

New Concepts for Machinery Condition Monitoring

Machinery Condition Monitoring Today in Water and Wastewater

Water and wastewater applications include common equipment like pumps, blowers, gearboxes, etc. Vibration monitoring is a proven technology for detecting and alarming when machine failures are imminent, it also provides advanced alerts of machinery degradation that may lead to future failures. These two goals require different approaches.



Detecting failures that are imminent and stopping machines before severe damage occurs requires some type of continuous vibration monitoring system. This may range from a very simple mechanical vibration switch to a very expensive rack-based, on-line machinery protection system. This system tells you that a failure is occurring or will occur within seconds to hours, but provides no information about the cause of the failure and is unable to detect most machinery degradation in advance.

In water and wastewater applications, only a few pieces of equipment actually require high speed on-line vibration monitoring and protection systems. For much of the equipment, regular interval-based but less than continuous monitoring, will provide acceptable levels of protection and detection of potential problems. Typical machinery protection solutions frequently prove to be either marginally effective or too expensive.

Providing advanced notice of potential problems to allow scheduled maintenance to correct the problems is usually a manual process performed by a highly trained vibration analyst. Vibration data is collected periodically, usually monthly, with a portable data collection instrument, and then trended and analyzed in specialized vibration analysis software.

Many water and wastewater utilities, especially smaller utilities, have problems implementing a vibration monitoring and analysis program or maintaining a program over time because it is costly to train and difficult to retain a well-qualified vibration analyst. The analyst and his skill level is key to the program. Manual programs typically die without a good analyst. Even though the benefits of a program can often be tremendous, the realities of implementation often force utilities to forego them.

In addition, a vibration monitoring program is frequently a separate function in the maintenance department and its goals and results are not well integrated into plant operations. Without integration this results in a condition monitoring program that is perceived as a costly program rather than a highly effective Condition-based Maintenance program that lowers maintenance costs, improves equipment reliability, and adds value. To gain the true value of a monitoring program, it must be tightly linked into operations to ensure that operating and maintenance decisions are driven by timely equipment information, not just data, which is available to everyone.

Dynamix — A New Approach

The Dynamix Vibration Monitoring System from Rockwell Automation provides an alternative solution to both types of vibration monitoring problems. A Dynamix system will automatically:

- gather data from a group of machines
- analyze the data to identify specific types of mechanical problems, and
- present actionable information with supporting data to both Operations and Maintenance personnel

The Dynamix system eliminates time delays inherent in a traditional condition monitoring program and ensures a tight linkage between Operations and Maintenance.

The Dynamix system combines:

- high speed on-line protection for your machines that need the capability and
- a surveillance-mode system that sequentially collects data from sensors mounted to other machines that don't require the high speed protection.

In either mode, a Dynamix system automatically performs the basic vibration analysis and then presents the identified problems and the supporting data on preconfigured HMI screens for Operations and Maintenance. Depending on the number of machines connected to a single Dynamix system, each machine is typically evaluated one to ten times each hour. If continuous on-line protection is part of the Dynamix system, that function is always providing sub-second interval shutdown signaling of serious problems.

A key part of the Dynamix system is the vibration analysis intelligence that is built into it. The data is analyzed and problems are presented as specific text descriptions as shown below. These results are immediately available to both Operations and Maintenance without needing a vibration analyst to manually review the data.

If a utility does have a qualified vibration analyst on staff, all of the collected data can be passed from the Dynamix system to the Emonitor vibration analysis software for more detailed evaluation. A qualified vibration analyst can always add more detail to the problems identified by the automated Dynamix system.

Central South Blower 1		Dynamix Machine Diagnostics	
Motor	Driven End Bearing	Normal	Driving End Bearing
Fan	Driven End Bearing	Normal	Non Driven End Bearing
			Bad Bearing-Danger
			Normal
Dynamix Machine Diagnostics Status:			
Bad bearings (Early stage)		Early detection of bearing wear. Verify by adding lubrication to the bearing and rechecking the system diagnostics.	
Dynamix Machine Diagnostics Fault List:			
Unbalance		Correct by balancing machine assembly. Check for missing balance weights. Clean fan blades and check for missing blades.	
Looseness/Misalignment		Check for looseness in supporting structure of machine. Check for looseness in effected bearings due to extreme wear. Verify alignment with laser alignment tool.	
Bad bearings (Early stage)		Early detection of bearing wear. Verify by adding lubrication to the bearing and rechecking the system diagnostics.	
Bad bearings (Late stage)		Detection of high bearing wear. Check or replace bearing before excessive wear causes machine looseness or bearing failure.	
Pump Cavitation		Pump outlet pressure much greater then inlet. Apply more back pressure to the pump, increase pressure to pump, or lower pump speed. Cavitation will cause premature impeller and bearing failure.	
<div style="display: flex; justify-content: space-between; align-items: center;"> MAIN PREVIOUS NEXT MACHINE OVERVIEW MACHINE BANDS MACHINE DIAGNOSTIC GRAPH BELL </div>			

