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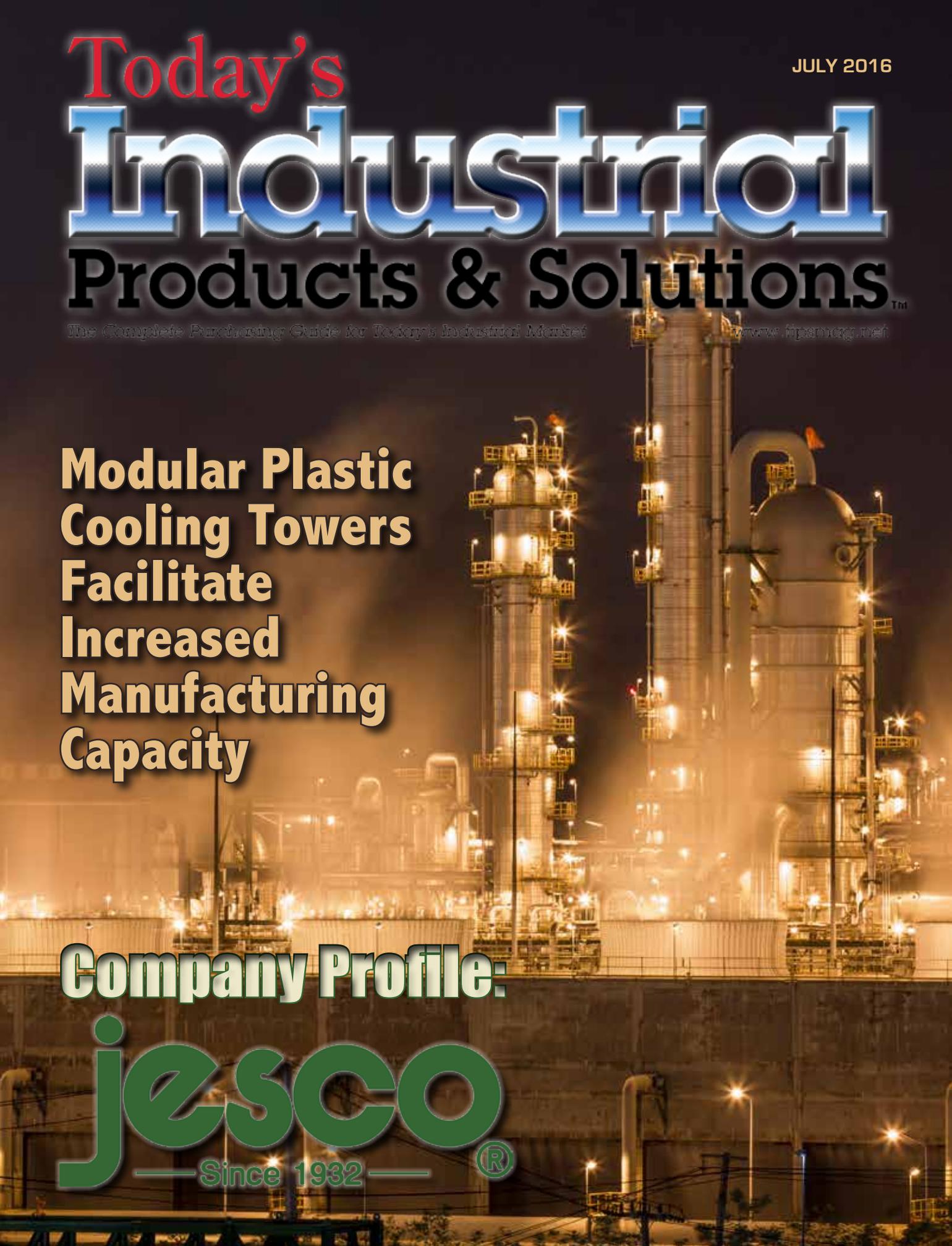
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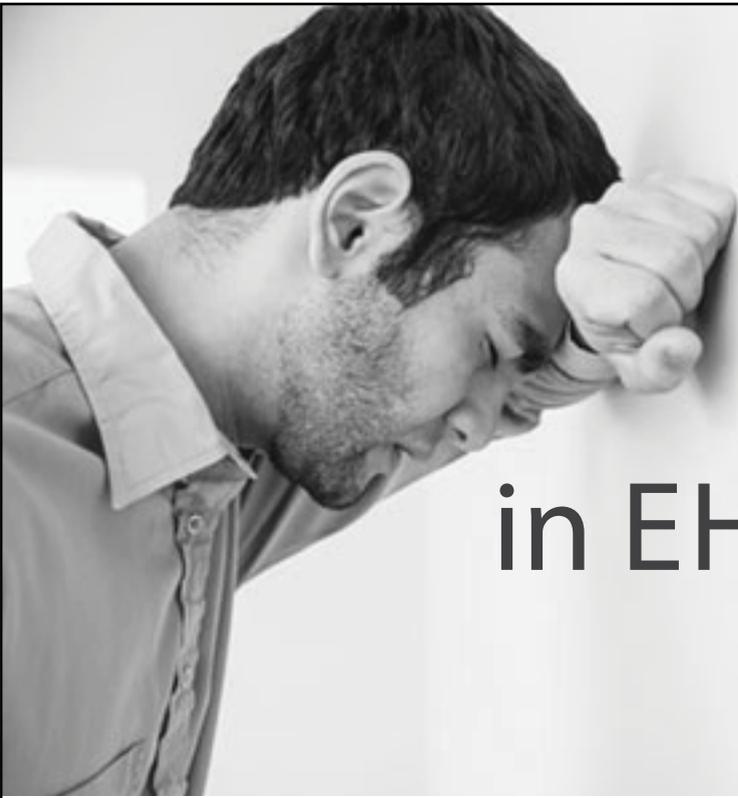


