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AUGUST 2019

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Resistance  
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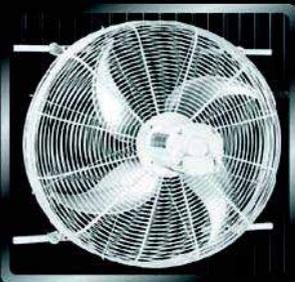
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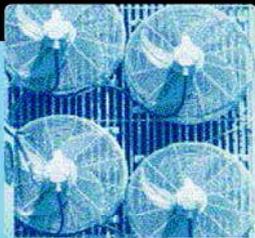
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Vol. 19 Issue 8

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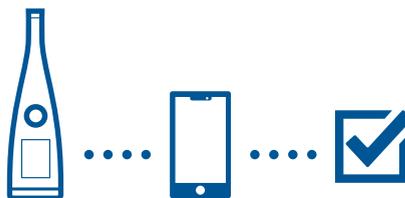
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# Continuous “Hands Off” Insulation Resistance Testing of Critical Motors



*Constant monitoring of critical motors while de-energized prevents failures on startup, reduces unscheduled downtime, saves on major rewinding repairs and increases personnel safety*

For decades, plant personnel have performed insulation resistance tests with handheld megohmmeters to prevent motor failures that lead to costly unplanned shutdowns, penalties and re-winding repairs.

However, these tests only provide a “snapshot” of motor health. In a matter of only a few days, motor windings and cables that are exposed to moisture, chemicals, contaminants or vibration can become compromised and fail at startup.

Portable megohmmeters also require electrical technicians to manually disconnect the equipment cables and connect the test leads on potentially energized or damaged equipment to perform the manual testing.

These tests expose technicians to potential arc flashes when they access the cabinet. In the United States non-fatal arc flash incidents occur approximately 5 to 10 times per day, with fatalities at the rate of approximately one per day.

With so much at risk, plant managers are recognizing the value of continuous megohm monitoring of insulation resistance that initiates the moment the motor is off until it is re-started again.



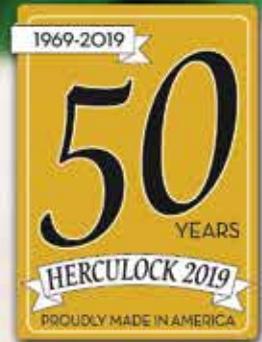
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Armed with this real-time information, maintenance personnel are able to take corrective actions ahead of time to avoid a failure that would interrupt production. By doing so, they can save utilities hundreds of thousands of dollars in repair fees for expensive rewinding, failure-to-produce penalties and lost production time.

Furthermore, permanently installed automatic testing devices allow for “hands-off” monitoring without having to access cabinets – keeping technicians out of harm’s way.

#### *Motor Protection at Utilities*

No matter the industry, processing plants rely heavily on motors, though the number and type vary depending on the size of the plant and type of fuel burned. Some plants can have as many as 20-30 critical motors, with 5-10 average.

Critical motors are essentially those that could significantly impair the ability to safely meet business objectives or affect production levels if unexpectedly offline. Examples include 480 volt motors up to 13,800 volts that are used to operate compressors, pumps and fans.

Most utilities maintain these motors through time-based preventative maintenance (PM) programs. Insulation resistance tests are typically scheduled on a semi-annual basis; however, given the reduction in personnel at most plants, it may even be less frequent. Based on these tests, motors may be scheduled to be sent out to repair shops for reconditioning.

Typically, insulation resistance tests are also conducted at the start of annual overhauls or planned outages, to identify any motors that might also need repairs.

Still, despite PM programs, motors that are offline or are frequently cycled can be quickly compromised.

“We had our fair share of motor failures, and it became quite costly,” says Richard Hohlman, who retired after 37 years working in power generation plants.

“Sometimes the failures can be really expensive,” says Hohlman. “At that particular plant, we had a couple of Westinghouse two-speed PAM AC induction motors and rewinding one of them would have been a six-figure expense.”

“From an O&M [Operations and Maintenance] perspective, if we can identify a weak motor and avoid the risk of trying to start it up and having it fail, that is a big savings,” adds Hohlman.

To avoid this scenario, Hohlman says he required all critical motors at a Long Island Sound 1500-megawatt plant that were shut down for 24 hours or more to be manually tested with a megohmmeter before being restarted.

