More efficient operation through temperature optimization

By intelligently regulating the addition from the return flow, the flow temperature in district heating networks can be gradually lowered. A nationwide first project of this kind started operation in October 2020 at Netzgesellschaft Niederrhein in Krefeld, Germany.

GRUNDFOS

Possibility in every drop

The disadvantages of high supply temperatures

District heating networks often operate with high supply temperatures above 100 degrees. The higher the supply temperature, the higher the heat losses, the risk of evaporation and the stress on the pipe system. For this reason, network operators have an interest in reducing the supply temperatures in order to counteract these disadvantages. However, this is often a problem in mixed networks which supply commercial and industrial consumers with much higher heating requirements as well as residential buildings. In these cases, a uniform supply temperature that suits the largest consumer is unnecessarily high for many other consumers in the network.

> **"Temperature optimization is an excellent way to further develop our district heating network in a future-oriented manner."**
>
> **Hans-Werner Leenen**, Managing Director
> Netzgesellschaft Niederrhein mbH

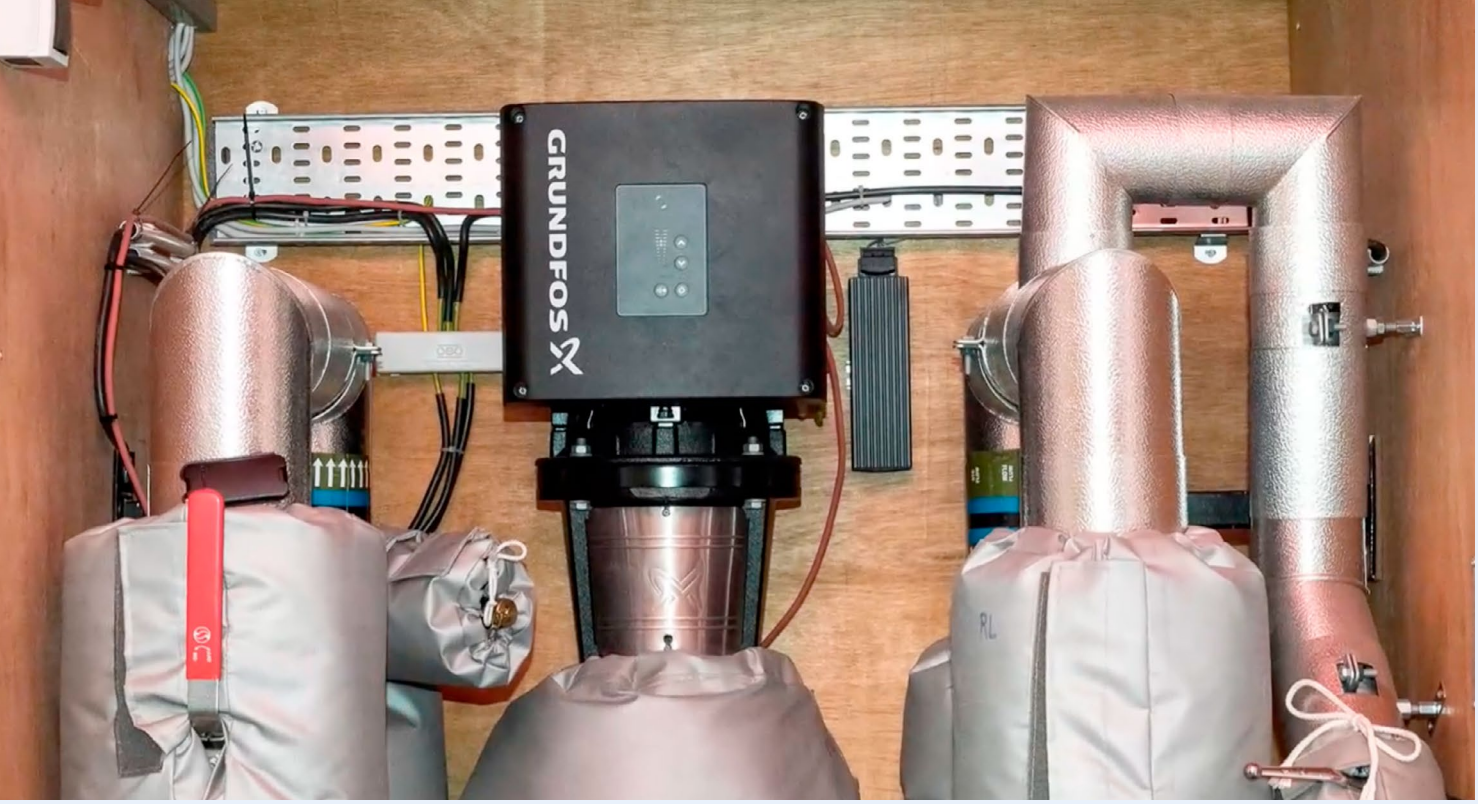
One solution is to set up different zones depending on the type and location of the consumers, which can then be operated as sub-networks with lower supply temperatures as needed. In 2019, Grundfos introduced a special temperature optimisation unit for this purpose, which can be used to reduce the supply temperature in the (sub-)network accurately using an intelligently controlled admixture from the return line. A system of this kind went into operation in Krefeld in October 2020 and was the first project of its kind in Germany.

