BREAKING DOWN THE BARRIERS
An easy guide to pre-insulated pipe
FOREWORD:

There are approximately 17,000 heat networks in the UK of which approximately 5,500 are district heat networks and 11,500 communal heat networks, according to the Association for Decentralised Energy (ADE). In total, there are now approximately 500,000 customers – mainly domestic – connected to some form of decentralised energy network in the UK, with the largest concentration in London, which boasts around 25 per cent of the total.

Whilst these numbers sound impressive, heat networks still only contribute around 2% of the UK’s total heat demand – a figure which is dwarfed by other European countries, where district heating systems have grown rapidly over the last 20 years and continue to be highly popular.

The knowledge base in the industry and awareness from end users of its benefits can certainly be improved. This is becoming increasingly important, not least following the Department for Business, Energy and Industrial Strategy’s (BEIS) decision to invest £320 million of public funds through its Heat Network Investment Project (HNIP) to support heat network projects from April 2019. If the UK is to reduce its carbon emissions through heat networks, the time really is now. District heating could provide as much as 17% of heat to our homes and 24% of heat to commercial buildings by 2050 according to latest estimates.

This guide aims to improve the industry’s collective understanding of the heat network itself, addressing some of the most commonly-held misconceptions surrounding them in the process.

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District Heating is the concept of at least one energy centre providing the heat demand for a number of buildings: residential, commercial, or multi-occupancy. This could be just two buildings or a whole city.

District heating is technology agnostic: a variety of heat sources can be used such as gas, Combined Heat & Power (CHP), Energy from Waste, industrial waste heat, or renewable energy sources such as heat pumps, biomass or anaerobic digestion. Heat sources could also be combined or changed after a period of time without the need to replace the heat network.

The hot water travels through an underground, pre-insulated pipe network connected typically to a heat interface unit (HIU) located in each building. This provides heating and hot water to each building. The cold water returns back to the energy centre to be heated and circulated again.

Heat networks can offer the following benefits:

- Carbon savings via local heat generation
- Lower bills to end users and can help reduce fuel poverty
- Lower maintenance costs of one central plant
- Fuel security and independence
- Flexibility of heat supply
- Economies of scale of building larger plant rooms
10 COMMON DISTRICT HEATING MISCONCEPTIONS

To develop new efficient heat networks, we firstly need to address some of the misconceptions which may have influenced many designers’ and contractors’ familiarity with heat networks in the past.

1. SPECIALIST TEAMS ARE REQUIRED FOR INSTALLATION

The first common fallacy is that all district heating pipework requires specialist welding teams on site for the jointing. This is true for steel pipes and large diameter PP-R polymer pipes but PE-Xa pipes are typically joined using either a permanent mechanical compression sleeve or a compression ring fitting. This mechanical jointing is much faster on site than welding, not least because it is safer, simpler, with fewer specialist tools and less room required in the trench. This means the mechanical or civil contractor on site can install the pipes themselves rather than subcontracting the jointing to a specialist welding team and having additional trades on site.

2. MECHANICAL FITTINGS ARE ALL THE SAME

The REHAU EVERLOC™ joint is a permanent compression sleeve fitting which involves expanding the pipes, putting the fitting in and then sliding the sleeve over it which holds it in place. No hot works are required. This tried and tested system has been used over 750,000,000 times worldwide across the REHAU heating & plumbing ranges and is known for its reliability and durability.

Many widely available brass compression fittings have to be manually tightened and therefore require tightening at regular time intervals during operation. In accessible areas within a building, this is potentially possible, but where the pipe is buried in an underground trench, regular tightening is not feasible unless access chambers are installed at every joint. Access chambers mean additional installation costs and heat losses as they are not as highly insulated as a shroud with soil cover.
POLYMER PIPES ARE ONLY SUITABLE FOR SMALL NETWORKS AND HOUSE CONNECTIONS

Contrary to popular belief, steel is not the only material suitable for district heating schemes. Modern pre-insulated polymer pipe is suitable for district heating schemes and uses the same PU insulation material as traditional pipe systems. PE-Xa polymer pipes are available up to 160mm and PP-R pipes are available up to 355mm. A 355mm can provide up to 16MW of heat at 80/50°C which allows many larger district heating projects to be a fully polymer network which reduces the risk of corrosion and removes the need for expansion mitigation in the trench.