“That became an expense in itself, because the tests are often conducted at different hours of the day, at overtime rates,” says Hohlman. “But, by doing it we avoided a number of motor failures.”

Hohlman says a member of his team discovered a continuous

testing and monitoring device, the Meg-Alert, and installed it initially on four circulating pumps and several induced draft fans. Later, the devices were also added to several forced draft fans and other critical motors throughout the plant.

The Meg-Alert unit is permanently installed inside the high



voltage compartment of the MCC or switchgear and directly connects to the motor or generator windings. The unit senses when the motor or generator is offline and then performs a continuous dielectric test on the winding insulation until the equipment is re-started.

The unit functions by applying a



non-destructive, current limited, DC test voltage to the phase windings and then safely measures any leakage current through the insulation back to ground. The system uses DC voltage levels of 500, 1000, 2,500 or 5,000 volts that meet the IEEE, ABS, ANSI/NETA and ASTM International standards for proper insulation resistance testing voltage based on the operating voltage of the equipment.

The test does not cause any deterioration of the insulation and includes current limiting technology that protects personnel.

“With continuous monitoring, the O&M team is aware at all times of the motor’s fitness for duty,” says Hohlman. “Every single time the motor shuts off, if it is for seconds, a day, or for the 10 days of an outage, the motor is being tested. And if it goes below a safe level, it alarms immediately and can lock the motor from even starting.”

This stands in stark contrast to the snapshot taken by a megohmmeter at the start of a shutdown. In a matter of a few hours or days, the motor can pick up considerable moisture due to humidity and contamination.

“An electric motor can absorb enough moisture in as little as a few hours in the southern region of the country to damage a motor on start up,” says Ricky Loupe, Electrical and Instrument Manager at a large plant that makes a powdered form of Polyvinyl Chloride (PVC) as well as the primary component ingredient, vinyl chloride. “There are many rainy

days with high humidity down here in the South, and moisture and electricity don’t mix.”

“When a motor is full of moisture and is started, the windings will go to ground and damage the motor,” adds Loupe. “So now you have a critical motor with damaged windings that will cost a significant amount of money to repair.”

An engineer at the time, he and his team conducted an analysis to determine the root cause of the problem and how to prevent it. After learning more about the Meg-Alert, he purchased one as a trial. Loupe says it was installed on a 4160V, 1200hp, WP enclosure motor that was used to drive a compressor on a chiller unit.

Based on production requirements, some of the chillers were turned off and only used when needed. This meant the motors on some of the units could sit idle. Prior to running a chiller again, the motors had to be tested using portable megohmmeters.

“Often this work was after hours, due to operations demands and requirements to start them up as quickly as possible,” explains Loupe. “We would have technicians come in on weekends – frequently at overtime rates – just to come and test the motors so they could start them.”

Loupe says with the Meg-Alert units, that information is now available in real-time. He was further convinced after the device, which is connected to the starter, would not allow the motor to turn on due to low megohm resistance

readings after a rainy day.

“The Meg-Alert would not allow the motor to start because there was too much moisture in the motor,” explains Loupe. “That, right there, paid for the continuous monitoring unit ten times over.” Today, the plant has Meg-Alerts on all ten chiller motors as well

as on four 900hp cooling tower pumps in another area of the plant.

#### “Hands-Off” Monitoring

The continuous monitoring system also allows for a “hands-off” approach that does not require service technicians to access control cabinets to perform a manual

insulation resistance test.

Instead and an analog meter outside on the control cabinet door shows the insulation resistance megohms readings in real time. The meter also indicates good, fair and poor insulation levels through a simple “green, yellow, red” color scheme.

When predetermined insulation resistance set point levels are reached, indicator lights will turn on to signal an alarm condition and automatic notifications can be sent out to the monitoring network.

Continuous monitoring can also show if the heaters used to maintain thermal temperatures or prevent condensation are working properly.

Most motors utilize heaters to maintain the temperature inside the motor so it doesn't vary drastically from operating temperature or ambient temperatures outside the unit. If it goes below the dew point, the motor will start picking up condensation while offline.

However, if these heaters fail to operate properly or the circuit breaker is tripped, maintenance personnel may not be aware of it until the motor fails on startup. Although these motor heaters are checked regularly, this can leave critical motors and generators unprotected for weeks or even months.

#### Preventing Arc Flashes

Perhaps more importantly, Loupe says the “hands off” approach reduces employee exposure to potential harm from arc flashes.

