RenewABILITY ENERGY INC.

POWER-PIPE®

Drain Water Heat Recovery Saves Energy In University Kitchen

Summary

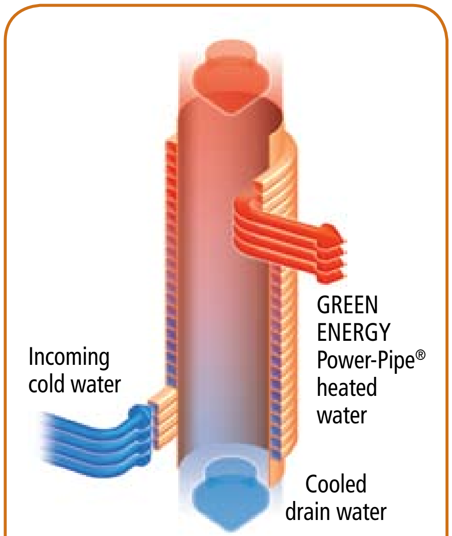
A Drain Water Heat Recovery system was installed in one of the kitchens in the Hart House building at the University of Toronto. The system was designed to reduce energy consumption of a flight type dishwasher by using a unique type of heat exchanger specifically designed for wastewater heat recovery. A key advantage of the system is that it is approved for use with potable water, allowing the heated water to come indirect contact with food or in this case, to be used in the final dishwasher rinse cycle. While the system has only been in operation for a short period is has surpassed expectations. With the low University energy costs, **the estimated annual savings is $1,225, resulting in a payback period of 3.7 years**.

Project Objective

The dishwasher uses domestic hot water (typically at 49C) to feed its final rinse cycle and increases the temperature of this water by passing it through a steam booster. The central steam plant of the university produces this steam. The purpose of the system is to economically save energy and reduce GHG emissions. The Power-Pipe® system design called for preheating domestic cold water and feeding it to the final rinse cycle instead of domestic hot water. Energy savings are achieved by: **reducing (eliminating) domestic hot water consumption and by reducing steam consumption**.

The Situation

The dishwasher operates on average <u>110 minutes per day</u>, 365 days per year – this is recognized as being a <u>short</u> daily operation schedule for a flight type dishwasher. The drainwater flow from the rinse cycle is consistently 4.8 ugpm at a temperature of 80-85C. The fresh water has an annual average temperature of 10C resulting in an average required temperature rise of about 70C.



How It Works

Based on the falling film phenomenon where water flowing down a vertical pipe clings to the inside surface, the Power-Pipe® heat exchanger efficiently recovers heat from the Drain Water stream without clogging or fouling. An "allcopper" construction ensures high heat transfer rates and minimal maintenance requirements. The Power-Pipe heat exchanger is double-wall and vented with no internal welds ensuring there is no chance of cross contamination.

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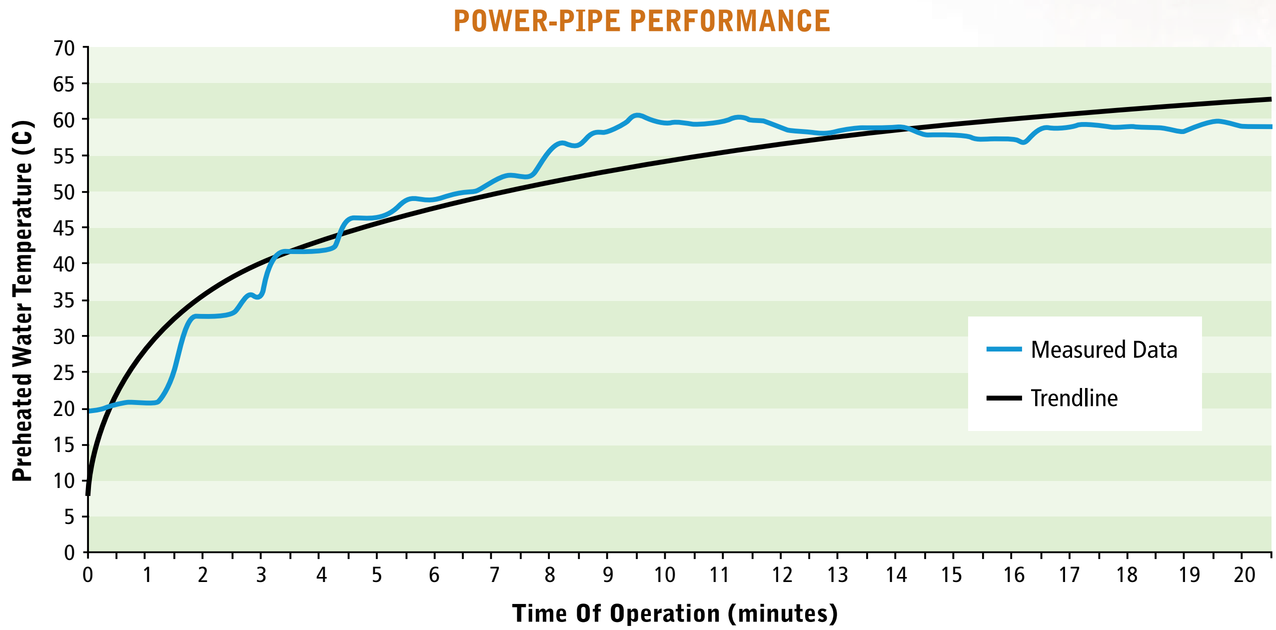
PERFORMANCE

Power-Pipe® Performance

The feed water temperature was measured using a datalogger with a probe inserted directly into flow entering the dishwasher. When the rinse cycle starts, there is an initial drop in temperature as fresh water circulates through an unheated Power-Pipe®. The temperature drops to the feedwater temperature for about 30 seconds after which time it rapidly begins to increase in temperature. The temperature of the feedwater increased 13C in 2 minutes and continues to increase at slower pace. The temperature tended to plateau at 52C although when a longer dishwashing cycle was measured, the temperature peaked at 60C. It is important to note that the temperature would reach 40C in about 3.5 minutes; this is the typical domestic hot water supply temperature in restaurants and cafeterias.



Economics

The total installed system cost was $4,505CAD. This includes the Power-Pipe® heat exchanger, piping and labour. Originally a Power-Swirl fitting was specified to further increase performance but it could not be included because the inlet drain pipe diameter was too large.

The savings is greatly dependant on how the dishwasher is used as longer washing cycles result in higher feedwater temperatures as can be seen in the chart above. For example if the dishwasher were to run for 3.5 hours/day then the simple payback would be about 1.2 years.

However, if we take a conservative view, the system is estimated to save the equivalent of 152 GJ/year representing an annual savings of about $1,225CAD and a simple payback period of 3.7 years. It should be noted that the internal university cost for energy in the form of steam is $8/GJ, which is exceptionally low. If the water were heated using natural gas, the annual savings would be $1,552CAD giving a simple payback of 2.9 years. The energy savings represent a reduction of 7.7 tonnes/year of CO2 emissions per year.

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