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Implementing Process Controls and Automation in Heat Treating

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Automation can be many different things across many different industries, so it's hard to have one definition to cover it in its entirety. In heat treating, automation is approached in categories. The types of processes and equipment may only have certain capabilities when it comes to mechanically automating a process, forcing heat treaters to look at nontraditional types of automation.



Many heat treaters need flexible equipment when it comes to processes and load sizes. Because of economic pressures and competition, costs and capital are being scrutinized. Does it take significant capital to automate a process? In the world of heat treating, it doesn't have to.

What is Automation in Heat Treating?

An automated process really needs to start with a plan and goals. For most heat treaters, the main drivers are obvious: quality, documented productivity and cost reductions.

“When we started down the path of new controls and software, we envisioned that it was going to be a company-differentiating event,” said Johnathan Rex, plant manager of Rex Heat Treat’s Lansdale, Pa., facility. “That’s exactly what happened, and we have been able to capture

an entirely different market of customers because we focused on the right investment in technology to get us there.”

In its simplest form, automation is creating a sequence of steps that flow continuously. Creating a sequence of steps to be automatic doesn't always require equipment. Simple steps for this to happen can be broken into, operational procedures, preventive-maintenance programs, shared data and smarter controls.

Proactive vs. Reactive Maintenance

Maintenance is tough and tends to be very reactive. A reactive approach to maintenance bypasses the crucial planning phase of production. The risk is reducing overall equipment utilization as well as any excess capacity, thus having opportunities for higher profit margins on the table. Using SCADA (Supervisory Controls and Data Acquisition) and smart process controls can help with this. Quick access to in-

formation that can be used by personnel throughout the facility enables a better decision-making process.

Referencing historical data, questions like these can be answered quickly: Did the load take longer to get to heat than usual? Is the temperature overshooting? Is my carbon percentage oscillating? This information can be valuable when the right person has access to it. The intent is to put yourself in a situation where you have confidence in your ability to produce quality parts.

Traditionally, data may have been available on paper charts but was not used effectively because it was not readily accessible. Today, there is more information with the use of open communication standards and plant-wide networks. Access to key data points has to be easy so the right person can analyze it, compare it to historical data and determine if action is necessary. Rework is double trouble in that it results in twice the furnace time, another notification to the customer, a longer delivery time and reduced margins on the job. To avoid it, put people, processes and equipment in place to identify the problem before it happens.

With a quick glance at a chart, one can identify if a load coming to heat had a problem. Sure, this information was available before, but comparing two different runs was not easy. With electronic information and tracking of load times, a quick, periodic review can be significant.

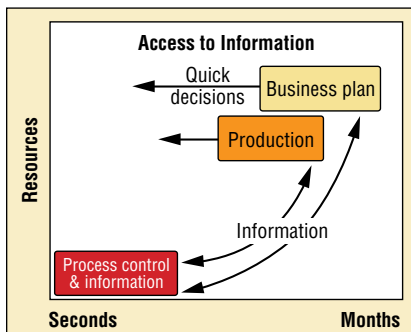


Fig. 1. Investments in automation are driving costs down.

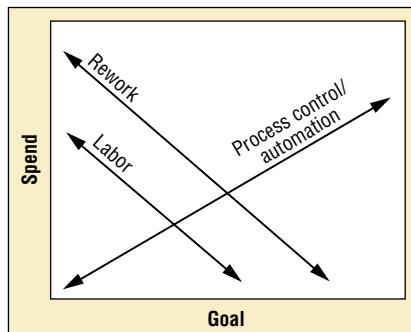


Fig. 2. Quick access to information provides valuable data for management to shorten decision time.



Fig. 4. Johnathan Rex of Rex Heat Treat uses the latest tools in technology to provide quick access to information from almost anywhere.

Carbon charts can frequently be evaluated and burner-tube leaks identified when looking at digital charts and identifying saw-tooth trends (i.e. an indication of air in the work chamber when on high fire and the carbon probe trying to compensate for it).

It is more common for an out-of-tune burner to be a more reactive maintenance task. With sensor and recording technology today, you can have quick access to current information to allow adjustments to the air-gas ratio that will lead to consistent uniformity and productivity. There are case studies that prove a tuned burner can increase capacity of a furnace tremendously, not to mention the gas savings benefit.

Business Process Optimization

It's no secret good labor in heat treating is tough to find. A significant amount of heat-treating experience is retiring from the industry and leaving a large gap in knowledge on the floor. Typically, key personnel can be categorized into operations, maintenance and quality. Aligning priorities across the organization is critical to one's success. There is no better starting point for making decisions than having information available that can be shared. Whether it is the furnace charts, current customers/jobs running, expected load completed time or planned maintenance, it all collectively feeds the planning process. This information can be accessible using controls and systems, and the data can be used to enable the management team to make more informed decisions that impact resources, equipment, quality and long-term planning. When the infor-

mation is used properly, decision processes become more efficient.

Many heat-treating operations have disjointed controls, leaving management to continuously monitor furnaces using personnel and chasing down information. "We have really been able to streamline our processes by using real-time electronic data," said Scott Wagner, production manager at Rex Heat Treat. "We now have an opportunity to manage production instead of chase information." Simply put, management can do a better job at planning production and maximizing furnace utilization with the information that is available.