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"With the continuous insulation resistance monitoring devices, you eliminate the potential harm of arc flashes by not having the technician open cabinets for megohm testing at all," says Loupe.

Arc flashes are an undesired electric discharge that travels through the air between conductors or from a conductor to a ground. The flash is immediate and can produce temperatures four times that of the surface of the sun. The intense heat also causes a sudden expansion of air, which results in a blast wave that can throw workers across rooms and knocked them off ladders.

Arc flash injuries include third degree burns, blindness, hearing loss, nerve damage, and cardiac arrest and even death.

Among the potential causes of an arc flash listed by NFPA 70E includes "improper use of test equipment." Although de-energizing equipment before testing and wearing appropriate personal protective equipment (PPE) is recommended, the best solution is to eliminate the need to access the control cabinets at all to perform insulation resistance tests.

In addition to the risk of arc flashes, Loupe has witnessed another potential risk firsthand that can occur if a motor shorts out within feet of an employee.

In the plant, personnel are only about five feet away from the motor when starting the chiller. If the motor shorts out, it can make a huge noise and throw out a mass of sparks.

"With continuous insulation resistance monitoring, you don't have an employee in harm's way if the motor fails on startup," says Loupe. "The device prevents that safety concern as well."

For more information, contact Meg-Alert at [www.megalert.com](http://www.megalert.com); phone (800) 778-5689; or at 8766 Frank Drive, Minocqua, WI 54548.

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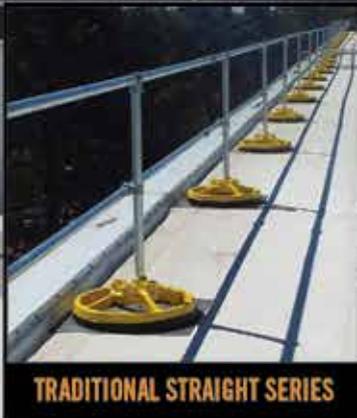
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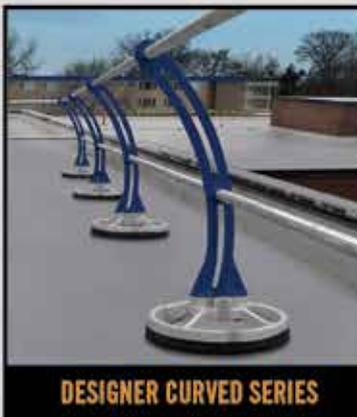
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# Erie Press Systems Merges with Ajax-CECO to Become the Largest Forging Equipment Supplier in North America

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North American manufacturers now have a one-stop, expedited domestic source for forging equipment as a result of the June, 2019 acquisition of Erie Press Systems with Ajax-CECO under parent company Park Ohio (NASDAQ: PKOH).

Park Ohio's acquisition of Erie Press Systems adds hydraulic press and stretch forming equipment to its already impressive selection of mechanical and hammer forging presses offered under the Ajax-CECO brand. By manufacturing and supporting all three brands, Park Ohio effectively becomes the largest forging equipment manufacturer in North America.

"By acquiring Erie Press Systems, we expand our engineering, manufacturing and service capabilities, control costs more effectively and benefit from economies of scale when working with our core suppliers," says Ken Copeland, president of Ajax-CECO. "The goal is to become a one-stop provider of new, rebuilt and remanufactured equipment for a variety of traditional and advanced forging applications, along with providing full service and timely support."

According to Copeland, part of the appeal

of the acquisition is that Erie Press Systems' extensive hydraulic press capabilities perfectly complement the equipment offered by Ajax-CECO.

Erie Press Systems has a long history, dating back to 1895 when the company originally began as the Erie Foundry Company. Today the company offers a line of standard mechanical forge presses as well as hydraulic presses for a variety of applications including forging (closed die, open die, and ring preforming), metalforming, carbon extrusion, composite presses and stretch forming machines – as well as support for a legacy line of forging hammers.

"Combined, the three companies have been in existing for more than 350 years," explains Copeland. "That means we can make equipment, parts, support and service for all three brands more readily available from a single source here in North America, while also increasing our ability to compete with overseas providers."

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# OEMs Opt to Eliminate In-House Lamination Operations

OEMs that make parts or products from flat-rolled steel, aluminum and other metals are eliminating in-house lamination operations and outsourcing to experienced coil coaters instead.