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Promoting Adhesion of Conformable Coatings to Multi-Component PCBs

Plasma-deposited primer promotes adhesion of silicone over-molding on printed circuit boards for LED displays exposed to harsh, year-round weather

Exposure to water, dust, oil, chemicals, movement and extreme temperature changes can damage circuitry. This problem is exacerbated for multi-component printed circuit boards (PCBs) found in outdoor devices that must withstand a wide range of weather conditions for decades with little or no degradation in performance. Vulnerable devices include environmental sensors, broadcast equipment, power supplies, billboards/signs, automotive components, solar panels and outdoor lighting.

This has led manufacturers to look for ways to protect electronic components to ensure reliability and stability in the field. One technique is to apply encapsulating coatings such as epoxies, polyurethanes, acrylics, thermoplastics such as ethylene-vinyl acetate and deposited hydrocarbons like Parylene to PCBs. However, for outdoor weather conditions a silicone over-mold is often the preferred method due to its low water absorption, wide temperature range of use (typically -50°C to 204°C), thermal stability, electrical resistance, and stability to ultraviolet light exposure.

Unfortunately, the topography of a PCB means the silicone must bond to many types of materials, including polymers, metals, alloys, ceramics and the FR-4 board itself, all of which have unique surface energies and chemistries. Without proper adhesion, silicone can begin to delaminate, not only at the edges of the electronic board but also in the form of small air pockets on, or around, components. This can lead to mois-

ture ingress and subsequent corrosion or electrical shorts.

“From a surface chemistry perspective, having a diverse group of materials to treat can be difficult because you need to develop a process for each, and the recipes can be different. It is very difficult to find any uniform treatment that works with all the different components on a printed circuit board,” says Kevin Lewis, a PhD chemist at custom silicone formulator Quantum Silicones (QSi). QSi is headquartered in Richmond, VA and manufactures a wide selection of silicone formulations for use in mold-making, potting and encapsulating, silicone gels, and coatings.

Promoting Adhesion to LED display PCBs

In a real world example, a longtime customer and manufacturer of outdoor LED displays approached QSi seeking a solution for its next generation of ruggedized PCBs. Unlike prior products that relied on mechanical adhesion of silicone, the next generation product required superior chemical bonding of the silicone over-molding because the company offers one of the longest product warranties in the industry.

To meet the requirements of the customer, QSi embarked on a mission with the development team at PVA TePla America to discover the best solution to improve adhesion of the silicone over-molding to the LED display’s multi-component PCBs. The Corona, California-based company is a leading system engineering firm that designs plasma systems for surface

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activation, functionalization, coating, ultra-fine cleaning and etching. The shared customer was already familiar with PVA TePla, having used its plasma equipment for other applications.

The goal was to co-develop the specific process that included a plasma-applied coating that would adhere to all the components and create a monolithic surface energy to create the best bond possible.

