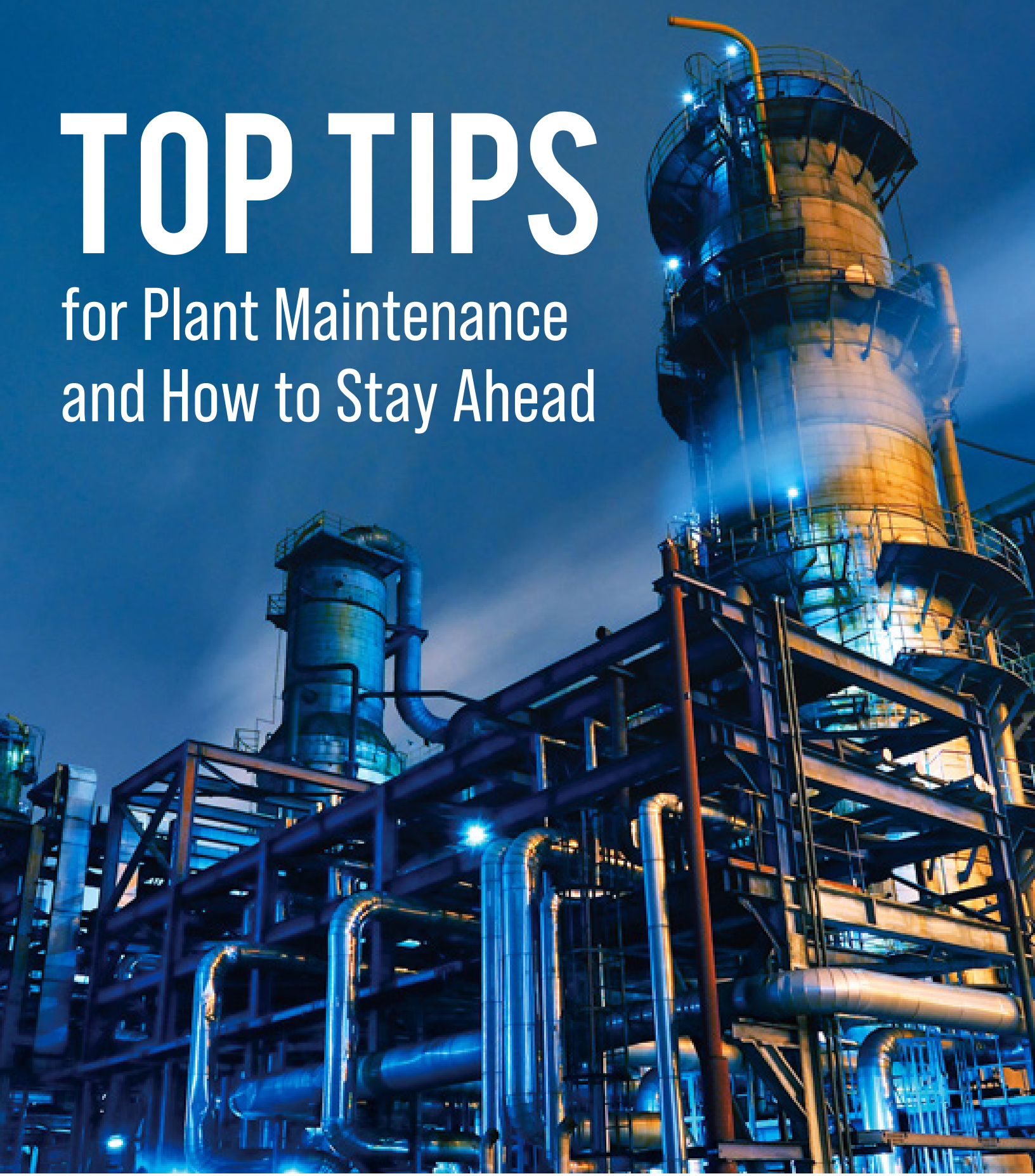

TOP TIPS

for Plant Maintenance and How to Stay Ahead

NED

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products

INTRODUCTION

Top Tips for Plant Maintenance and How to Stay Ahead

By Laura Davis, *Editor In Chief, NED*

In any business, thinking ahead and being prepared for complications is a necessity. Waiting until something unfortunate happens always leads to more stress, halted operations, and ultimately, more cash than necessary down the drain. And this isn't even strictly a business thing—in day-to-day life, planning is always better than not. Traveling, your house, your car…all things that need preparation rather than reaction.

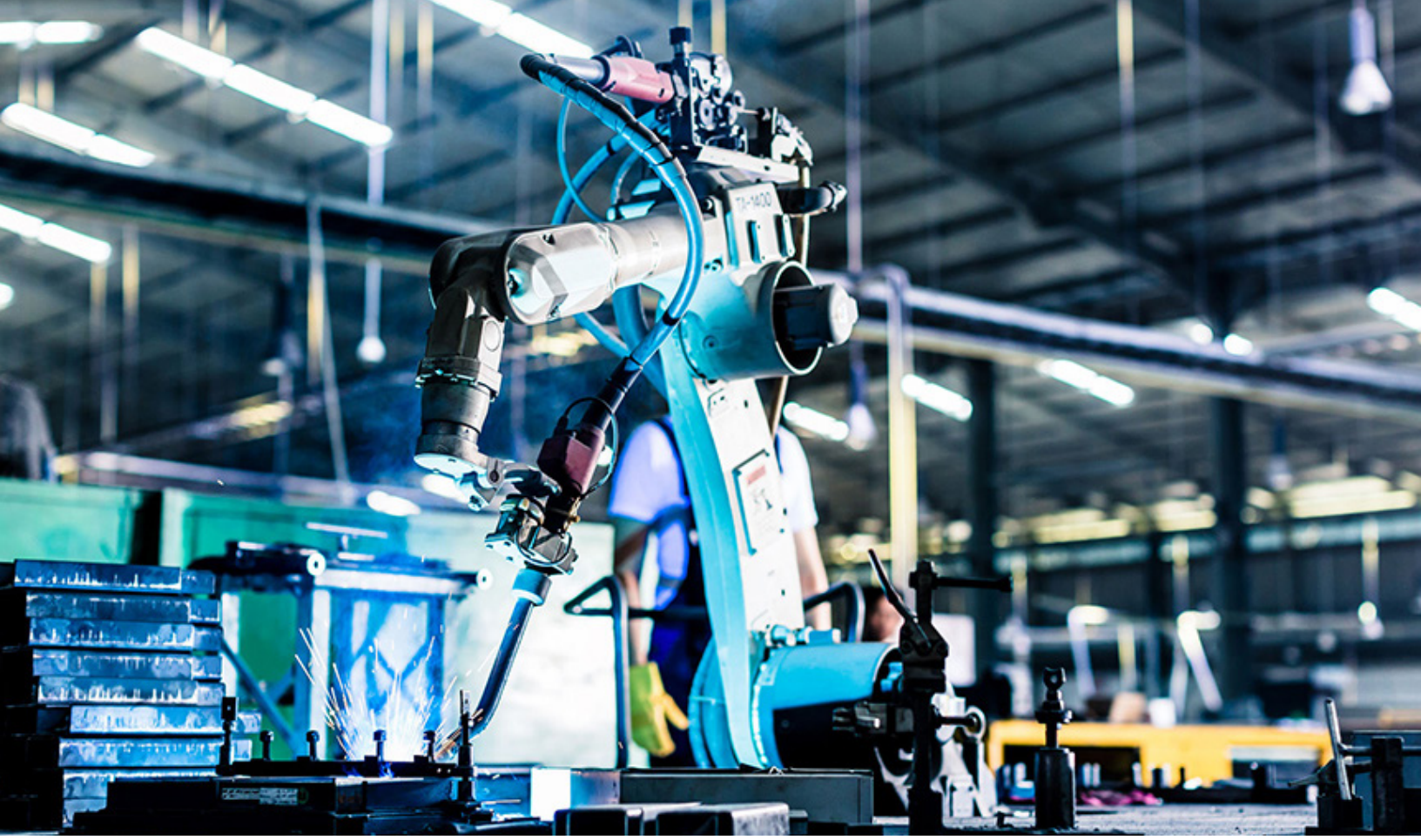
In manufacturing especially, plant maintenance has always been a hot topic but in recent years has become even more so with smart factories coming into the fold. Kind of like newer cars and refrigerators—with the addition of so many different electronic devices being put into these machines and equipment, there's more risk for something to break and causing a host of issues that trickle down. This is why new devices for maintenance prediction are flooding the market every year, promising to help catch issues before they become a big problem.

With all this new technology, predictive maintenance and general maintenance should be pretty easy, right? Well, it's not that simple. Some companies are smaller and don't have the capital to throw at newer technology, limiting their choices of solutions. Other companies have the cash but don't know where to start. And a large problem getting closer every year is the retirement of older colleagues, taking with them years of vast knowledge on the ins and outs of how certain machines operate. So, while predictive maintenance tech promises to fill that gap for us, there's just some knowledge that comes with experience.

To try and help with this, we've compiled our best content that explains what predictive maintenance really means—from small devices to large machines—and how you can start implementing a plan for your facility. You'll also get insight into the top solutions on the market right now and a wide range of practices for businesses small to large. In addition to digital maintenance for smart factories, we've included important tips and how-tos for maintaining equipment from cooling towers to welding guns that don't always need a fancy app, but rather just some good ole' manual troubleshooting.

And if you're still not finding what you need, we've got even more content on our site at *Newequipment.com*.

If you're looking for tips on improving maintenance, conquering maintenance techniques, and the one product to solve all your problems, then read on to get your facility in tip-top shape.



Improving Maintenance in Manufacturing

By Claudia Jarrett, Head of Sales - The Americas, EU Automation

Enterprises have responsibility for around 85% of the data held in this digital universe, according to the EMC Digital Universe with research & analysis by IDC report.

Manufacturing plants are just one type of enterprise contributing to this data production, by choosing to collect process data in order to monitor machinery status.

Manufacturers, faced with the constant pressure to keep up with customer demand while remaining flexible, are acutely aware of the threat of plant downtime. Caused by a multitude of factors—including machine failure—downtime can cost manufacturers up to $260,000 per hour, according to research by analyst firm Aberdeen Research.

Therefore, preventative maintenance, where equipment is maintained before it breaks, is essential, rather than reactive maintenance, which focuses on fixing equipment following a breakdown.

But for those in high volume, low margin industries such as food and beverage or automotive parts manufacturing, preventative maintenance may be wrongly seen as unattainable, due to perceived high upfront costs.

Prevention

The days of waiting for a system to fail due to overheating motors or leaking heat transfer systems, for example, are thankfully behind us. Plant managers now plan regular inspections, upgrades, and troubleshooting to avoid breakdowns. These simple steps are one way in which preventative maintenance can be carried out.