For OEMs that apply laminate films to metal parts or apply coatings to — as decorative finishes, the in-house manufacturing process requires a significant investment in equipment, plant floor space and ongoing maintenance for what can be a very temperamental process.

Not only that, but failure to precisely control what can be a very temperamental process can lead to laminates which do not bond properly or wrinkle, leading to excessively high scrap rates and even product returns.

For this reason, OEMs are increasingly outsourcing the application of laminate films to experienced coil coaters who can provide several alternatives: steel, aluminum or other metals in coil or sheet form with pre-applied (dry) adhesive; or fully laminated product that eliminates in-house processing altogether.

The result for OEMs can be significant, both in terms of speeding production and reducing operational costs. However, when paired with the fact that experienced coil coaters can produce high quality laminated products, it becomes a win-win scenario.

“Many OEMs are not fully aware of the alternatives for outsourcing part of, or all, the lamination operation to coil coaters,” explains Dan Chin, president of Universal Chemicals & Coatings (Unichem), a company that specializes in custom adhesives and coatings used in coil processing. “This is often simply because they have ‘always done it the same way’ — in house — but they can get a high quality laminated product and eliminate the costs and headaches associated with the process.”

## Laminates

The use of laminate applied to metal to fabricate parts or products is widespread throughout manufacturing. Decorative finishes provide the look of stainless steel, brushed copper, and wood grains, as well as a variety of colors, imprints, and a range gloss levels. Laminate films can also serve a functional purpose by providing scratch or chemical resistance.

Some of the more common applications including appliances (refrigerators and freezers, washing machines, dishwashers, microwaves, range or fume hoods), construction products (insulated wall panels, garage doors, roofing products) and the mobile and manufactured home markets (walls,

door panels).

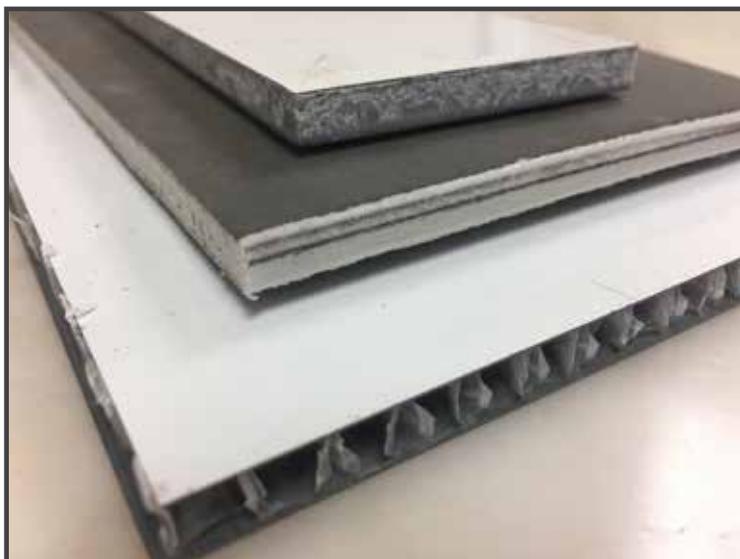
Applying laminates to metal requires multiple steps. First, the metal is prepared by chemically cleaning and pre-treating. A liquid adhesive or film laminate is then applied to the metal and cured in an oven. The laminate film is then bonded to the metal as the adhesive coated metal exits the oven and the laminate is fed into nip rollers to join the laminate to the adhesive. The laminated metal is then cooled.

According to Chin, in each step of the process there can be challenges which can lead to poor bonding or delamination.

“All kinds of things can happen during a non-continuous laminating process,” says Chin. “You can have issues with bonding caused by the cleanliness of the metal, improper application of the adhesive or insufficient oven temperatures. There could also be misalignments of the laminate that cause wrinkles in the film.”

Chin says this can lead to extremely high scrap rates in excess of 20%. Worse than that, OEMs may experience product returns and negative reviews due to delamination that occurs on a delayed basis once the product is in the field.

“If there is an issue with the bonding of the laminate, it can manifest later when a product is already in the hands of the customer,” says Chin. “Normally there would be quality control testing in place to ensure that doesn’t happen, but it is still possible. By the time the OEM finds out, it can become quite costly.”



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### *Outsourcing to Coil Coaters*

According to Chin, one option for OEMs is to turn to experienced coil coaters who can pre-apply B-stage adhesive to virtually any metal substrate. The B-stage adhesive is designed to reactivate and cure within a specific temperature range to bond the laminate. This eliminates several steps and can lead to a higher quality laminate bond.

