

# Improving Cost Efficiency in Heat Treatment

## The Future Gives the Gear Market Plenty to Think About in Areas Like Automation, Additive Manufacturing and Machine Learning

Matthew Jaster, Senior Editor

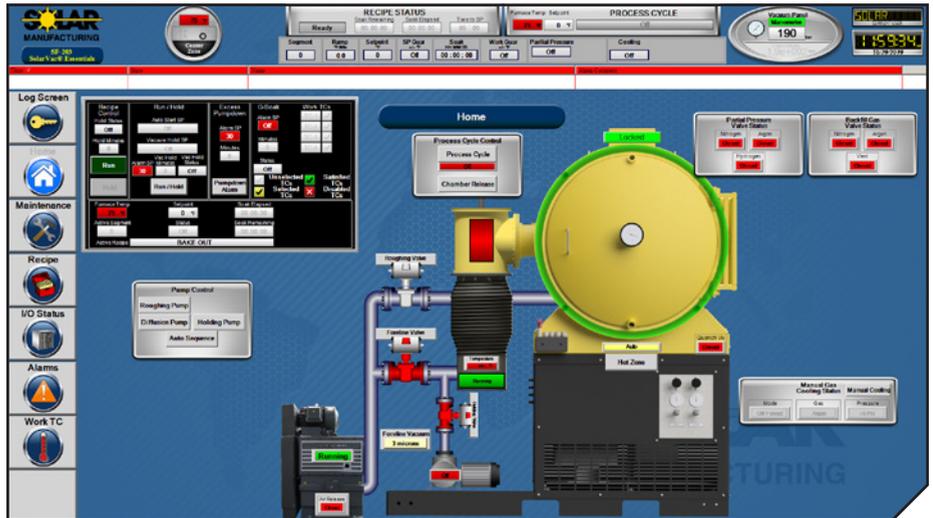
Think about the future. It's not as scary as it seemed thirty years ago. Sure, robots are everywhere, humans are co-dependent on their smart devices and cars are driving themselves, but there's much more going on behind the scenes. Data, automation and additive are creating many new opportunities in industrial manufacturing.

Heat treating gears, for example, is going through some technological advances that allows the equipment to perform faster, better and more efficiently than ever before. Companies like Solar Manufacturing, Seco/Warwick and Ipsen are on the leading-edge of these new innovations.

### Solar Ups the Ante on Automation and Control Advancements

Automation plays an essential role in ensuring quality and reliability, as well as improving cost efficiency, in heat treat processing.

"No matter the type of gears being treated or their application, they are a critical portion of our customers' product, and automation adds a tremendous amount of value to the process. By predicting precise 'wheels up to wheels



Essentials program for Mentor. Courtesy of Solar Manufacturing.

down' process times, the control system can monitor and alter the active process in real time when production runs start to fall short of their predicted model," said David Rossi, automation and controls engineer manager at Solar Manufacturing. "Because operator intervention can be reduced significantly, we can provide a more consistent, time-efficient product run, allowing higher utilization and throughput."

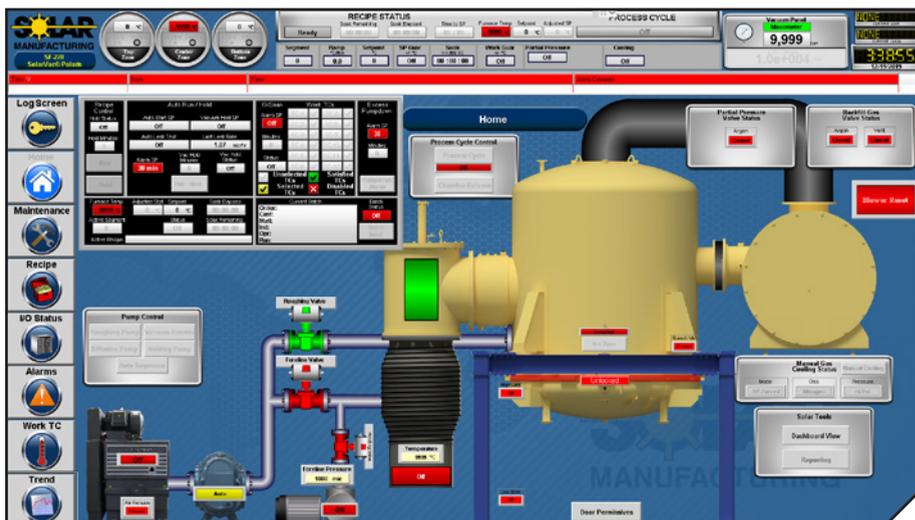
The company's *SolarVac Polaris Historian with Dashboards* is now

included in all *Polaris* core control systems, providing a rich depth of (up to) 500 data points recorded every second. Maintenance personnel can easily identify equipment failures while following up on predictive alarm conditions received automatically via email or text, Quality Control can compare order run metrics to analyze variations in component performance, and Production can monitor batch-specific utility usage, ensuring furnaces are running within their targeted utilization / OEE goals.

