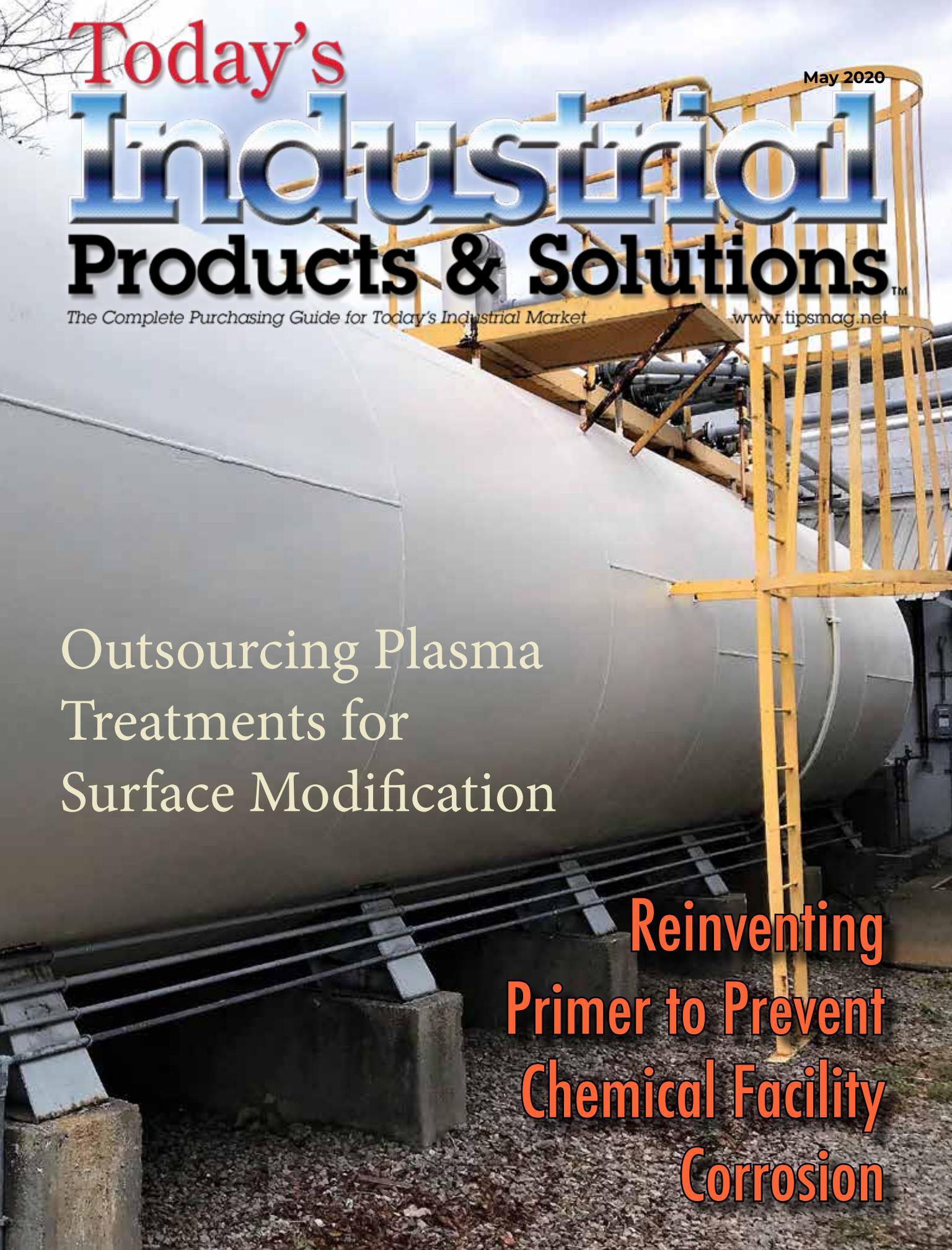


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The background image shows a large, cylindrical industrial storage tank, possibly made of stainless steel, with a dark, textured surface. A wooden support structure with vertical and horizontal beams is attached to the side of the tank. Several black pipes are connected to the tank, some leading into it and others exiting from the side. The ground in front of the tank is covered in gravel and some sparse vegetation.