But as Industry 4.0 technologies such as condition monitoring become more accessible, there are even smarter, more accurate, and less time-consuming methods available.

Many manufacturing plants now use predictive maintenance, a sophisticated form of preventative maintenance, to establish how well equipment is functioning and accurately predict failures before they occur. Not only does this reduce the risk of downtime-causing breakdowns, but it can also mean any necessary replacement parts can be ordered and are in stock in case of equipment failures.

In addition, monitoring the health of equipment can allow for gradual tweaks, where a huge overhaul would previously have been required for improvements. Alterations can improve the efficiency of processes, ultimately reducing costs by eliminating inefficient elements and increasing equipment lifespan through maintenance or replacement of wearing parts.

Where to Start

The first step a plant manager should take when implementing any preventative maintenance schedule is to gather as much data as possible. Crucially, this should include an accurate estimate of the real cost of downtime to the particular plant in question. Collating data collected by smart sensors, sales figures, and retrofitted systems should allow you to take into account loss of sales, wasted products, and the cost of emergency repairs, which can provide a useful baseline figure.

Using their experience of the plant, maintenance engineers should also be involved to produce an ideal plan for the plant, including areas they believe will require higher levels of maintenance, such as older equipment or machinery that is inherently prone to breakdowns such as motors, turbines or other moving parts.

This plan can then be used alongside the budget to produce a realistic maintenance plan, including what level of preventative maintenance can be employed. For some manufacturers, this will mean regular equipment checks, such as once a month for a section of a plant, or daily for more volatile machinery.

Data

If true predictive maintenance is chosen, data such as temperature, pressure, and vibration are collected by sensors and will be continually integrated, stored, and analyzed. The next question for manufacturers is how to make the most of these valuable, but large, data sets.

Once the data has been collected, the next step to make the most of its potential is to begin analysis. One popular option for data analysis is a cloud analytics service. Here, raw data is transmitted to the cloud, where it can both be stored and analyzed for trends that can predict an event including a breakdown. Many services also incorporate an alert system and warnings of impending breakdowns can be sent via a web portal, app, e-mail or text message to relevant personnel.

Other manufacturers, perhaps concerned about cybersecurity, the long-term stability of data stored in the cloud or the lag between data collection and analysis, will choose to undertake the analysis of raw data in-house. Although this is often significantly more resource-heavy, it does give plant managers complete control over their data.

Obsolescence

Regardless of which system is implemented, predictive maintenance can be used to manage obsolescence, in addition to reducing downtime and improving process efficiency.

This means parts can be ordered at the correct time to suit the maintenance schedule. Traditionally, manufacturers would have to keep a stock of parts that may need replacing, which take up valuable space on the plant floor that can instead be used for operations. Spare parts can also be bulky and produce health and safety hazards, including trip or fire hazards if stored on the plant floor.

Instead, manufacturers can choose to order replacement parts only when necessary, maximizing the space and resources they have available to them. A lot of companies now specifically tailor their business to supplying obsolete parts and are able to ship them worldwide within 24 hours, so there's no need to store parts on-site or to suffer extended periods of downtime waiting for them to arrive.

Preventative maintenance is essential for manufacturers to reduce downtime and the vast amounts of data now being produced by plants can be effectively used for predictive maintenance. When predictive maintenance is employed, the data collected can also be used for other purposes, such as increasing process efficiency and ensuring replacement parts are ordered in plenty of time. Therefore, proper collection and analysis of this data are essential to maximizing its potential and this will only become more important each year as the number of data increases.

6 Things to Keep in Mind When Switching to Predictive Maintenance

By Bryan Christiansen,
founder and CEO – Limble CMMS

Predictive maintenance (PdM) is a proactive, data-driven maintenance approach to monitoring real-time equipment operating conditions, to predict possible equipment failure and establish efficient maintenance schedules. It continues to gain popularity over traditional methods, such as six sigma and lean management, as a tool for driving industrial efficiency. PdM systems are capable of reducing maintenance costs by 12%, improving equipment uptime by 9%, extending equipment lifetime by over 20%, and minimizing health, environmental, and quality risks by 14%.

Here are some factors that plant managers and technicians should keep in mind when switching to predictive maintenance.

1. Infrastructure requirements

Predictive maintenance relies on sensors to collect real-time data from plant equipment. The sensors are capable of monitoring and detecting the slightest changes in equipment operation. Condition-based monitoring utilities collect data like temperature, pressure, vibration, rotational speeds, etc. Adjustments then can be made to prevent small errors from expanding into major failures capable of crippling plant processes.

Converting sensor data into alert signals and useful information requires a robust infrastructure that incorporates software and hardware platforms. These systems should be able to track and analyze data in real time, managing data from the multitude of sensors.

Before switching to a PdM system, identify plant needs and select appropriate sensors and system infrastructure that will be able to collect, convert, and manage critical machine data.

2. Data management

Huge amounts of data can be collected at any given instant by sensors fitted on critical plant

equipment. This data can be overwhelming in its raw form. When switching to a PdM system, it is important that the system is capable of filtering through and mapping out critical data from all sensors.

The PdM algorithms and predictive models should be able to predict failures and failure modes from analyzed data. The data-management platform is expected to provide a user-friendly interface, through which complex data is displayed in simple and understandable forms (graphs and pictorials), which can be acted upon to perform proactive maintenance.

PdM systems should be capable of collecting data on critical assets continuously, without affecting plant operation or the technical capabilities of the data-management platform.

3. User adoption and training

Switching to predictive maintenance means tht the maintenance staff will be exposed to new systems, software, and procedures. A PdM system is bound to disrupt existing maintenance practices, and it is important that staff understand additional software needs and changes that arise from its implementation.

A smooth transition to a PdM maintenance approach will depend on user acceptability and a clear understanding of systems by maintenance teams. Additionally, creating data models that will be used to predict equipment breakdowns is a complicated task and often will call for employing additional staff, such as data scientists and reliability engineers.

4. Ease of monitoring and alert generation

Before you switch to predictive maintenance it is critical that you adopt a system that is easy to monitor. Apart from breaking down complex data sets into understandable analytics, detection of errors and generation of appropriate alerts is equally important. PdM systems use alerts as feedback systems for effective communication between machines and maintenance teams.

A PdM system has to be capable of detecting and averting false alerts and generating structured alerts from specific data points. Accurate alerts that pinpoint location or root sources of errors are preferable to generic alerts. Creating a database for frequent alerts and error sources forms a basis for companies to develop a functional failure mode and root cause analysis model.

5. Dealing with security issues

Predictive maintenance ties industrial assets to various cloud computing platforms, enabled by IoT connectivity. These platforms are necessary for improving real-time data analysis and storage of equipment performance metrics.

Once plant equipment is connected to these platforms, maintenance moves beyond physical protection, bringing onboard cybersecurity strategies toward the management of industrial assets.

Priority should be given to the safety of IoT and cloud computing platforms adopted for PdM systems. There are several instances of attacks and security breaches on critical infrastructure facilities across the world. There have been reports of severe cyberattacks that have predominantly targeted the Industrial IoT technology. It is important that a PdM system incorporates robust security features against possible internal and external attacks.

6. Starting with a pilot project

Before you switch to a predictive maintenance model, it is important to lay down a strategic implementation plan. Implementation planning identifies critical plant assets and maps out possible implementation bottlenecks that may arise from adopting a predictive maintenance system.

Transitioning to a PdM system will take less time if a pilot project is implemented in advance. The pilot project can be used as a tool to train staff, test system security, and optimize predictive algorithms.

Many industries are shifting from reactive maintenance strategies to predictive maintenance. This has been hastened by the development of IoT technology, IoT-enabled CMMS solutions, and the fact that the cost of implementation is constantly dropping down.

It takes time for PdM strategy to be fully implemented. Challenges associated with implementation can be significantly reduced by performing prior, in-depth analysis of plant requirements, proper financial and material planning, and sufficient training of maintenance teams.

3 Maintenance Practices to Reduce Downtime

By TPC Wire & Cable Corp.

You don't have time for downtime. As an industrial manufacturer, you are tasked with pushing your production equipment to capacity while simultaneously trying to reduce downtime. Maintenance management and service are essential for your plant to operate at the highest level possible while continuing to optimize efficiencies.

How To Reduce Downtime

When your industrial plant is running in full swing, unplanned downtime becomes a very important consideration in production management and planning. There is no doubt that profit and revenue loss occurs when production targets can't be reached as a result of delayed output. Today, process improvement tools that promote lean manufacturing techniques can be used to proactively identify and troubleshoot maintenance issues ahead of the negative impacts they can cause on production.

To reduce downtime, take note of problem areas with a goal of actively adjusting for improvements by using these three maintenance management best practices:

1. Predictive Maintenance (PdM)

Right-On-Time Strategy PdM

- Consider people, skills, performance data, maintenance history, logs, and design data to make appropriate and timely decisions about your equipment's maintenance requirements.
- Analyze data trends to detect and correct a problem before it occurs. For example, if an electrical cable begins to degrade every two weeks, you can correct the problem before the cable fails.

Key Concepts of PdM

- Combine your information
- Analyze the information for equipment depreciation
- Determine the appropriate corrective action
- Use prediction algorithms
- Determine when to make the appropriate corrective action
- Get feedback on the root cause of failure
- Be proactive!

2. Preventative Maintenance (PM)

Minor PM

- Actively service your plant equipment with the most basic and essential maintenance such as cleaning, routine adjustments, and lubrication.
- Implement a timely and organized maintenance program to address your machinery's basic needs.
- Schedule planned maintenance time to fix out-of-service machinery so that more involved tasks can be completed at a time when you're anticipating them.

Major PM

- Replace machinery components based on run hours (or a similar factor) and their potential to fail in the future such as bearings, shafts, sensors, gears, piping, or electrical cabling.

Major & Minor PM

- Using a combination of these two practices will increase equipment reliability and can also play an important part in reducing downtime.

3. Proactive Maintenance

- Perform any kind of maintenance task to prevent or predict equipment failure.
- Transform reactive failure to a proactive failure by avoiding underlying conditions that lead to machinery degradation.
- Analyze the root cause, not just the symptoms.
- Determine potential failures in the design & operation departments—they can suggest solutions to the maintenance department to prevent failures.

Choose What's Best for Your Plant

Good maintenance practices, like the upkeep of an industrial plant's machinery, are critical to performance and success. Choose maintenance practices that are best suited for your plant's needs. Create a process to organize and implement those practices to insure they are acted upon in an intelligent and accelerated manner. Whether you're dealing with equipment failures due to extreme temperatures or harsh chemicals—preventing them from failure (in any way) is essential to reducing downtime.

