Cooling Water Reliability Study Addresses Recurring Equipment Replacement, Saving Estimated $800K Annually

AFT FATHOM™ CASE STUDY

Chemical and Petrochemical

PROBLEM

Avinashkumar Karre, Principal Process Engineer with Worley, performed a reliability study on a problematic cooling water system (Figure 1).

The system faced a flow imbalance, with some consumers unable to meet duty requirements limiting production. Other consumers received excess flow, resulting in high velocities with accompanying vibration and equipment erosion. The system's two parallel pumps operated at high flowrates far from the pump's Best Efficiency Point (BEP) (Figure 1.1).

Erosion on piping, tube bundles, and pump impellers required replacement every 4 years, with $2.16M in associated costs and downtime. Addressing the system's issues had been pending for 15 years, and the project had a challenging schedule due to a short shutdown window.

ANALYSIS

Karre first built and calibrated an AFT Fathom model to within 5% of field measurements. Complex heat exchanger components were modeled based on measured pressure loss data (Figure 1.2).

This 'base model' confirmed the poor flow distribution, but also revealed other issues including cavitation and poor control valve operation. Problematic high velocity areas were identified automatically using Design Alerts, ensuring any modified design kept all flow velocities below 12 ft/s (3.6 m/s).

Karre's 'modified' design added restricting orifices and downsized select piping to improve flow balance. Karre could easily compare the 'base' and 'modified' model results, which also enabled an overall cost analysis for the proposed improvements.

"The systematic design approach developed using the base AFT Fathom model is being used across all American and global projects to benefit customers."

- Avinashkumar Karre, Worley

SOLUTION

The additional pressure loss from the recommended layout improved pump operation, increasing efficiency from 55% to 85% (Figure 1.1). The associated energy reduction saved an estimated $287K per year, cost savings which are further improved by fewer impeller replacements.

The proposed design further eliminated operating issues including pipe cavitation and re-sized control valves had improved operating ranges. By addressing the root issues, the client could avoid replacement equipment and associated downtime for repairs.

Karre mentioned the knowledge and approach from this study has been presented at several international industry conferences. The approach now serves as a basis for oil and gas, refining, and chemical projects from different operating companies across US and global projects.

System Location:
United States

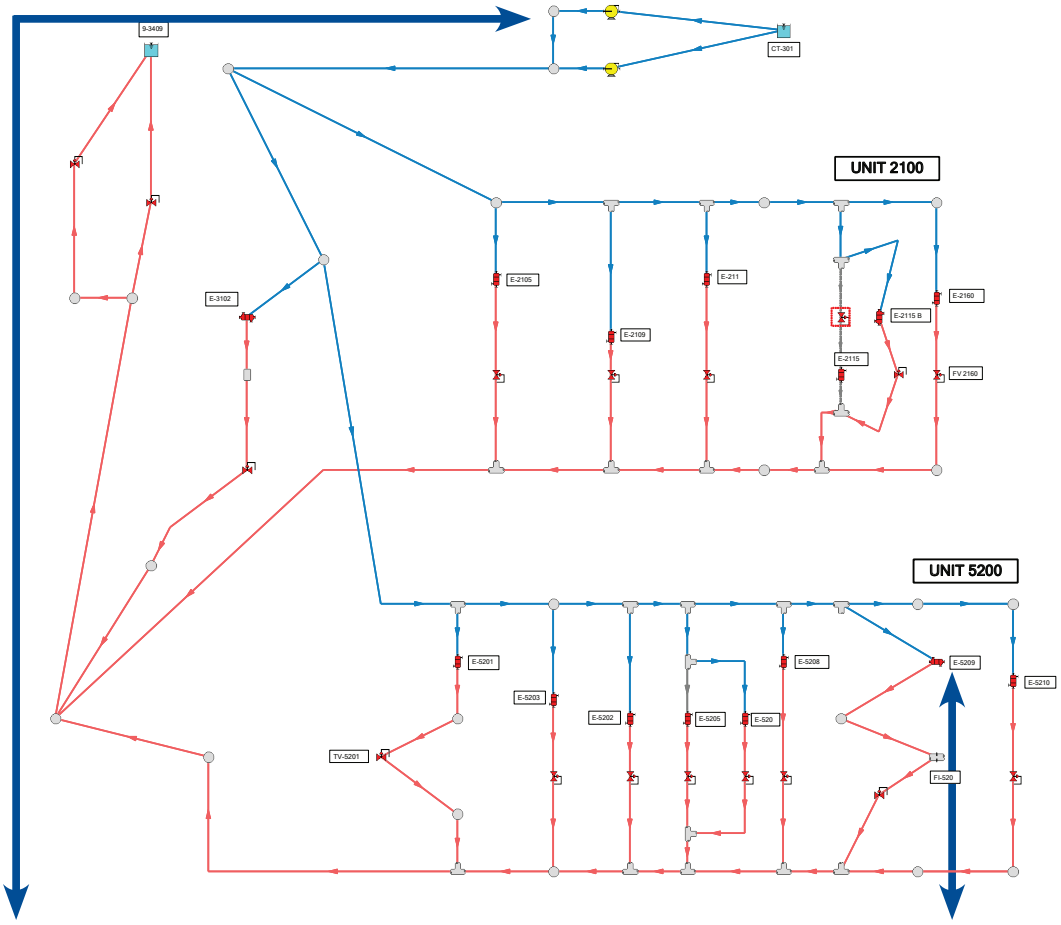
Worley
energy | chemicals | resources

ELEMENTS OF SUCCESS

Karre's concise solution to build, calibrate, and modify a flow model to address common operating issues serves as a model example of software-based flow analysis. The distribution of his work as a standardized approach further justifies Karre's Platinum Pipe Award Honorable Mention.

FIGURE 1

Workspace view of cooling watyer system, balancing flow across 14 consumers.



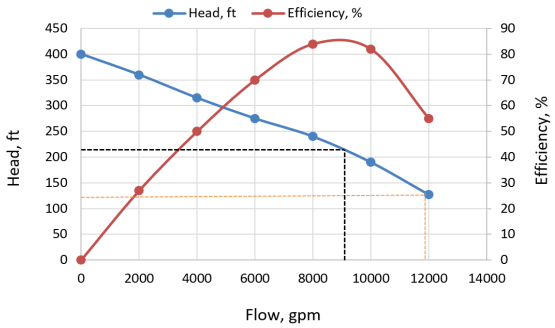


Figure 1.1: Pump efficiency improved from 55% to 84% by reducing flow through the pump

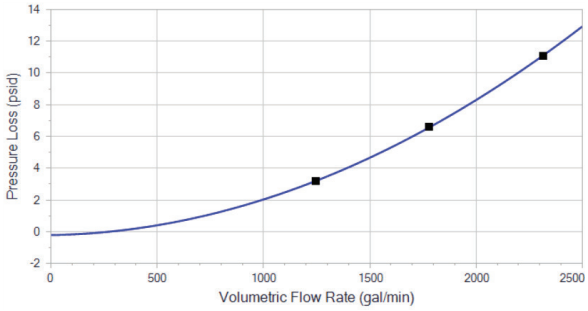


Figure 1.2: Heat Exchanger resistance curve developed from field measured pressure loss data