Utilizing PeakVue™ Technology for Continuous Valve Health Monitoring on Reciprocating Compressors

By Scott Bassett

With the expansions that are occurring in the natural gas (i.e. Fracking) industry, more emphasis is being placed on the reliability and health of the intake and exhaust valves on compressors. When a valve begins to exhibit signs of leakage, compressor efficiency can be greatly compromised. By using Emerson's PeakVue technology, along with the Emerson CSI 6500 monitoring system, the health of individual valves can be assessed and addressed in a timely manner in order to maintain maximum efficiency.

The CSI 6500 is especially qualified for this application due to continuous monitoring with the unique PeakVue methodology. Trend values can be tracked and monitored on each valve so that the valve in question can be repaired or replaced in a timely manner instead of having to replace a complete set. The transient capabilities also allows for replay of events in real time allowing for further diagnostic capabilities.

In the following examples, we have outfitted a reciprocating compressor pumping "wet" gas with high frequency accelerometer mounted on all 1st stage intake and exhaust valves. Wet gas refers to gas from the fracking method that has retained a large amount of liquid content. We are also monitoring all of the crossheads and taking an axial reading on each throw in order to monitor for looseness and or impacting that will occur as some of the mechanical components begin to wear.

It has been well documented that PeakVue data is a good indicator of high frequency occurrences such as flow turbulence and friction. In this study we will be showing the flow turbulence that occurs as each valve opens and closes and relate it to a consistent time in each revolution in order to determine valve action.

We will utilize the circular waveforms for our pattern recognition in determining the valve health. The circular waveform plots simply overlay one rotation on top of another instead of plotting it in strip format. This particular format enhances the repeating pattern seen in each revolution.

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Case Study

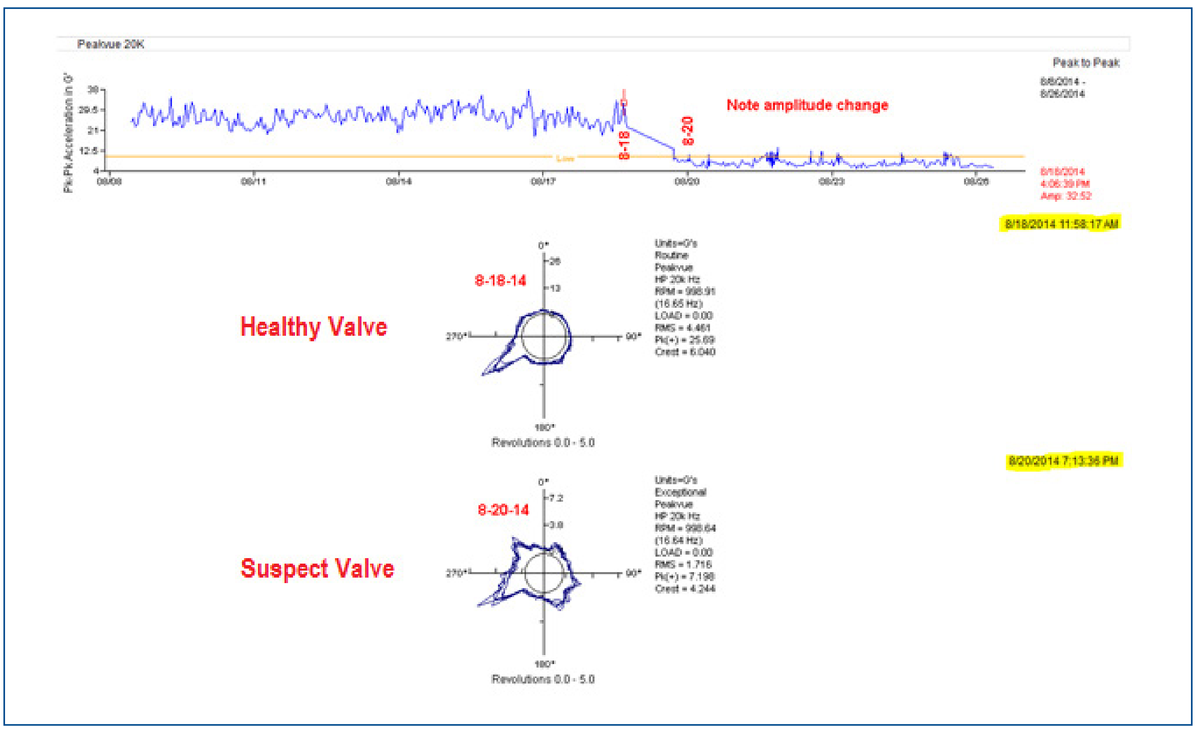
The compressors have been outfitted with a high frequency (10 mv/g) accelerometer mounted on one of the studs/bolts that hold the valve cover in place. Standard accelerometers are also mounted vertically on the crosshead section, and axially on the head.

