LOW COST, RELIABLE HYDROGEN SUPPLY

FURNACE ATMOSPHERE/STEAM COGENERATION TECHNOLOGY

hts.asminternational.org
Introducing the new CamPro™, stationary camshaft heat treating system. Building on Inductoheat’s patented SHarP-C™ Technology (Stationary Hardening Process for Crankshafts/Camshafts), this machine can produce a higher quality part with almost undetectable distortion, shorter cycle times and longer inductor life compared to conventional heat treating. The CamPro™ offers superior results while using less energy compared to conventional induction camshaft hardening.

Call or click today to learn more about our induction systems!
UNIQUE GAS GENERATOR PROVIDES LOW COST, RELIABLE HYDROGEN SUPPLY
Goutam Shahani, Kyle Finley, Nick Onelli, and Grzegorz Moroz
Gas generator combines steam methane reforming with an integrated heat recovery system to reduce the cost and improve the reliability of hydrogen gas supply.

REDUCING THE COST OF HEAT TREATING ATMOSPHERES
Bud Weiland
Conserving utilities is the simplest, most practical way for heat treaters to reduce costs and remain competitive.
Pressure on heat treaters continues to come from all directions including becoming more energy efficient, meeting increasingly stricter environmental regulations, providing faster turnaround times, producing higher quality parts, and keeping better records.

To ensure that your skills and talents match your company's and customer's needs, it's important not to fall behind as new developments are continually brought on stream. How can you keep up? Some methods to stay on top of the rapidly changing technical horizon include on-the-job training, continuing education, refresher courses, and self-learning through technical materials such as reference books and engineering magazines.

Conferences and expositions are also available, which focus on either a full range of heat treating topics or one specific technology area. In addition, technical conferences and expos are a proven, efficient way to bring new products and services directly to target audiences. Equipment suppliers and service providers are continually working to offer the tools required to help heat treaters stay on the leading edge of technology and survive in the globally competitive market. Expos are highly visible and interactive forums where you can meet face-to-face with hundreds of users and potential clients, assess the competition, and network with colleagues.

That these conferences are considered to be very important was evident in the more than 2100 attendees at Heat Treat 2015 in October in Detroit. Along with the 144 high quality technical presentations, nearly 200 companies highlighted their equipment, products, and services. Put a note on your calendar to mark Heat Treat 2017, taking place October 24-26, 2017, in Columbus, Ohio.

ASM's Heat Treating Society will continue to sponsor events that help raise the bar of heat treating expertise. If you are interested in helping to plan these events, consider joining the HTS Technology and Programming Committee. Contact Joanne Miller at 440.338.5151 ext. 5513, joanne.miller@asminternational.org.

Ed Kubel
Contributing Editor
Innovation

ECM Technologies and ECM USA have installed over 1000 cells of heat treating capacity with almost every Automotive company in the world. These systems provide low pressure vacuum carburizing and gas quenching for millions of parts that bring motion and reliability into our daily lives. From automatic, manual transmissions, dual clutch, CVT, to axles and even airplane engine parts, ECM and our processes are part of your lives. Let us build a system for you.

ECM USA, INC. 9505 72nd Ave, Suite 400
Pleasant Prairie, WI 53158  T. 262.605.4810
WWW.ECM-USA.COM
HTS MEMBERS INDUCTED INTO ASM’S CLASS OF FELLOWS AT MS&T15

Dr. Joseph W. Newkirk, associate professor, Missouri University of Science and Technology, Rolla, was inducted as ASM Fellow at the MS&T15 Awards Ceremony on October 6 in Columbus, Ohio. Newkirk (right) accepts his citation from ASM President Sunniva Collins, FASM.

Prof. Yongho Sohn, professor, University of Central Florida, Orlando, was inducted as ASM Fellow at the MS&T15 Awards Ceremony on October 6 in Columbus, Ohio. Sohn (left) accepts his citation from ASM President Sunniva Collins, FASM.

Prof. Chester J. Van Tyne, FIERF professor, Colorado School of Mines, Golden, was inducted as ASM Fellow at the MS&T15 Awards Ceremony on October 6 in Columbus, Ohio. Van Tyne (left) accepts his citation from ASM President Sunniva Collins, FASM.