What to Look for in a Condition Monitoring System

By Banner Engineering

Predictive maintenance is becoming essential to the smart factory. The ability to accurately track machine performance and anticipate failures before they occur is helping manufacturers improve overall equipment effectiveness and reduce wasted time and costs.

A leading solution for predictive maintenance is condition monitoring; however, collecting machine performance metrics is only the beginning. The ability to accurately interpret and communicate this data is essential for system reliability, and that's where machine learning comes into play. A condition monitoring solution with machine learning removes human error from the equation and makes predictive maintenance solutions smarter and more effective.

This article explains what predictive maintenance is, how condition monitoring with machine learning works, and 5 capabilities to look for in a condition monitoring solution.

What is Predictive Maintenance?

Predictive maintenance is the process of tracking the performance of crucial machine components, such as motors, to minimize downtime needed for repairs. Predictive maintenance enables users to more accurately anticipate when machine maintenance will be needed based on real-time data from the machines themselves. Because of this, predictive maintenance can help reduce machine downtime, increase the mean time between failure (MTBF), and reduce costs of unnecessary machine maintenance and spare parts inventory.

Traditionally, plant managers relied on preventative maintenance schedules provided by a machine's manufacturer, including regularly replacing machine components based on a suggested timeline. However, these timelines are only estimates of when the machine will require service, and the actual use of the machine can greatly affect the reliability of these estimates. On one hand, this means that you could be paying for unnecessary maintenance plans and replacement parts that aren't needed. On the other hand, many things can go wrong between scheduled maintenance visits.

For example, if bearings wear prematurely or a motor overheats, a machine may require service sooner than anticipated. Furthermore, if a problem goes undetected for too long, the issue could escalate to further damage the machine and lead to costly unplanned downtime. Predictive maintenance helps avoid these problems, saving time and costs.

Condition Monitoring with Machine Learning

Condition monitoring plays a key role in predictive maintenance by allowing users to identify critical changes in machine performance. One important condition to monitor is vibration. Machine vibration is often caused by imbalanced, misaligned, loose, or worn parts. As vibration increases, so can damage to the machine. By monitoring motors, pumps, compressors, fans, blowers, and gearboxes for increases in vibration, problems can be detected before they become severe and result in unplanned downtime.

Vibration sensors typically measure RMS velocity, which provides the most uniform measurement of vibration over a wide range of machine frequencies and is indicative of overall machine health. Another key data point is temperature change (i.e. overheating). Machine learning takes this information and automatically defines a machine's baseline conditions and sets thresholds for acute and chronic conditions, so you know in advance—and with confidence—when your machine will require maintenance.

5 Key Capabilities of a Smart Predictive Maintenance Solution

Machine learning is just one important element that creates a smart condition monitoring solution. The following are the top 5 capabilities to look for in a predictive maintenance solution:

- **Continuous monitoring.** The most effective predictive maintenance solutions will continuously monitor machines for critical changes, including changes in RMS velocity, high-frequency RMS acceleration, and temperature. Changes in these conditions are leading indicators of future failure, and a continuous monitoring solution will pick up on these changes in real time and allow for timely action.
- **Machine learning.** After mounting the vibration sensor onto your machine, most sensors require you to collect enough data to establish a baseline for the machine. Machine learning removes the chances of human error by automating data analysis. A condition monitoring solution with machine learning will recognize the machine's unique baseline of vibration and temperature levels and automatically set warning and alert thresholds at the appropriate points. This makes the condition monitoring system more reliable and less dependent on error-prone manual calculations.
- **Wireless communication.** A wireless condition monitoring solution is easy to deploy quickly, and it can be adapted as your needs change without requiring extensive downtime for cable runs. In addition, the ability to monitor machines in inconvenient locations allows for more comprehensive monitoring and increased reliability throughout your facility.
- **Local and remote indication.** When a vibration or temperature threshold has been exceeded, a smart condition monitoring system should provide both local and remote indications, such as sending a signal to a tower light in a central location or sending an email or text alert. This will ensure that warnings are addressed quickly regardless of whether the machine is within the sightlines of an operator.
- **Data logging.** A condition monitoring solution that allows you to log the collected data over time enables even more optimization. With a wireless system, vibration and temperature data can be sent to a wireless controller or PLC for more in-depth, long-term analysis.

Monitoring vibration and temperature using machine learning improves reliability, reduces unplanned downtime, and saves maintenance costs. It is also an easy way to start making better, data-driven decisions about your machines and transforming your facility into a smart factory.

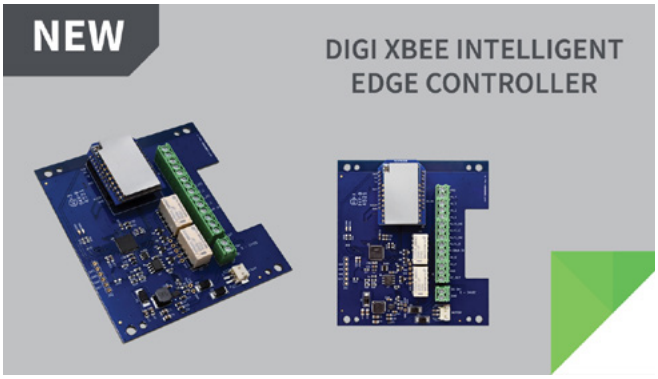
PRODUCTS

Reveal Machine Faults Quickly

The **3563 Analysis Vibration Sensor system** is a complete solution—hardware, software, and services—that integrates a powerful set of technologies to give detailed insights into anything from performance tracking to fault analysis to improve the reliability of equipment. It combines a high-frequency piezoelectric sensor, two MEMS sensors, and software, enabling maintenance teams to continuously monitor and analyze vibration readings for a facility's critical and semi-critical assets.

Fluke Corporation

MORE ONLINE: newequipment.com/21175741



Smart Edge Controller

TExtending industrial monitoring use cases to more remote asset classes is the **Digi XBee Intelligent Edge Controller** (IEC). It provides a deployment-ready upgrade to existing industrial sensors with the latest innovations in wireless and cloud technologies. It is compatible with 90% of existing industrial sensors and controls, providing SCADA systems with an IoT alternative.

When combined with Digi X-ON cloud, it can help companies monitor sensors or remote-control assets over Long-Range, Low-Power Wide Area Networks. Industrial devices can be monitored with sub-second latency with alarms and data wirelessly delivered through the Digi X-ON cloud.

Digi XBee IEC not only provides a faster time-to-market for IIoT OEMs and enterprises, it is also a value-added tool set for systems integrators and Value Added Resellers to address complex IIoT deployments.

Digi International Inc.

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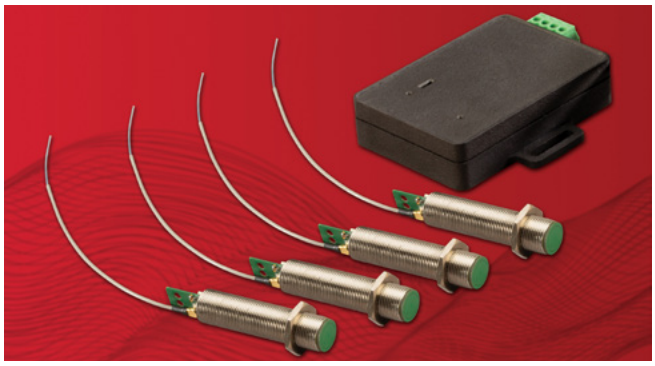

Wireless Probe System

The **Accumeasure Wireless Gap Measurement Probe System** consists of up to four battery-powered, wireless capacitance probes paired via Bluetooth to their receiving device and is ideal for rotating machinery. The wireless capability and compact design of the probes enables them to measure gap in difficult-to-reach locations. Featuring improvement over conventional eddy current probe systems, capacitance probes are not susceptible to temperature drift, have built-in calibration, and are immune to magnetic field interference.

MTI Instruments, Inc.

MORE ONLINE: newequipment.com/21244501

Fully Voice-Driven Industrial Wearable

The **RealWear Head-Mounted Tablet (HMT-1)** is a hands-free, voice-activated user interface that allows workers to be unimpeded by a mobile device while operating their tools or equipment while on the job. Advanced noise cancellation and voice recognition grant operators the ability to speak at a normal volume. In the same realm as smart glasses, the HMT-1 features a micro-display that delivers information immediately to the operator and can be flipped up, out of the way when not needed. The display is landscape-oriented and allows the viewing of PDF documents and manuals. The unit can be worn directly on the head or clipped to an approved hard hat and works with eyeglasses, safety glasses, and safety goggles.

RealWear, Inc.

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Smart Maintenance for Smooth MIG Welding

By David Lee, *Technical Director – Weld Mold*

In nearly 25 years as a forging tool and die welder, I've had some really good days. The die is hot enough, the radio is playing loud, and the boss is on vacation. All I have to do is keep the wire (FCAW in most cases) running at 20 pounds an hour. Easy, right? Few things can turn a good day into a bad day faster than feeding problems for a welder running wire.

In my experience, the feeder itself is usually not the problem. The problem starts at the drive rolls and can run all the way to the tip. It starts as what is described as "chatter" or "stutter": the wire refuses to feed smoothly, and the welder can feel the resistance in the handgun.

MIG guns come in many different sizes and run a variety of diameters and types of wire. From mild steel to aluminum, tool steel to copper-based alloys, MIG welders today are used in every industrial sector—including essential die and tool repair at forging shops everywhere. It doesn't matter where it's found—whether in the robotics-rich environment of the automotive plant or in the neighbors' garage—the one thing they all have in common is the drive rolls, cable, and torch that deliver the filler metal and shielding gas (or not) to the area needing a weld.

Whether you are running a solid or flux-cored wire, shielded or open arc or even sub-arc, wire-feeding problems are encountered in all of these types of welding. You've run literally miles of wire through your gun flawlessly with just regular tip changes, and now it decides to act up.

Here are five common problems with MIG equipment, along with some reliable solutions that I have learned, if conducted regularly, will keep your good day from going bad.

1. Drive Rolls Are Not Cleaned or Adjusted Properly

The drive roll groove (and knurls on rolls so configured) can become packed with the drawing compound (used during wire manufacturing to reduce the size of nearly all the solid or flux-cored wire used in the MIG applications), industrial grit from grinding, and smoke from welding. This can affect the tensioning and grip on the wire. Smooth rolls used for solid wire are less affected than knurled rolls used for FCAW wires.

The Solution

Periodically remove the drive rolls and clean them with a wire brush to eliminate the build-up of drawing compound, dust, and dirt that would affect the pressure and grip the rolls would have on the wire. At the same time, inspect the drive rolls for wear. They will wear out, especially if knurled.