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Outsourcing Plasma Treatments for Surface Modification

Reinventing Primer to Prevent Chemical Facility Corrosion

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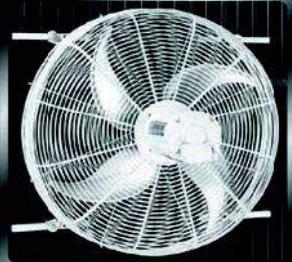
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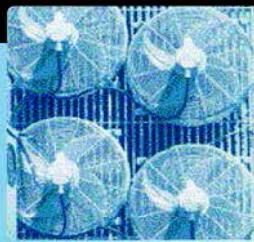
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Vol. 20 Issue 5

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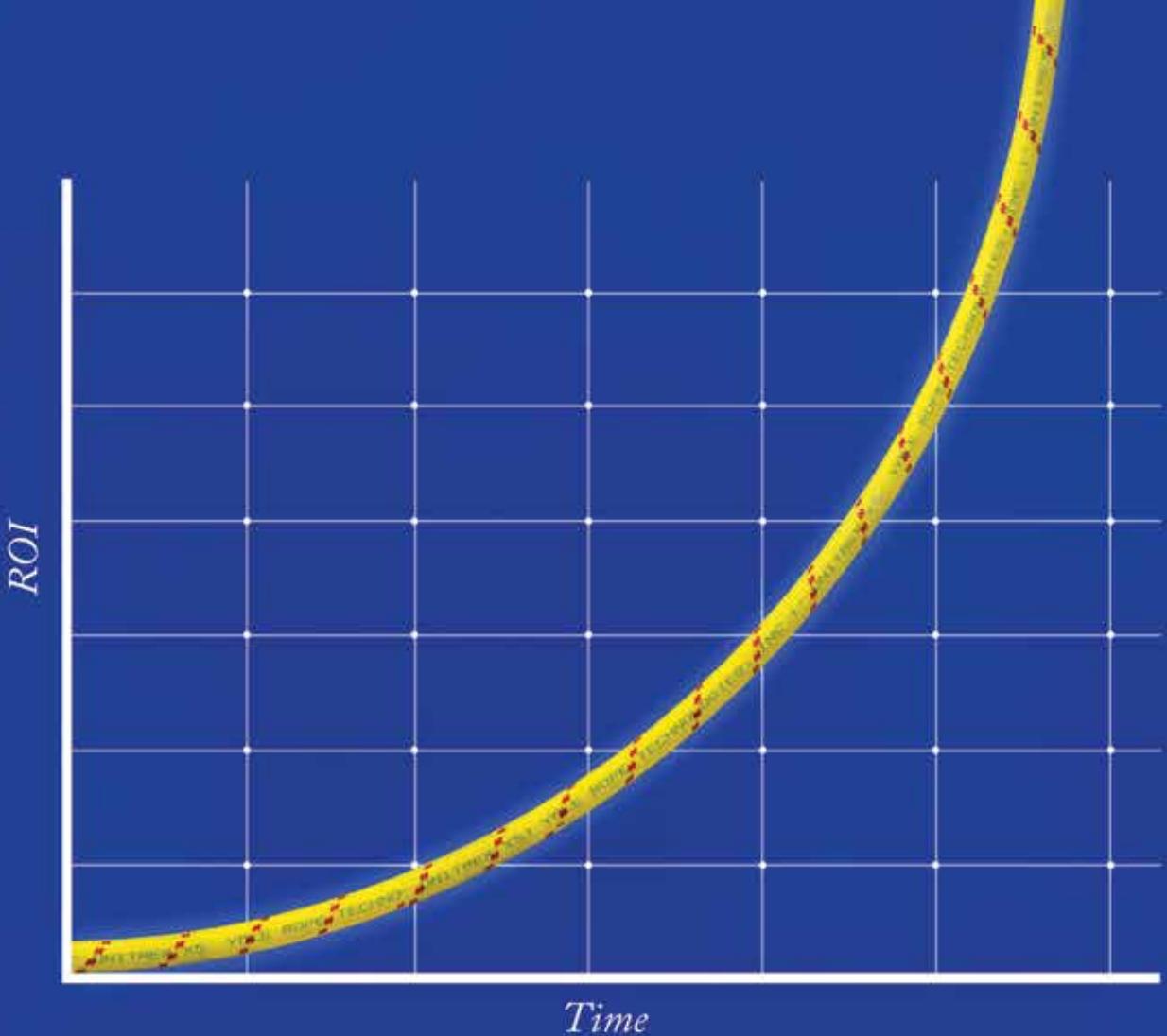
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Reinventing Primer to Prevent Chemical Facility Corrosion