An optimized option is to utilize dual purpose high frequency/temperature accelerometers on the valves. This gives automatic data correlation between temperature and vibration which gives additional predictive monitoring capabilities, as valves begin to leak, gas temperatures rise. By monitoring individual valve temperatures as well as individual valve vibration signatures the problem valve is more easily identified whereas monitoring cumulative data on a compressor head that only gives the general region of the problem.

Due to the fact that each region of valves will act at a given point in each rotation of the compressor crankshaft, being able to determine the phase angle of the occurrence is essential so that other signatures present in a given valve reading, can be related to other events happening on the compressor.

By continuously monitoring the vibration and temperatures on the valve over time, a rate of degradation can be established allowing the ability to predict the most optimum time to schedule valve replacement.

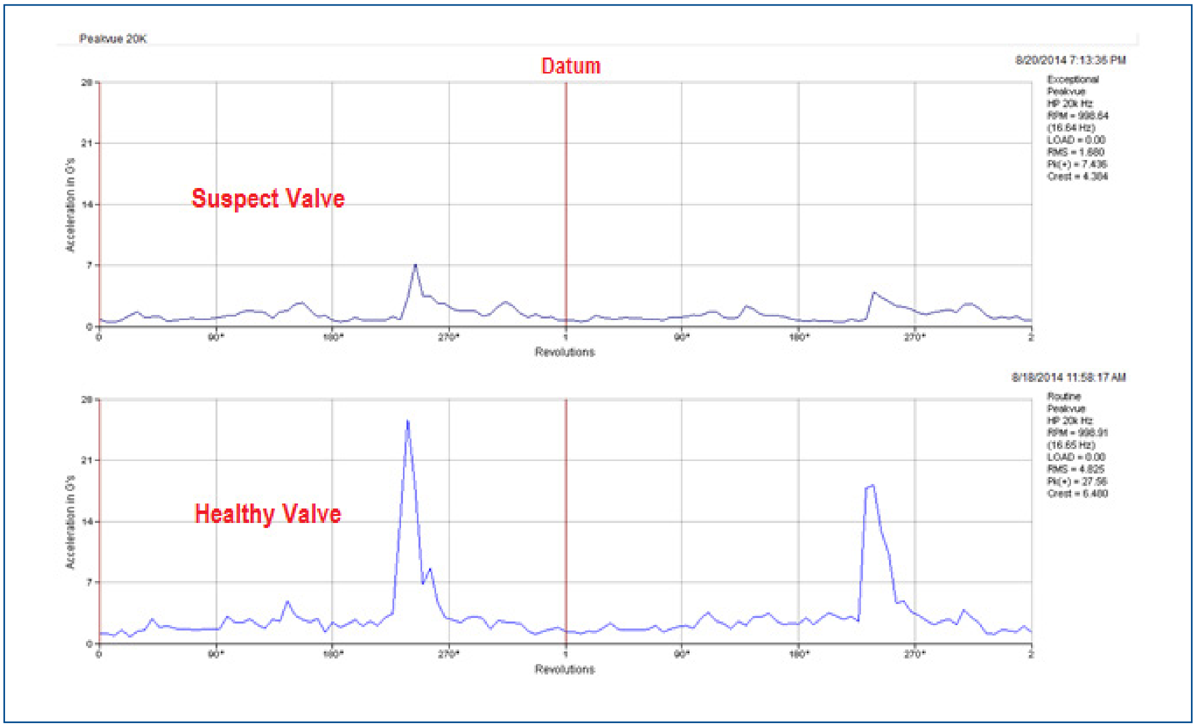
The following example shows how the trend values, as well as the pattern present in the circular waveform, changes as a valve shows indications of leakage.



Let's first look at the trend value. Given the fact that we are dealing with a form of flow turbulence instead of impacting, what we notice is that the amplitude actually decreases when a valve is not properly sealing. This is due to the fact that the Delta Pressure is less across an improperly functioning valve, the usual "surge" of gas as the valve opens and closes is substantially reduced.

Now look at the circular waveforms. Notice the "crisp" event that is present on the upper plot. This can be directly related to the phase angle of the compressor crankshaft and the timing of the valve. Also notice on the lower plot the event is less defined and shows a large amount of energy present during the entire revolution.

These waveforms can also be viewed in standard strip format if preferred. Notice the energy present at approximately 225 degrees. This is directly related to the timing of this particular valve operation. The top waveform shows a leaking or improperly functioning valve, the bottom shows the same valve operating correctly two days prior.



Conclusion

By utilizing PeakVue™ data collection, temperatures and viewing the circular waveform patterns we are able to determine the operational health of the individual intake and exhaust valves independently. This information along with the associated trend values from the peak-to-peak PeakVue™ waveform helps us to determine overall valve health as well as the rate of degradation of a given valve. Adding the vibration data along with the individual valve temperatures, helps to pinpoint issues and allow for the proper scheduling of repairs in preventing catastrophic valve related failures on reciprocating compressors.

Emerson Process Management
Reliability Solutions
835 Innovation Drive
Knoxville, TN 37932
T (865) 675-2400
www.assetweb.com

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