2. Drive Roll Pressure Is Too High

It's common when a feeding problem arises, to tighten the drive rolls in order to grip the wire better to overcome the problem. This is especially true when using knurled rolls for flux-cored wire. Because of its construction, flux-cored wire is easy to reshape from round to oval; with drive roll pressure and when using knurled rolls the wire develops "teeth". These teeth will start to wear the liner, guides, and tip like a saw. Solid wire, when used with knurled drive rolls, will not change shape like flux-cored wire, but will develop the "teeth" and similar wear.

The Solution

Periodically, before feeding the wire through the cable/hose assembly, use an air nozzle and shop air pressure to blow out the liner, first from the torch end and then, if convenient, from the feeder end. The amount of small debris blown out of the liner will surprise you. Shavings from the wear and wire have a tendency to "pack up" the liner at non-contact points and junctions (diffuser/tip.) This will cause the wire to chatter or stop feeding altogether. It will also wear out the liner more quickly.

3. Worn Spring Liner

The spring liner used for almost all cable/hose assemblies is removable and replaceable. Almost all spring liners have at least two bends that are constant. One coming out of the feeder, the other in the torch neck. The wire rubs the same spot and wears a groove in the liner. This acts as a high-friction area as the groove deepens, and the more bends that are permanent, the more it increases the drag on the wire causing it to "birdnest" at the torch inlet or stop feeding altogether.

This is also one cause of the chatter that frustrates welders.

The Solution

Occasionally index, remove, and inspect the liner. A kink in the liner will cause a feeding problem. Blow out the liner guide, turn the liner 90 to 180 degrees and reinstall it. (You did index it before you pulled it out, didn't you?) This will present a fresh area in the liner to the wear of the moving wire. Eventually, you'll need to replace the liner, but doing this can extend the service life by three or four times what it normally would be.

4. Diffuser/Tip Problems

The most commonly replaced item in a torch assembly is the tip. Because the tip is at the business end of the torch, it receives the lion's share of the abuse from the heat, spatter, and the operator.

The Solution

Aside from normal wear that results in the need for replacement, the tip is rarely the cause of feeding problems. But, it does show the results of the problem. If the tip has been replaced and feeding problems persist, then there is almost a guarantee that the problem has developed in one of the previously discussed areas.

5. Check Your Ground!

A bad ground can present itself as a stutter and cause the wire to perform as if it needs a voltage or speed adjustment. A lack of shielding gas coverage, liner or tip grab, or base metal contamination, will cause porosity.

The Solution

Make sure to occasionally check the ground at the power source, wire feeder, and work clamp. A bad ground can destroy a tip with burn-back and spatter.

One of the easiest ways to maintain good feeding characteristics, if everything else is right, is to use commonly available wire lube and cleaner, good for MIG and FCAW. Another good idea for preserving the consumables (nozzle and tip) is nozzle dip. These products won't correct for drive rolls issues, worn liners or weak grounds, but when used according to the manufacturer's recommendations and the above-mentioned tips, they will promote much longer component life, fewer feeding problems, and many more good days than bad ones.

8 Essential Electrical Measurements for Every Industrial Plant

By Sean Silvey, *Product Application Specialist – Fluke Corporation*

Always up and running is every plant's daily goal—that's why you invest so much into the maintenance of the equipment and infrastructure. Of all the electrical measurements made by maintenance technicians in the pursuit of operational excellence, these are the 8 most essential.

1. Three-Point Test Method

Safety first. Before working on an electrical circuit, follow LOTO procedure, and use the three-point test method to ensure your tool is working properly. This test ensures the absence of voltage at 50 volts or more.

- **Step 1:** Verify the tool is working correctly by testing on a known energized source or with an electronic proving unit
- **Step 2:** De-energize the circuit to be verified
- The tool should indicate zero energy
- **Step 3:** Check your tool again using the known energized source or electronic proving unit

2. Voltage

Being able to measure both AC and DC voltage is an important feature in simplifying your motor inspections. Quickly grab a meter and begin troubleshooting power supply issues to help ensure equipment is up and working smoothly. A clamp meter or multimeter can help raise a red flag to let you know when to grab a more powerful meter.

If an issue was raised, grab a power quality meter to investigate further, look for harmonic distortion, swells or sags that may be present at the motor. These can be a sign of increases in voltage requirement throughout your building if the cause is internal. If the cause is external, it can be caused by nature, such as vegetation affecting power lines. Both are worth looking into correcting if your motor is experiencing sags or swells in power.

It's a great option to use a clamp meter or multimeter during your regular preventive maintenance routes to look for voltage imbalance issues. Use that information to come back through later with a more powerful power quality tool to determine where the imbalance may be coming from.

3. Current

A clamp meter can help determine balanced and unbalanced loads throughout your facility. Again, these measurements will give you an idea of whether or not you need to come back through with a power quality tool to determine the unbalance.

Non-linear loads or devices that conduct current for less than the entire sine wave cause harmonics. Harmonic current flowing through system impedances generates voltage distortion. In severe instances, these harmonics can cause thermal trips or logic faults. As the voltage distortion caused by current harmonics increases, linear loads begin to draw harmonic current. In motors, the distortions can cause counter-torque resulting in more current and a host of other problems, including decreased motor efficiency, increased heating, and a shorter life of the motor.

4. Component Resistance

Checking the resistance of control circuits, like switches and relay contacts, can show what condition the components are in. The higher the resistance, the lower the current flowing through to the motor at the end. Most of the time, resistance starts out very low and increases over time; as dirt builds up, there is more wear and tear put on the components, insulation breaks down or moisture builds up.

Finding these kinds of issues and correcting them before the damage can prevent expensive repairs or asset replacement.

5. Circuit Continuity

Testing a circuit for continuity tells you whether two points are electrically connected or not. Use these checks to verify a proper connection or if there could be a break anywhere in the electrical path.

6. Circuit Loading at Panelboards (feeder cables, branch circuits, neutrals)

Sometimes a circuit load at the panelboard could cause sags down the line if the wiring isn't adequate for the loads they feed. If this issue presents itself in your facility, correct the wiring and loading issues first, then you can try other actions to minimize the source impedance like:

- Reduce the load on the panel (if necessary and possible)
- Don't cascade subpanels off subpanels
- Limit the length of feeder runs to subpanels

Be sure not to overload transformers as that can cause increased energy losses further down the line and ultimately cause premature failure in equipment.

7. Validate Load Measurements on Motors and Pumps

Motors and pumps are incredibly common machines in the industrial industry. Because they're so common, they are often overlooked as the possible cause of excess costs. But when not operated properly, motors and pumps can slow productivity and cause additional problems and costs.

It's important to make sure your load is properly balanced. Validate that the load to the motor is not overloaded with voltage or current flowing through.

8. Confirm Transformer Load and Line Voltage

When inspecting your motor, running a load test can determine the efficiency and thermal and dynamic stability of a power transformer. If the transformer is frequently overloaded, it weakens the system faster. Overloading generally causes overheating and eventually creates cracks in the insulation within the system. Using the meter, you can know what voltage and current should be coming out at the transformer, up to 1,000V line voltage. If something is off, you will need to grab a more powerful tool and continue investigating. Keeping an eye on transformer loads and line voltages during your regular preventive maintenance routes can help catch issues before they become too big.

Five Questions to Ask Your Plant Manager About Valve Trains

By Robert Sanderson
P.E, Combustion Safety – Rockford Systems, LLC

Does your manufacturing facility have a smokestack? If it does, your facility also likely contains a valve train, commonly known in industrial circles as a "gas train" or a "fuel train." This complicated series of piping and components require annual inspections, accurate record-keeping, and preventive maintenance to avert productivity issues.

"If you aren't sure what a valve train is, you're not alone. It is one of the most misunderstood pieces of equipment on the plant floor, said Robert Sanderson, P.E., Director of Business Development at Rockford Combustion Systems, a division of Rockford Systems, LLC. "As a result, the valve train rarely receives the consideration it should from thermal combustion professionals."

Sanderson notes that while it isn't necessary to know every engineered component of a valve train, you should be aware of what it does and why it demands your organization's attention. Essentially, a valve train controls the flow of fuel into thermal processing equipment. By controlling the desired ratio of fuel and air, the connected burner then properly oxidizes the mixture, safely releasing the energy needed to heat your furnaces, boilers, HVAC heaters, thermal oxidizers, and other equipment. In turn, the thermal process equipment performs critical production tasks such as drying gypsum boards, roasting and baking foods, heat-treating metals, fluid heating, and pollution control.

Owing to the presence of hazardous vapors and gases, poorly designed or inadequately maintained valve trains have led to fires, multi-million dollar losses, and injuries. Thankfully, you can significantly reduce the potential for mishaps by asking your plant manager these five simple questions:

1. Does the Valve Train Receive an Annual Inspection?

The entire combustion system must be inspected at least annually to ensure compliance. NFPA 86 standards provide guidelines to establish these measures, stating, "The user has the responsibility for establishing a program of inspection, testing, and maintenance with documentation performed at least annually." This applies to both new installations and modifications. Annual testing is typically required by insurance agencies, but other (often overlapping) codes and standards may need to be adhered to besides NFPA,

Learning about and acting upon the potential dangers of valve trains and scheduling annual inspections will help reduce risks and improve productivity in your organization.

equipment are cleared. This is important to make sure conditions are safe before intentionally lighting the fuel. Three basic requirements must be satisfied: combustibles feeding the process have been isolated, purge airflow is maintained, and purge time is completed.

Interlocked switches on the valve train ensure fuel is not entering the system when off. Purge airflow may be verified by using a flow-metering device or by measuring a fixed drop in pressure. The final requirement is verifying the purge timer, which is set for the time it takes to clear the system of combustible mixtures. The purge time is determined by the volume of the equipment and is at least four system volumes. Controls continuously monitor the purge airflow and timing. If anything is interrupted a restart and a new full purge must be performed.

3. Are any Components Missing?

As mentioned earlier, valve trains are complex and comprised of a series of components, each dependent on the last. Even the most basic combustion system will feature shut-off valves, manual shut-off valves, high- and low-pressure switches, pressure taps, and in-line strainers. Add to this regulator, valve leak-test systems, diagnostic gauges, and pilot accessories and one quickly recognizes the potential for missing parts either by design or accident. Your plant manager's maintenance records should indicate if alterations to the original equipment were made.

One frequently missing component of the valve train is the sediment trap. Sediment traps should be installed beneath incoming vertical drops to capture large debris and pipeline condensate. While sediment traps effectively prevent contaminants from getting into the gas equipment and are required by NFPA, many manufacturers do not include them unless specified.