Advanced primer converts rust into a protective layer and can be applied by any method, without the need to sandblast first

For chemical plants, chemical tank farms and refineries, atmospheric corrosion of steel is a continual concern that can require re-priming and re-painting every few years to prevent safety issues and the premature replacement of costly infrastructure.

Industrial primers represent a critical foundation for paints and coatings in harsh environments. However, they have certain limitations and have historically been unable to effectively deal with the eventual formation and future recurrence of rust. Traditional primers only encapsulate rust until the paint/primer is scratched, chipped, or breached and moisture and oxygen migrate under the film, allowing the corrosion to spread.

As a result, facility maintenance personnel or contracted coating applicators must repeatedly utilize costly, time-consuming and environmentally hazardous surface preparation methods such as sandblasting to prepare surfaces to be primed and repainted. However, not all environments can withstand the impact of sandblasting, which can damage critical surfaces and may be impractical for reaching hard-to-access areas such as cracks and crevices. Sandblasting is also expensive and time-consuming, and even poses its own safety risks to applicators and the environment.

Now, however, more advanced primers have been formulated that set a higher performance bar in corrosive environments. These reactive primers go beyond encapsulating rust to instead convert it to a protective material (iron phosphate) to minimize the risk of further corrosion. The chemical bond provides superior adhesion, high corrosion protection and also eliminates under-film corrosion.

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The rust conversion formulation also differs from prior technologies by using a non-toxic, ultra-low VOC water-based acrylic polymer solution that can be applied with minimal surface preparation and without the need for sandblasting of steel substrates.

Primer Pitfalls Allow Corrosion

One of the main reasons that petrochemical facilities are so susceptible to corrosion is that traditional primers have serious deficiencies in this area.

"We have found that the typical primer and topcoat needs to be replaced in a harsh chemical facility environment every couple of years," says Dave Marzano, owner of Maxim Contracting, a Newark, New Jersey-based industrial and commercial contractor.

"There are not many products out there that will stop the rust."

A common failure of primers is not sufficiently protecting against under-film corrosion.

"A primer must first form an effective chemical bond to the metal substrate," says Martin Lawrence, Managing Director of New Jersey-based NanoRustX LLC, a supplier of advanced primer technologies. "Without this, rust promoters like oxygen and humidity will creep underneath the primer causing further corrosion. Most primers on the market go only as far as encapsulating the iron oxide which is not 100% effective in preventing further rust from occurring."

Another reason that chemical facilities are prone to cor-

rosion when utilizing typical primers is that a high level of surface preparation is required because most rust primers on the market are sensitive to chlorides.

"Even a minute amount of chloride on the steel can cause coating system failure," says Lawrence. "This is why leading coating manufacturers demand extreme levels of surface cleaning (sandblasting) and removal of chlorides to a level of 5 mcgr/m², which is nearly impossible to achieve. Even when sandblasting is used for surface preparation, flash rusting will still occur."

In response, the search for more enduring corrosion protection at petrochemical facilities has involved the development of long-lasting primers that correct the deficiencies of traditional methods.

Lasting Corrosion Protection

NanoRustX (NRX) NanoPrime, for example, works by chemically reacting with iron and iron oxide (rust) to form iron phosphate and creates a Nano bond with both metallic and painted surfaces. The chemically bonded layer is insoluble and extremely corrosion resistant. This "bonding" process also provides superior adhesion and flexibility and stops under-film corrosion that occurs when conventional coatings are damaged.

The non-toxic, ultra-low VOC primer contains nano-polymers for added strength and durability and has been tested to successfully coat surfaces from rust-free to up to 700 microns of rust. The elasticity of the advanced primer makes it very durable in temperature variations from -670C to +2000C (-900F to 400F).