"From a quality standpoint, you are going to get excellent uniformity of the adhesive applied [by a coil coater] and it will be properly cured," says Chin. "Then, basically all the OEM has to do is laminate the film to the metal."

Another option is to eliminate the entire process completely. This eliminates the need for in-house labor, application equipment, curing ovens, and environmental emission control systems.

"Typically, the coil coater has a lot of experience running these types of products, so they can dial in the adhesive thickness and control the curing and laminating temperatures very closely to ensure the proper bond," says Chin. "That is going to translate to higher quality laminated product."

Coil coaters must also guarantee scrap rates below a certain level.

"There is no testing the OEM will need to do, other than spot checks for their own quality monitoring process. The coil coater takes care of all that," says Chin.

Chin adds that laminated coil can also be easily cut to just about any size, ready for stamping, forming or other finishing operations. This can eliminate several additional in-house steps and simplifies the process of maintaining an inventory of laminated metals in different sizes.

### *Adhesion Challenges*

Experienced coil coaters are also better equipped to handle difficult adhesion challenges, often with the help of adhesive formulators like Unichem that can deliver custom formulations and provide other advice about the lamination process.

"As an adhesive formulator, we can customize the adhesive to match more exactly what the OEM is trying to accomplish," explains Chin. "There are times the adhesive company, which has a specific catalogue of products, doesn't have a solution that works for specific applications."

One example is adhesives formulated to be more "forgiving" in terms of temperature curing ranges. This can help OEMs that have challenges with oven temperature or consistency across the width of the coil.

"By working with the OEM or coil coater and understanding the parameters, we can help to dial in a solution that is very specific and resolve problems they are having in the bonding process," says Chin.

Popular laminate films like TPO (Thermoplastic olefin) are also notoriously difficult to bond to metal. TPO can refer to materials such as polypropylene (PP), polyethylene (PE), block copolymer polypropylene (BCPP) and others.

Although there are standard adhesives used to laminate to TPO, Chin says Unichem has seen enough variances that they have developed several custom solutions specifically designed for that material.

"As we have been formulating for TPOs, we have learned there can be really specific requirements as to the performance criteria and type of testing required that we have had to modify the adhesive significantly in order to get it to work for all the parameters," says Chin.

Electrolytic Tinplate is another good example of a substrate that can be difficult to bond laminates and achieve the desired adhesion.

"Tinplate surfaces are very heat sensitive. Cure temperatures and other processing steps need to stay below 410 F, or within a 390 - 410 degree Fahrenheit range, otherwise tin re-flow can occur," says Chin. This means that adhesives also need to cure or bond at temperatures below this temperature.

