

Compressor & Turbine Vibration Testing Petrochemical

using the ZonicBook

Application Note #102

Application Summary

Many companies in the petrochemical industry operate refineries that supply fuel, base oils, and ingredients for a variety of consumer products used globally, from plastic bottles to automotive tires. They also produce chemical intermediates for manufacturing polyester resins and automotive, agricultural, and consumer products. The base oils are feedstock for motor oil, and the fuel is intended for gasoline, jet and diesel fuel, heating oil, and other products. They use state-of-the-art hydro-cracker and hydro-dewaxing processes to produce oils with very low sulfur and extremely high percentages of saturates.

A typical medium to large-size refinery contains from 2000 to 5000 hefty pumps and compressors that move, store, and process the numerous chemical products. The plants also use waste flue gas to produce heat for steam boilers and turbine-powered electric generators. The steam and electricity are used throughout the facility, but excess electricity is often sold to the local power grid.

Because these refineries handle thousands of barrels of crude petroleum each day, the pumps and compressors

that move them must remain in first-rate operating condition. Removing these components from service before a scheduled maintenance date can be very expensive in terms of lost production. Common problems that could take them out of service include vibrations due to worn bearings and unbalanced rotors and couplings. Vibration experts routinely monitor these units to check for abnormal and accelerated wear before stopping them for scheduled maintenance.

Potential Solution

A vibration specialist at a US refinery has the responsibility of regularly instrumenting what's considered critical machines. "We have machines that are always monitored, but we also have critical machines that are part of a unit that is hard to justify the installation of a continuous monitoring system, so we move a portable data acquisition system between them," says the specialist. These machines usually collect steady-state running data, but before she performs an overhaul or shuts them down, she collects startup and shutdown data as well.

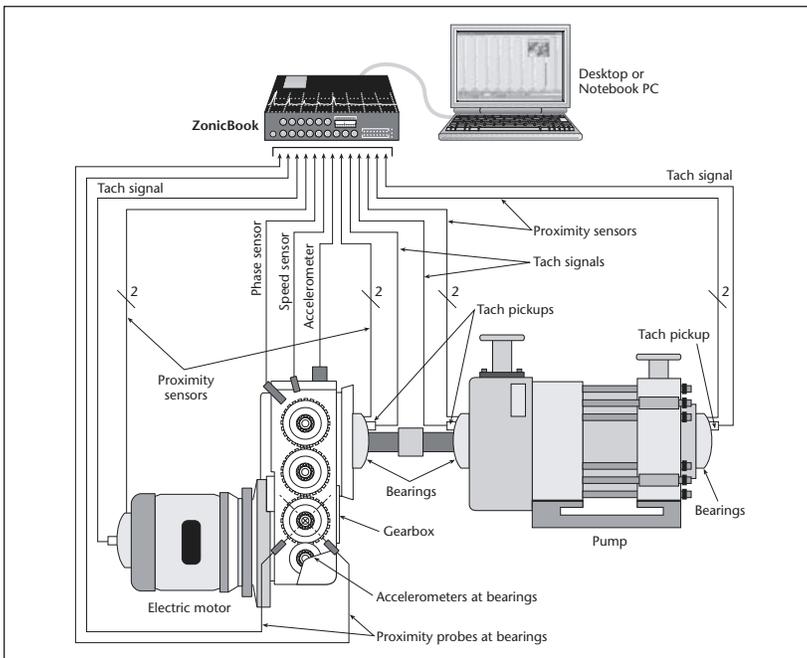
"Usually, I'll move the portable data acquisition system to a machine, leave it there for about a week, collect some critical data for an hour, shut it down, move it to another machine, and start acquisition again," she says.

The specialist had used some well-known, older data acquisition systems for a time, but the equipment had only 8 channels. She really needed 16 channels to measure machines with large gearboxes and multiple key-phasors, and a data acquisition system that could measure synchronous data — the bearing vibrations on both sides of the gearboxes simultaneously.

IOtech's Solution

The vibration expert evaluated a few widely used data acquisition systems and settled on the 16-channel ZonicBook™. "We could justify its purchase based on its portability and flexibility in being able to handle a wide range of sensors," she says. "I currently use the ZonicBook for 12 machines." And when she has a machine that's not equipped or instrumented with proximity or eddy-current sensors, she installs piezoelectric accelerometers. "One of the features that we liked about the ZonicBook was that it came with integrated circuit power capability to supply the accelerometers and let us go from one type of transducer to another very easily," she says.

