Predictive Maintenance Saves Money, Improves Plant Reliability

A predictive maintenance program started at the Cargill Vitamin E Plant in Eddyville, Iowa, has yielded hundreds of thousands of dollars in documented savings since 2001 through improved maintenance resulting in decreased process variability and greater reliability. Estimated savings through cost avoidance are even greater. For example, costly plant shutdowns have probably been prevented by daily monitoring of 1500 instruments and control valves, and then scheduling maintenance based on criticality of devices.

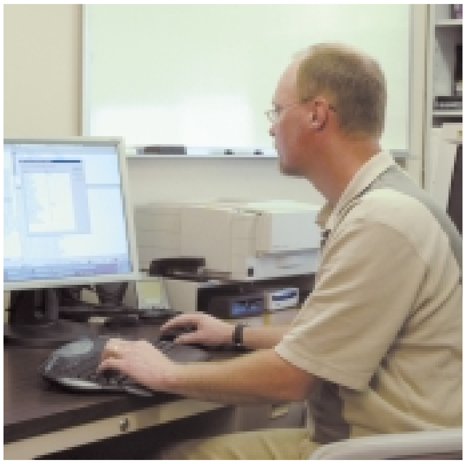
This is in line with a stated goal of finding cost savings through asset optimization and predictive maintenance, which were not previously practiced at the instrument level in this plant. Prior to 2000, schedule-based preventive maintenance was supported by reactive maintenance. We followed manufacturers' recommendations in caring for their products, and we reacted to problems as they arose. As long as things ran smoothly, nothing was done to seek out potential problems and prevent them from becoming actual.

Predictive maintenance is the term given to the practice of identifying production equipment needing maintenance attention before its performance gets to the point that product quality is reduced or an unplanned shutdown occurs. *Information* about the condition of equipment is the key to successfully predicting maintenance requirements in order to take timely corrective action.

The information we rely upon principally comes from smart, microprocessor-based field instruments that evaluate their own condition and that of associated equipment in addition to reporting the basic temperature, pressure, and flow data needed to control production processes. Even with these advanced devices in place, technicians formerly had to go into the plant, locate an instrument, and attach a handheld communicator to extract the information. The evolution of communications protocols, such as HART and FOUNDATION Fieldbus, and asset management software made it possible for engineers and technicians to communicate with smart field instruments from one central location.

Built in 1996, the Cargill Vitamin E Plant has nearly 1500 HART technology smart field devices connected to its distributed control system. In addition, digital valve controllers, or smart positioners, are installed on about 350 control valves throughout the facility. Massive amounts of diagnostic data generated by these devices are captured by the AMS Suite: Intelligent Device Manager software installed nearly three years ago. The information obtained is integrated into a single database, organized, processed, and presented on a PC monitor, all without interfering with control

Cargill's Eddyville, Iowa facility.



Wade Howarth, Automation Manager at the Cargill Vitamin E plant in Eddyville, Iowa, has helped his company achieve "hundreds of thousands of dollars in documented savings" over the last three years by applying a predictive maintenance strategy based on asset management software.

system inputs and outputs. Using this tool, technicians are able to look deeply into the process in a way never before possible. From the safety and comfort of the maintenance shop, they're able to perform all the functions generally associated with the handheld communicator - instrument commissioning, configuration, and troubleshooting of potential problems. Status Alerts inform them if the performance of specific instruments begins to slip. In addition, all maintenance activities are automatically documented.

Asset Management

To ensure that this software is fully utilized, we employ an asset manager, whose job it is to monitor the instrumentation, keep all configurations and calibrations current, and maintain the database. Based on information received from the field instrumentation, the asset manager determines maintenance needs and generates work orders as appropriate. He helped establish the predictive maintenance system and trains other maintenance personnel to use it.

He is also responsible for continuously monitoring the health and status of the 30 Critical Control Points identified as essential to the safety and quality of our product. Monitoring these critical points for baseline and calibration certification using NIST-traceable procedures allowed changing the quality control procedure from fully analytical to a process instrumentation-based system. The reduction of in-process testing has saved us enormous amounts of analytical testing time and dollars.