Mr. Zbigniew Zurecki, senior research associate, Air Products & Chemicals Inc., was inducted as ASM Fellow at the MS&T15 Awards Ceremony on October 6 in Columbus, Ohio. Zurecki (left) accepts his citation from ASM President Sunniva Collins, FASM.

HTS MEMBERS RECEIVE ASM AWARDS AT MS&T15

Mr. Richard L. Wilkey, president, Fisher-Barton Group, Waukesha, Wis., was awarded Distinguished Life Membership at the MS&T15 Awards Ceremony on October 6 in Columbus, Ohio. Wilkey (right) accepts his award from ASM President Sunniva Collins, FASM.

Dr. Frederick E. Schmidt, FASM, senior managing consultant and director, materials technology, Engineering Systems Inc., Aurora, Ill., received the William Hunt Eisenman Award at the MS&T15 Awards Ceremony on October 6 in Columbus, Ohio. Schmidt (right) accepts his award from ASM President Sunniva Collins, FASM.

BEST PAPER IN HEAT TREATING CONTEST

The ASM HTS/Bodycote award was established by HTS in 1997 to recognize a paper that represents advancement in heat treating technology, promotes heat treating in a substantial way, or represents a clear advancement in managing the business of heat treating. The award is endowed by Bodycote Thermal Process-North America.

The contest is open to all students, in full-time or part-time education, at universities (or their equivalent) or colleges. It is also open to those students who have graduated within the past three years and whose paper describes work completed while an undergraduate or post-graduate student. The winner receives a plaque and check for $2500.

To view rules for eligibility and paper submission, visit the Heat Treating Society website at hts.asminternational.org/portal/site/hts/HTS_Awards.

Paper submission deadline is December 11. Submissions should be sent to Joanne Miller, ASM Heat Treating Society, 9639 Kinsman Rd., Materials Park, OH 44073, 440.338.5151 ext. 5513, joanne.miller@asminternational.org.
MPI AND CHTE TO DIRECT ROADMAP IMPLEMENTATION FOR ADVANCING THERMAL MANUFACTURING

Thermal manufacturing plays a major role in the U.S. economy, employing more than five million people and producing nearly $3 trillion in value of product shipments annually. It promises to play an even greater role in the near future with the launching of a new roadmap, Advancing Thermal Manufacturing: A Technology Roadmap to 2020, developed by a consortium of experts from industry and academia.

Its purpose is to accelerate the development, adaptation, and implementation of advanced technologies throughout the thermal manufacturing community. These advances will drive greater efficiency and productivity in manufacturing, resulting in improved sustainability and global competitiveness.

The roadmap was developed over the past year by the Thermal Manufacturing Industries Advanced Technology Consortium (TMI ATC), a working group under the direction of ASM International including the Metal Processing Institute (MPI) and the Center for Heat Treating Excellence (CHTE), both located at Worcester Polytechnic Institute (WPI). Other group members include the Industrial Heating Equipment Association (IHEA), Metal Treating Institute (MTI), Association for Iron and Steel Technology (AIST), Oak Ridge National Laboratory (ORNL), Forging Industry Association (FIA), and the ASM Heat Treating Society (ASM HTS). Through facilitated workshops, TMI ATC gathered input for the roadmap from trade associations, professional societies, academic researchers, and companies who conduct thermal manufacturing processes. TMI ATC is funded by an 18-month planning grant from the National Institute of Standards and Technology (NIST) Advanced Manufacturing Technology Consortium (AMTech).

Up to now, various manufacturing sectors like heat treating, drying, curing and forming, extractive processing, metal casting, and technology transfer worked independently to enhance thermal manufacturing processes. Because these groups were acting alone, attracting the resources necessary to implement their plans was difficult. Thus, many challenges to developing and deploying advanced manufacturing technologies highlighted in earlier studies remain unaddressed today.

“This is the first time a thermal manufacturing group representing various sectors is working together to pool resources and knowledge,” explains Terry Mosier, managing director of ASM International. “Collaboration is critical, and ASM is pleased to lead this initiative with help from MPI, CHTE, and many others.”

ROADMAP PRIORITIES

There are seven priority action items in TMI ATC’s roadmap. Four that require research and development work that will be carried out by MPI and CHTE staff and resources at WPI include:

• Increasing the robustness of materials used in thermal-processing equipment

The benefits of thermal manufacturing have a far reaching impact. Courtesy of Nexight Group.
CHTE UPDATE

- Advancing tools to model and simulate entire thermal manufacturing processes
- Improving understanding of performance requirements and development needs of thermal-manufacturing sensors
- Identifying and implementing hybrid thermal processes and novel applications for existing thermal manufacturing

WPI will also take the lead in establishing a thermal manufacturing demonstration facilities network.