Using a Dynamix system, a utility can:

- give Operators the information they need to direct the maintenance of equipment when it's actually required,
- implement a basic predictive maintenance program without worrying about being able to retain a vibration analyst, and
- provide high-vibration shutdown signaling several times per hour in a very cost-effective manner for less critical machinery.

Dynamix System Configuration

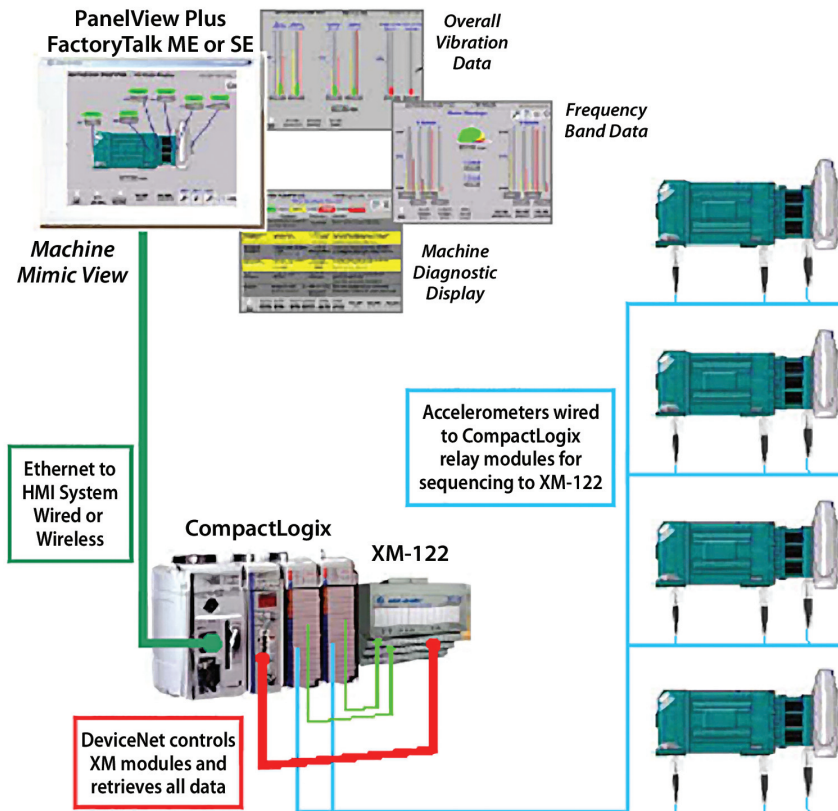
As shown here, a surveillance-mode Dynamix Vibration Monitoring System is a sequential monitoring system that is comprised of a standard XM-122 gSE Vibration Analysis module, an Allen-Bradley® CompactLogix™ programmable automation controller, and an HMI display system.

To ensure that the XM-122 is properly configured for each pair of sensors, the optimal configuration for each sensor is stored in the CompactLogix and is downloaded to the XM-122 module over the integral DeviceNet network when that sensor is connected to the XM-122 module.

The XM-122 performs several different measurements on the vibration data.

When the XM-122 has completed the data evaluation, the CompactLogix reads this data through the DeviceNet network. Using rule sets that are customized for each machine type, the CompactLogix evaluates the complete data set collected from a machine and presents specific mechanical defect descriptions along with supporting data on predefined HMI displays. If desired, the Dynamix system can be configured to provide an immediate shutdown signal if excessive vibration levels are detected.

When continuous on-line protection is required, a dedicated XM Series monitoring system can provide the protection function. The XM Series protection system is tied to the CompactLogix via the DeviceNet network and the predictive maintenance analysis is done in the CompactLogix while the real-time protection is provided directly by the XM system.