It is essential in any processing plant that one individual be designated as asset manager. That person must be very knowledgeable about the process and the instrumentation used for process control as well as the intelligent device management software. This resource is too valuable to be ignored, which could happen if a specific person does not have this as a full time responsibility with authority to take whatever action is necessary to protect the integrity of the processing system.

Predictive Maintenance

Emerson's Intelligent Device Manager software makes predictive maintenance possible. Once the process control system is optimized and all the loops are running as well as they can possibly run, monitoring of the field instrumentation helps sustain that level of efficiency. We now catch potential problems before they can impact quality or productivity. A case in point is a recent travel deviation alert on a control valve that caused technicians to check out the valve, which seemed from the control room to be operating properly. They found a plastic air supply line that was too close to a steam line had melted and collapsed, restricting the passage of air to the valve actuator. As a result, the valve was responding very slowly to control signals and introducing a lot of variability into the process, but the operators didn't know anything was wrong.

In another instance, technicians checking out the report of a "non-responding" instrument found that it had been disconnected at the termination panel. This "fail-open" valve was allowing the loss of nitrogen, which went unnoticed by operators for six months. While the process was not affected, fixing the problem prevented the further loss of nitrogen and reduced the loading on a scrubber by about 20 percent.

Many potential problems are simply avoided because the asset manager systematically checks every instrument on the network, looking for the warning signs that indicate an impending failure. When he catches a transmitter before it gets too far out of calibration or expires, he is helping to maintain the reliability of the production system. If early action by the asset manager avoids a plant shutdown, the savings could be substantial.

Since the predictive maintenance program began functioning, the reduction in work orders has been noteworthy, with maintenance following a more orderly plan and schedule. Previously, a great deal of time was spent reacting when something broke. We're still doing reactive maintenance, but now we're reacting to predictions based on field-based information and not breakdowns. Instead of smoke coming out of a motor housing, we react to an indication that there will be smoke unless something is done to prevent it.

Documentation Benefits

NIST-traceable calibration certificates must be provided as a part of the regulatory documentation in the Vitamin E facility. With our system, a calibration certificate on any instrument on the control network can be printed out showing that instrument's calibration history, accuracy, date last tested, condition "as found", condition "as left", etc.

To calibrate a transmitter, all the data required is downloaded from the Intelligent Device Manager database to a documenting calibrator, which is taken to where the actual calibration is done. At the end of the day, the results are uploaded to the PC and archived in the database. Some instruments do not have to be calibrated periodically as long as we can verify that their calibration parameters are within design specifications. The documentation within the instrument database serves as a reliable source for that verification, making these histories extremely valuable.

Conclusion

It is difficult to quantify the actual value of predictive maintenance in dollars. Savings in some cases, such as preventing the loss of nitrogen, are easily computed. If variability on a steam loop is decreased, the energy saving can be calculated, but how can you put a value on decreasing loop variability? Similarly, it is impossible to assign a dollar amount to time saved by technicians - often because no data is available for comparison. We are satisfied to say that enough has been saved to pay for the software.

A word of caution; do not expect immediate results! It is important for the individuals working with the software to understand it and learn how to recognize potential problem areas. A tool is valuable only if it is used properly. If a predictive maintenance program is implemented, an asset manager put in charge, and work practices changed as needed, savings should become apparent within 12 to 24 months.

Our work practices have certainly changed. We have been able to shift our focus to *prevent* from *correct*, and the documented savings are significant. We intend to keep exploiting the predictive maintenance environment and avoiding unexpected stoppages. The more we can plan and schedule our work, the more efficient we will be, and that is our ultimate goal.

— By Wade Howarth
Automation Manager
Cargill Vitamin E Plant
Eddyville, Iowa

Reprinted with permission from Pharmaceutical Processing May 2004