

Drain Water Heat Recovery System

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Abstract

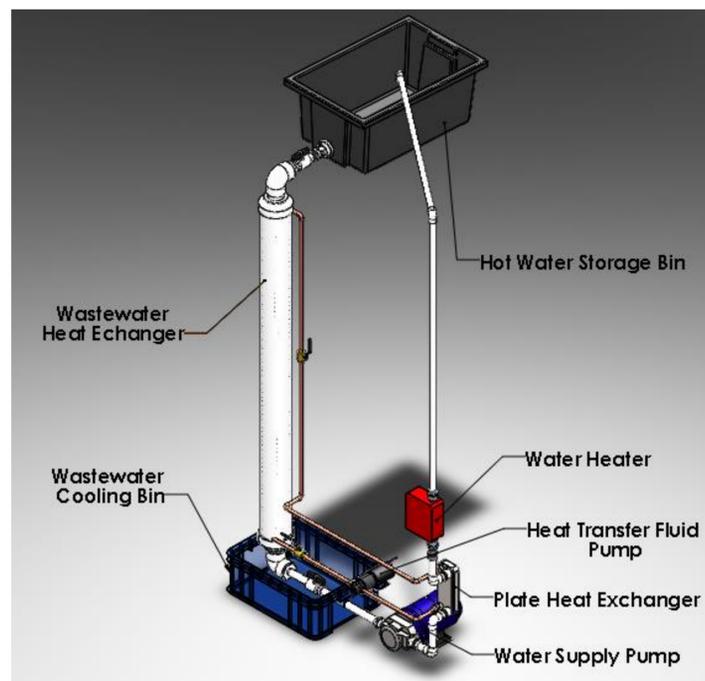
The Drain Water Heat Recovery System (DWHRS) is designed to raise the efficiency of a residential building's water heating system. The device captures heat from drain water as it flows through a residential building's drainpipe and into sewer. The system then applies that collected heat to the incoming fresh water before it enters the building's water heating system. With the incoming water preheated to a higher temperature than when it first entered the building, the water heating system will use less energy to further raise the water's temperature. The design of the DWHRS addresses the drawbacks of currently available heat recovery systems, and it is designed to be compatible with Chicagoland's least efficient buildings; prewar multifamily buildings.

Introduction

The targeted demographic of The Drain Water Heat Recovery System is pre-war multi-family housing units located within the city of Chicago. A "pre-war" building is any building that was constructed before 1942. Buildings that were constructed during the pre-war era were not designed to be energy efficient which leads to them having a higher energy consumption. Daily, a single unit in a multi-family building produces 12,129.73 KJ of heated water which passes through the waste drain. The entire Chicagoland area produces 6,066,199,268 KJ of heated water that passes through building's drainpipe.

Methods and Materials

- Wastewater Heat Exchanger (WWHE)
 - Transfers heat from drain water to the heat transfer fluid.
 - Designed by Team 57.
- Compact Plate Heat Exchanger
 - Bell & Gossett BP400-LP.
 - Exchanges heat between heat transfer fluid and fresh water.
- Heat Transfer Fluid (HTF)
 - Dynalene HF-LO.
 - Found to be a compatible fluid based on simulations of the WWHE.
- Water Supply Pump
- HTF Supply Pump
- Water Heater
- Hot Water Storage
- Water Cooling Bin



Results

- The DWHRS prototype can raise incoming water temperature by an average of 22.74 ° C (40.93 ° F).
- For our profiled building, an estimated 67.925 MJ of heat is saved on an average day. This equates to \$2.96 on energy costs.
- For a single unit : 15.6 cents daily
- For all prewar housing in Chicago: \$77,971.42 daily.

Conclusions

Pre-war buildings are the focus of this design project due to their poor performing water heating systems. The energy consumption is extremely high which leads to high cost in power for the water heater. The Drain Water Heat Recovery System can recover an average of 54.5% of available heat and has the potential to save the Chicagoland's prewar multifamily housing 28.5 million dollars on energy each year. Extensive work was put into this design. However, due to the COVID-19 outbreak, an actual prototype was not able to be assembled. Instead, computer aided design software was used to complete this project.

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