“WPI is uniquely qualified to work on this initiative,” explains Diran Apelian, director of MPI. “Under the umbrella of MPI, we not only have CHTE, but also the Advanced Casting Research Center (ACRC) and the Center for Resource Recovery and Recycling (CR3), and the Center for Advanced Research in Drying (CARD), incredible knowledge and expertise that will come together to further progress in thermal manufacturing. We are thrilled to be a part of this work,” says Apelian.

The impact of thermal manufacturing on the industry is significant. According to Nexight Group, a technical and management consulting group located in Silver Springs, Md., the benefits of advanced manufacturing technologies are far reaching. About 5.4 million people work in the industry and are employed by about 101,000 companies. Of this group, 97% are small and medium enterprises, which is why it is critical to the U.S. economy to secure funds to implement TMI ATC’s roadmap. Nexight was hired by ASM to lead the TMI ATC roadmap development and facilitate implementation planning for priority actions that resulted.

ASM and WPI jointly launched Advancing Thermal Manufacturing: A Technology Roadmap to 2020 to the industry at the ASM Heat Treat Society Conference and Exposition in Detroit in October.

It is anticipated that NIST will provide additional funds for implementation through the AMTech program in FY 2016, with additional financial support for implementing this five-year plan being sought through various approaches. To learn more, visit tmiatc.org.

CHTE is located in Worcester, Mass., on WPI’s New England campus. The university was founded 150 years ago this year. For more information about CHTE, visit wpi.edu/+chte, call 508.831.5592, or email Rick Sisson at sisson@wpi.edu, or Diran Apelian at dapelian@wpi.edu.

Busted!
This company’s QA program AND reputation

Like Humpty Dumpty, it is hard to put the pieces back together once a real world product quality disaster strikes. The ultimate cost of a recall will be far, far greater than any savings from cutting corners or not investing in a quality assurance program in the first place. With our broad spectrum of physical testing machines, software, and technical support, Tinius Olsen can help you assure quality from material to end product. To international standards and your toughest specifications. Reputations (yours and ours) depend on it.

Like Humpty Dumpty, it is hard to put the pieces back together once a real world product quality disaster strikes. The ultimate cost of a recall will be far, far greater than any savings from cutting corners or not investing in a quality assurance program in the first place. With our broad spectrum of physical testing machines, software, and technical support, Tinius Olsen can help you assure quality from material to end product. To international standards and your toughest specifications. Reputations (yours and ours) depend on it.

Busted!
This company’s QA program AND reputation

Like Humpty Dumpty, it is hard to put the pieces back together once a real world product quality disaster strikes. The ultimate cost of a recall will be far, far greater than any savings from cutting corners or not investing in a quality assurance program in the first place. With our broad spectrum of physical testing machines, software, and technical support, Tinius Olsen can help you assure quality from material to end product. To international standards and your toughest specifications. Reputations (yours and ours) depend on it.

Busted!
This company’s QA program AND reputation

Like Humpty Dumpty, it is hard to put the pieces back together once a real world product quality disaster strikes. The ultimate cost of a recall will be far, far greater than any savings from cutting corners or not investing in a quality assurance program in the first place. With our broad spectrum of physical testing machines, software, and technical support, Tinius Olsen can help you assure quality from material to end product. To international standards and your toughest specifications. Reputations (yours and ours) depend on it.
Hydrogen furnace atmospheres in conjunction with nitrogen or argon, carbon monoxide, and methane provide protective and oxide-reducing characteristics, which enhance the physical and chemical properties of heat treated metal products. Gas mixtures containing hydrogen are used as a protective atmosphere in many heat treating processes including annealing, brazing, and sintering. This article provides an overview of Hydroprime, a unique steam methane reformer that uses an integrated heat recovery system to reduce the cost and improve the reliability of hydrogen gas supply.

