MISSION

The Mission of Solar Atmospheres is to add significant value to our customer's operations by thermally treating parts, principally in a vacuum environment, with an unwavering commitment to honesty in all relationships.

We will strive to fulfill this mission while…

- Performing our work with an emphasis on quality and responsiveness.
- Operating with an awareness and appreciation of the value of our customer's parts while in our care.
- Forever looking "forward" in the area of technical capabilities.
- Demonstrating a willingness to "accept the challenge."
- Providing and maintaining a work environment that is safe, clean, and reflects our respect for human dignity.
- Providing our employees with an opportunity for personal growth, challenge and reward.
- Maintaining a workplace that is environmentally friendly.
- Sustaining long-term growth and profitability.

The Spotlight is a quarterly publication of Solar Atmospheres

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The Solar Family Looses a Close Friend

John Barron

John Barron, a long time friend and Solar Manufacturing employee, passed away at the end of May of this year. He was married to his wife, Jennie, for 21 years and had two stepsons. Born in Philadelphia, he graduated from Germantown High School. He then received a bachelor's degree from Villanova University in Electrical Engineering.

After graduating from college, he was a senior airman in the U.S. Air Force during the Vietnam War, specializing in intelligence information gathering. After his service, he joined Leeds and Northrop in their Philadelphia plant, the furnace division. He then joined Vacuum Furnace Systems for 20 years, as an electrical engineer and then Chief Engineer. In 2007, John Barron came to Solar Manufacturing as our Technical Director and then our Chief Engineer. John was known and well liked by many within the Solar organization and by customers in the field. He also served on the National Fire Protection Association, in the 86 Committee, where he annually presented Vacuum Furnace Safety and Technology.

The flag of the United States represents the true freedom of this country. Since John was in the Air Force for four years, his wife was presented with a flag of the United States with military honors, on his burial commitment. We will be flying that flag in front of Solar Manufacturing as a token of respect to John and all of our courageous men and women that serve or have served to protect our country. His dedication, life and work ethic shows that he was a true patriot. He will truly be missed by all.

Did you know?

Many "oil quenched" steels can be heat treated in a vacuum furnace and "gas quenched".

In the past, most tool steels were referred to as "air hardening", "oil hardening" or "water hardening." These terms referred to the quench media needed to harden these materials. Air cooling is relatively slow, oil is faster and water quench is the fastest. The faster the quench, the greater the tendency for part warpage or distortion.

Today's modern vacuum furnaces cool by circulating a quench gas, usually nitrogen in the furnace. The gas is drawn through a heat exchanger via a blower motor, removing heat from the load. The rate of heat removal can be increased by advancing the cooling gas pressure and strengthening the motor speed. The rate of heat removal by gas can equal the rate of oil quenching. Other factors, such as material type and cross section also influence the end results.

When heat treated in a vacuum furnace and high pressure gas quenched, traditional "oil hardening" steels will distort much less because of the uniform rate of heat removal. The surface of the material will also remain clean. Oil quenching creates surface scale and greater part distortion. Thus, gas quenching allows parts to be machined closer to finished dimensions prior to heat treating, ultimately resulting in less to no post heat treatment processing.

Solar Atmospheres' Vacuum Gas Nitriding Meets the Challenge

As Solar Atmospheres continues to strive for new and emerging heat treating markets we can proudly announce that our new vacuum gas nitriding process has met the stringent requirements set forth by the SAE-Aerospace Specifications.

Gas nitriding is a surface hardening treatment where nascent nitrogen (N) is diffused into the surface of steel parts. The result is a hardened exterior case enriched with nitrogen at the surface of the steel. The hardened case provides increased wear resistance and induces compressive residual stresses at the surfaces of parts, which significantly increases fatigue strength/life. The wear resisting surface is supported by a relatively ductile shock-absorbing core, capable of withstanding high load bearing applications. Another benefit of a nitrogen enriched surface is improved corrosion resistance in a variety of corrosion susceptible applications.

