Ten Top Technologies for 2008

Reed Miller – Editor

A new year of technological triumphs (and flops) has begun, and it is anyone's guess which technologies will meet a market need in the thermal-processing industry. We make our best guess as to those technologies that have the potential to meet those needs.

Several of the 10 technologies to be highlighted have a few things in common. One of the commonalities is energy efficiency. As the cost of energy to fuel our processes increases, the market demands solutions that improve our energy efficiency.

Our picks for 2008 have broad applicability to the thermal-processing industry, particularly in the area of heat treatment. One industry segment with much development activity is the area of coatings – from high-temperature "paints" to thermal sprays to nanotechnology. Let's see how this year's developments may impact your business.

Melting

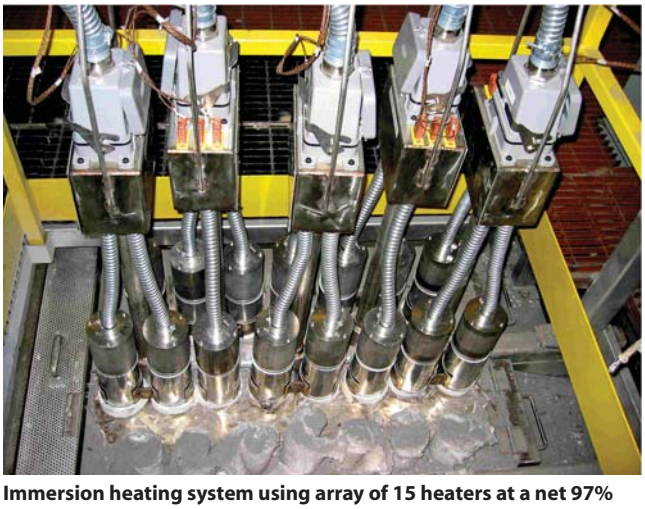
The isothermal melting process (ITM) is a highly efficient (97%), direct-immersion, high-watt-density, electrical-resistance system that may significantly impact the aluminum melting process. Since ITM relies on electricity, the primary energy source can be nuclear, coal, natural gas, biomass, low energy-content waste gas, oil, hydroelectric-turbine and even yet-to-be-developed sources. This versatility is important because of the uncertainty of future energy supplies.

While the potential ITM applications vary, the aluminum industry usage alone can result in potential energy savings conservatively estimated at 50 trillion BTUs per year with an annual savings of $750 million. Melt loss is reduced by at least 75% with energy savings of more than 6 kWh/lb. Read more about this development in February's *Industrial Heating*.

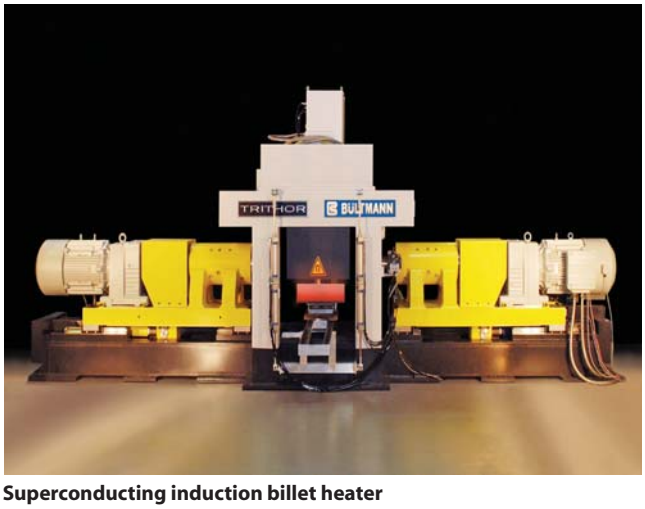
Superconducting Induction Billet Heater

This heater can electrically heat nonmagnetic alloy billets with a net efficiency of approximately 90%. The dramatic increase in efficiency results from the use of a high-temperature superconducting (HTS) material and the employment of a fundamentally different heating method. Operating at liquid-nitrogen temperatures (approximately 68°K) with a closed-loop, almost maintenance-free cryogenic-cooling system, the HTS wire conducts electricity with essentially no resistance. This enables the superconducting induction billet heater to create an extremely strong magnetic field while consuming very little energy.

The HTS coil creates an intense, steady-state DC magnetic field using only a few kilowatts of electricity, including the cryogenic-cooling system. The HTS DC magnet coil is essentially loss-free and remains cold throughout the heating process. The billet or workpiece is placed in the strong DC magnetic field and rotated to induce eddy currents in the workpiece. These circulating currents heat the billet



