CASE STUDY: Systems Boost Engine Availability

Background & Challenge

A midstream processor of raw natural gas uses large-bore, slow-speed integral engines for compression during gas processing. The company had repeated head and power cylinder failures, resulting in costly maintenance and production downtime. They tried to maintain adequate performance using manual balancing. However, manually balancing an integral engine is a potentially hazardous, time-consuming process. It is often performed at inadequate intervals to compensate for changes in compressor load, process parameters, ambient condition or variations in BTU fuel content.

Response

To improve performance and availability, the processor turned to Windrock's Platinum online system and AutoBalance® system. The patented AutoBalance® system continuously balances the engine load across all cylinders using peak firing pressure data from the Platinum system. During operation, poor combustion quality was identified in a cylinder (see high peak firing pressure angle deviation in Figure 1). An increase in this parameter indicates the cylinder is not firing consistently from cycle to cycle, resulting in excessive wear, poor fuel economy, and increased emissions.

Based on the warning and data review, the unit was shut down and pre-combustion chambers were examined. The existing pre-combustion chamber port was found to be significantly worn (Figure 2), resulting in poor combustion since the flame front from the pre-combustion chamber does not propagate through the air/fuel mixture in the cylinder as designed.

Results

After replacing the pre-combustion chamber and restarting the unit, pressure curves for the cylinder were compared (Figure 3). These plots include the "stat boxes" that represent the maximum deviations and the standard deviations of both the peak firing pressure and the crank angle at which the PFP occurs over a 30-cycle average. The stat box improvement signifies the cylinder is now firing consistently.

Figure 4 shows how the fuel system was compensating for the poor pre-combustion chamber performance with the valve position. After repair, the system was able to maintain its share of the engine load with less fuel, improving fuel economy and reducing emissions. The producer documented average savings of 7.8% fuel per engine using the Windrock AutoBalance system. Additionally, the machine was no longer exposed to excessive wear forces, such as cylinder detonation.

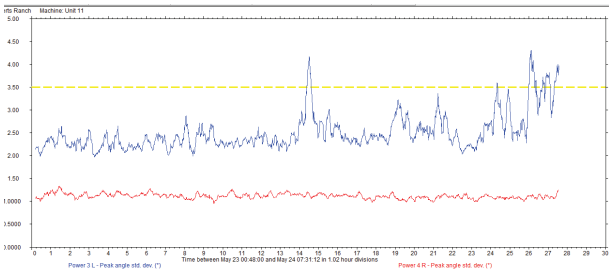

Figure 1 - Standard Deviation of peak firing pressure angle

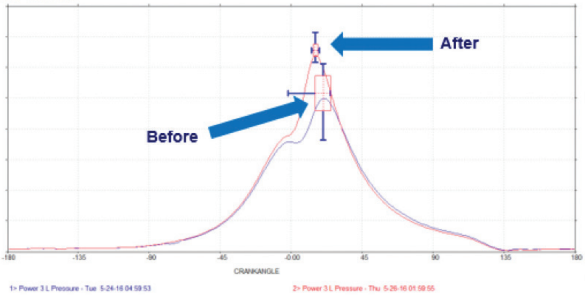

Figure 3 - Before and after power pressure curves

Removed New

Figure 2 - Old and new pre-combustion chamber ports

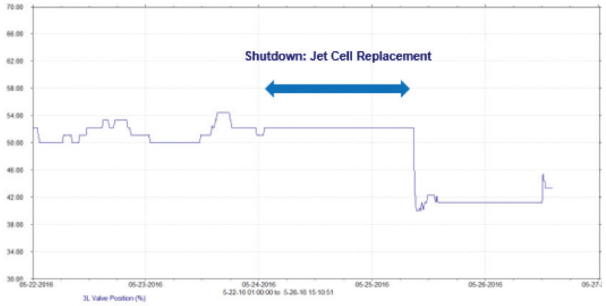

Figure 4 - Valve position trend