Hydrogen and nitrogen atmospheres are used in the sintering and annealing of powder metallurgy (PM) parts to enhance the physical and chemical properties of these products as shown in Fig. 1. Relatively small volumes of hydrogen (<1095 Nm³/h, or 1 MMSCFD, million standard cubic feet per day) are supplied in bulk by trailer, or produced on site by electrolysis, methanol, and ammonia dissociation, as well as steam methane reforming (SMR). Steam methane reforming is the dominant method used to produce hydrogen at a relatively large scale (>1095 Nm³/h), but the technology has not been widely adopted at a small scale due to cost and reliability considerations. Linde’s Hydroprime plant is an innovative hydrogen generator based on proven steam methane-reforming technology. The plants are compact, efficient, and flexible. Figure 2 shows a representative plant.

**HYDROPRIME PROCESS TECHNOLOGY**

Steam methane reforming is the predominant method used to produce hydrogen on an industrial scale. Hydroprime plants use a unique heat integration concept combined with SMR. In the process, desulfurized natural-gas feed is mixed with preheated water and fed into tubes filled with nickel catalyst. Reactions that occur at elevated temperature and pressure include:

- Reforming: \( \text{CH}_4 + \text{H}_2\text{O} \leftrightarrow \text{CO} + 3\text{H}_2 \) (1)
- Shift reaction: \( \text{CO} + \text{H}_2\text{O} \leftrightarrow \text{CO}_2 + \text{H}_2 \) (2)

Approximately 75% of the conversion to hydrogen occurs in reaction (1). Reaction (2) drives the equilibrium balance further to yield a hydrogen-rich gas. Reforming is an endothermic reaction, while shift conversion is an exothermic reaction. Both reactions (1) and (2) occur in the reformer. However, only reaction (2) occurs in the shift converter. The shift reaction uses a promoted iron-oxide catalyst. Both reactions are equilibrium limited based on outlet temperature and pressure. Reaction products are a mixture of \( \text{H}_2, \text{CO}, \text{CO}_2 \) and \( \text{H}_2\text{O} \). A simplified block flow diagram of the SMR process is shown in Fig. 3.
The overall reforming reactions are endothermic (require heat), which is supplied by the combustion of fuel. Tail gas from the pressure swing adsorption (PSA) system meets most of the fuel requirement with the rest being supplied by natural gas.

The hydrogen-rich stream is purified using pressure swing adsorption. PSA is a physical process that depends on selective physical binding of gas molecules. Hydrogen is essentially not adsorbed by the proprietary adsorbent material, a mixture of carbon molecular sieve and zeolites, because it is nonpolar and highly volatile. The system operates on a repeated cycle consisting of two basic steps: adsorption and regeneration. Regeneration consists of depressuring, purging, and repressuring.

**PLANT DESIGN**

Inputs to the modular plant are natural gas, demineralized water, and electric power. Outputs are high purity, gaseous H₂. There is no export steam. This plant produces H₂ with the following specifications:

- **Flow rate**: 165-330 Nm³/h
- **Purity**: 99.999+%   
- **Pressure**: 13.8 barg

The plant is designed to be easily shipped all over the world. It can be hauled on a flatbed truck, thereby simplifying logistics and transportation. Figure 4 shows a 14 m long by 3 m wide by 4 m high partly assembled plant module in transit.

Plants are heat integrated for high thermal efficiency. Typical operating characteristics for a 330 Nm³/h (0.3 MMSCFD) plant are:

<table>
<thead>
<tr>
<th>Operating parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₂ capacity, Nm³/h</td>
<td>330</td>
</tr>
<tr>
<td>H₂ purity, %</td>
<td>99.999</td>
</tr>
<tr>
<td>CO + CO₂, ppm</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Pressure, barg</td>
<td>13.8</td>
</tr>
<tr>
<td>Natural gas / H₂</td>
<td>4.4</td>
</tr>
<tr>
<td>MM cal/Nm³ H₂ (HHV)</td>
<td>4.4</td>
</tr>
<tr>
<td>Power, kW</td>
<td>60</td>
</tr>
<tr>
<td>Demineralized water, kg/h</td>
<td>550</td>
</tr>
</tbody>
</table>

These results were achieved in actual commercial operation over an extended time.

Advantages of the Hydroprime plants include:

- Simple, quick site installation
- Outdoor installation
- Excellent accessibility for maintenance
- Small footprint

The plants are standardized with fully automatic fail-safe controls, allowing unattended operation with remote start-up and 24/7 monitoring. This enables quick response to
even the slightest production interruption. Furthermore, the system provides virtually 100% uptime for H₂ product supply with the addition of a simple liquid backup tank.