“In terms of surface energy, the best strategy is to deposit a thin film coating over everything so the silicone only has to bond to one surface energy,” says Dr. Lewis. “By working

with PVA TePla, we hoped to find a process using plasma that could basically harmonize all of the many surfaces and turn it into one.”

The joint effort ultimately led to a unique, multi-step plasma treatment process that converts the surface energies of each sub-component into like polar groups, which significantly improves the overall bond uniformity.

Plasma Treatment

The use of plasma is already well established for PCB cleaning (plasma desmear and etch-back by plasma) and deposition of coatings including hydrophobic and super-hydrophobic barrier coatings on PCBs without the use of wet chemicals.

Plasma is a state of matter, like a solid, liquid, or gas. When enough energy is added to a gas it becomes ionized into a plasma state. The collective properties of these active ingredients can be controlled to clean, activate, chemically graft and deposit a wide range of chemistries.

Plasma treatments are often conducted in a batch process in a low pressure vacuum chamber, or can be atmospheric for inline systems.

Roughly speaking, plasma equipment manufacturers fall into two categories: those that produce commodity, off-the-shelf products and those that design and engineer systems to fit the needs of a specific application and/or to resolve unique surface energy challenges.

Companies such as PVA TePla of Corona, Calif. are often tasked with the latter. In many ways, the application of plasma to meet unique surface requirements is the domain of chemists and other scientists. This is reflected in the accumulation of experts at the company, which includes three Ph.D scientists and surface, polymer, physical, bio and organic chemists, as well as engineers, plasma physicists and metallurgists.

When companies present PVA TePla with a challenging surface chemistry problem they are encouraged to visit to their lab in Corona CA. This gives an opportunity to brainstorm with their technical team and run experiments together. It is during these technical customer/supplier meetings that many of the best experimental matrices and ideas are produced. In addition to designing and manufacturing plasma systems, the company also serves as a contractor manufacturer



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and so has the in-house equipment to run parts and conduct experiments, with full customer involvement.

For this particular project, QSi dispatched two of its senior chemists, Eric Washington and Dr. Lewis to work onsite at the PVA TePla lab with Dr. Barden.

The task began by securing hundreds of samples of the components on the PCB board from the customer and its suppliers so that tests could be conducted individually and together. The silicone over-molding was then applied over a variety of catalysts and primers and tests performed to determine the degree of delamination. In addition to conducting surface tests with a contact angle goniometer, Dr. Lewis also devised a grading system to compare the options.

As part of the process, the silicone formulations were altered in an attempt to obtain better interaction or adhesion to the plasma coating. The plasma coatings were also varied in type, thickness, and composition.

Dr. Lewis estimates that the total number of permutations evaluated considering silicone formulations, plasma coating variations, and quantity of components resulted in over 4,500 samples being evaluated over an eight-month period.

This led to the development of a multi-step modification process to the PCB surface, completed in a batch process in a plasma chamber designed and manufactured by PVA TePla.

The initial step in the process is a precision cleaning/surface activation treatment followed by the deposition of an inert chemical primer that serves as a tie layer for the over-molding and provides a uniform surface energy for the silicone to bond.

Each batch can process 15-20 boards in approximately 20 minutes before the propriety silicone formulation is applied. Although the process was performed in a batch chamber system, it can also be implemented on an inline chamber system to meet high-speed, large volume production requirements.

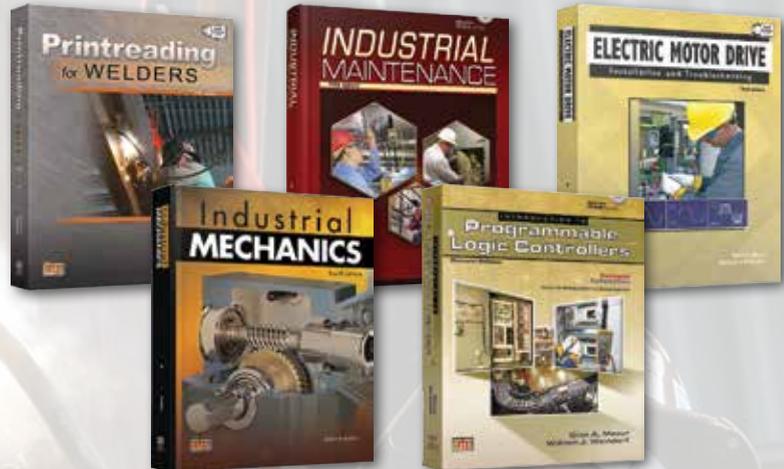
Even with the process now firmly established for the existing customer, Dr. Lewis still continues to make frequent visits to PVA TePla about once a quarter to expand his knowledge base and to develop new methods to improve the adhesion between QSi's different silicone chemis-

tries and various substrates.