"This data is presented via a customizable, easy to use web-based dashboard. Because the data is also available directly from the intrinsic SQL Server, customers can easily integrate the furnace live and historical data into their own MES/ERP systems via standard SQL queries," Rossi said.

Software is an additional area where Solar can unify the heat treat equipment on the shop floor.

"Expanding outside of the standard PLC/HMI offering to include our *Historian* software, we also offer optional batch reporting packages and centralized recipe management software that will integrate with our customers' business centers to help tie together all plant-wide Solar Manufacturing furnaces," Rossi said.



Maintenance personnel can identify equipment failures using Polaris. Courtesy of Solar Manufacturing.



Polaris dashboard (courtesy of Solar Manufacturing).

From a performance standpoint, *Historian* allows Solar’s service technicians to conduct extensive troubleshooting of the equipment during factory acceptance testing and commissioning. Knowing how the furnace equipment performed at commissioning and comparing this with current performance metrics helps maintenance personnel identify changes and perform root cause analysis for any anomalous conditions.

“Based on customer requests, we are now leveraging integration with our customers’ ERP and MES systems and have established a means for centralized recipe control and disbursement across all plant-wide Solar Manufacturing furnaces. We have also started development into augmented reality solutions that will tie live process data with web-based technical documentation,” Rossi added.

Many of these new innovations received plenty of attention during the Heat Treat 19 show in Detroit (October 15–17). Rossi said that Low Pressure Carburizing (LPC) is significantly impacting the gear manufacturing market. This process is an improvement over traditional gas carburizing in terms of absence of inner granular oxidation (IGO), providing improved root-to-pitch ratios of the carburized depths, and when coupled with high pressure gas quenching, results in less part distortion. The LPC process also produces consistent carburizing and heat treating results which complements the benefits of automation and control advancements

in the industry.

“We received an amazing amount of feedback this year on the aesthetics and long feature list of both our *SolarVac Polaris* and *Essentials* control system at this year’s ASM show. Our *Essentials* system is a streamlined control platform that can scale from our popular skid-based Mentor furnaces up to the largest systems we manufacture. We proudly displayed our Mentor at this year’s show,” Rossi said.

Additive manufacturing is another area that is getting more attention at Solar.

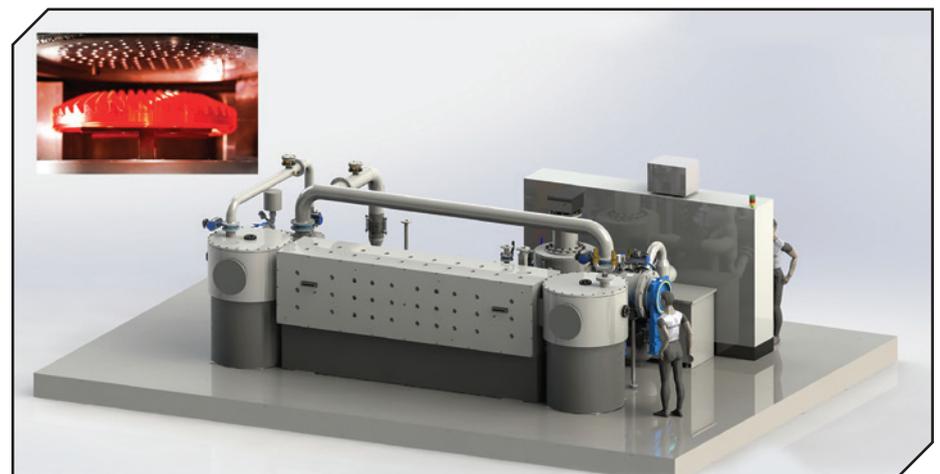
“Vacuum furnaces are an integral part of the Additive Manufacturing (AM) market. When using vacuum furnaces for this market, extremely tight temperature uniformity is critical, particularly at high sintering temperatures. Low vacuum

levels and slow ramp rates can benefit from automated holds during the ramp to minimize outgassing of residual binders, and in some cases, we can introduce hydrogen partial pressure to the process. These are just some of the technologies offered to our customers,” Rossi said.

He believes the AM market may have an impact on the brazing industry. Multiple components that were brazed together to form a single part can now be printed in one step. As the AM market continues to grow, raw material processing will be reduced and more near-net finished parts will be heat treated, according to an ASM paper entitled, “Vacuum Furnaces Were Made for Additive Manufacturing,” by Robert Hill. The AM parts will need the processing advantages vacuum furnaces offer over atmospheric furnaces.