The Solar Technology Center and Solar Manufacturing Engineers worked together to design a state- of-the-art Vacuum Gas Nitriding Furnace. The result of this collaboration is a vacuum furnace with precise process control systems for regulating the nitriding atmosphere, a prerequisite to providing accurate and repeatable case depth and microstructural requirements of the nitrided part, including white layer control. Specifically, the process utilizes an accurate blend of anhydrous ammonia and nitrogen to control the gas nitriding potential, or percent dissociation. Microprocessor controls and electronic mass flow meters continuously monitor and adjust the nitrogen to ammonia ratio to a desired nitriding potential or percent dissociation throughout the gas nitriding process, thus controlling the case depth and white layer formation.

The front loading, single chamber, graphite retort-less furnace can be efficiently loaded and unloaded in much less time than a conventional vertical nitrider. The use of a vacuum pump-down prior to heating (in lieu of lengthy purge cycles through a retort) and of an external gas cooling system operating at a positive pressure results in faster overall cycle times of up to 50% compared to traditional gas nitriding.

A variety of materials have been nitrided successfully based on customer specifications, including 4140, 4150, 4330, and 4340 steels, Nitralloy, and H-11, H-13, and A-2 tool steels. A typical cross section containing the surface of a part shows an even distribution of nitrogen throughout the case. White layer is also even and well defined. If white layer is a deterrent, it can be minimized or eliminated owing to the furnace's precise process control systems. Single stage, two stage (Floe Process), and proprietary multi-stage cycles have been developed to provide superior metallurgical properties much more efficiently than those achieved by traditional gas nitriding.

From small laboratory size loads to loads up to 2000 pounds, Solar Atmospheres is able to provide you with state -of-the-art Vacuum Gas Nitriding services complete with case depth measurements, hardness profiles, and white layer measurements. Our Technology Center and Metallurgical Laboratory, staffed with highly trained and regarded engineers, scientists, and technicians, strive to provide the highest quality product to meet your nitriding needs.

Virginia Osterman, PhD, Technical Consultant

Solar Atmospheres of California Update

Solar Atmospheres of California has been going through a lot of updates and changes since the groundbreaking in May of 2010. Customer response has been very positive and additional equipment has been committed to the new operation. New personnel with a "green facility operation" background have been added.
Solar Atmospheres of California broke ground in May with a cere-

mony that had many local California officials present for this occasion. The building itself will be a total of 21,750 square feet with 3000 sq. ft. of two-story office space. The plant will be equipped with roof skylights, a heavy duty reinforced concrete foundation and well insulated frame work. Solar Atmospheres of California will be located in San Bernardino County, northeast of where Interstate 15 and 10 intersect. This is approximately 40 miles east of downtown Los Angeles in an area known as the "Inland Empire".
Construction is quickly progressing. Grading of the property site, pouring the concrete foundation and building/office framing are all

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with key titanium producers and manufacturers. As a result, SAWPA has been recognized as the only commercial heat treater in the world that is fully approved to perform the Boeing Beta Anneal Slow-Cooled Aged (BASCA) specification under vacuum atmosphere. Recently, Solar has signed a long term agreement with RTI International Metals Inc. RTI, the lead integrator of Boeings multiple supply chain partners, will extrude, machine, and assemble the finished titanium components used for the seat tracks in the floor structure of the 787. Solar will provide services such as; vacuum heat treating, vacuum creep forming and fluorescent liquid penetrant inspection of structural components manufactured by RTI. This new contract makes Solar the exclusive vacuum heat treater for the 787 PAX Floor Pi-Box Seat Track Program and extends our role as a strategic supplier to RTI. "Solar has been under long term contracts for aerospace products that are supplied to The Boeing Company since 2000 and this contract continues to strengthen our position in the aerospace market. Once again, Solar has proven itself a leader in vacuum technology while displaying its dedication to hurdling any technical issue inherent with any new program involving an airplane," Bob proudly reports.

complete. Extensive development engineering is going into the facility on the front end of the project to maximize efficiency and product throughput. Many of the support equipment items have been placed on order and will be scheduled into the facility as construction progress allows.