"There are always applications where a customer needs improved adhesion," says Dr. Lewis. "(Building of adhesion is a function of time and temperature, but most customers are not patient with the time and prefer to run processes at lower temperatures so we are always searching for ways to drive improvements in adhesion toward shorter times and ambient conditions."

For more information, contact PVA TePla America at 951-371-2500 or 800-527-5667, JamesB@pvateplaamerica.com or visit www.pvateplaamerica.com.

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Tutorials

RegScan also produces a number of helpful videos for our users. They answer most commonly asked questions on using the RegScan One interface. You may wish to visit our Informational & Tutorial Videos Page prior to submitting a ticket to see if your question can be answered with the assistance of one of these videos.

Conference

And now RegScan has gone beyond the computer screen to bring partners and clients their first ever Inaugural Regulatory Conference. Government officials, regulatory experts and executives from Fortune 1000 companies will gather on Capitol Hill in Washington D.C. on May 24th-25th, and be among the first to learn what the Environmental Protection Agency has planned for 2017 and beyond. And with RegScan, sometimes it is all fun and games. We're taking everyone out to the ballgame with box seats for the Washington Nationals as they host the National League Champion New York Mets.

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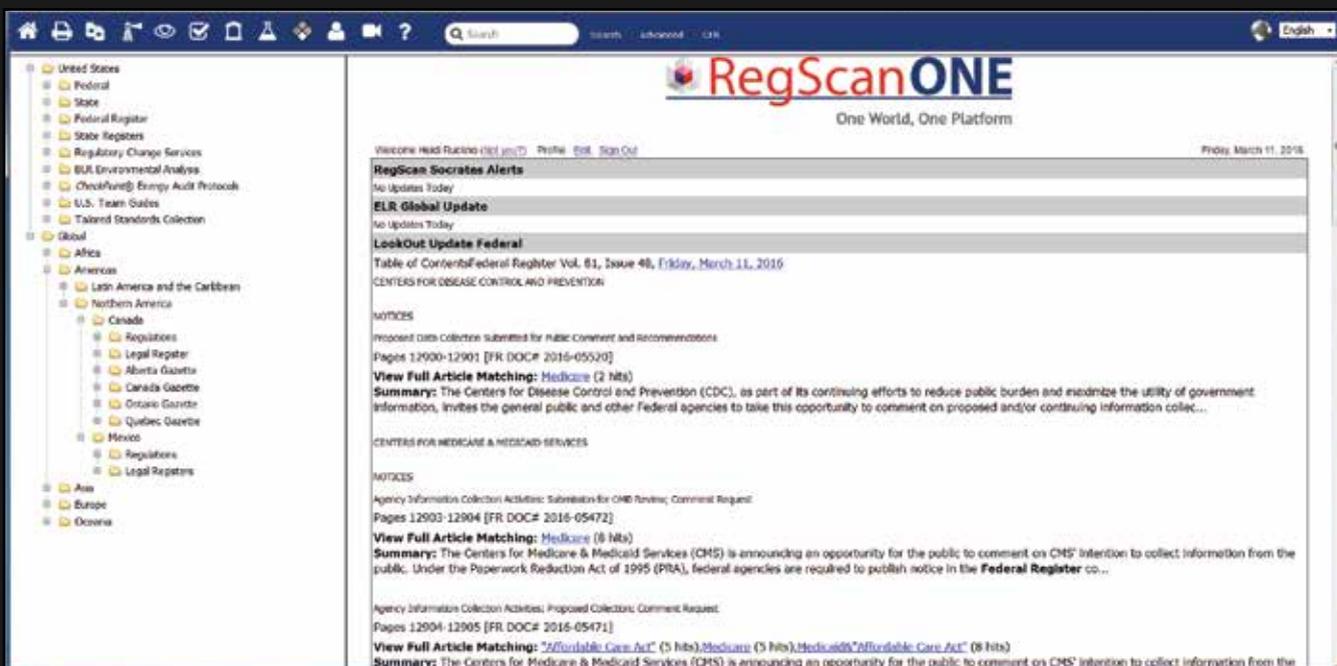
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Modular Plastic Cooling Towers Facilitate Increased Manufacturing Capacity

Replacing a failing galvanized cooling tower with a high-efficiency plastic system enables wire manufacturer to dramatically increase manufacturing capacity

Cooling towers, used to reduce the heat of circulating water used to cool industrial processes and HVAC systems throughout the world, have undergone substantial design changes over the years. This is particularly noticeable with the introduction of HDPE (high-density polyethylene) cooling towers, which are recognized for providing longer service life with reduced maintenance requirements.