Solar is currently looking into both machine learning and augmented reality.

“Machine learning has the potential to provide automated anomaly detection, alerting maintenance to possible eminent equipment failure. In addition, this technology can assist the quality department by flagging batch runs that look different and may require additional analysis,” Rossi said. “Augmented reality provides maintenance with immediate contextual access to manuals, drawings, and service documentation right at the equipment where it is needed. This has the potential to reduce time spent servicing equipment and training maintenance personnel.”



Seco/Vacuum launched two two products in 2019 including the Super IQ and the UCM 4D Quench (courtesy of Seco/Warwick).

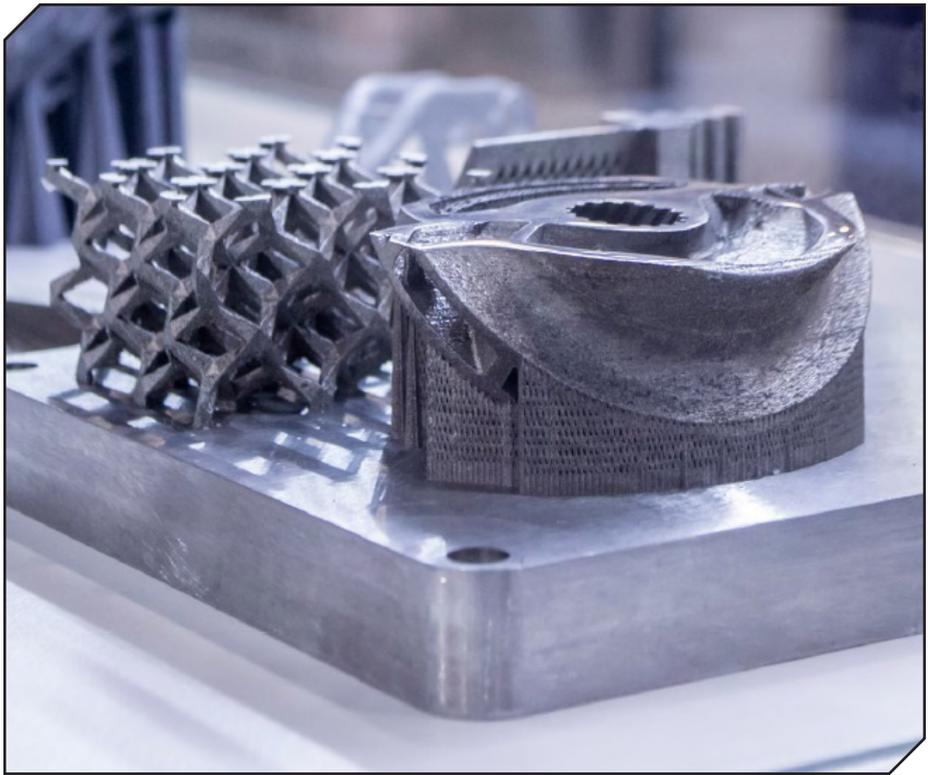
## Seco/Warwick Examines Practical Use of Advanced Automation

The practicality of advanced automation is an area that Seco/Warwick has been focusing on for several years. “The development of automation continues on a strong and fast pace, as manufacturers shift their requirements towards logical, well thought out systems in conjunction with smart, autonomous solutions. These drivers make it possible to maintain production continuity while adapting quickly to emerging technologies when making key production, investment and business decisions,” said Sławomir Wachowski, Seco/Warwick automation director.

One area of interest are the control cabinets considered the ‘brain and nervous system’ of an industrial furnace. An industrial computer installed in the control cabinet, comprised of an array of PLCs, acts as a process manager and an intuitive communication interface between the operator and the manufacturing process as well as with other control components and instrumentation to ensure safe and continuous operation of the equipment.

Another key technology is the control system which was recently updated in the automotive industry with one of Seco/Warwick’s long-term furnace customers — NordGlass. The company is adopting a self-learning temperature control system that, thanks to the use of FuzzyLogic combines with over 2,000 control elements to adapt the glass bending temperature to the glass model. This technique ensures optimum production with maximum performance and eliminates waste while preserving the company’s strict optical specifications.

According to NordGlass, the company had been looking for a control solution that would recognize the glass type, its shape, properties and texture, and would be able to independently adjust the correct temperature required for glass bending. The system was also supposed to work in non-linear product recognition mode, as one production line can be used for various glass from various manufacturers and belonging to different production models. Smart, adaptive learning was the most important requirement for the development of the



**Ipsen has been working with 3D printer manufacturers for almost a decade and recognizes the importance of serving this rapidly growing industry.**

furnace control system.