Another frequently non-compliant device are gas-pressure switches. Found in pairs, these switches monitor and ensure the fuel pressure remains within a safe operating window. Often, however, these switches are bypassed, improperly set, or incorrectly installed.

"An untrained maintenance team member may inadvertently bypass or adjust a switch to get the equipment running immediately," noted Sanderson. "Switches that are bypassed or set to impossible pressures provide no protection whatsoever. Additionally, these switches must be electrically sealed to preclude explosive vapors from flowing backward through the wiring system."

4. Is the Valve Train Vented or Ventless?

Unless valve train components are listed as "ventless," vent lines are necessary. Simply installing vent piping is often insufficient. Vent lines must be correctly engineered, installed, and routed to appropriate and approved locations to be effective. Even when vent lines are properly installed, building pressures can vary sufficiently which may prevent optimal burner performance. Vent pipes have also been known to fill with spiders, bees, and other nesting insects. Once plugged, the pipes will impede the escape of gasses, leading to a potential gas build-up inside the facility.

In short, vent lines are another potential failure point. Vents must be inspected regularly by maintenance staff for leaks or blockages. When given the choice always go with ventless components.

5. Are Emissions Being Controlled?

Emission compliance is a major focus in many industries and geographical regions, such as California. Is your plant compliant with the appropriate regulations? If not, agencies may issue hefty fines or shut down production completely until modifications are made. Sometimes, a simple burner tuning will ensure a system operates within requirements. At other times meeting new Environmental Protection Agency (EPA) or revised local requirements necessitate modifications to existing valve trains, since installing a low NOx burner often creates the need for improved fuel control too.

Summary

Learning about and acting upon the potential dangers of valve trains and scheduling annual inspections will help reduce risks and improve productivity in your organization. Find the valve trains in your plant and have a look at them. Can you find evidence of inspection such as documentation, stickers in the control box or other supporting paperwork? Do the shut-off valves have fittings for testing? Or are they fitted with dirty and corroded test plugs? If you cannot find evidence of a recent annual inspection, do not risk becoming a statistic. Instead, have a conversation with your plant manager or maintenance team lead.

Chiller Maintenance Tips: 3 Quick Questions with Tim Kane

By Jonathan Katz

A cold blast of reality is hitting many industrial facility managers: Inefficient chillers are leading to increased energy costs and reliability issues.

Typically, the reason is a lack of maintenance. Energy consumption can double in just a few years without routine chiller maintenance, according to Goodway Technologies, a global manufacturer and marketer of industrial maintenance and cleaning solutions.

A chiller is the single largest consumer of power and most expensive piece of equipment in a building, explains Tim Kane, president and CEO of Goodway Technologies.

"Chillers account for over 50% of the electrical usage in most facilities, according to the North Carolina Energy Office," Kane says. "The U.S. Department of Energy estimates that chillers are expending up to an additional 30% in energy through inefficiencies. Regular maintenance of chiller systems helps decrease energy costs and extends operational efficiencies."

Several new advancements in chiller maintenance are helping facility managers and technicians improve reliability. Some of these technologies include quick-connect shafts and brushes, Speed Feed gun systems, and drop-in tube cleaning tablets.

NED recently spoke with Kane to gain a better understanding of how these systems work and how they can help improve efficiency and reliability in industrial facilities.

NED: WHAT DID THE EARLY DAYS OF CHILLER MAINTENANCE LOOK LIKE?

TK: *Chiller maintenance has certainly come a long way, though it's still quite a manual and labor-intensive process to do correctly.*

Many years ago, the only option for cleaning chiller tubes was to attach a brush to a metal rod and clean out the tubes. This was extremely time-consuming and often required multiple people to get the job done. It could also cause worker injury because it required repetitive motions.

In all, cleaning a chiller, which in many cases has hundreds of tubes, could take many days. With today's technology, that time has been reduced to just a few hours.

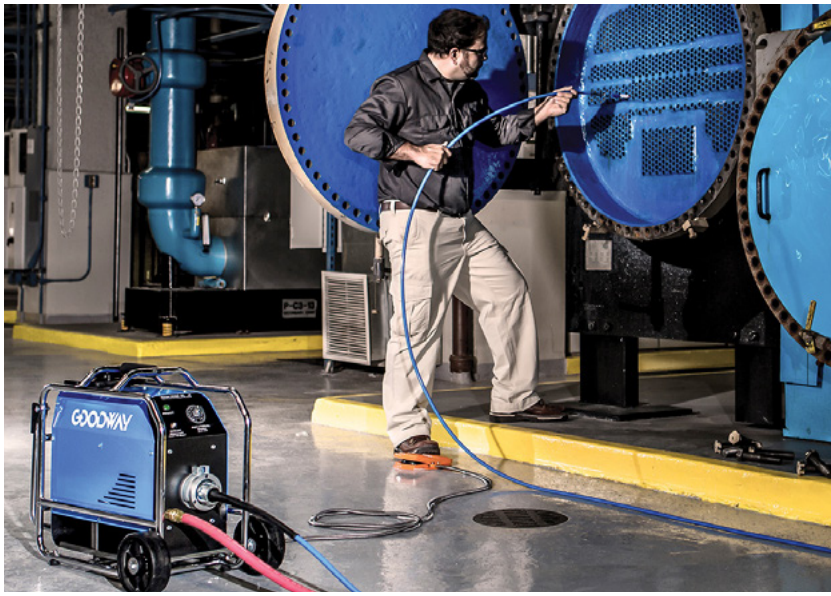
As a result, the biggest advantage today is that efficient and easy-to-use tube cleaning equipment means that the job gets done instead of being pushed aside due to difficulty.

NED: WHAT DO YOU THINK THE BIGGEST INNOVATIONS IN CHILLER MAINTENANCE HAVE BEEN IN THE PAST FIVE YEARS?

TK: *There have been a few innovations that have not only sped up the process but also made the cleaning more impactful.*

The introduction of technology like the Speed Feed gun system allows the user to simply press a button to push and return the cleaning shaft and brush down the tube. This not only speeds up cleaning but reduces operator fatigue.

A more recent innovation includes quick-connect shafts and brushes. During the cleaning process, an operator can go through 25 to 50 brush changes or more. The quick-connect system eliminated the need to spend a few minutes for each brush change, saving valuable time and effort.



Another innovation was the introduction of variable-speed shaft rotation. Historically, tube cleaners have spun their brushes at a fixed rate. With the introduction of rifled or internally enhanced tubes to chillers and other heat exchangers, the fixed RPM tube cleaners could sometimes miss cleaning the valleys of these rifled tubes. Using a variable RPM machine allows the user to better match the natural grooving pattern of the rifling, assuring a better, more consistent cleaning.

However, one of the biggest leaps forward in tube cleaning technology was the introduction of Goodway's RAM-PRO-XL, which features TubeGuard technology. This technology couples advanced tube-cleaning machinery with a tablet-based cleaner and has the ability to actually clean, disinfect, and protect chiller tubes. This process enhances the performance and condition of tubes by eliminating biofilm for a better clean and at the same time adds a corrosion inhibitor to prevent oxidation of chiller tubes. The drop-in tablet is pre-measured and simply dissolves in the RAM-PRO-XL onboard reservoir during tube cleaning.

The newer tools and equipment are designed to provide more portability, make it easier to use, and oftentimes it only takes one person to complete the task, instead of requiring two or more people to implement the cleaning.

NED: HOW IS GOODWAY ADDRESSING CHALLENGES RELATED TO CHILLER MAINTENANCE?

TK: *Goodway is considered a category-maker, developing very specific engineering-based solutions for its customers. We are uniquely positioned because of our direct selling path to the HVAC market. This allows us to speak with hundreds of our customers each day, giving us a significant advantage over OEMs that are separated from the end user by distribution channels.*

We also spend a lot of time listening to feedback from our customers, whether it be on a certain product or general pain points they experience when performing maintenance or sanitation. We look for opportunities to provide solutions to problems and make it easier for facility managers and personnel to do their job. Our in-house design engineering team has focused on developing customer feedback into extended capabilities for the job at hand.

PRODUCTS

Accelerated Application Development

Assisting OEMs and end users to rapidly configure and implement advanced edge computing, visualization, and IIoT technology, **PACSystems Edge Solutions** is a portfolio of turnkey industrial hardware and software to reduce the time spent integrating, developing, and validating digital transformation. They allow for personnel to easily collect and visualize critical data and analytics locally for maximum uptime.

The ready-to-deploy solutions deliver a scalable range for edge capabilities in fit-for-purpose packages. They enable the monitoring of machine health, the improvement of actionability and visibility into performance, and they can notify operators or potential issues before they become downtime events.

The information collected is presented on a single, common human machine interface from machine to enterprise level. Organizations are able to begin with one application and build as needed. The solutions are fully licensed and optimized combinations of Emerson's edge and IIoT software and computing hardware.

Emerson Electric Co.

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AI Solution Eradicates Defects

Dataprophet PRESCRIBE uses advanced predictive and prescriptive machine learning capabilities to predict defects, faults, and quality errors, and prescribe optimum control parameters to improve production. PRESCRIBE ingests and analyzes process and quality control information from databases, spreadsheets, streaming sensors, and PLC sources, and can record up to a thousand data points a second. State-of-the-art machine learning models are able to learn from this data to identify optimal control bounds. PRESCRIBE helps operators identify when operational parameters have exceeded the target control bounds and prioritize the changes required to optimize production and reduce scrap.

DataProphet

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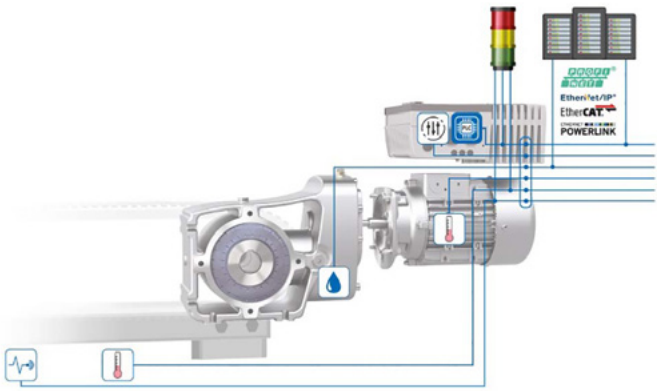

Condition Monitoring for Predictive Maintenance

NORD's **Condition Monitoring** solution helps maintain machines and plants proactively as a preventative measure to reduce downtimes and increase overall efficiency. It provides real or near-real-time drive and status data which is recorded periodically or continuously to optimize operational safety. This data is stored on a local industrial PC where you can have the drive information transferred and summarized on a remote dashboard.

