Emissions Control System Energy Reduction with AFT Arrow

Power Generation

PROBLEM

An emission control system was being redesigned by Orbital Engineering, Inc. to incorporate Variable Frequency Drive (VFD) fan systems to improve system efficiency in light of rising process demands.

The existing design consisted of two 7,500 hp (5,600 kW) damper-controlled fans, two baghouses, and two spray dryer absorbers. When the system was constructed, one of these flow paths was intended to serve as a standby system, but increased process demands led to both subsystems being used concurrently and fully utilizing maximum installed capacity at times.

SOLUTION

The AFT Arrow model was used to identify the configuration with the greatest energy savings across system states. Simulation results showed that the VFDs allow the system to operate at reduced RPMs with dampers fully open, minimizing the flow resistance across the dampers to improve system power consumption.

Energy savings varied by design and operating conditions, with the introduction of VFDs provided a range of power consumption savings of 1,030 to 2,820 kW, an efficiency improvement of 12 to 37 percent. For average flow conditions, this savings was in the range of 2,060-2,540 kW, or 25-30 percent (Figure 2).

"The AFT Arrow model was used to identify the configuration with the greatest energy savings across system states."

-Mike Dominik, Oribtal Engineering, Inc.

ANALYSIS

The exhaust treatment system was modeled from just upstream of the flue gas dry spray absorbers to the exit of the exhaust from the stack to atmosphere. The system components modeled were two parallel paths of ducting, the two absorbers, baghouses fan dampers, induced draft fans and motors, and exhaust stacks (Figure 1). Fan dampers were modeled using measured inlet pressures and fans were modeled using manufacturer-provided pressure and efficiency curves.

505 days of field data was used to calibrate pressure losses in a model built by secondary consultant, Purple Mountain Technology Group. Scenarios included the minimum day, average day, maximum fence line vacuum day, and maximum flow day. The AFT Arrow Goal Seek and Control Module was used to match model pressure drops to system pressure measurements by varying the friction design factor used for all ducting. These calibrated scenarios provided strong agreement to energy consumption data within a 2-7% error for various operating conditions.

After calibrating frictional losses to match field data, the operating conditions listed previously were modeled for four permutations of VFD configurations using new or existing baghouse bags and new or existing baghouse bags.

orbital ENGINEERING, INC.

ELEMENTS OF SUCCESS

The energy savings combined with the amount of validated field data data used to calibrate the model earned Dominik the Platinum Pipe Award for Correlation to Test/Field Data.

FIGURE 1

Figure 1: A system diagram of the power plant exhaust treatment system and corresponding AFT Arrow model.

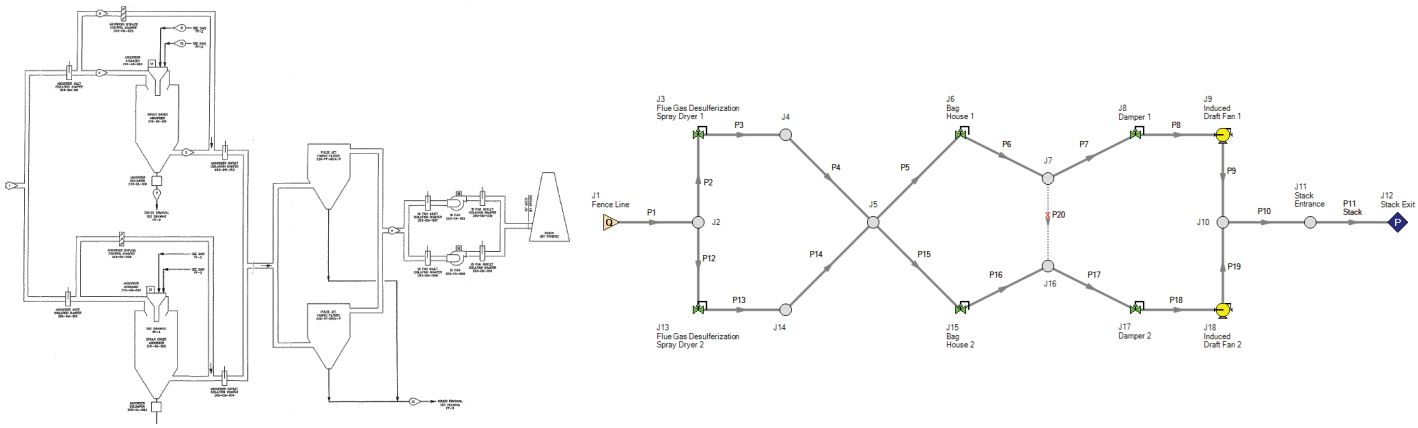

FIGURE 2

Figure 2: A comparison of total fan power consumption and fan speeds with and without VFDs, and with new or existing bags and motors.