The furnaces for this plant are being constructed by Solar's sister company, Solar Manufacturing. California will start with four production furnaces that will vary in size. The first one is a 24-foot deep, car bottom vacuum furnace with a load capacity of 50,000 lbs and dual 35" diffusion pumps. The second furnace is a six-foot deep, 10 bar quenching vacuum furnace that can process up to 3,000 lbs. The third furnace is a 2 bar quenching furnace that will allow for larger part configurations to be run and will have a 35" diffusion pump for more enhanced vacuum integrity. The fourth furnace will be a large capacity air tempering furnace that will process loads up to 5000 lbs at a time. A -310°F cryogenic freezer will be added for processing precipitation hardened stainless steels that require a deep freeze treatment in order to achieve high tensile strengths.

In early July, it was announced that Charles (Chuck) Miller will be hired as Manager of Maintenance and Facilities Engineer. He has many years of supervisory experience in the heat treating industry. Some of Chuck's areas of expertise are vacuum furnace maintenance, pyrometry, instrumentation, hot zone fabrication and repair, among many other areas of proficiency. His first assignment is to work with Derek Dennis, President of the California facility, to help engineer and support the furnace installation and equipment.

Solar Atmospheres of California remains dedicated to bringing a state-of-the–art vacuum heat treating facility to Southern California.

Please contact Derek Dennis at ddennis@solaratm-ca.com
or 951-304-3790 for any questions regarding Solar's wide variety of services or facility progress.

15,000 lb. ingot after homogenizing

Bob and his team of experienced metallurgists, engineers, and technicians have become experts in the area of titanium vacuum thermal processes such as: beta annealing, slow cooling, homogenizing, solution treat, creep forming, and stress relieving.

Virginia Osterman, PhD, Technical Consultant

Cryogenic Treatment Review

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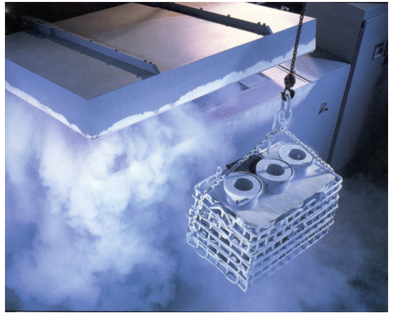

•This can lead to dimensional instability in processing or service because there is a volume increase associated with the phase change of austenite to martensite

The problem is particularly acute with grinding, where retained austenite and its propensity to result in grinding cracks is a major concern in the gear industry. Thus, cryogenic treatment to eliminate retained austenite is highly desirable to avoid strain-induced distortion of parts.

3. Cryogenic treatment will amplify distortion.
• If distortion is present after quenching, cryogenic treatment will make it worse. This means that from a "cryogenic standpoint" marquenching or vacuum gas quenching are desirable because both tend to minimize quench distortion.

Metallurgical Thought-To-Be Truths

1. The martensite that transforms from retained austenite during cryogenic treatment is structurally different than the "bulk martensite" that formed from the high temperature quench.
• Tempering after cryogenic treatment initiates the preferential precipitation of fine eta-carbides only in the martensite formed from retained austenite transformation. Only epsilon-carbides are precipitated within the bulk martensite.
• Eta-carbides enhance wear resistance by adding strength and toughness to the martensitic matrix. Note the use of the word toughness; this is an important attribute used to describe retained austenite and its contribution to wear resistance in certain specific applications.

2. Interrupted cooling before complete transformation can "stabilize" retained austenite.
• Stabilization reduces the ability of austenite to transform to martensite. Therefore, it is highly desirable to perform cryogenic treatment of steel as an integral part of the heat treatment cycle, as Solar does.

3. Cemented carbide wear improvement due to changes at microvoids.
• The results of one study showed that only abrasive wear resistance (not hardness or other typically measured mechanical properties) was improved by cryogenic treatment. With cryogenically treated cemented carbide, "plastic flow" may take place at defects (microvoids that are points of stress concentration) due to shrinkage on cooling, which results in residual compressive stresses on the surface of the voids on return to room temperature. Such stress reduces the effectiveness of the defects in lowering the localized strength of the material and this situation results in the reduction of abrasive wear.