NORD DRIVESYSTEMS

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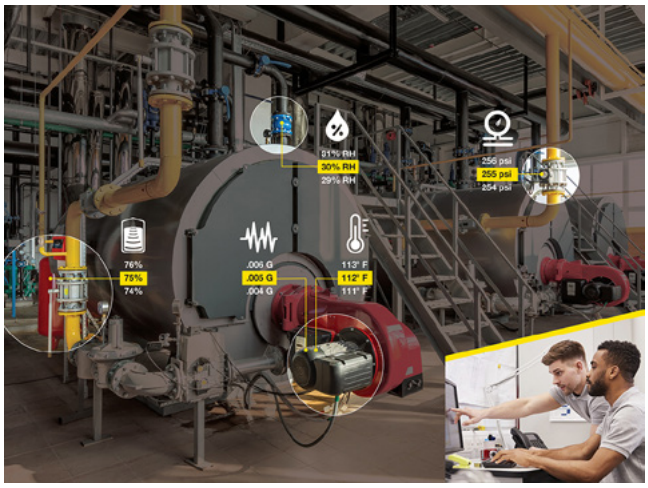

IIoT Productivity Kits

SmartSolutions features easy-to-install, integrated, and customizable IIoT kits of sensors, wireless solutions, and LED lighting. The kits, combined with integrated software, immediately bring predictive monitoring and maintenance data online. The sensors establish a baseline and quickly identify areas for preventive repairs, bottlenecks in the process or other risks to overall equipment effectiveness.

Banner Engineering Corp.

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How Preventative Maintenance Can Make Manufacturing More Reliable

By Talmage Wagstaff, *Co-Founder and CEO – REDLIST*

From a defective product that causes potentially disastrous recalls to a product delivered to your customer outside of spec, production machinery that isn't properly maintained is a manufacturing nightmare. When you think of preventative maintenance, you probably think a little bit of lubrication and recalibration doesn't make that big of a difference. However, root cause analysis of recalled products has shown repeatedly that a lack of a preventative maintenance program can cause those exact results.

By ensuring that you have an effective preventative maintenance program in place in your facility, you are actively playing a role in quality control in your facility. Manufacturing has plenty of variables that can sometimes be beyond our control, but preventative maintenance on your production equipment isn't one of them. What you lose in terms of production to perform preventative maintenance is gained back multiple times by producing a consistent and superb product that is meeting or exceeding quality standards.

1. Equipment Efficiency Means Product Reliability

By keeping your manufacturing facility properly maintained, you're ensuring that your machinery is running as intended. Lack of preventative maintenance is a common cause of process variation, and it doesn't take years to occur. The further off calibration a machine drifts, the greater the variance. Process variation often results in defective product or product that is off-spec.

For example, if your fruit filler is supposed to drop 3 oz. of strawberries per cup, yet it is only dropping 2.3 oz. into each cup because of a bad flowmeter, you are going to have customer complaints about the product having a low fruit percentage. Conversely, 3.2 oz. of strawberries per cup, and you have now skewed the product cost per unit for the entire batch, resulting in higher manufacturing costs and a lower profit margin.

With an effective preventative maintenance program in place in your manufacturing facility, you are ensuring that something as simple to remedy as a bad flow meter doesn't result in scrap or rework product, or even customer complaints. By performing preventative maintenance, machines aren't given the opportunity to result in misformulations because of parts failure. Instead, they are regularly inspected, lubricated, calibrated, and tested to ensure that they are running at optimum levels and producing the highest quality product as they were designed.

2. Reduce Scrap And Rework Product

Rework products and scrap products are costly. In order to reprocess faulty or below-standard products, you're adding production expenses but not increasing the product output. It isn't difficult to see how this could quickly turn into a manufacturing headache.

Efficiently operating equipment is the key to a consistent product. It only takes a small variance to ruin the taste or look of an entire batch, and depending on the variant it may be a

scrap product that cannot be reblended to salvage the batch. That is the equivalent of throwing raw materials directly down the drain.

Think about how many batches it requires to rework a tank of a product if you can only use a 7% rework in your formula. Depending on your batch size, there is a good chance that you'll end up losing product to expiration before you'll be able to use the contents of the rework tank. If that sounds costly, it's because it absolutely is.

3. Scheduled Output Vs. Actual Output

When a lack of preventative maintenance on your manufacturing equipment causes a large enough variance between scheduled output and actual output, it starts a chain reaction of negative effects in your facility. Because of less product output, production runs must increase to fill orders. Orders may be delayed, resulting in unhappy customers. It's a domino effect and it doesn't repair itself.

Once a certain percentage of the scheduled output is not being met, the reasons for the variance need to be investigated. Poorly maintained manufacturing equipment doesn't need to be a reason production goals aren't met. With a preventative maintenance program in place, it doesn't take long to have equipment running as it is intended, with reduced breakdowns and higher quality output.

4. Less Downtime

Broken equipment resulting in unplanned downtime increases costs in almost every aspect of the facility. Labor of those on the clock, yet not producing. Parts costs are usually a substantial amount higher because you're now repairing and replacing parts instead of performing the measures to keep everything running on spec. And chances are, if you have allowed the equipment to run until the point of breakdown, there is a much larger repair to be performed than simple preventative maintenance would have cost.

The fact is, preventative maintenance programs have been proven to reduce equipment breakdowns and also maximize the life of your machines. The manufacturer provides preventative maintenance guidelines that should be strictly adhered to in order to see the best possible results from the equipment. By following the guidelines for preventative maintenance, you're protecting your assets, increasing output, and decreasing downtime caused by equipment breakdowns.

5. Balance Maintenance And Productivity

The ultimate goal of the facility is to achieve a balance of maintenance and productivity that prolongs asset life while meeting plant production needs. Without proper preventative maintenance, you're virtually guaranteeing that you'll see product variations due to poorly operating machines. The extent of the variation is the only real question to ask yourself.

Taking the time and effort to properly maintain your facility is an effective tool in the fight against scrap and recalled products. When you manufacture a consistent product because your production equipment is running at its peak capacity, you're greatly reducing your chances of shipping products that are going to leave unsatisfied customers asking for refunds.

6. Develop A PM Program Before Breakdowns Happen

Putting a preventative maintenance program in place with the assistance of a Computerized Maintenance Management System (CMMS) only sounds difficult. Once you decide on the CMMS that would best suit your facility, you simply need to put together an asset listing and input the manufacturer's suggested preventative maintenance timelines. The time and labor that you expend on developing your preventative maintenance program is a mere drop in the proverbial bucket when you consider the price of one load of a recalled product. Don't wait for your production machinery to cost you customers and money. A CMMS and skilled maintenance team can ensure that your facility manufactures a quality product every single time.

Caring for Bearings: Essential Maintenance Tips To Keep Your Plant Rolling

By Matt Nagel, Sr. Applications Engineer - NSK Americas

When most people consider ball bearings, they envision robust and rugged machine parts that can take all kinds of knocking about, vibrations, high temperatures, and friction. But the reverse is true. Bearing reliability depends on many different factors such as loading, speed, fitting, setting, operating temperature, and being kept in pristine conditions. Handling with extreme care along with lubrication and maintenance to avoid contamination and other environmental factors is also essential.

Since rolling bearings are high-precision machine parts, they must be handled while taking the following main precautions into account:

Keep Bearings and Surroundings Clean

Dust and dirt—even if not visible—have harmful effects on bearings. Keep bearing handling rooms as clean as possible, and do not remove bearings from their packaging until just before use.

Handle With Care

Heavy shocks during handling may scratch or cause other damage to the bearing, possibly resulting in premature bearing failure. Strong impacts can result in brinelling, breaking, or cracking (see troubleshooting below). Never use a bearing that has been dropped, as it may be dented and can cause a high level of acoustic noise.

Always Use Proper the Tools

When handling bearings; avoid general-purpose tools. When applying lubricant, never use an applicator that can leave contaminants behind, like a cotton swab which can leave fibrous particles.

Protect Bearings From Corrosion

This is the cause of 95% of bearing failures, so if this sounds like a broken record when it comes to corrosion, this is why. Even perspiration on the hands as well as various other contaminants can cause corrosion which is why wearing gloves is advisable when handling bearings.

Key Bearing Performance Factors

It's necessary to periodically inspect and maintain the bearing under its operating conditions, to maximize the bearing life. To determine the bearing replacement period and the replenishment intervals for lubricants, there are a few telltale factors to monitor:

Bearing Noise

During operation, a sound detection instrument, like a stethoscope or a proprietary instrument, can be used to investigate the volume and characteristics of bearing rotation noise. It is possible to distinguish and diagnose bearing damage by its sound.

Bearing vibration

Irregularities can be analyzed by measuring the vibrations of an operating machine. A frequency spectrum analyzer can measure the magnitude of the vibration and the distribution of the frequencies. Test results can determine the likely cause of the bearing irregularity.

Bearing Temperature

This can be measured from the housing outside surface, but a better way to do it is to obtain a direct reading from the bearing outer ring by a probe going through an oil hole. Because the temperature tends to increase with operation, wait one to two hours after the start of an operation to monitor the temperature.

Effects of Lubrication

The main purposes of lubrication are to minimize friction and reduce wear inside bearings. It does this by dissipating frictional heat and cooling, and by sealing the unit to prevent rust from forming. Bearing lubrication methods fall into two categories: grease and oil lubrication. Each has its advantages in certain application conditions and proper selection of the method will impact performance.

Lubrication whether oil or grease, will deteriorate over time, and periodic replenishment is required. The replacement intervals depend on the operating conditions (i.e. temperature), type of grease used, the magnitude of the bearing load, and the oil quantity.

Troubleshooting Linear Motion Components

While radial bearings must be maintained properly for a longer life, when bearings are used in linear motion components there are specific issues to watch out for.

In general, if rolling bearings are used correctly they will survive to their predicted fatigue life. Bearings can fail prematurely, however, due to avoidable mistakes. This is caused by improper mounting, mishandling, poor lubrication, contamination or abnormal heat generation when operating.

If the nature of the failure can be determined, a countermeasure can be taken to reduce similar failures or prevent them from happening again. Here is a troubleshooting guide to the most common issues:

Flaking

When linear guides approach or reach their rolling fatigue life, scaly particles flake away from the surface of the raceways and balls. There are a few reasons this is happening.

It could be the natural life of a linear guide; improper assembly or misalignment; poor flatness of the mounting surface; insufficient or improper lubricant; or intrusion of foreign matter or water. If flaking is noticed, there are a few steps to repair the issue.

Improving the flatness of the mounting surface or the accuracy of the assembly could offer a solution. If lubrication is the culprit, try switching to a better method or try a more suitable lubricant to see if that resolves the issue. If there is contamination of any kind, review the protective covers and/or enhance the sealing capability of the linear guide.

