Determining pump efficiency using thermodynamics and computer generated models

Overview
KCF Technologies requires a method to measure pump efficiency by measuring the temperature and pressure differential. They currently have a means of determining differential pressure, and are interested in finding a way to measure differential temperature compatible with their current technology. Additionally, KCF Technologies wants to find the efficiency of a Penn State Building’s pumping system.

Objectives
Thermistors were used to measure the differential temperature across a pump. One Pt 100 thermistor was placed at both the suction and discharge sides of a pump. TinkerForge bricklets, coded using Python, converted and sent the data to a wireless KCF Technologies sensor, or a connected computer. To determine the pumping system’s efficiency, the modeling software PIPE-FLO was used. The model was created using a drawing submitted by Penn State’s OPP, as well as various fluid and element parameters.

Approach
Differential Temperature Project:
- A thermistor, the Pt 100, was selected based on sensitivity.
- The TinkerForge Bricklets were researched and ultimately purchased.
- The bricklets were programmed using Python.
- The thermistors were implemented in the bricklet system, tested, and calibrated.
- A housing for the bricklets was designed in SolidWorks and built using additive manufacturing.
- A thread adapter was manufactured in the Penn State Learning Factory.
- The thermistors were inserted into the inlet and outlet sides of a pump in Steidel.
- The system was tested and data was collected while the pump running, as well as off.

Pumping System Modeling Project:
- Toured the Penn State Building and discussed situation with the Site Manager.
- Contacted Penn State’s OPP to obtain construction drawings and submittal values.
- Attended PIPE-FLO Webinars, and created a PIPE-FLO model of the pumping system.
- Continually added more complexities as information was presented.
- Validated the model by comparing results to operational data.

Outcomes
- KCF Technologies can use the TinkerForge technology to find pump efficiency using differential temperature.
- The Penn State Building’s HVAC system is found to be working efficiently. The components with the biggest deviations between model calculations and operational data are the heat recovery coils.