The specialist monitors the machine so she knows its current health. She looks for problems that might keep her from reaching her next scheduled shut down or



Typical prime movers for petrochemical industry pumps and compressors are intended to operate for 24 hours per day for at least a decade. Because of such demanding requirements, the motor bearings and gearboxes are monitored for vibrations that might come from unbalanced rotating components or prematurely worn bearings and gears. The ZonicBook monitors the speed with tachometers and the vibrations with proximity sensors simultaneously to ensure that the components constantly remain in first-rate condition.

anything that she might have to change. For example, the last time she started a particular generator, she detected some misalignment. "We had a coupling replaced earlier, and when the machine was brought back on line, it still experienced excessive vibration, so we knew something was different," says the specialist. It turned out to be a new, but defective coupling between the coil shaft and the turbine. "We immediately got it squared away."

"We also liked the ZonicBook's number of lines of resolution and the playback features for handling the data," she says. "We like to see the waveforms overlaid; open in multiple plots. And it is really good at viewing and analyzing a lot of data." The specialist says it has the bandwidth, the speed, and all that she needs for steady-state work. It monitors the different states of the machine and can be left unattended to acquire the data she needs.

The specialist's main sensors are proximity probes. Although she doesn't typically perform condition monitoring or collect a lot of accelerometer data — perhaps only 3 to 10% of the time — she likes to have the capability when she does need it. She uses the ZonicBook primarily for diagnosing specific problems. Says the specialist, "For example, when we used accelerometers, it was on a machine that was marginal. It would produce sufficient revenues, but not all the time. When put in that type of situation, machines tend not to be instrumented completely, but we installed accelerometers to keep an eye on it, and the data it collected was in the proper range."

"I'm a software person," says the vibration specialist, "so, I found the eZ-TOMAS™ and eZ-Balance™ software quite easy to learn." She likes being able to adjust the alarms on the bar graph, and the 360-degree type plots, for setting up the phases. Also, she likes the plot functions and being able to adjust the scale. "When we first got the ZonicBook, we were not accustomed to dealing with some of the events that were occurring in cascade," she says. "But being able to see negative plots, or looking behind a peak of a waveform is a great feature. For example,

initially, if I started a machine and had a 1X or a 3X at high amplitude, and set it up to observe it from only a positive angle, I couldn't see anything underneath 3X, that is, the cascade. But now I can set the angle to negative and then view it."

Conclusion

Petrochemical companies in the US are increasingly using IOtech's ZonicBook to monitor and analyze vibrations in high

capacity process pumps and turbine generators. Vibration experts monitor some critical machines continuously while others share a portable data acquisition system among them. Before shutting down a machine for scheduled maintenance, they measure the vibration to make certain it is within expected tolerance. If it is not, then they look for additional problems that must be addressed beyond the normal maintenance activity. This procedure often extends valuable production time.

ZonicBook/618E

Vibration analysis and monitoring has never been easier than with the new ZonicBook/618E™ and eZ-Series™ analysis and monitoring software. The ZonicBook leverages 25+ years of experience providing vibration measurement solutions. This new Ethernet-based solution adds another dimension — the *lowest cost* full-featured 8 to 56 channel analyzer available. The ZonicBook hardware is the signal conditioning and acquisition engine, while the eZ-Series software in the PC defines the specific analysis and monitoring features of the system.

Features

- 8 dynamic input channels, expandable up to 56 channels
- 4 tachometer channels for rotational measurements
- High-speed Ethernet connection to the PC for continuous recording
- Four eZ-Series software packages address a wide variety of vibration monitoring and analysis applications
- TEDS support



Software Overview

Four software packages are available for the ZonicBook, each tailored to a particular vibration measurement and analysis application. Choose the package that suits your application now, and upgrade to additional packages as your requirements evolve.

- **eZ-Analyst™** provides real-time multi-channel vibration analysis, including overlay of previously acquired data while acquiring new data, strip charts of the throughput data files, cross channel analysis, and direct export to the most popular MODAL analysis packages, ME Scope and Star Modal.
- **eZ-TOMAS™** provides on-line vibration recordings, limit checking, storage, and analysis of rotating machinery. Order track, Waterfall, Orbit, Polar, Bode, Spectrum, and Trend displays show machine startup or shutdown events, as well as diagnose long term changes in machine health.
- **eZ-Balance™** is used to balance rotating machinery with up to seven planes. A balance toolkit, including Split Weight calculations, supports the balance process. The balance vectors are displayed on a polar plot so the user has a visual indication of the improvement. Time and spectrum plots show detailed vibration measurement during the balance process.
- **eZ-NDT™** package is exclusively used in production applications to determine the quality of composite-metal products at production rates of 1 part per second.

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