Because the advanced primer actually chemically reacts with galvanized steel surface, no surface preparation is required other than a water wash. The water-based acrylic polymer is not sensitive to chlorides or rust and can actually neutralize them. Unlike initial generations of rust converting primers, the primer performs equally well on clean, partially corroded and heavily rusted surfaces. Typically, a power wash (240 bar/3500 psi) is all that is needed before applying to steel (clean or corroded), galvanized steel or aluminum in order to remove loose paint, dirt and grease. The primer can be applied to a corroded surface by hand brush, roller or airless spray gun on the substrate. After the application of the primer, a single coat of a low VOC top coat will complete the job.



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When a chemical plant in the Newark, New Jersey area had a number of roof exhausts with severe corrosion, Marzano, who had sought a lasting corrosion solution for his customers, applied a coat of NRX NanoPrime with no topcoat to a 50' high roof stack as a trial.

"The roof exhausts were so rusty the chemical company was ready to replace them, which would have cost about \$7,000 to 9,000," says Marzano. "However, about five years later there still is no visible rust on the roof exhausts. The success of the trial demonstrated the primer's effectiveness against chemical plant corrosion, so we have applied it many times since then on everything from roofs, exhaust fans, and exhaust stacks to tanks for carbon monoxide and sulphuric acid."

In one of Marzano's recent applications, his Maxim Contracting work crew coated four outdoor and three indoor chemical tanks, ranging from 1,500-10,000 gallons, including a liquid nitrogen tank and a 2,000-gallon CO2 tank.

Using a spackle knife and palm sander to remove existing loose flaking paint and rust, and a water wash with nearby hose, the surfaces were readied for applying the primer. The system included two coatings of primer applied by roller, followed by one application of the customer supplied water-based, industrial epoxy topcoat.

"With NRX NanoPrime, less surface preparation is required compared to other primers," says Marzano. "Also, it can dry in 30 minutes to touch and takes about two hours to apply a second coat, depending on temperature, which is much faster than typical primer and paint. So, we finished the job in a few days rather than a week, which helped to reduce potential downtime for the facility."

"But the bottom line is that the primer prevents corrosion and really lasts," concludes Marzano.

For more information on NRX NanoPrime, please visit www.nanorustx.com, email sales@nanorustx.com or call 1-973-751-2200.

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Outsourcing Plasma Treatments for Surface Modification



Medical Device Manufacturers Turn to Contract Processors for Plasma Treatments to Enhance the Value of Products

In the medical device industry, plasma treatments are often utilized to solve problems that cannot be resolved other ways.

Whether attempting to improve adhesion of dissimilar materials, depositing coatings, cleaning surfaces, applying a protective coating that repels water for example or biological fluids or enhancing surface wettability or functional coating, plasma treatments often add significant value to medical devices.

For many medical device manufacturers, the application of plasma-applied coatings and surface treatments can play a significant role in new product development, but also when upgrading legacy medical devices under 510(k) guidelines. As a result, the industry is aggressively investigating and applying plasma to products such as well plates, microfluids, IOL's, stainless-steel guide wires, cardiac pacemaker or implantable cardioverter defibrillators (ICD), catheters, stents, and vascular surgical tools.

"Medical device manufacturers are continuously looking for unique ways to technologically advance their products to be the market leader," says Michael Barden of PVA TePla, a company that designs and manufactures plasma systems, provides surface modification research, and also serves as a contract processing center. "Often, the top tier products incorporate some form of advanced coating to functionalize the surface."

However, when medical device manufacturers want plasma-treated parts or components without having to invest in in-house equipment, the solution is to utilize a contract processor. In this approach, parts are sent in, treated and returned within 1-2 days, or up to a week for larger volumes. For small or infrequent batches, this can lower the price per part significantly.

The most common application for contract processing is to improve the bonding power of

chemical adhesives, whether metal to plastic, silicon to glass, polymers to other polymers, biological content to microtiter plates and even bonding to PTFE. However, it also is used often to clean, activate, chemically graft and deposit a wide range of chemistries on the surface of parts or components.