Typically, one accelerometer is mounted at each bearing location on the machines being monitored. All of the accelerometers are wired to isolated relay cards in the CompactLogix system. Under program control, the CompactLogix activates the relays to sequentially connect pairs of accelerometers into a single 2-channel XM-122 module.

It evaluates the overall rms or peak vibration like a traditional protection system. It performs a full spectrum analysis of the vibration and evaluates the vibration levels within four programmable frequency bands. It also makes a "spike energy" measurement to detect early indications of bearing problems. The frequency band and spike energy data is used to isolate specific types of machinery mechanical problems.

HMI Displays

The standard HMI displays use predefined faceplates and templates to present the results on FactoryTalk® View ME or SE software. FactoryTalk View can run on a PanelView Plus® or any Windows®-based industrial or office computer. The HMI system is coupled to the CompactLogix controller through either wired or wireless Ethernet connections. Since the displays use directly addressable data from the CompactLogix, displays can easily be developed for most other HMI software packages that can communicate to the CompactLogix controller.

Mimic displays can easily be established for any type of mechanical configuration or machine you may have. Multiple machines can be on a single display or use multiple pages for a group of machines.

Current values for all frequency band measurements on a machine are shown as bar charts on the Dynamix Band Display (see picture).

Programmed warning and danger levels are shown in yellow and red for each band.

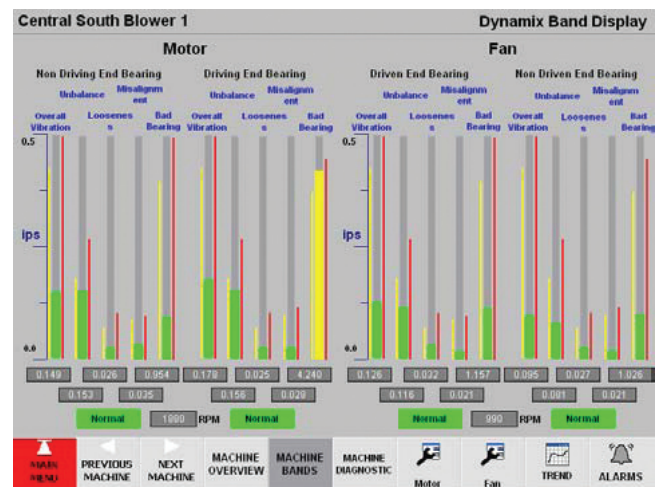
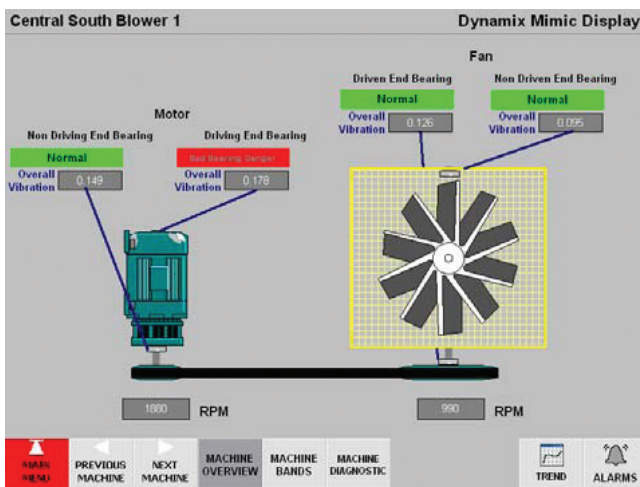
A trend chart provides daily averages for the past year for any selected parameter as well as current trends. When something is changing, it is immediately clear to both Operations and Maintenance.

Other displays allow the user to modify the programming of the XM-122 vibration analysis module to adjust alarm levels or frequency bands.

If desired, custom displays can easily be developed by you or us to meet specific requirements you may have.

Dynamix – A Perfect Vibration Monitoring System for Water & Wastewater Applications

- High-speed machinery protection applied where it is really required
- Automated surveillance-mode monitoring of other equipment
- Automated analysis of most common types of problems
- Operations and Maintenance immediately see the same information and recommendations
- Surveillance-mode automated machinery shutdown available for expensive machinery
- Easily monitors machines in remote locations using wireless communications
- Highly cost effective machinery monitoring and protection solution



An alarm summary faceplate shows the alarm status of all sensors in the system. A simple mouse click takes you directly to the alarms details.

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