Cleaner, More Energy Efficient: Trends in the Heat Treat Industry

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An advancing technology and higher energy costs appear to be leading heat-treating companies in the gear industry toward cleaner, more energy-efficient processes. These processes may offer some relief to heat treaters through cooler factories and some relief to their companies through reduced energy usage.

Also, the heat treat industry has long-term goals for making heat treating cleaner and more energy efficient.

An Advancing Technology

An advancing technology among the gear industry's heat treaters is vacuum carburizing and hardening, according to Bob Cvetichan, manager of the heat treat department at Horsburgh & Scott Co. of Cleveland, OH.

Cvetichan says he sees an industry-wide trend toward vacuum carburizing and hardening. In his opinion, the process is becoming more popular because it's cleaner than gas carburizing and hardening, as well as conventional through-hardening.

In Cincinnati, OH, the president of Cincinnati Steel Treating Co. agrees.

"It's cleaner," says Jerry Wolf. "Vacuum furnaces are not hot. They're cold on the outside."

Their coolness could make those furnaces easier to install in a manufacturing plant because the heat treat operation wouldn't need to be a separate department in the plant.

Cvetichan adds that the cleaner vacuum process would make for cleaner workplaces, which could raise heat treaters' morale.

According to Wolf, vacuum carburizing and hardening appears to have advantages over conventional carburizing and hardening.

He says there's evidence that vacuum carburizing and hardening deepens the optimum carbon level in the case, increasing the gear's load-carrying capacity. He adds that the process—with high-pressure gas quenching—appears to reduce distortion in gears and makes remaining distortion more uniform. Also, there's no intergranular oxidation on the gear's surface.

Wolf cautions that the process may not be readily adaptable for use in job shops, but it can be used in high-volume production where there are large loads of similar gears.

Vacuum carburizing and hardening has been around for a long time. But Wolf says it had "a black eye" for a while because it was expensive to install and maintain, and it created soot, which got on everything—including gears being treated. Also, gas quenching—which is currently used with vacuum carburizing and hardening—didn't quench parts fast enough, thereby requiring the use of oil quenching.

Wolf says atmosphere carburizing and hardening of gears is "here to stay" as a heat treat process. But, he adds that vacuum carburizing and hardening will start nibbling away at traditional carburizing and hardening.

According to Wolf, people would look at vacuum carburizing and hardening more seriously today than they would've one or two years ago. Still, he says converting to the vacuum process will be slow because of high capital costs.

More Energy Efficient

Many heat treaters in the gear industry are trying to make their operations more energy efficient. Their efforts are in part a response to high energy costs they faced in 2000 and 2001.

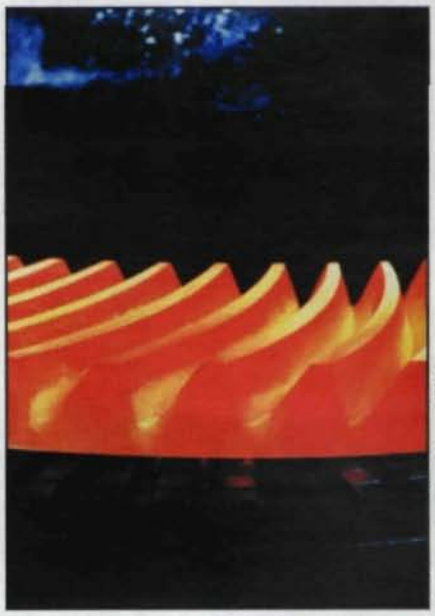

Photo courtesy The Gleason Works

Merit Gear Corp. of Antigo, WI, installed recuperative burners in two of its three heat treat furnaces to make them more energy efficient. A recuperative burner uses an integrated inner and outer tube system to burn gas more efficiently.

"It's like having a high-efficiency furnace in your house," says Don Clemins, manufacturing manager of Merit Gear.

Heat treaters appear to benefit from the burners, too. Clemins explains the burners create less exhaust gas, so the furnaces give off less heat, making the factories not as warm during the summer.

Merit Gear installed those burners because its energy costs in 2001 went up 20% from its usual costs. The company absorbed those higher costs.

The Gleason Works of Rochester, NY, tried to reduce its energy usage by shutting down one of its three rotary hearth

Reduced Ammonia in Factories: A Trend Toward Ion Nitriding

Besides a trend toward vacuum carburizing and hardening, Bob Cvetichan of Horsburgh & Scott Co. also sees a trend toward ion nitriding, another type of vacuum process. Like vacuum carburizing and hardening, ion nitriding can create a better workplace for heat treaters.