According to Barden, the companies that tend to opt for contract processing generally fall into two categories.

The first has little or no experience with plasma treatments, but may have heard that it can resolve issues or add value to products.

"For many customers, plasma is not the first thing they have tried, but they have read or heard 'you may be able to use plasma' to solve a specific problem," explains Barden. "They have a target for their material or the chemistry, but very often they don't know exactly how to get there. So, it can be somewhat experimental."

When this is the case, the initial capital costs may be a deterrent. Even large medical device manufacturers may opt to avoid purchasing equipment initially if the product is new, or a new version, and production quantities are unknown.

The other type of inquiries received are from companies where outsourcing is a core concept of their corporate philosophy. This could also be true for medical device companies that want to develop the product, but only assemble and do final packaging in house, along with contract sub-assemblers.

Plasma Treatments

According to Barden, many contract processing projects involve using plasma to create a high-energy surface to resolve bonding issues with chemical adhesives.

Plasma treatments are utilized to increase the surface free energy of the material to be bonded.

When a substrate has a high surface energy, it tends to attract. For this reason, adhesives and other liquids often spread more easily across the surface. This wettability promotes superior adhesion.

Adhesion promotion can be achieved by increasing the surface free energy through several mechanisms, including precision cleaning, chemically or physically modifying

the surface, increasing surface area by roughening and primer coatings.

The net effect is a tremendous improvement in bonding. In some cases, up to a 50 times bond strength improvement can be achieved.

On the other hand, substrates that have a low surface energy, such as PTFE, are difficult to adhere to other materials without first selectively altering the surface to increase the free energy.

"When a surface is really hydrophobic, like Teflon, it's very difficult to bond to it," says Barden. "If you apply a liquid or adhesive, by nature it pools and will not spread effectively across the surface."

There are several plasma methods employed to increase surface energy, including physical and chemical plasmas along with PECVD coating surfaces.

Silicon, another material widely used in the industry for its low surface energy, often it is utilized as an over-molding compound to protect electronic boards from extreme conditions.

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 PCB board but also in the form of small air pockets on, or around, components. This can lead to moisture ingress and subsequent corrosion or electrical shorts.

"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 Barden. "A process using plasma can basically harmonize all of the many surfaces and turn it into one."

To accomplish this, PVA TePla has developed a specific process starting with 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.



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Gas plasma can also provide surface conditioning of in vitro diagnostic platforms prior to the adsorption of biological molecules (protein/antibody, cells, carbohydrate, etc.) or biomimetic polymers. This includes precision cleaning of the substrate at the molecular level, along with raising the surface energy to improve surface assimilation of the intended content.

"Microtiter and multiwell plates are often made of polystyrene, which is extremely hydrophobic. Water will bead on it," says Barden. "However, if you treat polystyrene with oxygen plasma it will become very hydrophilic, so liquid spreads everywhere. This allows aqueous solutions containing biological content to spread and deliver biomolecules to the surface while providing a hydrogen bonding platform to adhere them."

However, some in vitro diagnostic substrates require more selective surface chemistry to immobilize a customer's proprietary molecules. For this, PVA TePla has recently developed methods for chemically functionalizing various polymer platforms for the selective adhesion promotion and conjugation of bio-active molecules.

This is achieved by providing particular chemical functionality or linker chemistries at the surface, allowing conjugation of a wide variety of molecules ranging from small molecule drugs to peptides to larger biopolymers such as carbohydrates and antibodies. Amino, carboxylic, hydroxyl and epoxy functionalities are important examples of the chemistries that are readily obtainable using a gas plasma surface treatment.

Expertise in Plasma Treatments

Contract processors should ideally bring a combination of resources for plasma R&D and experience with many customer types in markets beyond medical devices.

Working with a contract processor also has tremendous advantages when it comes to tapping into the years of technical expertise applying a variety of plasma treatments. This can often speed research and development efforts significantly.

In many ways, the application of plasma is the domain of chemists and other scientists. Companies like PVA TePla, for example, have three Ph.D. scientists and surface, polymer, physical, bio and organic chemists, as well as engineers, plasma physicists and metallurgists on staff.

