Sewer Thermal Heat Recovery Systems

Purpose

The purpose of this fact sheet is to describe regulatory requirements and provide guidance for projects to recover heat energy from the sanitary sewer collection system. These projects use technology, like heat exchangers and heat pumps, to repurpose energy from wastewater conveyed in the sanitary sewer collection system for heating and cooling.

No sewer heat recovery system projects have been submitted, but a few are being considered. This document is intended to provide interim guidance for those projects as they move through project development and planning. As with any new concept applied to wastewater facilities, these recommendations may change as project details are defined.

The use of heat pumps for heating and cooling is not new. Geothermal systems using the earth as the heat transfer medium, are quite common. In recent years, heat recovery projects using wastewater from the sanitary sewer collection system have been gaining interest for energy conservation.

The focus of this document is for systems that would be owned and operated by an entity who is not the collection system or wastewater treatment plant (WWTP) authority. Examples of these systems typically include an off-line heat exchanger that draws water from the collection system, circulates it through a heat exchanger and returns the water to the collection system.

The factsheet can also be used to help develop a heat recovery project at a WWTP, but those projects will need to go through the processes defined in the National Pollutant Discharge Elimination System (NPDES) permit for construction at the facility.

The Minnesota Pollution Control Agency (MPCA) strongly supports energy conservation and efficiency provided it does not adversely impact the transport or treatment of the wastewater.

Permits and approvals

Sewer thermal heat recovery is a new concept but fits within the existing NPDES permitting framework. Existing NPDES permits can address these types of systems similar to the pretreatment program. The authority already exists for the WWTP to control users of their system and a sewer heat recovery system could follow that same model. A sewer heat recovery system can be handled much like a significant industrial user and would not require additional rule making or a separate MPCA permit.

In accordance with Minn. R. 7049.0120, Subp. 24(A)(2), the MPCA or local control authority may designate sewer heat recovery systems as a significant industrial user (SIU) if it is determined to significantly impact the treatment system.

An NPDES permit modification is not required to install a sewer thermal heat recovery project in an existing wastewater collection system. A sewer thermal heat recovery system does not appear to be a risk to the collection system or WWTP provided the owners of the collection system and WWTP adequately control the user to prevent impacts to the collection and treatment system. All permitting and regulation of sewer heat recovery systems are handled by the local authority through an individual control mechanism or a pretreatment like agreement to define the roles and responsibilities of each party.

An evaluation of the impacts to the treatment process should be completed to determine the impacts to the collection and WWTP. If it is determined that there are potential adverse impacts to the wastewater collection

and treatment system, specific requirements should be included in the control mechanism, or the project may be denied. The individual control mechanism defines the roles and responsibilities of each party.

As an example, King County, Washington has a program for sewer heat recovery that is similar in nature to a pretreatment program and enters into a formal agreement with the user of the wastewater from their collection system.

Local permits and approvals

The receiving collection system and WWTP shall issue permits, contracts, or other individual control mechanisms, much like in the pretreatment program, to assure that the heat recovery system doesn't cause problems in the collection system or at the wastewater treatment plant. The following should be considered:

- City/collection system owner – permission and conditions to remove and return sewage from their collection system.
- Receiving WWTP – permission and conditions related to impacts to the treatment facility.
- Any other local building permits that may apply for construction of the sewer thermal heat recovery facility.

Submittals to the MPCA

It is the collection system and WWTP responsibility to regulate the discharges from users of its treatment and disposal system. They shall prevent any pass through of pollutants or any inhibition or disruption, including temperature, of the collection system, treatment processes, sludge processes, or disposal that contribute to the violation of the conditions of their permits or any federal or state law or regulation limiting the release of pollutants from the Publicly Owned Treatment Works (POTW). [Minn. R. 7049.0100]

The permittee should do the following when considering a heat recovery project:

1. Any proposed projects for sewer thermal heat recovery shall be reported to the MPCA engineer assigned to the WWTP before construction begins. Preferably, the MPCA should be included in the planning stages of a project. Assigned staff can be found here.
2. A copy of any control documents (permits, contracts, agreements, etc.) shall be submitted to the MPCA.
3. Plans and specifications shall be submitted to the MPCA prior to construction.
4. An evaluation of the heat loss impacts to the collection and treatment system.
5. A discussion of treatment required (grit, screening, etc.) prior to the heat recovery system and how any removed material will be disposed.
6. Estimates of energy use of the sewer thermal recovery system and savings from heating and cooling costs.

System design recommendations

The following are recommendations for the design of wastewater heat recovery systems:

1. The transfer of heat shall be limited to not impact the collection, transport, or treatment of the wastewater.
2. The collection system shall be protected from damage or increased operation/maintenance during construction and operation.
3. All wastewater removed from the collection system must be returned to the collection system. No release of wastewater shall be allowed. Any release outside of the collection system or heat recovery system must be reported to the Minnesota Duty Officer.
4. Systems should be of a "closed loop" type where the wastewater remains within pipes at all times. Other methods for heat transfer may be considered, but additional controls may be required to assure no wastewater is released from the system. Heat transfer equipment should not be placed within the operating collection system to prevent the collection of debris that could cause operation problems.

5. Heat transfer mediums shall not be discharged to the collection system unless expressly allowed by the local authorities.
6. Provisions shall be included to address high flow events in the collection system to prevent the release from or overloading of the heat recovery system.
7. Any material removed from the wastewater, such as screening or grit, shall be disposed of in accordance with state rules and regulations. These materials may be returned to the collection system if it is determined by the local authorities to not cause issues in the downstream system.
8. Systems should be designed to limit the potential for human exposure to wastewater. Steams, mists, spray, or other exposure to the wastewater during normal operation should be limited.
9. Systems shall be equipped with controls and alarms for remote monitoring of the operation of the system.
10. Odor control should be considered.

Monitoring and reporting

The sewer thermal heat recovery owner or operator shall report annually to the collection system, wastewater treatment plant and MPCA on the performance of the system. The report shall include, but not be limited to:

1. The volume of wastewater diverted from the collection system and returned to collection system.
2. The impacts of wastewater temperature on the overall treatment and operation of the collection and treatment system.
    a. The temperature of wastewater diverted from the collection system and returned to collection system.
    b. The temperature of the wastewater entering the WWTP.
3. The amount of heat, power, or electricity produced and cost savings relative to other heating and cooling systems. This should include the cost to operate the system versus the energy savings realized.
4. The amount of material (grit, screening) removed from the system and how disposed.
5. An inventory of sewer heat recovery systems shall be reported in the pretreatment annual report.
6. Any releases, incidents, or operation issues encountered.

If you are considering a sewer thermal heat recovery project, contact the MPCA engineer assigned to the WWTP to discuss the project and any issues or concerns. Assigned staff can be found here. It is best to keep the MPCA involved starting with the planning phase of a project.

Additional resources

King County, Washington sewer heat recovery
https://kingcounty.gov/en/dept/dnrp/waste-services/wastewater-treatment/resource-recovery/sewer-heat-recovery

King County, Washington design standards, user agreement, application form
https://kingcounty.gov/en/dept/dnrp/waste-services/wastewater-treatment/resource-recovery/sewer-heat-recovery/potential-users

Denver Metro Thermal Energy Recovery
https://www.metrowaterrecovery.com/innovations/heat-recovery-program/