Chemicals & abrasives

IIoT for corrosive chemical pumps

Route-based data collection of pump performance presents both a safety risk to personnel and a risk of equipment failure. However, an Industrial Internet of Things approach to condition-based maintenance allows engineers to create an optimal schedule for their equipment.

The industrial chemical industry relies on pumps to move highly corrosive fluids. These applications create unique challenges to safely and routinely analyze the data required to measure pump and machine train health. More specifically, route-based data collection presents a safety risk to personnel needed to complete this task. In addition, route-based data collection allows for large gaps in monitoring, potentially increasing the overall risk in the event of equipment failure.

By shifting toward advanced condition monitoring techniques, one industrial chemical company achieved more accurate trending analyses of the equipment's behavioral data. This is designed to assist in the development of age-related asset failure modes, reduction in the unplanned downtime of the equipment, and improved rotating equipment maintenance strategies.

The problem

The problem was that a solution that provides wireless sensors to collect critical information, while simultaneously being suitable for the corrosive environment, was not readily available.

This problem was simplified by being broken down into three specific areas.

1. The first is finding the hardware, or sensor, that is suitable for the corrosive environment.

2. The second is determining an appropriate wireless sensor capable of measuring the required variables to detect equipment issues and predict equipment failures.

3. The third challenge is to find a partner with the analytical software and domain expertise required to interpret the data.

4. The industrial chemical company partnered with a global aftermarket repair and service company to provide a solution that meets at this challenging three-pronged problem.

The solution

The aftermarket service provider has historically provided customized solutions that solve end users' problems. Therefore, it was able to customize its existing sensor body design to utilize the necessary materials to withstand the corrosive environment. Manufacturing a small batch of sensors suitable for the application had the potential to present economic challenges. However, the material modifications proved to be achievable without being cost prohibitive.

One of the ways this challenge was met was by changing the sensor material from an aluminum alloy to a stainless-steel body that would provide more protection in the corrosive environment. The material properties protect the internal electronics and measurement instrument from the potentially corrosive environment. The aftermarket service provider worked closely with the plant to specify the suitable material for the sensor body.

Results

Return on investment for Industrial Internet of Things (IIoT) projects can be difficult to measure. The expectation is that the investment in condition monitoring will result in cost savings in these three ways:

1. Reducing unplanned equipment downtime.

2. Improving maintenance planning.

3. Collecting data remotely, allowing more time for the analysis of collected data instead of route-based data collection.

The solution also lowered the reliance of traditional route-based data collection methods by collecting data remotely. This saved the time required to prepare

Average Amplitude Levels Observed															
	Channel 1			Channel 2			Channel 3			Channel 4			Channel 5		
	V	H	A	V	H	A	V	H	A	V	H	A	V	H	A
Current Period 11/3/20 - 11/10/20	0.071	0.228	0.030	0.007	0.009	0.011	0.022	0.022	0.018	0.111	0.151	0.265	0.090	0.308	0.036
Previous Period 10/27/20 - 11/3/20	0.065	0.203	0.025	0.005	0.008	0.010	0.020	0.020	0.017	0.099	0.132	0.235	0.081	0.275	0.033
Percent Change	9%	11%	16%				7%	8%	7%	10%	12%	11%	10%	11%	7%

Figure 1. Machine train average amplitude levels.

to enter the corrosive environment and the time spent collecting data. As part of the aftermarket service provider's project scope, analysts submitted weekly reports summarizing changes in machine performance to the chemical company's engineers.

In a recent report, vibration amplitude trends week-over-week were monitored to identify dynamic behavior of the vibration amplitude levels. Figure 1 shows the average overall vibration amplitude levels experienced by each channel compared to the previous week's average overall values.

Further analysis showed the data used to determine the root cause behind the increase in overall vibration. By reviewing the most severe vibration observed, analysts began to focus on potential root causes of failure.

Figures 2 and 3 show that the dynamic excitation of the discrete frequency is at 35.313 Hz, which was assumed to be the 1x running frequency, or operating speed of the machine. The discrete frequency excitation did not change between the two FFT spectra. Despite this, the overall vibration amplitude has changed from 0.276 to 0.342 inches per second (ips) RMS, a ~24% increase.

While this increase in vibration energy could have been due to changes in pump flow rate or machine running speed, another possible explanation is that a condition present has degraded over time. The type of degradation could be general wear or a specific component such as a bearing, seal, etc. By detecting performance changes, engineers and operators were able to come together to determine how future maintenance actions may be changed to prevent a more catastrophic and expensive failure.

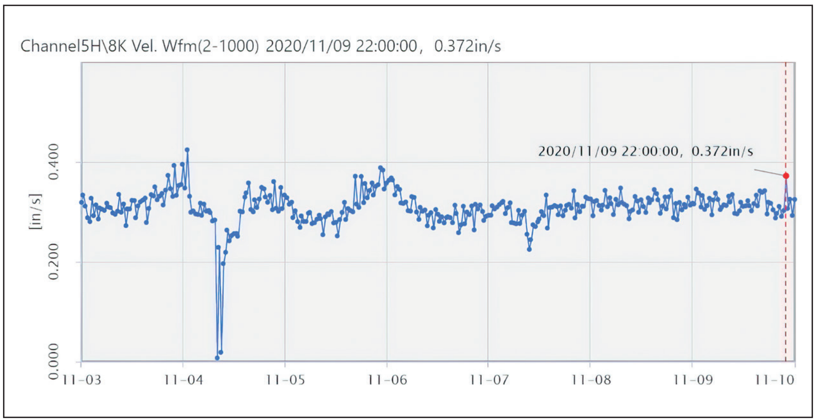

Figure 2. Channel 5 horizontal direction overall amplitude trend.

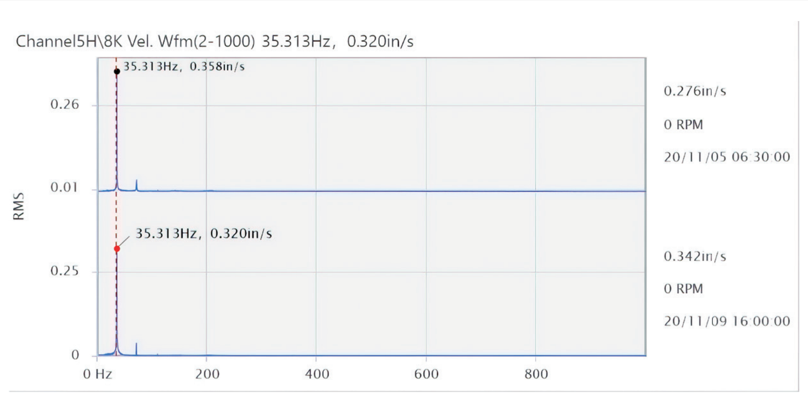

Figure 3. Multiple spectrum (FFT) for Channel 5 horizontal direction.

Conclusion

This approach to condition-based maintenance will allow plant reliability engineers to interface with plant operations to create an optimal maintenance plan for their equipment. By working with the aftermarket service provider's condition monitoring engineering team, plant reliability engineers will continue to identify operating conditions that negatively impact machine health and trend failure modes before they become catastrophic. While the condition monitoring projects are ongoing, there is the consideration of expanding the sensor footprint at the site, providing the chemical company with more data points to reference moving forward. ●

About the Author

Ares Panagoulias manages the sales and engineering of IIoT Wireless Condition Monitoring product and services. He works directly with customers to utilize wireless data collection to improve rotating equipment maintenance strategies, increase availability, and reduce downtime in the nuclear, power utility, pipeline, and oil & gas industries.