"Because we see the similarities in the types of materials being treated, our experience allows us to develop and optimize custom proprietary processes quickly and efficiently, saving our customers significant time and money in the development phase of product development" says Barden.

An extensive knowledge and experience manufacturing plasma equipment is also a plus, given that most contract processors just purchase equipment from global providers.

However, with a background in plasma equipment manufacturer, the contract processor can provide critical insight on validation, production methods, fixturing, as well as hardware and software modifications. Examples include special hardware for batch processing, such as a mass flow controller, a different pump configuration or unique chamber sizes.

Additional specifications for a process for electronic part, anti-static so when it comes out of the plasma because it's an electron emitter, it can accumulate static; Anti-static fans can be used to remove static on the parts when the chamber is opened.

"Depending on the application and complexity, customers face strict industry requirements and often have unique product of processing requirements," explains Barden. "Generally, we have existing solutions for most of the things, so usually that is not a concern."

Even the way the parts are delivered to the contract processor, or how they are packaged and returned can be modified as needed.

Parts can be sent in specific counts in bags or in specifically designed pre-loaded trays, for example. Once treated, the parts are typically packaged in polyethylene bags, but for customers with electronic devices like PCBs, antistatic bags can be specified to protect components from electrostatic discharge (ESD).

The company operates nine plasma system lines. So, what happens is usually we can run through three jobs simultaneously.

As for turnaround time, it depends on the quantity and complexity of the processing. However, it can be quite

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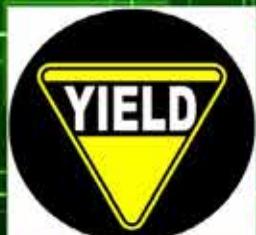


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fast. A single batch can be completed in an hour, and large batches of, say, 1,500 parts can be treated and shipped within a day or two.

For medical device manufacturers interested in treating parts and components with plasma, but do not want to make the investment just yet, or require only small batches, outsourcing it to a qualified contract processor could be the solution they are seeking.