Sub-network with an optimised temperature

The system is used in the district heating network of SWK Energie GmbH. As a 100% subsidiary of SWK Stadtwerke Krefeld, Netzgesellschaft Niederrhein mbH (NGN) operates networks for electricity, gas and drinking water as well as a 95-km district heating network, which supplies the centre of Krefeld and the district of Uerdingen, among other areas. The main source of heat is a nearby waste and sewage sludge incinerator, in addition to two heating plants and a combined heat and power plant. The network supplies around 1700 consumers and provides an output of 95 megawatts of heat on cold days.

Depending on the season, the network operates at a supply temperature of up to 120 degrees, but the operator would like to change this. "For us, lowering the supply temperature is an important way of operating our network more efficiently and it will allow us to connect additional heat sources in the future," explains Hans-Werner Leenen, Managing Director of NGN. "Feeding in process heat produced by local industry, for example, requires a supply temperature of about 90 to 95 degrees or even lower. That's why we are very interested in solutions that allow us to reduce the supply temperatures in the network with full security of supply for our customers."

NGN explored a solution of this kind in 2019 in meetings with Grundfos, which also involved district heating experts from the company's Danish headquarters. At the end of 2019, the operator then decided to use the Grundfos temperature optimisation solution initially in a pilot project covering only part of the network. It was easy to identify a suitable section of the network. "For the pilot project, a line that is connected to the main network via a branch pipe was an obvious choice," explains Tobias Kox from the Asset Management and Planning department at NGN.



"There is a shaft with various measuring sensors on the branch pipe, which meant that we were able to install the station there with relatively little effort."

The necessary civil engineering work took place in spring 2020. The installation of the system with the pipes, power connections and the cabling for the measuring equipment was delayed as a result of the COVID-19 pandemic. Just in time for the start of the heating season, the system went into trial and test operation at the beginning of October.

> **"We were able to reduce the supply temperature as planned and had no problems or customer complaints."**
>
> **Tobias Kox**, Asset Management and Planning
> Netzgesellschaft Niederrhein mbH

Admixture from the return flow

This section of the network in the Uerdingen district supplies a total of 35 consumers with heat. Customers in the mixed-use area include three schools, a supermarket and a number of houses and apartment buildings. The connected load is about 4.5 megawatts of heat. The temperature is lowered using the Grundfos temperature optimisation unit. This is installed between the main network and the relevant section of the network and connects the supply pipe with the return pipe. The return flow is routed through the unit and added to the supply flow by a temperature-controlled pump.

The temperature optimisation unit is fully equipped with the necessary components such as a pump, valves, temperature and pressure sensors and an intelligent temperature control system. The control unit determines the setpoints for the admixture on the basis of external parameters, such as the supply and return temperature, and by monitoring the system operating data. Grundfos offers the unit as a pre-assembled system, so that the station in Krefeld could be installed in a cabinet and connected to the hydraulic and electrical systems without a large amount of work.