THERE IS NO BENEFIT FROM CHANGING THE OPERATING TEMPERATURES OF A HEAT NETWORK

The flow and return temperatures have a significant impact on the CAPEX and OPEX of a heat network. The greater the delta T (difference between flow and return temperatures), the smaller the pipe diameter used. Reducing the distribution network by one or two pipe sizes can greatly reduce the material costs. Secondly, a lower flow temperature reduces the heat losses throughout the system, which will in turn reduce the operating costs for the operator. As such, a 70/40°C network is more efficient than a 80/50°C network. The only caveat to consider here is that it may not always be possible to reduce the flow temperature on a retrofit project without either first upgrading the heat emitters or changing the operating schedule.

DISTRICT HEATING PIPES REQUIRE LEAK DETECTION

Leak detection is required for steel district heating pipes due to the potential corrosion risk should water ingress occur. Polymer pipes do not require leak detection as they do not corrode, have far fewer joints and are not typically welded on-site. If there ever was a mechanical damage of the heat network, the leak location could be identified via alternative methods such as thermal imaging, ultrasonic or tracer gas technology. From our recent experiences, we have supplied replacement pipes to various projects where the original steel pipes have become corroded in less than 10 years, sometimes even less than five years.

RAUTHERMEX Pre-insulated PE-Xa pipe

RAUTHERMEX is a pre-insulated PE-Xa pipe with a high-performance PU foam which makes it ideal for heat networks over long distances where heat losses are critical. Coiled polymer pipes such as RAUTHERMEX offer huge advantages over traditional steel pipework due to the pipe weight, speed and ease of installation.

RAUTHERMEX is available in UNO 25-160mm and DUO 25-75mm.
SINGLE DISTRICT HEATING PIPES HAVE LOWER HEAT LOSSES THAN TWIN PIPES

This is a common misconception, as theoretically it would make sense that a single pipe has more insulation around it and therefore boasts lower heat losses. However, a single pre-insulated pipe buried in the ground is surrounded by soil which is around 8-12°C in temperature, whereas a twin pipe has a second pipe within the outer jacket which is operating at temperatures of 40-60°C. This means a twin pipe typically has over 30% lower heat loss than two single pipes of the same PE-Xa pipe diameter.

DELIVERY OF PIPES TO SITE IS A NIGHTMARE

We all know that things can go wrong on site from time to time, which is where using a supplier such as REHAU with the ability to offer rapid delivery from the largest stock in the UK can be worth its weight in gold.

It should almost go without saying that district heating pipework is particularly large – both in terms of length and diameter. As a result, many will have experienced difficulty in either having their pipework delivered to, or stored on, the project site. Key to avoiding these challenging hurdles is planning well in advance – especially when it comes to site access. Working with a supplier with expertise in district heating will generally mean pipes can be delivered on a size of vehicle to suit the site without causing major disruption or running the risk of failed delivery.

ALL DISTRICT HEATING PIPE MATERIALS HAVE THE SAME INSTALLATION TIMES

For the contractor quoting for a heat network installation, it is important to quote valid installation times if switching materials in a specification. The length of time that a trench is left exposed is a key consideration for contractors so the speed of making a joint is key. There are significant installation time savings that can be achieved by using polymer so it is important to ensure the installation is priced up accurately. There is also far less potential for additional costs on a polymer heat network as any last-minute changes can often be overcome on site with no additional materials or labour. It’s important that any contractor installing district heating pipe is fully trained on that particular manufacturer’s products which is why REHAU offer our RE04 installation academy either on-site or at the customer’s premises.

