Heating networks in the urban subsurface

As everyone knows, under the pavements and streets in cities there is a jumble of cables and pipes for the layman. Most, if not all, of these cables and pipelines are part of the public infrastructure. They ensure that all homes can be connected to all important utilities. In addition to the direct residential connections that are usually located under the sidewalks, the central main network, such as the sewer, is usually located in the middle of the street. In order to avoid unwanted pipe or cable breaks during work, there is a clear overview of the various networks for most cities. To this end, a so-called KLIC notification in the Netherlands is made for each pipeline installation (https://klic-app.nl/nieuws/kabels-en-leidingen-kaart-nodig-doe-een-klic-melding/). However, the KLIC registration is not always accurate and/or complete. In that case, (expensive) test trenches have to be dug to see what is actually there and where.

With the intended natural gas-free nature of Dutch cities, an extensive pipeline system (of gas) will be able to disappear. However, this does not mean that there will be fewer pipes in the future. The natural gas network is likely to be replaced by a heating network in many neighbourhoods as part of the necessary energy transition. Using the available knowledge about the location of all pipes and cables, this new use of the subsurface is not such a big problem in itself, were it not for the fact that a traditional heating network requires a lot of space and that limitations in the subsurface greatly increase the cost price.

A traditional heating network works with relatively high temperatures (between 55 and 110°C depending on the situation). In order to limit heat loss as much as possible, this pipe system is wrapped in a large amount of insulation, which increases the total diameter of the central pipes as well as that of the residential connections. Especially these last meters require more space under the pavement. In addition, they also create potential problems associated with the supply of drinking water due to warming of the subsurface.

As is well known, the drinking water must not become too warm (safely below 25°C) because otherwise there is a risk of legionella. Because a traditional heating network works with a high temperature (even if there is good insulation), the ground in the vicinity of the pipe heats up slowly and these pipes must be at a certain distance from the drinking water pipes (the guideline is 1.2 to 1.5 m).

So far, a good solution to this problem has always been found, but with the generally rising temperatures in the urban area, the entire soil is heating up further and it is becoming necessary to increase the safety distance between the heating network and the drinking water network. This increases the complexity in the construction of a traditional (higher temperature) heating network. To a lesser extent, this also applies to the main network that lies under the street, but since there is usually more space there, there are less problems with regard to the desired distance. Moreover, due to the high temperatures, traditional district heating is carried out in (welded) steel pipes, making crossing existing infrastructure complicated (and expensive). In addition, breaking up the street (especially with asphalt) is also much more expensive than building it under a sidewalk or landscaping.

A 5th Generation District Heating and Cooling network (5GDHC) avoids a large part of the above problems because the temperature used in the distribution pipes is a maximum of 40 degrees (the so-called exchange part of the 5GDHC system). For heating, this is a lot lower than traditional heating networks, so the amount of heat released is less. Furthermore, since the temperature in the cold pipes for cooling of a 5GDHC system is between 10 and 20 degrees

Celsius, this temperature is under normal circumstances almost the same as the ground temperature.

In addition to the advantage of reducing the warming of the soil, the costs of constructing a 5GDHC network can be much lower. This is because - through local exchange and use of local resources and storage - not all energy has to be "pumped around" from a central point. The pipes can therefore be thinner and therefore the trench width when digging. In addition, cheaper (flexible) materials can be used, the thermal expansion is much smaller and these pipes can be laid more cheaply (under paving stones instead of asphalt).

However, the large cost difference occurs with regard to the traditional heating network because the construction of a higher temperature network requires a specific approach to prevent leaks during the operational period. Any repairs can also be a lot more expensive because high temperatures are used (including health and safety requirements) and specific expertise is required (welding methods, etc.). Even if there may not be enough knowledge about the specifications and associated costs of a 5GDHC and a ZLT (Zeer Lage Temperatuur, or very low temperature) exchange network, it is clear that these networks can be built from simple PVC pipes, which means that the material costs for this component can be very low.

In summary, a 5GDHC network or a ZLT exchange network not only has advantages in terms of better use of energy, but also does not contribute to unwanted heating of the ground and is cheaper to build than traditional heat networks. The lesser degree of warming of the ground may become very important for the drinking water companies (and therefore for everyone) in the near future. These benefits are often forgotten. To take advantage of these advantages, specific knowledge is often needed about 5GDHC and all its principles. XChains has this knowledge.