Trouble-free operation

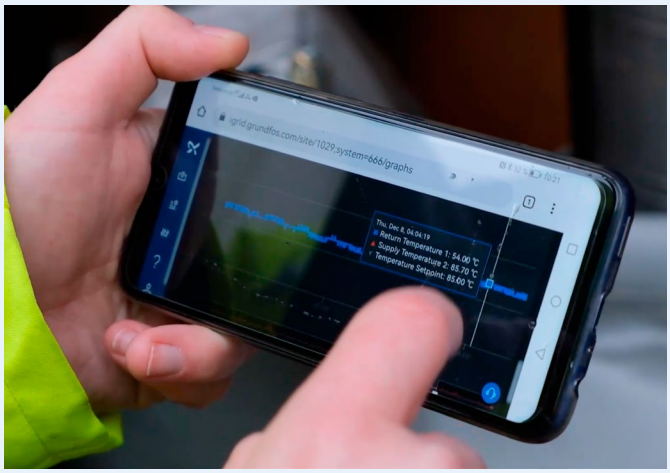
After twelve months of operation, including a complete heating season, the experience with the pilot plant has been positive. "We were able to lower the supply temperature from about 120 to 95 degrees during the heating season as planned and had no problems or customer complaints," reports Tobias Kox. "Even during a cold period in February 2021 when the ambient temperatures were very low, the supply with the lower temperature functioned without problems. During the summer, we were initially able to reduce the supply temperature from just under 100 degrees to 85 degrees, but a further reduction will certainly be possible here in the future."

The key to trouble-free supply temperature reduction is the intelligent control of the pump. "The challenge is to regulate the specified setpoint temperature as precisely as possible," says Tobias Kox. "In a complex district heating network, this is not straightforward because of the various disturbance variables, which is why, as expected, fine-tuning was necessary in the first few months. We have repositioned some of the measurement sensors and the Grundfos technicians have helped us to further optimise the control system. Ultimately, the aim was to provide the system with more information on temperature and pressure conditions in the network so that the pump can react more precisely when the water is added from the return flow."

Positive conclusion

"We are very satisfied with the results of the pilot project," says Tobias Kox. "In practice, a temperature reduction of up to 25 degrees with the appropriate fine-tuning is safe and problemfree, even in the winter when the demand for heat is high. A supply temperature which is permanently below 100 degrees allows the network to be operated more safely and efficiently, and in future we will also be able to feed heat sources with temperatures below 100 degrees into the network."

> **"In the future, we will also be able to feed heat sources at temperatures of below 100 degrees into the network."**
>
> **Tobias Kox**, Asset Management and Planning
> Netzgesellschaft Niederrhein mbH



Following the conclusion of the pilot project, NGN is already looking to the future. "This project is only the first step for us," explains Hans-Werner Leenen, Managing Director of NGN. "If our experience of the solution is positive in the long term, we will certainly optimise other sections of the network and also investigate feeding in other heat sources. At a supply temperature of 90 to 95 degrees, for example, we can feed in the process heat from a manufacturing company on site and initial discussions are already underway. Overall, we see temperature optimisation as an excellent opportunity to develop our district heating network here in Krefeld and to prepare for the future."

Significant potential

Grundfos believes that there is significant potential for similar projects in Germany. "District heating networks have usually evolved over decades, and the optimisation that is needed is often a major challenge," explains Thomas Gierlich, Senior Sales Developer CBS D-A-CH at Grundfos. "With the temperature optimisation unit, we can offer operators a straightforward way of setting up temperature zones and allow them to benefit from the changes quickly. This represents a good investment and makes a valuable contribution to the heating transition."

1124/CBS/40155647-Brandbox

Grundfos Holding A/S
Poul Due Jensens Vej 7
DK-8850 Bjerringbro
Tel: +45 87 50 14 00
www.grundfos.com

GRUNDFOS