Controls and Data

Process control can be defined as the ability to meet certain parameters over time using inputs from the process and controlling outputs for desired results. Today's control and sensor technology makes much of this automation. With technology enhancements come more sophisticated controls to make better decisions. The decisions can be on the process itself, productivity, quality and safety. Traditionally, the inputs for a process were disconnected. Today, more of these are being brought together to provide a more holistic view of the control decision process.

PLCs, discrete microprocessor controls and a hybrid of the two are what you see on most heat-treating equipment. Microprocessor controllers typically provide single or multiple PID control loops with expanded features such as event and recipe management. In many cases, the controllers are defined for specific processes or can be programmed to provide function-



Fig. 4. Johnathan Rex of Rex Heat Treat uses the latest tools in technology to provide quick access to information from almost anywhere.

ality for a specific process. PLCs can also have PID control loops developed as part of the logic created in the controller.

To get full use of the control technology, it is best to create an opportunity for repeatability and allow the level of flexibility that is necessary for the equipment and operation. A foundation for this is recipe control. A recipe gives the steps of the heat-treatment process. It can be a simple ramp to temperature and a timed soak or a more complex process by which multiple temperature inputs, time, atmosphere, pressure and other variables need to be managed.

Incremental steps can be taken to put more automation in place and provide better access to information. Using recipe control to automate a nitriding, vacuum carburizing or even a simple temperature ramp/soak leads to greater chances of running the process correctly, resulting in repeatability. Automation of a process using programmable controls eliminates variations in process from shift to shift or operator to operator.

A recipe program set up in advance to "step" through the process and automatically advance to the next step upon desired results leaves the controller in charge. Operators can be taken further from the decision process by implementing scanning technology so the recipe is automatically selected based on a shop card or part number. This reduces the chance for the wrong heat-treat cycle and gets the parts heat treated correctly the first time.

Controls provide user-defined audible, visual and electronic alarms indicating



cycle-complete or a deviation from the process. Recipes can be set up so that, upon completion, the heat is turned off. This eliminates unnecessary costs and ensures parts are at heat for the necessary amount of time. Smart alarms capture the attention of operators when a situation needs to be addressed. Again, simple steps automate a process, which positively impacts labor and utilization.

With more devices and sensors monitoring the process and a system in place to capture information, data is very easy to access remotely. Whether it is a critical job where periodic remote monitoring is necessary or the ability to tweak a cycle, it can be done.

“We have access to our system 24/7 remotely,” Rex said. “I can be ‘eyes on’ critical runs or evaluating a step in a cycle. With the right systems and people in place, we capture every level of the heat-treating market by using technology and information to refine our processes and deliver quality parts to our customers efficiently.”

Historical information and simulation can lead to more precise control parameters. The more access to these data points, the greater is the opportunity for repeatability.

Industry Specifications

Advancements in process control and technology have resulted in more industry requirements. Whether it is CQI-9 requiring an endothermic generator to be continuously controlled and monitored or AMS 2759/12 requiring automatic control to produce a continuous compound

layer with controlled phase composition, both of these requirements can be accomplished utilizing control technology. Using AMS 2759/12 as an example, processing equipment is defined in the document. The method of control is not specified, but it is pointed out that the furnace should be equipped with gas-analyzing equipment capable of measuring the concentration of the reactive gas. This in itself does not specify automation. However, using an integrated process controller that can ensure temperature, time and gas concentration and maintain a safe operating furnace does.

In many cases, industry specifications drive a certain amount of documentation, which is required to provide a customer or auditor as proof of the process. This might be required when the parts are completed or on-demand when a customer requests the information. Electronic data and SCA-DA systems have made this task easier.

“The old days of tracking down a chart, copying it and mailing or faxing it are a thing of the past, and I don’t miss them,” explained Sarah Mansuetti, a metallurgist who works in quality control at Rex Heat Treat Lansdale.

It is more and more common that information is shared electronically. Whether via email or an attached file, it still gets to the heart of the requirement, which is proof of the heat-treating process.

Customer Service

There is a whole different level of service that can be provided when smart controls and data acquisition are utilized. “We have opportunities to work with our customers

on product development and process improvements,” Rex said. “We embrace the opportunity to work with customers on special projects or witness processes in real time and produce an information packet upon their departure.”

Quick access to information allows an efficient response to a customer requesting data or order status. “With our system in place, I can have an answer for a customer while on the phone with them. I know what to be looking for before I pick up the handset, promptly tell the customer we have two hours left on the final cycle and the parts would be ready by mid-day,” Wagner explained.

Prior to having a system, this required “boots on the floor” to find the job, determine the time remaining and getting back to the customer.

In Conclusion

Today’s heat treater depends on the science of the past but will rely on the technology of the future to stay competitive. Technology moves forward every day and requires that we embrace the technology and automation to remain competitive. Those who resist change will be left behind wondering why their business is declining and will be surpassed by the growing global competition. Those who embrace the opportunity automation and digital documentation provides will grow and prosper. **IH**

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