homogenous welding connections, the functional reliability of the entire piping system can achieve lifetimes of over 50 years for operating temperatures up to 90°C and 100 years with operating temperatures up to 70 °C. For each temperature profile, accurate estimates can be provided.

However, as resources are becoming scarce, it is our common responsibility to use these as wisely and effectively as possible. To neutralize the impact of hot and cold water transport piping systems, Thermaflex is committed to the Cradle to Cradle® philosophy[3]. Recently the first milestone

[3] Cradle to Cradle® is a registered trademark of McDonough Braungart Design Chemistry, LLC

in our ongoing commitment to increase a 100% sustainable assortment was accomplished; the Flexalen 600 range has achieved Cradle to Cradle Certified™ Basic.

The entire Flexalen 600 range is recyclable. Additionally, the impact of each produced component by Thermaflex is measured through Life Cycle Analyses, which helps us.

Energy Efficiency - sustainability

The actual pre-insulated piping system Flexalen 600, providing among other things the combination of excellent water absorption and moisture resistance (i.e. water vapour barrier-µ-value, resulting in a consistent insulation performance over its lifetime, has been realized originally in co-development with NUON/Vattenfall. To meet the challenges of energy efficiency and sustainability, Thermaflex is applying a holistic approach, by taking the whole project concept starting from design optimization, installation, operation until end of lifetime recycling into consideration. The co-operation with leading DHC interest groups is a key element in a co-creation process of future DHC distribution solutions.

Training: The right man for the right job

In order to help our stakeholders to benefit the most from our introduced solutions we offer comprehensive training and certification for design and installation as well as on- and off-site support for our customers. These are key elements in developing our know-how as well as securing the quality, reliability and efficiency of the installed systems. Learning from best practice for continuous improvement of these courses are cornerstones of the Thermaflex Academy.

Logistics: The right material at the right place & time

Another key element for successful implementation and operation of a DHC grid to our experience is the early involvement of our implementation team into the project planning process, which allows projects to be delivered in a Just-In-Time framework. Total lead and instalment times can be significantly reduced by the combination of the ‘prefab philosophy’ and Thermaflex’ flexible supply chain.

Success stories

2010-15: District Heating Purmerend, Netherlands

The combination of the redesign and the use of new materials (cf 'Slimnet') led, in this renovation project, to a 30% heat loss reduction compared to the original network. The solid planning and a largely pre-fabricated piping system resulted in the connection of about 40 residences per week to the re-engineered district heating network.

2013: District Heating Otopeni, Romania

The first step of renovation of the DH scheme in Otopeni, Romania, has been realised with Flexalen (main diameters PB d225, d160 and d110). Installation times were reduced by 75% and total installed costs reduced by 40% in relation to the traditional approach with pre-insulated steel.

2010-13: District Heating Hengelo, Netherlands

Connecting existing houses to a new district heating grid (retrofit), using primarily the Flexalink technology, resulted in a reduction of 20% of the total installed costs (for trenching, installation and network components) compared to a steel implementation. This was realized at a rate of 14 houses per day including trenching and street works.

2012-13: District Cooling St. Vincent, Caribbean

A resort located on the Caribbean island St. Vincent used Flexalen for the distribution of chilled water as well as for hot and cold sanitary lines. The long lengths and high flexibility of the pipe system were ideally suited in dealing with the many height differences of the seaside island. Other important decision factors were the condensation prevention and the ease of the complete installation, which resulted in an approx. 50% saving time compared to a steel network.

All mentioned project references can be found on http://news.thermaflex.com/home. More detailed information can also be provided on request.

Main conclusions and further challenges

Implementations of our solutions all over the world have shown that we were most successful in helping our stakeholders achieving their objectives where we combined scientific and technological progress with clear understanding of and involvement in the challenges of design, installation and operation of DHC grids. Daily practice in the field proofed that the benefits of new generations of DHC solutions materialize best using a more holistic approach. We need to match different or new network concepts with more optimization parameters in design, as well as implementation of more and more prefabricated solutions. Being in active dialogue with our stakeholders and projects realized over the last couple of years have shown that the total material cost becomes secondary to the total cost of implementation in determining the investment level. If one is prepared to look at the total cost of ownership the benefits do even increase more by lower maintenance, longer depreciation times and rest values.

To our opinion, it does not stop here. Optimization on implementing and operating a utility solution must take into account the challenges and possible benefits to **all** known stakeholders and interests involved. Just to give an example.

The combination of the speed of implementation with a lower disturbance to the built environment and a smaller claim on resources will actually lower the barriers for fast and large scale roll outs and increase the acceptance of district heating, cooling and potable water networks. At the same time, it lowers the entrance barriers to enable the use of locally available renewable energy resources and, can therefore facilitate our common challenge of energy transition.

Last but not least, we should build a future that will last beyond our own generation and those to come. Lifetime expectancy of all common infrastructure and energy solutions should become depreciable accordingly. The ecological footprint is not only determined by energy production and the efficiency of distribution. We are also responsible for the choices as to what we put in the ground and what will happen with it once it has to come out again. Sustainability levels are determined by the most current insights into potential toxicity, working conditions as well as recyclability of materials. For renovation of existing networks, this poses the additional challenge of removing obsolete pipe systems and disposing of them in the most responsible way. For new or extended networks, at least we can make sure we leave a positively balanced inheritance.

Further information:

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