POLYMER PIPES CAN ONLY BE USED FOR PROJECTS WITH A MAXIMUM 70°C FLOW TEMPERATURE

This misconception comes up regular in discussions with designers but with over 45 years experience of producing PE-Xa pipes as one of its pioneers, REHAU can debunk this myth. Many schemes we work on today operate at continuous flow temperatures of 80-85°C but the most-efficient schemes are already being designed at 70°C where possible. According to BS EN 15632, PE-Xa district heating pipes have a minimum service life of 30 years at 6 bar and 80°C continuous flow temperature with an allowance of 90°C for one month per year and 95°C for 100 hours per year.

THE DIFFERENCE BETWEEN LIFE EXPECTANCY AND WARRANTY

We regularly face questions about how another pipe manufacturer offers a 30 year or 50 year warranty on their pipe system but this is often confused with pipe system lifespans. It’s important to check what the actual pipe system warranty is, as it is likely to be far shorter than the lifespan.

Keeping the above 10 topics in mind, which considerations need to be made at the planning stages of a project to ensure a simple, quick, and cost-effective installation that stands the test of time? Read on to find out.
5 TIPS FOR DISTRICT HEATING PROJECTS

When it comes to designing, installing and commissioning the pipework runs for any district heating project, it is important to refer to the latest version of CIBSE CP1: Heat Networks: Code of Practice for the UK. This guide sets out minimum requirements and best practice for all stages of a district heating project and includes checklists to support the project team all the way through the project delivery.

For the pipework-specific procedures, the following tips will act as a solid foundation when it comes to planning and implementing a well-designed project on site.

1. ENSURE THE HEAT NETWORK IS DESIGNED FOR EFFICIENT OPERATION

It is important to ensure that the network has been designed on the actual heat loads, not peak assumptions. The more consumers a heat network has, the greater the impact on the total heat load and therefore its CAPEX. The flow and return temperatures should always be optimised (as per misconception #4) to ensure low heat losses, lower material and installation costs. In various heat networks, the topic of diversity can be applied to reduce the total peak load of the plant as not all users consume their peak load simultaneously.

2. PREPARE AND PLAN ON SITE

Contractors are responsible for multiple layers of a district heating installation; from ensuring lengths of pipe are correctly labelled, to their arrival on site, and even the way they are laid within a trench. For this reason, proper planning of storage and vehicle access on site is absolutely essential. By working in close liaison with the pipe supplier from the very start of a project, none of these issues should occur, which ensures cost-effective completion of the project.
The reality is, once pipes arrive on site, there will generally be a period of time where they need to be stored and then handled before being installed in the correct location. During this phase, it is vital that the following considerations are made:

- Are the pipe ends covered to avoid debris entering the heating circuit prior to installation?
- Have steps been taken to ensure no pipes have come into contact with rough surfaces during storage on site that could cause damage?
- Ensure mechanical equipment (such as a forklift) is used to lift and move coils.
- Ensure all processes have been subject to an on-site health and safety assessment.

When it comes to laying the pipe itself, the most common technique is to use an open, narrow trench in which the pipe can be laid and joints made up. A polymer trench uses a narrower trench than traditional metal pipes due to the lack of welding space required in the trench and no expansion loops being required in the network. Other types of installation technique may be used in the event that an open trench is not feasible or cost savings can be achieved. These techniques are:

- Pull-through: a particularly useful technique for regeneration projects where old pipework is still in-situ, a pull-through technique allows new pipe to be directed through suitable pipelines to minimise disruption.
- Ploughing-in: this is a form of trenching whereby a trench is ploughed for the exact size of the pipe, to allow the pipe to be fed directly from the coil into the trench. The technique makes installation quicker, but is only valid for soft-dig installations.
- Horizontal Directional Drilling (HDD): pipe is pulled through a drilled borehole which has been created using a drilling machine. This technique tends to channel pipe through buildings, or under major roads and railway tracks, for example.