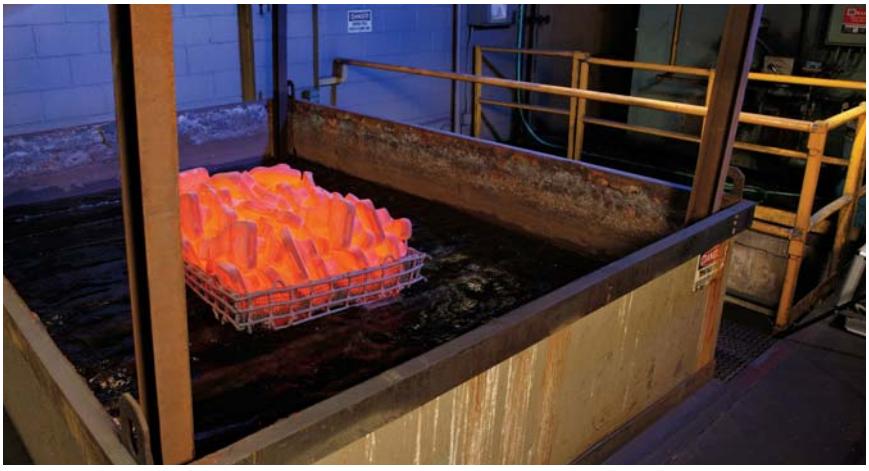
Immersion heating system using array of 15 heaters at a net 97% energy efficiency



Superconducting induction billet heater

in the same manner as the conventional system, but they are created using much less energy.

Through process quality and productivity improvements combined with unparalleled energy efficiencies and capital cost savings, the superconducting induction billet heater may prove to be a superior heating option for many applications.



Load of parts being quenched in polymer-based quenchant

Electrochemical Hydrogen Recovery System

Currently in late-stage development, H2 Pump LLC (H2P) – with funding support from the New York State Research and Development Authority and the Department of Energy – has demonstrated new technology that separates and purifies hydrogen process gas emanating from industrial heat-treating furnace applications. The system integrates electrochemical gas-separation membrane technology with a proprietary system design to separate hydrogen from other gases, purify it and "pump" it back to the front-end of a process or to other applications.

In the electrochemical process, hydrogen is actually split apart and then recombined after passing through the membrane-based separator. Hydrogen is the only gas that is processed and as a result exits the device in a high-purity state. It is cost effective, reliable and can operate in numerous hydrogen-containing atmospheres, including high CO and other gases. The "3-in-1" device separates, purifies and pumps hydrogen in a single stand-alone box and can process hydrogen "on demand."

Being a new technology, the company is currently seeking demonstration partners. If interested, contact the company by e-mailing Info@h2pumpllc.com. More information on this technology will be forthcoming in the pages of *Industrial Heating* in 2008.

Polymer Quenchants

These new, polymer-based products from Dow offer several benefits over the current technology. They were formulated without nitrites and provide superior corrosion production and bacteria resistance. They are nonflammable, aqueous polymer solutions that contain a non-nitrite corrosion-inhibitor package. This package protects not only the parts being heat treated but also the quenching bath and fixtures. Another benefit is that emissions are reduced during the manufacturing process. The products do not produce smoke, soot or other waste products related to oxidation. Reduction in the amount of soot and smoke is beneficial to those who must work in close proximity to these processes.

Manufacturers will be able to quench medium- to high-carbon steels and alloy steel of most grades including 300- or 400-series stainless steel. The first-to-be-released ULTRAQUENCH™ RL Plus quenchant will be most applicable to induction hardening, direct quenching from the forge or continuous-cast quenching processes. These products outperform similar materials including water, PVA and soluble oils.

Bonded Refractory

A refractory product – branded Thermbond – was recently granted a European patent for the technology used to produce its entire family of refractory products. Rather than mixing with water like traditional refractories, a phosphate-based "liquid activator" is employed in combination with proprietary dry components to create an exothermic (heat-releasing) chemical reaction. This reaction causes it to set quickly, thereby allowing it to be heated up much more rapidly than traditional refractories.

This refractory product actually bonds on the microscopic level to inorganic substrates and enables existing refractory linings to be repaired rather than replaced. Often the majority of an existing lining can be saved by veneering a new hot-face right onto the old refractory. The refaced units are in like-new condition. Saving labor and material costs allows manufacturers to be back in service faster than with conventional refractories.

Ceramic Heat-Distribution Sensor

A new temperature-sensing ceramic disk has been developed that can be used as an effective quality-assurance tool for the heat-treat process. The TempTAB is a modified disk – about the size of a quarter – with a small hole in the center to allow it to be hung on wires suspended in the load or simply placed flat within the load or on a furnace belt.

This product can be placed inside the furnace – for example in the same locations where survey thermocouples would be placed – to measure temperature uniformity within the furnace. The ceramic disk senses and "records" the peak temperature at each location without interrupting production or introducing contaminants into the furnace chamber, and it does all of this without wires. Once the

heat-treatment process is complete, the disks are removed from the furnace and their width dimension measured.

This temperature-sensing device is designed as single-use and can be disposed of once the physical measurement is taken. This user-friendly technology makes it possible to conduct uniformity surveys as part of a quality-assurance program without impacting production schedules. *Industrial Heating* will present an article in 2008 giving more information on this new technology.