Wear and Tear

Wear and tear on the rolling contact surface or the balls can result from severe friction, and this is generally a result of insufficient lubrication, improper installation or an intrusion of foreign matter. If misalignment isn't a factor, checking the sealing capability and the lubricant is the best option.

Fretting Corrosion

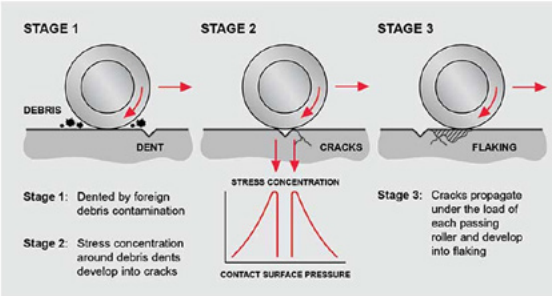
A specific type of wear that results from repeated rubbing between contacting surfaces. It is almost certainly caused by completely dried-out lubricant on the contacting area because of minute amplitude oscillation.

Use anti-fretting grease and distribute the lubricant over the contact surfaces by longer stroke motions at a certain frequency (i.e.: once every 5,000 cycles).

Indentations

Occur on the raceway at each ball location like the deformation caused by a Brinell Hardness Test. High energy impacts or improper handling of the product at its installation or in transit will easily cause this sort of damage. General dents on the raceway could also be caused by contamination or intruded metallic particles. If this is suspected, improved sealing and filtering of lubrication oil is advisable.

FIG. 1 - SURFACE ORIGINATED FLAKING IN CONTAMINATED ENVIRONMENTS



Electrolytic Corrosion

Presents in pit-like spot corrosion on balls and raceways. Caused by an electric current, creating sparks through a thin oil film, between the contact points of the raceways and balls while a linear guide was in operation (electric potential difference between a rail and a ball slide).

An effective countermeasure would be to provide an electric circuit so that the current doesn't pass through the linear guides.

Corrosion

Can be noticed on raceways and balls. This could be a result of water or corrosive substance intrusion, inadequate lubrication or improper storage. Review the sealing function and the lubrication system, as well as the storing condition. It might make sense to cage to a higher anti-acid material or better surface treatment.

Damaged Ball Recirculation

Occurs when balls become free from the ball slide due to broken plastic ball re-circulation parts. This could be caused by abnormal wear caused by lubrication failure and intruded particles. If this is the case, review the lubrication system, and improve the sealing function.

In the case of butting rail specification, a ball re-circulation part collided with the rail at the rail butting position because of excessive misalignment of rails in lateral and vertical directions. This can be resolved by improving the butting accuracy (lateral and vertical aligning accuracy at butting position).

Another cause could be the feed speed rate exceeding the permissible speed in which case reviewing the feed and looking at adding a high-speed end cap on the linear guide.

Keeping Dirty Power Out of the Plant

By Chris Walsh, Director of Global Sales & Service, AMETEK Powervar

Manufacturing and test equipment involve some of the heaviest, highest-stake investments for engineering managers as they seek to maximize efficiency and throughput in the plant. Yet, unplanned downtime due to power quality issues can interrupt production flow, resulting in productivity losses, increased maintenance, and erosion of customer trust. With productivity losses due to downtime tracking anywhere between 5% and 20%, zero unplanned downtime has become a top priority among manufacturers. In fact, studies have reported the cost of equipment downtime averaging as much as $260,000 per hour, with larger businesses pushing that figure into the millions.

With so much at risk, there is increasing pressure to ensure equipment performs at its optimum every time. As such, time-consuming and costly maintenance, errors, and damage are a key source of frustration for managers and equipment manufacturers alike. While some disruptions might be expected throughout the lifespan of equipment, and while some warranty service calls and errors may be legitimate, it's important to never count out one of the most misunderstood factors plant operators face when diagnosing trouble with manufacturing machines—the power environment in which they are situated.

Highly calibrated, intensely used equipment requires high-quality power to operate seamlessly. But even the most advanced and carefully engineered equipment is inevitably impacted by the electricity that enables it to run. When your manufacturing environment is impacted by dirty power, trouble ensues, including system lockup, undetected data logic errors, and slow degradation of system components. Performance degradation of fine-tuned machinery can stem directly from weaknesses in power infrastructure and disturbances from other devices within a facility. Everything from the HVAC system, to the elevators, refrigeration systems, other equipment in the plant, and nearly everything in between can contribute to dirty power.

The Most Harmful Threats Are Invisible

What does all the equipment in a manufacturing plant have in common? It all relies on the power supply to operate. With today's increased demand for deliverables and a truncated timeline for bringing products to market, downtime has no place within manufacturing facilities. You would typically think that power anomalies with visible consequences, such as surges or outages, would cause the greatest amount of damage to systems. However, it is actually the disturbances you cannot see that are most common—and can be the most harmful.

Disturbances are constantly happening within your plant's power environment, including those that can cause major errors, degradation, and disruptions that slow down or even entirely halt manufacturing operations. A whole slew of power anomalies, including sags, spikes, surges, electrical impulses, high-frequency noise, and high voltage transients are present to some degree all the time. Most components and systems used by manufacturers, on their own, are not designed to stand up to this constant bombardment of power disruptions. These disruptions have a rippling effect on manufacturing timelines and can greatly impede the equipment's ability to perform by slowly degrading sensitive instrument components or even causing system failures.

With the presence of so many invisible anomalies on a day-to-day basis, it should come as no surprise that up to 88% of service calls are triggered by these hidden power irregularities, as they are often overlooked and left to wreak havoc on equipment. These disturbances can cause a whole range of challenges—breakdowns, data errors, inaccurate measurements, shortened equipment life, and increased service calls—resulting in major time, money, and effort investment spent on maintenance that has nothing to do with the quality of your equipment, and everything to do with the quality of power being fed to the factory. Even worse, the extended timelines associated with system downtime and the risk to the integrity of products caused by power anomalies can hurt your company's reputation, the hardest to repair of all.

Don't Be Haunted by Ghost Errors

Fortunately, there are power quality solutions designed specifically to diagnose and protect against the hidden day-to-day power disturbances caused by normal operations, as well as visible power disruptions. By leveraging a proper power quality solution, managers of manufacturing facilities can ensure uptime for max throughput, max efficiency, and max protection of their equipment investment. In turn, this keeps operations and maintenance costs down, drives productivity, and promotes safety within the manufacturing environment.

Power quality systems act as a filter between your equipment and its electrical supply to ensure the smooth performance of connected equipment. To ensure optimal protection and power conditions, a solid power quality system should include three technologies: a surge diverter, a low impedance isolation transformer, and a noise filter.

Most of the power quality solutions on the market include a surge diverter, a noise filter, or a combination of the two. However, the presence of a low impedance isolation transformer is critical to ensure clean power. It isolates the power between the outlet and the connected equipment to separate ground and neutral voltage at the source. As a result, the solutions ensure only clean, reliable power consistently enters the equipment, keeping systems online and free of errors caused by power disturbances.

(Protect) The Bottom Line

Increased downtime for manufacturing equipment due to power quality issues disrupts the flow of business, reduces productivity, and most frighteningly, threatens customers' trust in your brand. When it comes to your valuable manufacturing equipment, the stakes are too high to neglect the issues an unstable power environment can cause. With so many invisible anomalies that can threaten your equipment straight from the power source, it is critical that you approach your power environment with a proactive mindset.

Power protection is about proactively mitigating and managing the risk to your equipment from power-related failures including performance degradation, erosion of sensitive or even microscopic conductors and circuits from low-amplitude power disturbances, and surges. Proper power quality protection is therefore a highly effective risk management strategy when it comes to protecting your equipment, your investment, and the integrity of your brand.

10 Easy Maintenance Tips to Save Energy on your Cooling Tower

By Steve Klein, P.E., MBA – Baltimore Aircoil Co.

Routine maintenance also helps conserve water and extend the operating life of your cooling equipment Over time, a neglected cooling tower's leaving water temperature will increase, raising energy costs by up to 6% for every 2°F increase. However, a well-maintained cooling tower will continue to function at the original optimum efficiency keeping energy costs low.

Follow these 10 simple maintenance tips to get the most out of your cooling equipment.

- Check the overall condition of the unit and listen for any uncommon noises to establish a baseline of any potential issues
- Before beginning any hands-on work be sure to follow proper lock-out procedures and disconnect motor switches to ensure your safety
- Inspect and clean debris from strainers to keep the system free of excess materials
- Inspect the water distribution system and check for dry areas over the fill coil section to avoid scale build-up and increase system capacity. If the surface is not fully wetted check the nozzles for cracks and clogs
- Flush dirt and debris from the cold water basin through the tower drain or sump strainer to maintain water filtration and keep dirt from collecting. Installing a basin sweeper piping in addition to a filtration system will function as automatic maintenance.
- Check the make-up water supply for the appropriate pre-determined water level to conserve water and reduce air entrainment.
- Adjust the bleed rate accordingly for your local water quality and evaporation rate regulations, preventing the accumulation of solids in recirculating water
- Fix any tension problems on the belt to ensure optimal belt drive system performance
- Routinely check the oil level, oil quality, and shaft alignment for a gear drive system following the manufacturers' recommendations to assure reliable service
- Lubricate fan shaft bearings every 3 months at a minimum to maintain proper operation. Installing automatic bearing greasers is easy and can eliminate monthly bearing maintenance

Maintenance frequency varies depending on the condition of the circulating water and the environment in which the unit operates. Good maintenance habits will help prevent equipment failure and extend equipment life. Storing critical parts in the inventory will also help reduce downtime in the event of an emergency. Save time, money, and energy with these 10 easy tips and get the most out of your cooling equipment.

The Blind Spot of Predictive Maintenance

By Laura Davis, Editor In Chief, NED

When it comes to machine health, there are numerous products to choose from that promise to ensure the predictability and reliability of equipment. It's all with good reason too: machine health can be one of the largest factors for keeping up with production. However, even with all of the machine health products and software, there's a possibility you're not acquiring all of the pertinent data if you're not running continuous diagnostics on all equipment. We spoke with Jon Biagiotti, Product Marketing Manager at Augury, to see what exactly this blind spot is in predictive maintenance and how continuous diagnostics makes a difference.

NED: HOW WOULD YOU CHARACTERIZE THE CURRENT STATE OF PREDICTIVE MAINTENANCE?

