Neckarpark Stuttgart: Heat from waste water

Sewage stinks and is filthy – but it is suitable for supplying heating and cooling to buildings. In Stuttgart’s new Neckarpark urban district, the energy in the municipal waste water is extracted by means of a trough heat exchanger in the sewage channel and utilised via a low-temperature local heating network. This provides the basis of the energy concept for the new district, which is being created with highly energy-efficient buildings on the brownfield site belonging to the former Bad Cannstatt railway freight depot.

As an alternative heat source for saving fossil fuels, waste water heat provides a particularly interesting option for municipalities because they have the sole right to utilise the waste water that accumulates in their area. To enable it to assess the possibilities for using waste water for heating and cooling in Stuttgart, the city commissioned a study. The analysis of the temperature in the aeration tank at Stuttgart’s main sewage treatment plant showed that even in periods of cold weather the temperature is at least 12 °C. The waste water, which flows with a speed of at least 1,300 litres per second into Stuttgart’s main sewage treatment plant, can potentially provide nearly 11 megawatts (MW) of heat output and around 17 gigawatt hours (GWh) of heat each year.

In summer it makes sense to utilise the cooling potential of waste water. For economic operation, the consumers should lie within 300 metres of the sewage channel. Based on these criteria, a waste water heat potential map for Stuttgart has been created. In addition to suitable sewers, the municipal buildings are also recorded as heat requirement points. Seven per cent of the sewers in Stuttgart are suitable for utilising heating and cooling energy.

In addition to determining the potential, since 2011 the city of Stuttgart has already realised two projects in individual buildings with an output of 490
Waste water heat potential map for Stuttgart. Based on the total length of the sewage network, seven percent of the sewage collectors are suitable for heating and cooling. © Landeshauptstadt Stuttgart

kW. In 2016 these are to be followed with the supply to the City Museum (160 kW) and the Katharinenhospital/Klinikum Mitte (400 kW).

Neckarpark energy concept

The new Neckarpark urban district, which is situated on the 22-hectare brownfield site belonging to the former Bad Cannstatt railway freight depot, includes approximately 450 apartments, hotels, as well as service-based and commercial enterprises. It is being realised with buildings which, thanks to the high-quality design of their building envelope and technical equipment, have only low energy requirements. Recently, other uses have been added such as a sports clinic, sports pool and a multi-generational centre. In addition, it is intended to supplement the supply area with two hotels. In conjunction with the resulting increased domestic hot water requirement, which makes up more than 50% of the overall heat demand, the adjustment of the primary energy factors carried out with the 2014 German Energy Saving Ordinance (EnEV 2014) makes a review of the overall energy requirements for the district necessary. Future developers were originally required to undercut the requirements of the 2009 German Energy Saving Ordinance (EnEV 2009) by at least 45% (KfW Efficiency House 55).

The realisation of the Neckarpark as a low-energy development would enable the supply temperatures of the planned heating network to be lowered to 30 °C or less. This in turn would enable the large-scale use of waste water heat. Various heat exchanger systems are capable of doing this: channel-integrated and as a bypass. In 2015, the city of Stuttgart opted to use a trough heat exchanger, i.e. a heat exchanger in the sewage channel with an extraction capacity of 2,100 kW. The operating requirement: The flow rate of the waste water must be sufficient enough to prevent or rinse away deposits. This requires a gradient of at least 0.1%. The energy in the waste water shall be withdrawn by the trough heat exchanger and fed into a low-temperature local heating network. The heat for heating domestic hot water shall be generated in a heating centre using a CHP plant. The heating network is designed as a 4-line network: a supply/return for low-temperature space heating and a supply/return for the hot water for domestic hot water heating. Such an optimised “heat supply/building” overall system, with the integration of renewable energies, could also be used for the extensive expansion of district and local heating in areas with low thermal densities.

The energy centre and heating network for the new urban district will be built in 2016. The waste water heat utilisation is scheduled to go into operation in 2018. Further information on the EnEff:Wärme project, entitled “New Neckarpark Stuttgart urban district: Local heating and cooling energy from waste water”, can be found at eneff-waerme.info.