While these attributes are compelling, the idea of incorporating this technology to increase production capacity is, for many, an unexpected benefit of the HDPE cooling tower technology.

An example of this capacity benefit occurred when Tencarva Machinery was asked by Strand-Tech Martin, a leading manufacturer of prestressed concrete strand and high carbon wire, to evaluate a galvanized cooling tower that had required extensive service over its lifespan, and was beyond repair.

Tencarva Machinery is a distributor of liquid process equipment and custom engineered systems, most of which incorporate pumping packages and electrical controls. The company



HDPE engineered plastic cooling towers are designed to solve corrosion which have plagued metal towers due to problems such as soft water, a water treatment, and ambient factors such as salt air or caustic industrial

serves industrial and municipal markets in the Southeast.

“Our inspection made it clear that the existing cooling tower, a typical galvanized model, was beyond practical repair,” says Chad Plott, of Tencarva. Plott explains that the main problem was a destructive, corrosive effect on the metal-clad shell produced by salt air that permeates coastal areas such as Charleston SC, where Strand-Tech Martin’s manufacturing plant is located.

The process used by Strand-Tech to produce its PC strand wire and high-carbon wire products requires a cooling tower for the wire-drawing machines, which run at very high temperatures.

“They were barely getting enough cooling from the old tower, and really wanted a cooling tower that would

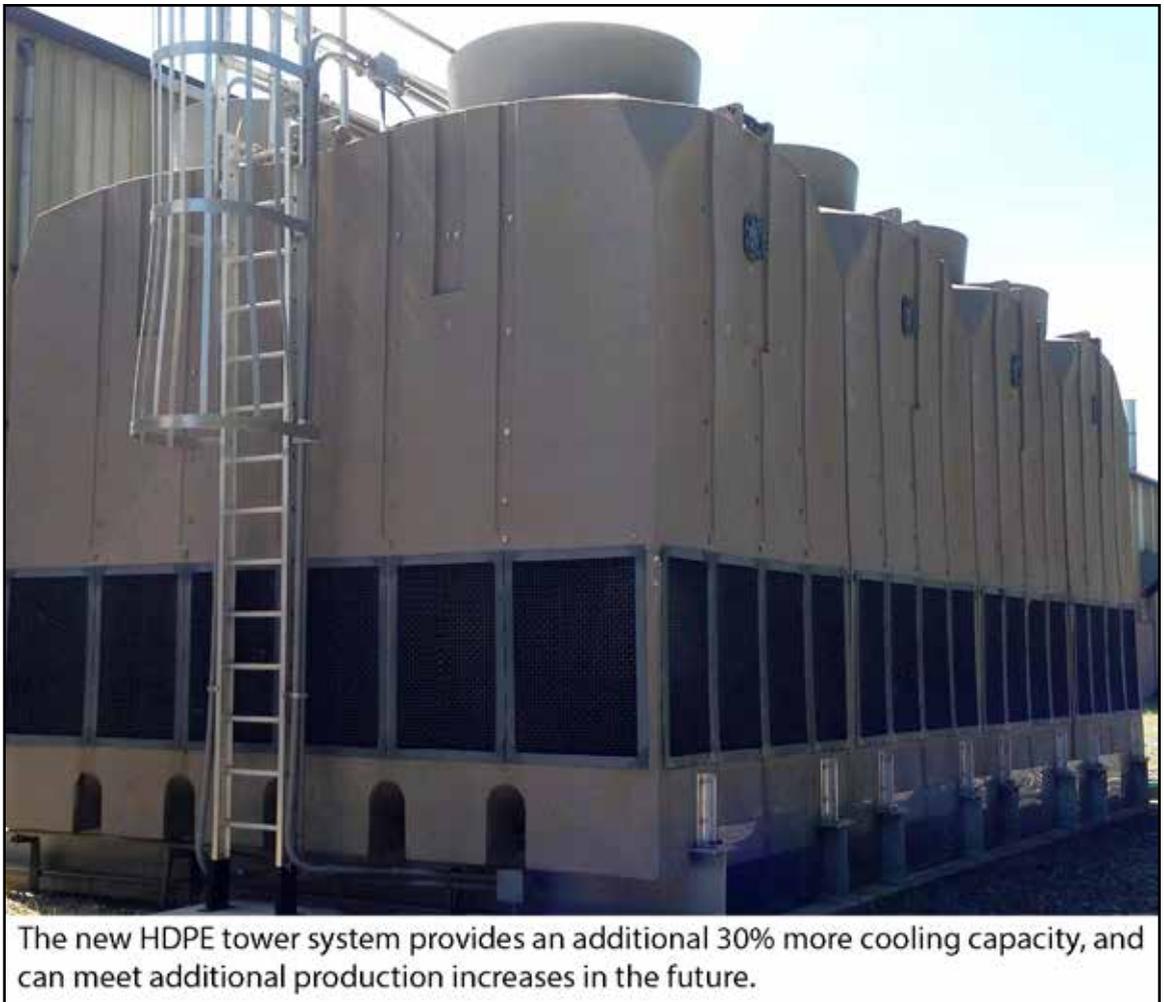
allow them to expand the number of machines they run,” Plott adds.