According to Wachowski, the system proposed to NordGlass is more than just logic coded into the PLC. It is a system for processing large amounts of data that is the basis for executing control over thousands of precise heating elements. Process stages include recognition, interpretation, data use, adaptation and action. When executing the process, the system continuously learns, draws conclusions, interprets data and takes action; in other words, it autonomously selects and changes the glass bending temperature in order to give it the required features. This hints at how large a role automation and IIoT will play in heat treat systems now and in the future.

Seco/Predictive, based on predictive analytics, together with the Seco/Lens based on augmented reality technology, are some of the recent solutions supporting production and service processes. Awareness of the need to implement advanced and intelligent solutions, often called “the brains” of an entire production line, is constantly growing.

The company’s augmented reality (AR) application Seco/Lens is an application that, based on Microsoft holographic computer — HoloLens,

introduces heavy industry into the world of augmented reality. It can superimpose previously developed 3D model of the device for heat treatment of metals enabling its monitoring, diagnostics, maintenance of the production process, remote repair and planning the most optimal layout of the production line on the hall. Seco/Lens allows for very accurate visualization of Seco/Warwick solutions, as well as for conducting training on the operation of the device without the need for expensive and time-consuming travel.

Advancements and technologies to the furnaces themselves include the new Seco/Warwick UCM 4D Quench vacuum system. This enables customers to achieve the same results or better as oil press quenching but with gas cooling after vacuum heating in a continuous, single-piece flow vacuum heat treatment system. 4D Quench is a cost-effective alternative for quenching and distortion control that cools as rapidly but without the issues associated with oil. (learn more on page 19).

“Globally, a number of various industries use heat treatment in their day to day processes. Automotive, aerospace, energy, commercial heat treaters, heavy

construction machinery, and the tool and die sectors to name a few. As the years go on, together with the heat treatment market getting bigger and better, the needs and expectations, due to the digitalization and globalized standards, are changing,” said Paweł Wyrzykowski, CEO of Seco/Warwick.

### **Ipsen Offers Titan Furnaces for Additive Manufacturing**

Ipsen USA was recently awarded an order to supply a West Coast aerospace customer with four Titan H6 2 bar vacuum furnaces that will be used for heat treating additively manufactured parts in full-scale production. Ipsen shipped two of the furnaces in November and will ship the remaining two in early 2020.

“Ipsen has the industry’s best lead time with the Titan furnace. This, coupled with a product designed specifically for the AM industry, made Ipsen the obvious choice for this project,” said Ipsen’s Vice President of Sales, Pete Kerbel in a recent press release.

Additive manufacturing (AM) is changing the landscape for production and design with the ability to produce complex components made to rigorous standards with short lead times. Heat treating is an important step in post-processing most metal AM parts to meet strength and material density requirements.

Ipsen has been working with 3D printer manufacturers for almost a decade and recognizes the importance of serving this rapidly growing industry. While AM has primarily been used for prototyping and low-volume production, companies are now looking to AM for high-volume, mass-produced metal parts.

Ipsen is committed to keeping pace with emerging technologies to build the next generation of furnaces. As additive manufacturing becomes more desirable, Ipsen is working to ensure customers have the right products for their evolving needs.

Additionally, Ipsen recently expanded its aftermarket services across the United States, Canada and Mexico. Five Regional Sales Engineers (RSEs) to assist customers with replacement parts, retrofits, upgrades, service and technical support for any brand of atmosphere or vacuum heat-treating system.

Ipsen’s RSEs have diverse backgrounds with experience in engineering, machine repair, and metallurgical processes. The RSEs are supervised by Matt Clinite, customer service sales manager at Ipsen.

“They are each incredibly unique in their own individual strengths,” Clinite says about the RSEs. “One common trait they all share is integrity and a ‘customer first’ attitude.”

The RSEs fill a crucial role within the organization by creating a more efficient system for managing customers’ needs and streamlining the process between new equipment sales, aftermarket service, and field support.

“Our team is here to identify risk points with our customers’ equipment,” says Clinite. “Our goal is to help our customers better prepare for maintenance planning and experience maximum furnace uptime and reliability.”

### **Data, Automation and the Future**

The end game is finding the right personnel and the right technologies to help gear manufacturers produce better gears. As our State of the Gear Industry Survey

suggests (page 32), manufacturing is in a constant state of change, it’s necessary to take a good, hard look at areas like data, automation, controls, and additive manufacturing to see what technologies and heat treat capabilities need to be considered heading into the next decade. ⚙️

#### **For more information:**

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