The final stage of a district heating pipework installation is to ensure it performs as it should once in-situ and will continue to do so for the full lifespan of the project. Compromising on commissioning is certainly a false economy as it gives contractors the opportunity to identify and resolve any potential snagging issues before the district heating scheme goes live. While the specifics of the commissioning procedure are likely to vary from one project to the next, the following should act as a bare minimum:

- Pressure testing
- Regular pressure and temperature checks during installation, commissioning and regular maintenance
- Monitoring of water quality and composition during commissioning and whilst in operation

1 www.cibse.org/CP1
Piperdam Leisure Resort, Dundee

Piperdam is an award-winning resort set in 650 acres of Angus countryside. Located just 10 minutes from Dundee and 20 minutes from Perth, the resort has more than 80 self-catering lodges, sleeping from 2-12 people, as well as restaurant and leisure facilities on site.

Six years ago, Piperdam’s owners collaborated with a local installation company – Hydroscot Energies – on an energy strategy for the resort. Piperdam is off the mains gas grid and was reliant on expensive alternative fuels, such as LPG and Kerosene, so the owners were keen to find more sustainable and cost-efficient methods of heating the tens of holiday lodges located on the site.

Hydroscot Energies recommended a phased programme of installations, starting with three networks to provide heating for 70 holiday lodges. Each network would be powered by a biomass boiler ranging between 200kw to 1MW. The main commercial complex complete with swimming pool, spa, gym, restaurants and bars was powered by a Biogas Combined Heat and Power (CHP) plant.

To transfer the heat from the plant rooms to the lodges, the scheme required pre-insulated pipework. As the lodges are spread across a large area, the pipe runs were quite lengthy in places, so the customer needed a product which would minimise heat losses as much as possible to ensure the efficiency of the system was upheld. After consulting with REHAU on which products would be best for the district heating, Hydroscot Energies specified RAUTHERMEX and RAUVITHERM pipework.

RAUTHERMEX is a PE-Xa pipe suitable for a variety of low carbon heat installations and featuring high performance PU foam, which makes it ideal for district heating installations over long distances where minimising heat losses is critical. Hydroscot Energies specified RAUTHERMEX for the spine of the district heating installation at Piperdam, to carry the heat from the biomass plant room towards the lodges.

RAUVITHERM pipework was then used to transfer the heat from the RAUTHERMEX spine to individual lodges. RAUVITHERM is currently the only PE-Xa district heating pipe manufactured in the UK, which saves an estimated 29% on CO₂ emissions annually.

Scott Gaffney, owner of Hydroscot Energies, said: “By using RAUVITHERM for short runs and RAUTHERMEX over the longer distances, we’ve been able to play to the strengths of each pipe and deliver an abundance of heat to each lodge in the most efficient way.

“Both pipe product types have been really easy to install too, which makes things better for us. We are all quite efficient with the bespoke installation tools now!”

Piperdam is now under new ownership, but the new managers want to continue with the energy strategy implemented by Hydroscot Energies. Further expansion of the resort is planned, with as many as 50 additional lodges added to the site in the next phase, so the network will be expanded as required to meet the needs of the park.
CONCLUSION:

In reality, there is unlikely to be one single approach that can be used across every single district heating scheme in the UK, but that’s certainly not to say some common principles apply to what we consider to be best practice.

A heat network system is only ever as good as its design, installation and operation, and in that respect, thorough planning and visibility of the full scope of a project is needed to ensure pipework installation can play a vital role in the long-term performance of a system. CIBSE’s CP1 guidance certainly provides comprehensive guidance for designers and contractors to follow when it comes to best practice. Among them there are various specific challenges or misconceptions regarding district heating pipework shown in this guide that can exist and should be openly discussed.

Choice of pipework is critical, and we now find ourselves in a position where there are more options on the market than ever before. This increases the importance of contractors familiarising themselves with exactly how certain materials, jointing techniques, and manufacturer-led support can benefit them. After all, delivering a district heating scheme on time and within budget will always be the most important objective.

By working closely with industry partners such as REHAU, contractors working in the industry can play a key role in ensuring district heating schemes fulfil the potential they have to contribute significantly to the UK carbon reduction targets for years to come.

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