The Strand-Tech application is an open cooling system, Plott explains. It includes pumps that feed water to the wire drawing machines from the cooling tower. The cooling water goes through some heat exchangers on the wire drawing machines, and provides some spray cooling on the machine, and also travels through coolant passages in the wire drawing dies. Eventually, the water gravity-feeds from that production equipment back to the cooling tower.

When Plott was asked to make a recommendation for a replacement cooling tower, he suggested an HDPE type of tower manufactured by Delta Cooling Towers (deltacooling.com). HDPE engineered plastic cooling towers are designed to solve corrosion problems, which have plagued metal



...n problems,
...aggressive
...al gasses.



The new HDPE tower system provides an additional 30% more cooling capacity, and can meet additional production increases in the future.

towers due to problems such as soft water, aggressive water treatment, and ambient factors such as salt air or caustic industrial gasses.

The design that Tencarva selected for the wire production facility was the TM Series, a modular cooling tower system that allows isolation of up to eight cooling cells for maximum operational flexibility. Plott recommended a four-cell configuration, which can produce up to 1,580 cooling tons.

Boosting capacity
Plott explains that one of the primary reasons for the customer's inquiry into a new type of cooling tower was that because, in addition to structural damage, the old tower's efficiency had fallen off. As a result, cooling capacity was only marginally sufficient for production, and the company was looking to increase production capac-

ity significantly.

Plott says that since the new HDPE tower system was installed, in late 2014, it has provided an additional 30 percent cooling capacity, more than enough for the added production output his customer has required, and will likely meet additional production increases in the foreseeable future.

If yet more cooling capability had been needed, the modular design of the TM Series could easily have allowed doubling the capacity of the four-cell cooling tower that was recently commissioned via the installation of an eight-cell version.

Supplemental benefits
In addition to solving the corrosion and cooling capacity problems, Plott says the new cooling tower technology has provided other significant

benefits to his customer.

Among those is the 20-year standard warranty on the double-walled HDPE shell, which is a standard warranty on all Delta products. Also, the tower fans now come with direct-drive motors which relieves the maintenance and downtime issues commonly associated with belt-driven or gear reducer systems.

"This is the high bar among industry products," Plott says. "And I think it attests to the longer life expectancy of the HDPE type of tower design.

Another built-in advantage is the cooling tower's higher efficiency, including the fan drive system. It is composed direct drive fans staged, with two fans per cell. "This staged design means it's not always necessary to run all of the fans continuously," Plott says. "The payoff is a

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substantial savings on electric power consumption.”

The ease of installation of the four-module cooling tower was also an unexpected benefit. Because Delta products are pre-assembled at the factory, installation normally goes quickly and easily.

“As far as installation was concerned, nothing unexpected occurred,” Plott says. “Tencarva supplied the pumps and cooling tower, and the customer provided a contractor who performed the installation. Even with the modular design, installation was fairly easy to complete. The installers were able to use the existing footprint as well as use the same water storage area underneath the cooling tower mounting pad.”

Maintenance is another positive. Not only will the corrosion problem of the salt air become obviated, but also the simplicity of the direct-drive fan system will require minimal service.