### *Time to Make the Switch?*

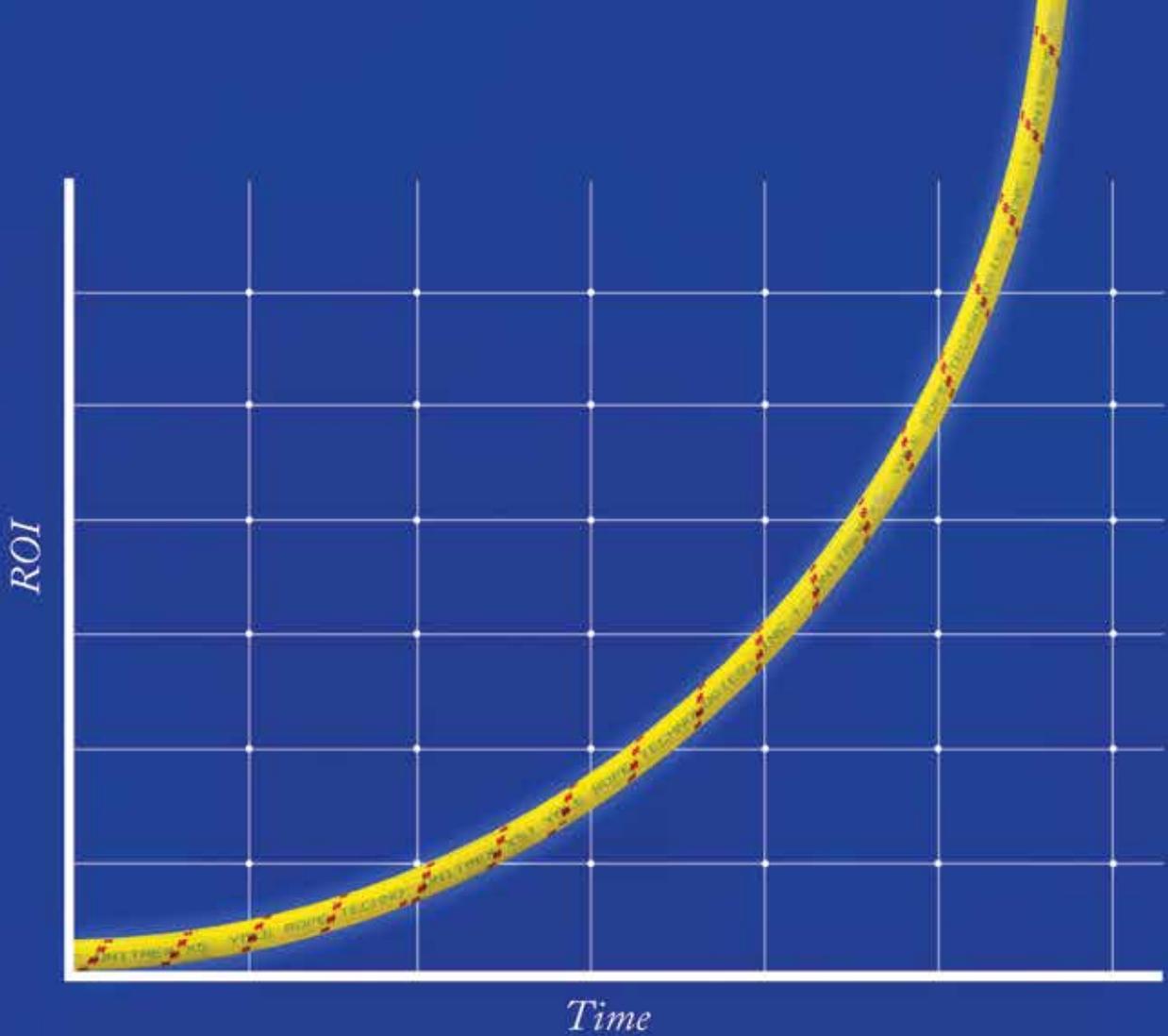
Chin says that a good time to consider the transition is for plants that are utilizing aging equipment that can be time-consuming and costly to maintain or when scrap rates or performance issues with in-house laminating are excessively high.

"If the [lamination] equipment is 10 or 15 years old, it can become more problematic and require increasingly more maintenance. Outsourcing the entire process to coil coaters might be a better alternative than upgrading the equipment, which could be a huge investment," says Chin.

"Certainly in a manufacturing facility, the process of laminating can become a production bottleneck," says Chin. "Because depending on the temperatures and thickness of the metal substrate, you can only process it a certain speed." In some cases, outsourcing lamination operations – particularly those that are proving difficult and time-intensive – can speed up overall production.

"OEMs no longer have to worry about that if they receive laminated product in the sizes needed. They can immediately move to forming and finishing steps and definitely speed up production significantly if the laminating bottleneck is eliminated," adds Chin.

For more information, contact Unichem at: 1975 Fox Lane Elgin, IL 60123; or Call: +1 (847) 931-1700, Fax: +1 (847) 931-1799; email: [sales@unicheminc.com](mailto:sales@unicheminc.com) or visit online at [www.unicheminc.com](http://www.unicheminc.com) •



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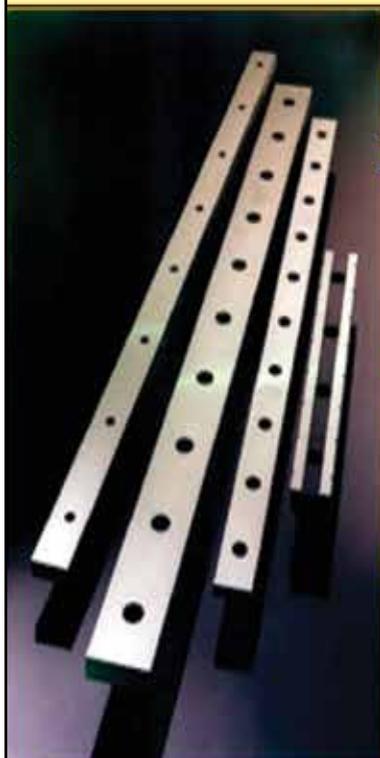
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