The Most Marketed Benefits
Improved dimensional stability and improved service performance.
• Gun barrels, automotive racing parts - including engine blocks and heads - intricate parts to be EDM and numerous others, even including aluminum bats, and golf clubs and balls, report enhanced performance.
• Musical instruments purport improved sound quality.

Summary
Cryogenic treatment is primarily performed for dimensional stability and improved wear resistance. Wear resistance is very application specific, but significant improvement in wear resistance has been realized for certain applications using cryogenic treatment, and most notably for tool and die steels. Just trying cryogenic treatment may lead to the discovery of improved performance for a particular application.

Don Jordan, Corporate Metallurgist

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UPCOMING TRADE SHOWS

IMTS 2010 — International Manufacturing Technology Show — Connecting Global Technology — September 13 - 18, 2010 - Chicago, IL - McCormick Place

McCormick Place
September 13-18
Chicago, IL
Booth # N-6414

TITANIUM 2010 — October 3-6 • Orlando, Florida — Gaylord Palms Convention Center

Gaylord Palms Convention Center
October 3-6
Orlando, FL
Booth # 101

DESIGN 2 PART SHOWS

John S. Knight Center
October 6-7
Akron, OH

DESIGN 2 PART SHOWS

Long Beach Convention Center
October 20-21
Long Beach, CA

SOLAR ATMOSPHERES

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August 2010 , Vol. 16
A Solar Atmospheres Publication

Cryogenic Treatment Review

Cryogenic treatment is primarily performed for dimensional stability and improved wear resistance in specific applications. There have been many claims that cryogenic treatment, performed as a part of the heat treatment cycle, leads to improved performance characteristics. A large amount of research has been done, but the results show a fair amount of variability. However, results have proven advantageous, even dramatic, for improved wear life of metal parts, particularly in abrasive wear applications, after cryogenic treatment.

The application of cryogenic treatment for improved wear life is dependent on part chemistry and function. The most common use for cryogenic treatment is for tools and dies, particularly those with high carbon content, such as: A2, D2, and 440C. The information below is criteria to help you make a decision on specifying cryogenic treatment for a particular application.

FACTS
1. Cryogenic treatment transforms retained austenite to martensite, which increases hardness.
•This may or may not increase wear resistance and/or part life depending on the application. Retained austenite adds toughness to the structure, which enhances impact and fatigue resistance, both of which are important properties in many types of wear applications. Tough/ductile austenite inhibits crack initiation and blunts crack propagation. But increased hardness or "deformation resistance" resulting from cryogenic treatment often does result in increased abrasive wear resistance for many applications.

2. Retained austenite can transform to martensite under strain-induced conditions.

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Solar Atmospheres, Inc: Your Source for Vacuum Thermal Processing

15,000 lb. ingot before homogenizing

Since the grand opening of Solar Atmospheres of Western PA (SAWPA) in 2000, over 80 million pounds of titanium have been processed. Given that this quantity is equivalent to the amount of titanium produced annually, Solar Atmospheres has become a major player in the vacuum thermal processing of titanium and titanium parts. It was not by chance that SAWPA was located in the Western PA region. Strategically located close to three major titanium producers, Solar Atmospheres also provides convenient pick up and delivery service to their customers.

With the availability of one 36 foot and three 24 foot vacuum furnaces SAWPA is capable of processing titanium loads up to 150,000 lbs. The vacuum processes available with these furnaces, in addition to other special capabilities such as liquid penetrant testing of heat treated titanium parts provides titanium producers and manufacturers a true epicenter for titanium vacuum thermal processing and development. According to SAWPA's President, Bob Hill, "We have been processing very large titanium pieces with great success. As a matter of fact, the largest ingot processed at SAWPA was almost 15,000 lbs. Most toll heat treaters cannot homogenize such a large part at 2400°F for 24 hours in vacuum without creep and handling issues." SAWPA utilizes its patented load car design and has developed specialized fixturing to address these two problems and to avoid any adverse eutectic reactions which would occur with use of standard nickel based furnace fixturing.

A key reason for the success of SAWPA in titanium thermal processing comes from the hard work and knowledge of Bob Hill, President (Western PA). Bob, awarded the prestigious ITA Titanium Achievement Award in 2009, worked long and hard to develop business relationships

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