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

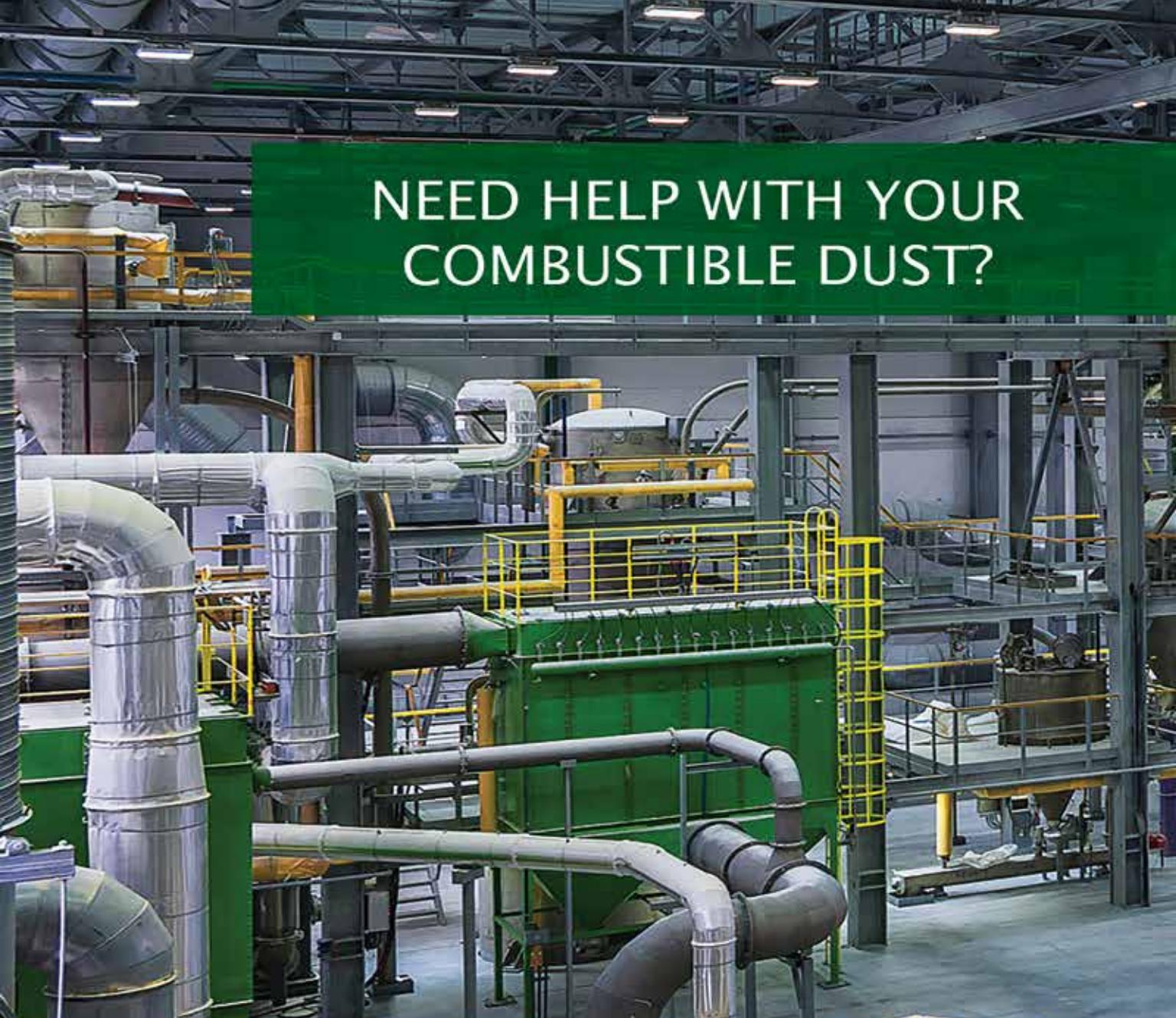


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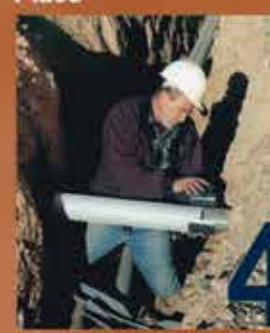
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Step 2: Cut Split Duct Conduit to Fit



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Step 3: Snap in Place



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Step 4: Attach Adapters



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A Tethered Tool System for Applications Involving Work at Height

LEAVE IT TO THE EXPERTS

Snap-on provides a drop prevention system like no other. We'll work with you to determine your drop prevention needs... including the tools, attachment points, lanyards, pouches, and holsters, that combine to create a turnkey solution that enables your workers to do just that...WORK.

SAVE TIME AND MONEY

Engineered attached points don't interfere with the functionality of the tools, and are more durable than simple "add-ons" that require frequent maintenance or replacement.

BEAT THE STATISTICS

About 70% of drops happen during the exchange of the lanyard from one tool to another. The Snap-on Tools@Height system features independent tethering, which means each tool is attached to its own lanyard. Minimizing exchanges reduces the likelihood of drops and increases safety.

MINIMIZE RISK

Independent tethering also allows the tool to be removed from and returned to its holster or pouch using just one hand. Safety is improved by allowing the user to maintain the critical "three points of contact" when working at height.

RETAIN CONTROL

Our modular approach means you can configure the tools/holsters based on a user's personal preference, while providing a system that meets your safety standards.

See what the most comprehensive tool drop prevention solution in the industry can do for your team's safety and productivity by contacting:

Bob Schnuck | Power Generation & Utility Market Manager
413-519-3380 | robert.a.schnuck@sapon.com