**USER BENEFITS**

Hydroprime plants offer a viable alternative for relatively small (<1095 Nm³/h) hydrogen requirements. The plants are shop fabricated with efficient use of labor in a controlled environment, ensuring high quality control. Modular design reduces field construction, minimizes risk, and provides a faster project schedule. The plants also provide superior environmental and safety performance based on low emissions and reduced truck deliveries. Furthermore, the combination of low utility consumption and high reliability offers a cost-competitive solution for relatively small, industrial hydrogen consumers. Linde can provide “over-the-fence” supply of H₂ molecules. In this arrangement, the end-user purchases the molecule under long term contract, eliminating the need for any capital investment and responsibilities related to ownership such as installation, operation, maintenance, repair, insurance, manning, and back-up of product in case of plant stoppage. Alternatively, these plants can also be owned and operated by the end user.

**CONCLUSIONS**

A Hydroprime gas-generator plant is a standardized steam methane reformer developed to reduce the cost of and improve the reliability of hydrogen supply for relatively small industrial consumers, offering advantages over traditional supply modes such as electrolytic plants, conventional steam methane plants, and truck-delivered bulk hydrogen. Hydroprime plants are highly heat integrated, which translates into low operating cost, and they offer high reliability and both superior environmental and improved safety performance. The modular units are fully automatic with fail-safe controls, allowing unattended operation with remote start-up and monitoring. Modular open-skid design provides easy site installation and accessibility for maintenance. Ten units have been built, nine of which have been in commercial operation for a long time, demonstrating performance in a variety of applications worldwide.


Hydroprime is a registered trademark of Linde AG.
REDUCING THE COST OF HEAT TREATING ATMOSPHERES
Conserving utilities is the simplest, most practical way for heat treaters to reduce costs and remain competitive.

Bud Weiland, ERC International Inc., Cleveland

While natural gas costs have been declining since 2014, bulk nitrogen costs have not followed the same track. As nitrogen supply becomes an increasing portion of the total cost to process metal products, technologies to generate nitrogen on-site become viable. Many of the largest industrial gas suppliers will install on-site air separation plants for producing nitrogen for their larger consumers, but these arrangements typically come with high-commitment take-or-pay contracts. For consumers in the middle range (e.g., 10-60,000 scfh nitrogen requirements), bulk liquid nitrogen is the least expensive among expensive options. By comparison, cogeneration technology, producing two utilities using one process, has the potential to greatly reduce costs at facilities that can fully use both utilities.

BENEFITS OF COGENERATION TECHNOLOGY
ERC International supplies cogeneration equipment to manufacturing facilities that consume both nitrogen and steam, with the largest market presence in the metals processing industries. The fastest return on investment is seen by facilities using delivered liquid nitrogen and plant steam.

There is also added value to facilities generating their own endothermic gas, a carbon-intensive atmosphere used in the heat treating industry. The typical ERC user is a metal processor that has large heat treating furnaces, consumes nitrogen in the range of 10-60,000 scfh, and uses steam (or hot water) for heating acid pickling tanks. For bright annealing and annealing of medium carbon alloy steels, endothermic gas is sometimes blended with nitrogen. All of these utilities (nitrogen, steam, and the total supplies for the endothermic generator) are delivered by one ERC cogeneration unit.

ECONOMIC BENEFIT
The economic benefit comes from replacing the cost of nitrogen and endothermic gases with just the cost to run the purification section of the cogenerator. The fuel to run the steam section of the cogenerator (natural gas or propane) is equal to the fuel being used to generate plant steam, and, thus, is cost neutral. The difference is that the cogenerator products of combustion are carefully controlled to be suitable for purification into a very good atmosphere gas compared with conventional plant boilers that are just venting their products of combustion. Users keep their...

Schematic of ERC International fuel-based nitrogen cogeneration system.
existing boilers to fulfil excess steam demand. Therefore, the cogenerator stays at full steam, maximizing the “free” nitrogen delivered. ERC users include steel and copper-tube manufacturers, aluminum manufacturers and many other metal processing companies. Typical payback for supplied ERC units ranges from six months to one year. ERC conducts surveys at prospective plants to determine the potential economic value.

