BEP Pump System Optimization Study of a Canola Oil System

Manufacturing

Applied Flow Technology

? PROBLEM

Ishwar Dhere, Process Engineer with Stantec Resourcenet India was tasked with analyzing estimated pump head, normal operating line velocities, and pressure analysis for a new canola oil processing system.

The system consists of multiple pumps, atmospheric tanks, vacuum tanks, hydrodynamic reactors, heat exchangers, centrifugal separators, bleaching and basket filters, strainers, mixers, and control valves.

! SOLUTION

With the initial analysis in AFT Fathom completed, it was evident that velocities and pressure drops across the pipes in several areas, particularly in the separator subsystems, exceeded design criteria for the centrifuges. These pipes were changed from 3-inch pipes to 4-inch pipes in a revised design.

Using larger pipes in this area (Figure 1) reduced flow velocities from 2.8 m/s (9.2 ft/s) to 1.6 m/s (5.2 ft/s) (Figure 2). The revised design was modeled, and head rise requirements from these results were used to identify appropriate pumps for the final system. The final design refines approximately 100 m^3 (26,000 gallons) of canola oil per hour.

AFT Fathom revealed that velocities and pressure drops in several areas, particularly the separator subsystems, exceeded design criteria for the centrifuges, leading to a new design with revised line sizes.

ANALYSIS

The entire proposed system was modeled inside of AFT Fathom in steady state as ten subsystems to determine how the system would operate and identify problem areas. A Navisworks 3D model of the proposed canola oil system was used as a reference for inputting pipe lengths and fittings in Fathom, with all pipes specified as ANSI Schedule 40 Stainless Steel.

Flowrates for nine pumps were determined by process engineers and modeled as positive displacement pumps to calculate head rise requirements. To represent a worst-case scenario for the pumps, supply tanks were modeled at their minimum pressure or liquid level and discharge tanks were modeled at maximum pressure or liquid level except for the tank for the fully refined canola oil, which was assumed to be 80 percent full.

Pressure drops for heat exchangers, centrifuges, and mixers were assumed, and pressure drops for flow meters, bleaching filters, basket filters, and strainers were specified using external estimates. The hydrodynamic reactors are sensitive to cavitation and thus the pressure at the reactor subsystem discharge was required to be 400 kPa (58 psia).

Stantec

Platinum Pipe Awards Honorable Mention: Most Interesting Model

ELEMENTS OF SUCCESS

The complexity of the modeled system, the effective use of pump sizing practices, and design revisions due to AFT Fathom results earned Dhere an Honorable Mention for the Most Interesting Model.

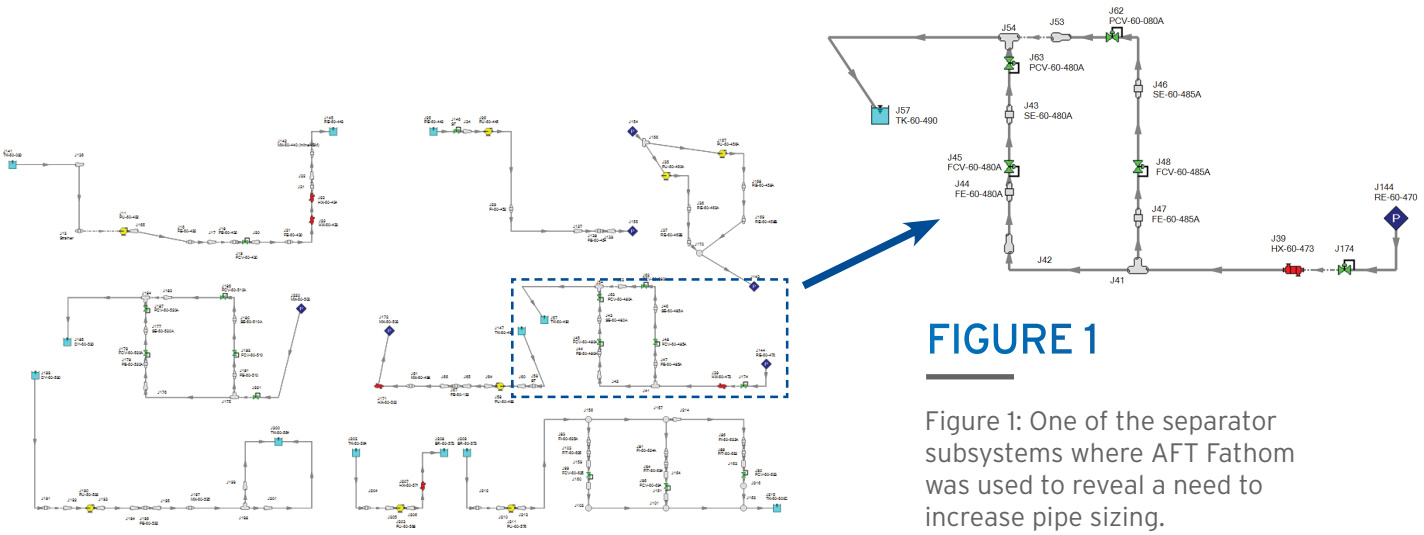

FIGURE 1

Figure 1: One of the separator subsystems where AFT Fathom was used to reveal a need to increase pipe sizing.

FIGURE 2

Figure 2: The revised design increased line sizing in a centrifugal separator subsystem (Figure 1) which brough flow velocities within design requirements and yielded pressure drop benefits.