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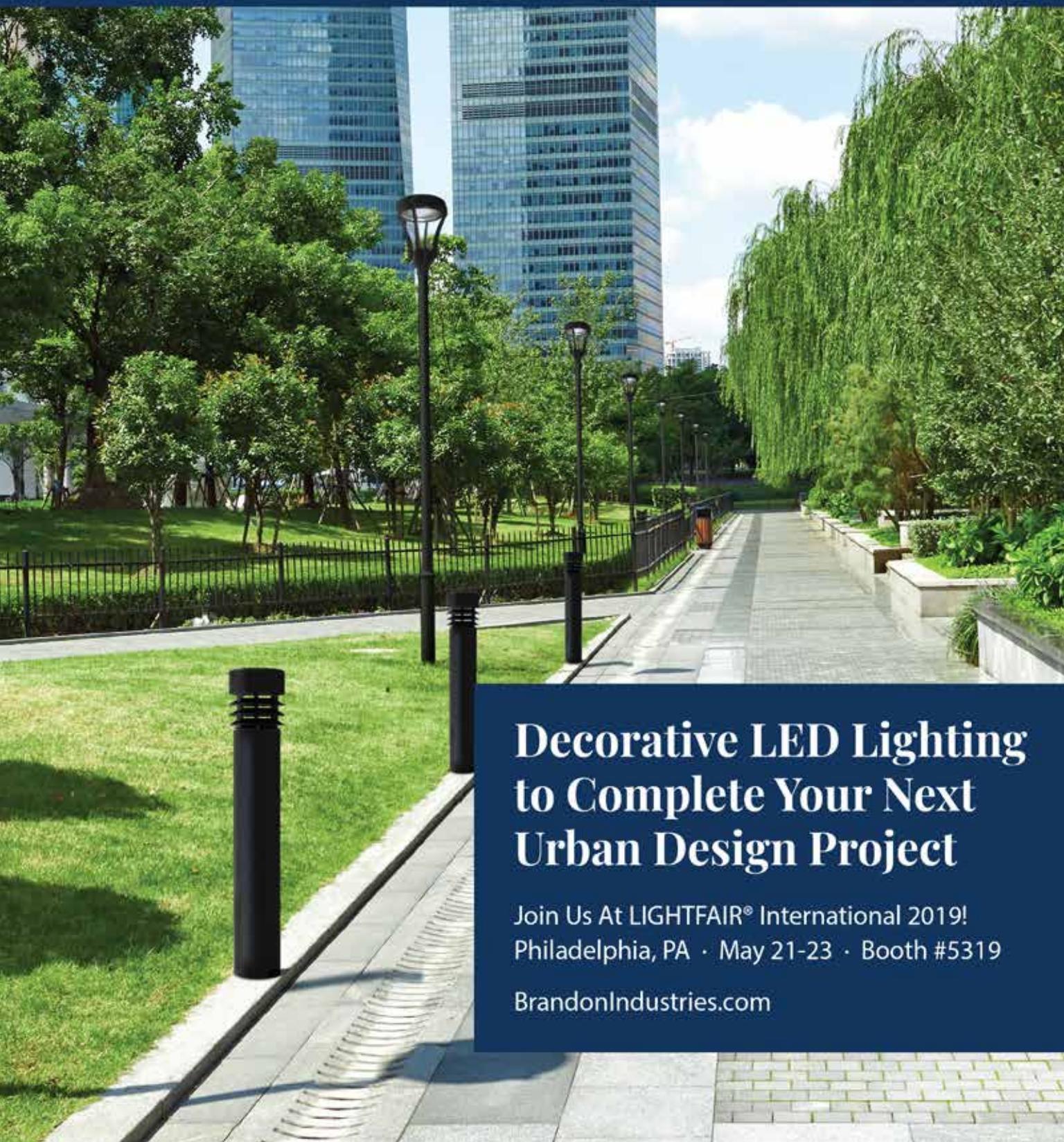
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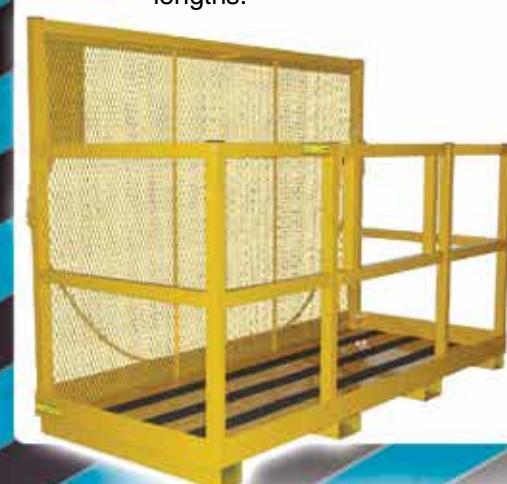
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