**PROTECTIVE ATMOSPHERE**

The high purity atmosphere produced by ERC cogenerators is well suited for annealing and many other metal-processing applications. The output contains not only nitrogen (N₂), but also the required reducing gases (H₂ and CO) necessary for successful processing of metals to produce a superior bright finish. For annealing medium- and high-carbon steels where decarburization must be avoided, enhanced purification is provided to further reduce CO₂, H₂O and O₂ to levels approaching those of 99.999% liquid nitrogen. The atmosphere is much more robust than straight nitrogen due the presence of H₂ and CO₂, and tolerates furnace leaks and other sources of CO₂, H₂O and O₂, while still producing a superior metal finish.

**GREEN TECHNOLOGY**

Besides the direct economic benefit from nitrogen savings, the ERC unit can result in reduced emissions. Given that the products of combustion from steam boiler operation are not vented, but instead are recycled to the heat treating furnace, total emissions of the heat treating facility are minimized. Especially when replacing nitrogen/endothermic systems, a study should be conducted to determine the magnitude of a reduced carbon footprint, and the value of potential credits to the facility.

**CASE STUDY: QUALITY/COST UPGRADE**

In 2010, a steel-tube manufacturer (PTC Alliance, Fairbury, Ill.) upgraded an existing furnace to enable processing medium-carbon steel tubes, producing a bright finish without decarburization on the inside or outside of the tubes. Prior to the upgrade, the furnace was used to process low-carbon steel tubes, and did not have the capability to produce tubes free of decarburization (which was not a problem for the market they were serving). The goal of the project was to convert the furnace to enable processing high-strength automotive products.

The company consulted the furnace manufacturer about making the necessary furnace conversion, and it was recommended to take the traditional approach of converting to nitrogen/endothermic atmosphere. Instead, the tube processor selected an ERC cogenerator with enhanced purification and RAD-CON atmosphere control system. The resulting bright finish on the steel tubes exceeded expectations, and met all decarburization specifications on the inside and outside of the tube. Today, the plant continues to successfully produce tubes for this application.

**OTHER APPLICATIONS**

Other manufacturers that installed ERC cogenerators over the past two decades include carbon-steel tube manufacturers, steel-coil producers, companies producing steel laminations for motors, aluminum producers, steel rod and bar suppliers, steel golf-shaft manufacturers, copper and brass tubing manufacturers, and producers of sheet steel.

For more information: Christopher J. Messina, president, RAD-CON Inc., Cleveland, OH, 440.463.4224 (mobile), chris.messina@rad-con.com, www.rad-con.com, or Bud Weiland, ERC International Inc., part of the RAD-CON Group, Cleveland, 440.610.6239 (mobile).
What if your furnace could …

… tell you that it isn’t operating correctly?
… tell you when a vacuum pump rebuild is going to be necessary?
… tell you that you are at risk of experiencing discoloration in the next cycle?
… tell you that you will not pass the leak back test in three weeks?

What if your furnace could warn you about a heating element failure, order the part and schedule the service needed to install it?

These what ifs are the motivating drivers pushing predictive maintenance technology to the forefront of product development and maintenance strategies for industries across the globe. And, in the near future, customers are going to expect all heat treatment furnaces to be capable of leveraging the Internet of Things to perform such analysis.

Currently in the thermal processing industry, when a heat treatment furnace breaks, the result is clear: production comes to a grinding halt and the personnel necessary to resolve the issue might not be readily on hand. As a result, companies are faced with unplanned downtime until the problem is resolved, potential overtime wages for the necessary personnel, the cost of rushing critical part shipments and more.

In an effort to combat this issue, the ultimate goal of predictive maintenance and Ipsen’s PdMetrics™ software platform for predictive maintenance is to …

Achieve powerful performance, experience cutting-edge technology and utilize predictive maintenance capabilities in a single, compact vacuum furnace: the TITAN® 2.0. This furnace incorporates years of customer feedback to deliver improved, user-friendly features, all while maintaining a global platform, small footprint and short delivery times.

- Available in horizontal, 2-bar models
- Includes PdMetrics™ software platform for predictive maintenance and diagnostics
- Features intelligent SCRs (silicon-controlled rectifiers) for efficient heating control
- Incorporates a high-definition display with a touchscreen and scrolling marquee, making critical furnace parameters visible from a distance

Read the full technical article here to learn more:

www.IpsenUSA.com/Predictive-Maintenance