Coating Technology

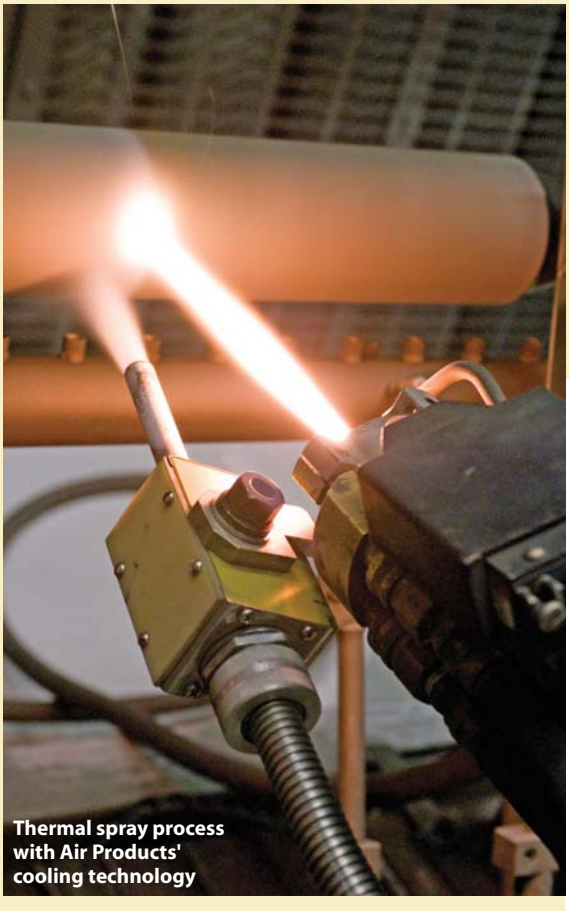
Several new technologies fall into this broad category. These will be described individually in this section.

Thermal Spray

A new thermal-spray cooling technology has been introduced by Air Products that uses cryogenic nitrogen vapor (-320°F) to maintain part temperature during thermal-spray coating applications. This U.S. patent-pending technology makes high-quality thermal-spray coatings possible by maintaining part temperature within a predefined narrow range, even for heat-intensive spraying processes. The technology can enable the user to apply coatings faster and at a lower cost than traditional cooling methods.

Exposing a part to too much heat can negatively impact coating adhesion, substrate and coating hardness, fatigue life, corrosion resistance and dimensional tolerances.

One method used by thermal-spray applicators to keep part temperatures within a closely set range is forced-air cooling combined with interpass breaks. This traditional practice, however, increases downtime and reduces productivity as well as wastes powder and process gases. The thermal-spray cooling nozzles can be mounted directly on the robotic arm next to the thermal-spraying gun. During spray application, the cryogenic vapor jet follows the thermal-spray plume to maintain the part's temperature within the specified range.



Thermal spray process with Air Products' cooling technology

High-Temperature Coating

Protecting parts from oxidization and deoxidization at high temperatures can be a problem for heat treaters. A new ultrahigh-temperature aluminum and ceramic-filled coating makes it easier. This product, called Corr-Paint™, is a single-part coating system that can be applied by conventional spray equipment. It protects parts at temperatures to 1400°F.

Nano Surface-Treatment Technology

Technological developments in the 21st century would not be complete without a discussion of nanotechnology. Nano-Tech Surface Treatment Technology (NSTT) is a proprietary process that creates a nanolayer of critically chosen atoms on a part's surface prior to heat treatment. The result is an enhancement of alloy properties by stopping oxidation, scaling, bubbling, decarburization and grain growth.

A simple example of an application for this technology would be automotive catalytic-converter-jacket parts where iron-base alloys have reached their limits and much higher-cost iron- or nickel-base alloys are being contemplated as a replacement. If the lower-cost steels are treated with NSTT, an expensive alloy change may be unnecessary. Watch for more on this technology later this year.

Energy-Harvesting Wireless Technology

One of the limitations to fully implementing wireless-sensor technology is the power requirement. This revolutionary technology – based on the IEEE 802.15.4/ZigBee wireless networking standard – utilizes energy harvesting to facilitate battery-free operation in a totally wireless environment without the need for either communications or power connectivity.

Conclusion

This sampling of new technologies for our industry is by no means exhaustive. It is our hope, however, that you may find at least one of these highlighted technological developments useful for your business in 2008. **IH**

AIR PRODUCTS

For more information about Air Products' thermal spray cooling technology, please call 800-654-4567, code 583.

Introducing a new approach to thermal spray cooling.

New Thermal Spray Cooling Technology Using -320°F Nitrogen

Nothing gets thermal spray operators fired up quite like overheated parts. That's why Air Products has created a way to put your overheating issues on ice.

Introducing Air Products' thermal spray cooling technology. It's the industry's only cryogenic nitrogen cooling process, and it allows temperature control within a range of +/- 20° F. Our cryogenic spray nozzle installs easily on any thermal spray gun to cool parts twice as fast as air alone. Allowing you to work faster and more efficiently, with less wasted powder, process gas and booth time.

To learn more about how you can freeze your overheating issues, call 800-654-4567, code 583, or visit airproducts.com/spray3.

AIR PRODUCTS

tell me more
www.airproducts.com/spray3

©2008 Air Products and Chemicals, Inc.