JB: *Rapidly evolving. A transition is occurring from viewing predictive maintenance and vibration analysis as siloed tasks to the bigger picture of machine health as an enabler of manufacturing digitization and an indicator of company health overall. Poor machine health can negatively impact all aspects of organizations that are dependent on industrial equipment, from the quality of their products and brand image to their ability to deliver goods on time to customers.*

At Augury, we are addressing the blind spot of Digital Machine Health through continuous diagnostics. Our full-stack digital machine health solution monitors critical assets by combining vibration, temperature, and magnetic data with advanced artificial intelligence. This mechanical data is gathered using IoT-enabled wireless sensors. Proprietary machine learning algorithms then compare these unique machine signals to thousands of similar recordings. Based on this analysis, the technology can tell stakeholders what's wrong with their equipment, possible causes, and how to fix them. It's extremely actionable.

NED: WHAT DO YOU SEE AS THE BIGGEST BENEFITS OF APPLYING DATA ANALYTICS TO DIGITAL MACHINE HEALTH?

JB: *There are numerous benefits to this. The avoidance of unexpected machine failure increases uptime, maximizes OEE (Overall Equipment Effectiveness), and reduces repair costs, as faults can be caught earlier and fixed at lower costs. However, there are also less obvious benefits. With complete visibility into Digital Machine Health, companies gain increased predictability and the ability to more accurately forecast output, while becoming more agile. For instance, optimized digital machine health allows companies to reduce the amount of inventory kept in warehouses or from having to rush order costly spare parts.*

Visibility into Digital Machine Health is also helping foster a shift in the culture of manufacturing companies by creating a common language and universal metric to utilize. On a factory floor, you'll have the maintenance, operations, and reliability teams that all have different, sometimes contradictory, goals. Taken to an extreme, the maintenance team would stop the product line frequently for repairs to meet their goals, the operations team would run machines constantly to meet their goals, and the reliability team is left in between. Through Digital Machine Health metrics these teams can work cross-functionally to achieve common goals. This shift towards utilizing digital machine health aligns with the Total Productive Maintenance (TPM) model that is starting to be adopted more as it enables more cross-functional pods.

NED: WHAT ARE THE INDUSTRIES THAT CAN BENEFIT THE MOST FROM DIGITAL MACHINE HEALTH SOLUTIONS?

JB: *There are an endless number of companies across the commercial, industrial, and manufacturing sectors that could benefit from digital machine health solutions. Typically, when we walk into a plant, we see that 30-40% of critical equipment can use some sort of repair. The industries that benefit most typically relate back to the cost of downtime and managing risk.*

Most of our customers are part of the Fortune 500, spanning the consumer-packaged goods (CPG), the bottling industry, engineering wood products, automotive parts, plastic resins, and pharmaceutical manufacturing industries.

NED: DO YOU HAVE ANY CUSTOMER EXAMPLES YOU CAN SHARE?

JB: *Sure, one example that comes to mind is our work with one of the top 10 beer bottlers in the world. They were focused on minimizing downtime occurrences. Soon after deployment of our continuous diagnostics, the algorithms identified a bearing that was wearing out on a filler's main drive. The motor had problems in the past but wasn't easily accessible. It was also only scheduled to be checked once every few months. With the advance notice, the bottler timed the repair with planned downtime. During the repair, it was estimated that the bearing may have only lasted one more week before failing, which would have led to a minimum three-hour shutdown for repairs. This would have translated into 180,000 bottles of lost production, a $360,000 loss of value at retail.*

PRODUCTS

Plant Wide Asset Monitoring

Delivering a cost-effective, easy-to-install solution, the **Sensata IQ** platform, makes it easy to deploy asset health monitoring to prevent unplanned downtime. The IIoT platform enables factory managers and maintenance engineers to intuitively monitor all their assets from anywhere, including on a smartphone, PC or tablet. It uses AI to process data from a broad portfolio of Sensata IoT devices and qualified third-party sensors to gain the health insights.

Sensata Technologies, Inc.

MORE ONLINE: newequipment.com/21240673

AR Platform for Enterprises Offers Vertical Solution

REFLEKT ONE, the Operating System for Enterprise Augmented Reality (AR), lets companies and ecosystem partners benefit from vertical-specific solutions to solve industry problems with AR. The Operating System for Enterprise AR is a platform, device, and tracking agnostic and integrates with leading Industry software such as Siemens PLM TeamCenter, Manufacturing Process Planner or the Cumulocity IoT platform from Software AG. The Augmented Work Platform for front-line workers includes an AR Viewer application and a no-code content platform. With the ONE Viewer, teams visualize critical information and IoT data on all major platforms and AR glasses. Visual step-by-step instructions displayed in the worker's field of view provide a frictionless experience.

RE'FLEKT Inc.

MORE ONLINE: newequipment.com/21128435

3-in-1 Circuit Breaker Finder

The **CBF200 Circuit Breaker Finder** is a useful, one-person operation tool for electricians. The tool features a comparison mode that identifies the correct breaker, even when signal strengths are very close. The receiver also functions as a Non-Contact Voltage Detector and the transmitter enables users to detect faulty wiring in 3-wire receptacles and tests GFCI for proper operation.

Triplett Test Equipment & Tools

MORE ONLINE: newequipment.com/21170224

Video Inspection Borescope

The **KTIXD3K Video Inspection Borescope** is a diagnostic tool for automotive, maintenance, and industrial applications. Featuring on board storage for up to 30 images and a 180-image rotation, the tool provides users lighted and color visual access into the interior motors, electric components, and hard-to-see areas.

The borescope has a probe length of 46 in. (116.8 cm), a 2.5 in. LCD screen with 160 x 240 resolution, and 4X digital zoom. Additional features include a fixed 8.5 mm forward view imager, digital imaging with 640 x 480 resolution, and 6X adjustable brightness.

The tool housing design is small yet strong, allowing for the combination of comfort and functionality. The borescope has been designed to troubleshoot vehicle problems and find efficient repairs, saving time and money.

K-Tool International

MORE ONLINE: newequipment.com/21238222

Seven Tips to Retain Tribal Knowledge

By Oliver Sturrock, CTO, Fluke Digital Systems

Baby boomers reached a peak size of 66 million in the workforce in 1997—the largest generation of workers ever—but have since dwindled to 41 million as of 2017, according to the Pew Research Center. Their ages in 2017 ranged from 53 to 71.

As one generation shrinks, another balloons. Millennials (those born between 1981-96) took over as the labor force's largest age group in the middle of this decade and numbered 56 million in 2017.

With more and more boomers retiring, they're taking with them long-held beliefs, work styles, and, in many cases, vast quantities of tribal knowledge. Losing the latter—that exclusive, often technical, product or process information that is stored inside someone's head—is what will be most felt by the companies they are departing.

In the manufacturing world, this knowledge may be as simple as understanding why an eerie sound is emitted when a huge piece of expensive equipment warrants maintenance. It may be how to do makeshift fixes of key assets using tools, wires, and who knows what. It may be a technician who long ago came up with an obscure software workaround to enable old databases and servers to continue to interoperate. No one else may ever figure out how to keep this system running without an expensive new fix.

It's in a company's best interest to capture as much of this intelligence as possible to ease the transition to a newer, younger workforce—even if those workers don't buy into the way things were previously done.

The outflow of baby boomers and influx of millennials and soon Generation Z is taking place at the same time as massive technology changes impact industries, including the Industry 4.0 innovations. This confluence of events is destined to leave a knowledge gap and, likely, a skills gap ahead. Retaining or repurposing tribal knowledge for consumption by younger workers is indeed a challenge. The competitive advantage goes to companies that find ways to pull it off.

Here are some strategies to help:

Transfer knowledge the YouTube way

Yes, encouraging the documentation of processes is smart, but doing it via the written word...not so much. Older workers generally don't like writing instructions (and don't always get them right). And many younger workers don't care to pore over pages and pages of steps. Try using videos to share knowledge via YouTube, which has pioneered showing people how to do things.

For example, documenting how to make sensors and software work together to provide asset conditioning monitoring data can be much more effective with a visual dimension. Your videos don't have to be anything fancy (and don't even have to go on YouTube). Make them simple and consumable and share with only those who need to know. Having a veteran maintenance tech wear enterprise-connected smartglasses and record their work is one easy way to do it.

Leverage Smart Technology To Capture Intelligence

By collecting data and applying machine learning or natural language processing to analyze it for patterns and conditions, technology is essentially pulling exclusive information out of someone's head and making it visible to teams. If you have workers writing daily logs or providing voice recordings that recap activities, getting them to tag key information using their tribal knowledge can help machine learning synthesize the unstructured data and turn it into valuable insights. Your new generation of workers is expecting that technology to be applied this way to pass down information.

Move Away From Break/Fix to Maintenance Reliability

Today, the worker who got up at 3 a.m. to repair a machine is judged a hero. Maintenance teams that are always successfully troubleshooting problems are star performers. But what if machines rarely failed, and maintenance teams were free to attend to the needs of the whole operation, proactively? With computerized maintenance management systems (CMMS) and Industrial Internet of Things (IIoT) platforms, processes can be automated and maintenance more predictive. This enables companies to more efficiently manage assets, free up maintenance resources, and offset the loss of their longtime fix-it gurus.

Provide Workplace Technology That Is Faster and Simpler

Management can learn from newer generations and their affinity for applications and tools that are easy to operate and accessible from anywhere. Products from companies like Apple, Google, Amazon, and Microsoft have shaped their views on technology. Many, for example, prefer touchscreen functionality over knobs and dials. While it may be challenging to build the tools they will adopt, it's time to start.

This new, "consumerized" or "democratized" technology may lack decades of tribal knowledge, but it's here to stay. And it's best to make the change now while both the experienced workers with tribal knowledge and the younger digital natives are all still in the plant to work together on making the transition the right way.

Encourage Online Problem Solving

A long tradition exists of testing a job candidate's tech knowledge and skills by not allowing them to access the internet for help. It's time to rethink this. For young workers today, the internet is a go-to problem-solving tool. Whether they are job candidates, software developers, or whatever, avoid forcing them to demonstrate an ability to recall knowledge. Encourage them to leverage any and all resources to get the job done.

Incentivize Employees To Learn From Each Other

At many companies, resentment runs both ways. Older workers may be annoyed at seeing younger counterparts move in with new ideas and ways of working. Younger workers may begrudge the older generation for sticking around and delaying their chances for leadership roles and promotions. It's not one generation immediately displacing another—the demographic shift is gradual, and seasoned employees will still be around for a while. There's much to be gained by offering incentives for them to spend time together sharing and learning. Get creative here. There are several gamification companies out there ready and willing. It's a win-win and the knowledge transfer does help the company.

Cultivate Young Leadership for Driving Change

For at least the foreseeable future, companies will need people, as robots will only take over jobs that don't require much thinking and analysis. Leaders will come from all the generations in the workforce, but the Gen Xers—those between the baby boomers and millennials—may be your best bet for driving change. They get the need for smart technology, but they also respect and value experience and tribal knowledge. In fact, they have much of their own. NED

The Leading Edge of Manufacturing Innovation