In the end, the new solution will provide the best of both worlds, added production capacity with no maintenance headaches or downtime surprises.

For more information, contact Delta Cooling Towers, Inc.; Phone: 800-289.3358; Fax: 973.586.2243; E-mail: sales@deltacooling.com; or visit the website: www.deltacooling.com



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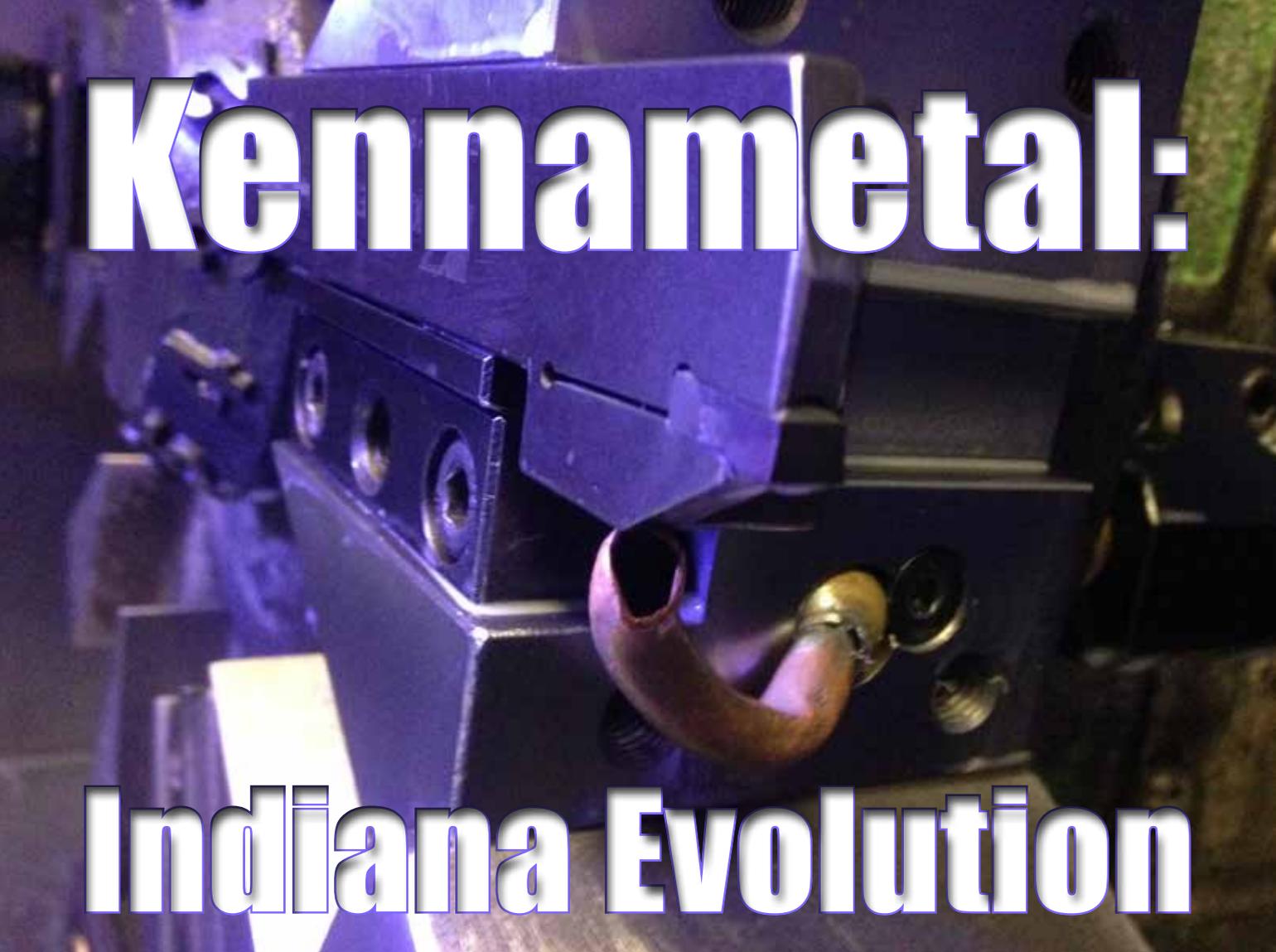
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Patent # 5826398, 6073415

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Kennametal:

Indiana Evolution

A job shop in the Midwestern US State of Indiana cuts insert costs in half and triples tool life with Beyond Evolution™ grooving and cut-off tools from Kennametal

Since the day some ingenious machine tool engineer first mounted a metal tube on an engine lathe, machinists have been looking for a better way to cut off parts. From hand-ground bits to high speed steel blades to indexable carbide inserts, cut-off tool technology has continued to improve over the years, increasing metal-cutting efficiency and lowering operational expenses along the way. One large step in that evolution came with the development over recent years of multi-purpose cut-off tools able to switch hit as grooving, turning, and profiling tools, giving manufacturing companies the ability to simplify setups and shorten production cycles, and in some cases keep fewer tools in the crib.