Cvetichan describes ion nitriding as offering easier control over microstructures than gas nitriding, so resulting gears have desired microstructures. He adds that ion nitriding offers better repeatability than gas nitriding.

Ion nitriding mainly uses nitrogen and hydrogen as process gases—not ammonia, so there would be less ammonia smell in factories.

"A lot of heat treaters who do nitriding—gas nitriding," Cvetichan says, "you can walk into their plants and know they do nitriding."

Because ammonia isn't used, heat treaters don't need to measure its dissociation in ion nitriding.

Cvetichan, however, doesn't see the trend toward ion nitriding as a trend away from gas nitriding. He explains that in his opinion, ion nitriding provides better quality control, but gas nitriding can be cost effective.

furnaces, but the company had to fire it up later because of production demand.

Although a machine tool company, Gleason Works heat treats materials for its gear-manufacturing equipment.

In its heat treat operation, Gleason Works' natural gas costs had increased 39%. Dino Giordano, supervisor of heat treatment and electroplating, says those costs decreased significantly by the end of 2001 but have fluctuated since then.

The company looked for other cost savings by installing better thermal controls on its atmosphere furnaces, as well as installing thermal modules to speed the heat-up and cool-down processes, getting rid of some outdated heat treat equipment, and switching from generators that use natural gas to a liquid nitrogen/methanol mixture. With the nitrogen maintaining the furnaces' atmospheres, the furnaces can be started quicker for on-line use.

Horsburgh & Scott is also tweaking its equipment to save energy. Cvetichan says segments have been ramped up, holding times have been reduced and cycle lengths have been changed. Also, the company is installing better seals on its furnace lids to reduce heat loss.

Horsburgh & Scott saw its natural gas costs go up more than 100% in the first quarter of 2001.

Cvetichan remembers that Horsburgh & Scott's energy contract expired at a very bad time—when energy costs were out of this world. But, the company had to have the natural gas, so it had to negotiate a new contract—no matter the costs.

Since then, Horsburgh & Scott's natural gas costs have gone down 67%. But, the company got caught in another contract. It had to negotiate a new contract before natural gas returned to its previous prices.

Wolf says Cincinnati Steel Treating is always looking for better burners and insulation, but efforts to improve energy efficiency are incremental. For example, the company upgraded its radiant tube burners to recuperative units several years ago. He adds that there's no new super-efficient heat-treating equipment on the market.

Cincinnati Steel Treating saw its natural gas costs jump 60% in August 2000, when its contract expired and it had to negotiate a new one.

"We had escaped the big bullet," Wolf says. During the 1999–2000 winter, energy prices were higher.

"We didn't get hurt as bad as some heat treaters did," Wolf says.

Still, the company raised its prices. Wolf says the raises were the company's first in four years, that the higher energy costs were the straw that broke the camel's back.

Cincinnati Steel Treating negotiated a new contract, locking in energy prices that looked good—at the time. Energy prices later dropped and are now lower than Cincinnati Steel Treating's locked-in

prices.

Wolf says that's the gamble that you take in today's volatile energy market.

Industry Goals

Many heat treaters took steps to reduce their energy usage in the short term. Their industry has goals for dealing with energy usage in the long term. The goals also deal with environmental impact.

In 1999, a research and development plan was issued by the ASM Heat Treating Society, an affiliate organization of ASM International. The plan was supposed to be a starting point for implementing the heat treat industry's "Vision 2020" goals.

Based on industry needs, "Vision 2020" was a view of the ideal future, with the following goals: use 80% less energy, improve insulation, eliminate emissions, reduce production costs by 75%, increase furnace life tenfold, reduce furnace prices by 50%, get rid of distortion—thereby maximizing uniformity—in heat-treated parts, get a 25% annual rate of return on investments in capital equipment, and create 10-year partnerships with customers.

In early 2001, the heat treat industry was facing higher energy costs. In February 2001, Roger J. Fabian, the heat treat society's president, wrote to the industry that higher natural gas and electricity costs again stressed the importance to the industry of achieving the "Vision 2020" goals.

To work toward those goals, the society was picked by the U.S. Energy Department to coordinate development and communication of the industry's research and development plan. To manage the research and development programs and projects, a number of industrial companies created an independent organization, the Center for Heat Treating Excellence, located in Worcester, MA.

Fabian wrote: "Only through the commitment of the entire heat treating community can we keep our industry competitive in an unpredictable economy." ○

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