Innovative System for Heat Recovery from Wastewater

Sewers – always available sources of energy
Schematic diagram of a ThermWin system with screen in a manhole and a heat exchanger and heat pump above ground (patent pending)

Typical Raw Wastewater Temperature during Dry Weather
A pair of heat exchangers and a heat pump at a wastewater treatment plant recovering wastewater heat for sludge drying

Energy is becoming ever more expansive and burning of fossil fuels accelerates global warming. Increased utilisation of renewable energy is the best solution to save fossil energy resources, reduce or avoid emission of carbon dioxide and slow down climate change. Heat recovery from wastewater for heating of buildings is possible and has become cost-effective. Wastewater has a substantial thermal energy potential. The question is: How can we recover this heat efficiently?

Close beneath our feet is a hidden source of energy that has remained virtually unnoticed in the past: domestic and municipal sewage. Generally its temperature is in a range between 10 °C and 20 °C all year round. Even during winter its temperature does not, or at most for a few days, drop below 10 °C. For this reason sewage is an excellent heat source for effective and economical operation of heat pumps. Recovery and use of this heat is cost-effective where large buildings and complexes are heated. The recovered heat can also be fed into existing or planned local heat distribution networks.

Heat can be recovered at wastewater treatment plants, preferably from their effluents. This is technically relatively simple, but wastewater treatment plants are often located remote from buildings that could be heated with the recovered heat. Heat recovery from treated wastewater is the best option where the treatment plant itself needs much heat, e.g. for sludge drying. Recovered heat can also be supplied from wastewater treatment plants to big nearby heat consumers, such as building yards, business parks or factories.

Alternatively, heat can be recovered from sewers and used for the heating of buildings in their proximity. In this case it is important to investigate the effect that cooling of the sewage could have on the operation of the wastewater treatment plant.

Present systems for sewer heat recovery use long and large heat exchangers that are installed on the invert of sewers. However, such systems can only be installed under certain circumstances. There are many structural and hydraulic requirements and constraints limiting installation of such heat exchangers in sewers. In many cases, where sufficient recoverable sewage heat is available and much heat is needed nearby, installation of such heat exchangers would be too difficult and expensive. Our Huber ThermWin Solution is an excellent alternative and opens a far wider field for sewer heat recovery.

The basic concept of our ThermWin Solution is that heat exchange does not take place within sewers, but remote from sewers, even above ground. We divert wastewater from the sewer and pass it through a screen for removal of course solids. Screened wastewater is then pumped through an external heat exchanger. The removed screenings are returned into the sewer, as is the wastewater after its passage through the heat exchanger. Screening of the wastewater is essential to prevent clogging and blocking of the heat exchanger and to permit use of a rather compact and inexpensive heat exchanger. Operation, maintenance and service of the system are easy because all components, the screen as well as the heat exchanger, are located outside of the sewer and are easily accessible. This feature is most important for the operators.

Operation of our ThermWin system are described as follows: A portion of the wastewater flows from the bottom of a sewer through a valved connection into the screen basket of a vertical screen ROTAMAT® RoK 4. Coarse solids are retained in the screen basket and then removed and lifted through a vertical pipe with a screw. At the upper end of the vertical pipe the lifted screenings slide down over a chute and drop back down into the sewer from another connection near its crown level. The screened wastewater, after it has been
pumped through a compact heat exchanger and has been cooled, is returned to the chute and flushes the screenings back down into the sewer. The returned cooled wastewater and the screenings continue their way down the sewer.

Our ThermWin Solution offers many benefits; the most important thereof are explained hereafter:

1. **Quick and easy construction**
   Only a manhole next to a sewer needs to be constructed underground. The sewer remains virtually unaffected throughout construction and installation. No deviation of sewage is needed. Ground water drainage, if necessary, is limited to the short manhole construction period.

2. **Easy and inexpensive installation**
   The heat exchanger is installed next to the heat pump and a heat storage tank in a building that is located near the heat consumers. The screen is quickly installed in the manhole and can be lifted out by use of common lifting gear.

3. **Compact, inexpensive and easily accessible heat exchangers**
   Heat exchangers for the cooling of screened wastewater are comparatively compact and inexpensive. Due to turbulent flow, their heat transfer coefficient is good. In addition, they have a far lower volume / heat exchange surface ratio. And the heat exchangers are easily accessible, which facilitates cleaning.

4. **Minimized heat losses**
   Hot water pipes between heat exchanger and heat pump are very short. Heat losses of compact and well insulated heat exchangers are negligible.

5. **Independent from sewer size and shape**
   Since no component of the system needs to be installed in sewers, there are no constraints by sewer size and shape. Only two connections are drilled through the sewer wall.

6. **Simple control strategy**
   Depending on heat demand and wastewater temperature, the wastewater flow through the heat exchanger is controlled by a pump. This flow is independent from the wastewater flow in the sewer.

7. **Limited heat exchanger fouling**
   Growth of bio-films is unavoidable on surfaces that are exposed to wastewater. Bio-films can reduce heat transfer coefficients by over 50%. However, turbulent velocities in the heat exchanger and high shear forces keep bio-films thin.

8. **Easy maintenance**
   Since our heat exchangers are installed in a building, no costly and dangerous inspection, maintenance and repair work within sewers is needed.

9. **Quick implementation**
   So far unused sewer heat is available in close proximity to potential consumers. Fast construction and installation permit quick tapping of this source.

10. **Reduced use of fossil fuels**
    Generation of 1 kWh of heat in a boiler needs about 1.15 kWh of fossil energy. The same heat is made available with the heat pump consuming 0.2 to 0.3 kWh of electrical power which is generated in a power station from around 0.5 kWh of fossil fuel. Savings of fossil fuel are thus 50% to 60%. If power/heat cogeneration or regenerative power were used, savings would be even higher.

11. **Cost-effectiveness**
    Thorough cost calculations for big heat consumers, such as big buildings or sewage sludge dryers, have shown that heat recovery from wastewater is often cost competitive in comparison with conventional heating.

12. **Environment and climate protection**
    Heat recovery from wastewater is a step toward reaching the new European goals for the reduction of greenhouse gas emissions and increased use of renewable energy. Wastewater should no longer be considered as waste, but as a valuable resource. With more sophisticated technology, wastewater energy can not only be reused for heating in winter, but also for cooling in summer. It can thus be used all year round. Almost anywhere domestic, commercial or industrial wastewater is not far away where heat is needed. This heat source is available within cities and towns, where most heat is needed. Heating of large buildings or of their hot water systems, e.g. of nursing homes, hospitals or schools, is as feasible as feeding recovered heat into local heat distribution networks. Our ThermWin system offers an innovative solution for recovery and reuse of heat from municipal sewers.

Related Products:
- Energy from Wastewater

Related Solutions:
- Wastewater Heat recovery: HUBER Solutions for Local and Short Loops