Searching for simplicity

One such company is EMC Precision, a family owned and operated precision machining job shop headquartered in Elyria, Ohio. Since 1925, EMC has provided prototype to production machining and value-added services to a range of industries including fluid management, hydraulic fluid & power, automotive, recreational, and other OEMs. Ian Dotson, manufacturing engineer at EMC's Sheridan, Indiana facility says he was happy with the tool life and performance of his existing cut-off solution, and was only looking for a reduction in his tooling costs when he called his local Kennametal distributor, CCA Inc.

The salesperson there introduced him to Kennametal's Beyond Evolution™, a single-sided grooving and cut-off system with multidirectional turning capability, through the tool coolant, proprietary chip control, and "Triple V" secure seating geometry. Dotson admits he wasn't too concerned about the bells and whistles, as long as the tool performed as well as what he was already using, and saved the company some money. He was pleased with the results.

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“We were using a 0.118 in. wide (3 mm) PVD-coated insert to cut off 0.75 in. diameter (19 mm) 4140 steel hydraulic actuators,” he says. “We swapped out the old tool for a Kennametal Beyond Evolution cut-off and kept the feeds and speeds the same. After several runs, we determined tool life was essentially identical, so from a performance perspective there was no difference, at least not on this job. But the Beyond Evolution inserts are dramatically less expen-

sive, roughly 40 percent of what we were paying for our legacy tools. It was a clear win for us.”

Triple time

The next win came on a job Dotson was running on one of EMC’s Daewoo Lynx 220 CNC lathes, a transmission gear shaft made of 1-1/4 in. (32 mm) 8620 steel, and using a 0.236 in. wide tool (6 mm) to back turn a journal on the left side of the part prior to cut-off. In this application, insert cost

was still a concern, but Dotson’s primary goal was tool life improvement.

“The Daewoo isn’t equipped with high pressure cutting fluid, and the standard pump was unable to generate enough pressure for us to utilize coolant through the tool on our old cut-off system,” he explains. “Because of this, we’ve been stuck with flood coolant, and have always had some chip control issues as a result—the chip would roll back on itself and starve the cutting edge of coolant.”

Despite the less than perfect cutting conditions, the Beyond Evolution performed beyond expectations. “We achieved very good results,” says Dotson. “This time we increased the cutting speed a bit, from 350 to 400 sfm, and bumped up the feedrates by about 30 percent. Even so, tool life increased threefold, to just over 2600 pieces per insert. I’m confident we could have cranked up the feeds and speeds even more, especially if we had plumbed the tool for coolant through, but there was no need. This operation supplies another machine, and that one was already running as fast as it could go. The big thing for us was getting more parts between tool changes, and that’s exactly what the Beyond Evolution did. It’s an excellent product at a very competitive price point.”

At the forefront of advanced materials innovation for more than 75 years, Kennametal Inc. is a global industrial technology leader delivering productivity to customers through materials science, tooling and wear-resistant solutions. Customers across aerospace, earthworks, energy, general engineering and transportation turn to Kennametal to help them manufacture with precision and efficiency. Every day nearly 12,000 employees are helping customers in more than 60 countries stay competitive. Kennametal generated more than \$2.6 billion in revenues in fiscal 2015. Learn more at www.kennametal.com

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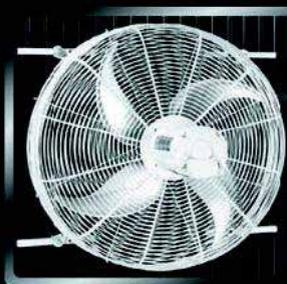
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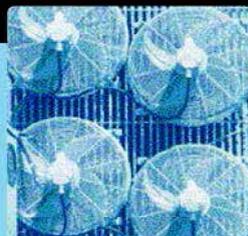
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