In this current edition of our HICON customer journal, you will read about the latest facilities EBNER has installed at our customers’ plants around the world. A technical report on hydrogen quenching outlines the latest discoveries and options for hardening and tempering steel strip. This is a hot topic at the moment, yet again proving that investing in research and development, as we have done for decades, is essential for a technology leader like EBNER. This is the only way we can ensure that soon-to-be-implemented limitations are already technologically possible while maximizing economic advantages.

Lead-free premium steel strip made possible for the first time thanks to HICON/H2Q® technology is setting new, future-oriented standards in environmental responsibility and many other areas.

Enjoy reading this issue of the HICON Journal.

SuccesS MEANS tAKING ON RESPONSIBILITY

Ladies and gentlemen,
Esteemed readers of the HICON Journal,
Friends and colleagues,

Robert Ebner
CEO

YourS,

Robert Ebner
CEO

The articles can also be found on our website. Download the latest issues under NEWS & PRESS / HICON® Journal.
A new facility in Brazil from EBNER, representing a massive increase in capacity. Is Brazil so thirsty?

It almost looks that way! In this case, we are talking about a 6 zone gas-fired HICON® pusher-type furnace facility with the complete ingot handling system, power and control systems and a higher level process control system. The facility heats 30 cast aluminum ingots at a time up to rolling temperature, representing a maximum net charge of 750 tons (826 USt). A major long-term increase in capacity, especially when you consider that the facility we installed in 1999 is still operating to Novelis’s fullest satisfaction.

For what kinds of products is this aluminum destined?

Novelis produces sheets mainly used to manufacture beverage cans but also for special applications. The newly-installed facility is intended to cover the surge in demand due to major sporting events, such as the upcoming 2016 Olympic summer games and the World Cup that took place in Brazil this summer, in addition to generally strong South American market growth.

There is quite a distance between the pusher-type furnace and the rolling mill roller table - how did EBNER’s engineers solve this issue?

It’s not just the distance that led us to consider an alternative to a roller table. We also had to make sure we did not interrupt or make huge detours for service and maintenance access paths to other facilities. The solution: a charging car which accepts the aluminum ingots after they have been downended and transports them along a fixed rail before transferring to the rolling mill roller table via a hydraulically lowered beam. This solution worked so well that the existing pusher-type furnace is now also being served by the transport car.

The facility achieves shortest annealing times despite high temperature uniformity and very high throughputs. Novelis is extremely ambitious with respect to environmental responsibility and careful use of resources. This makes the HICON® pusher-type furnace with its especially low energy consumption particularly attractive.

How long has the facility been in operation?

Commissioning was completed and production started in summer 2013. Can by can, Novelis says, "Yes, Novelis CAN!"
TIME FOR A CHANGE

From molten metal quenches to hydrogen quenching technology

HARDENING AND TEMPERING STEEL STRIP

Hardened and tempered steel strip is used in a broad spectrum of applications, ranging from everyday items to high-performance tools and safety components. The product requirements are complex, encompassing special microstructure, highest possible homogenity, precise tensile strength tolerances, extreme flatness and geometry characteristics as well as special surface properties.

TECHNOLOGY

Continuous in-line hardening and tempering of unalloyed and low-alloy carbon steel as well as martensitic Cr steel strip using hydrogen quench systems or molten metal quench technology is a process that has won worldwide acceptance. In a continuous steel strip hardening and tempering line, unalloyed and low alloy carbon steel strips can be transformed with the following technologies:

- Martensite (martempering) with hardening, leveling and tempering to produce material for hand saws, band saws, head saws, circular saws, springs, flapper valves, tools, etc.
- Bainite (austempering) with isothermal transformation in the austempering duct and following furnace units, to produce material with good bending and punching qualities for products such as blanking knives, cutting and minting lines, precision components for the automotive industry, etc.
- Pearlite (patenting) with isothermal transformation in the patenting section, to produce material for safety belt springs for the automotive industry, cable drum springs, high-strength spiral springs, etc.

Stainless steel strip (chromium martensite) is martempered to produce material for leaf springs for compressors and cooling units, tools, cutlery, etc.

OTHER APPLICATIONS INCLUDE:

- Annealing cycles for multi-phase steels with quenching gradients of >200 K/s.mm and subsequent transformation to produce DP, CP, TRIP and Q+P steels for automotive applications.
- Normalizing anneals with limited quenching gradients < 25 K/s to produce “earing-free” material (such as battery sleeve strip).
- Recrystallization anneals and subsequent overaging.

Well-designed and flexible facility concepts allow several technologies to be combined in a single facility. This ensures highly-economic facility utilization.

FACILITY DESIGN WITH HICON/H₂Q® HYDROGEN QUENCHING TECHNOLOGY

Unalloyed and low alloy carbon steel strips require very high quenching speeds, which used to be possible only in a molten metal quench. The experience gained from the many molten metal quenches we have supplied which incorporate innovative 2-stage hardening, has been seamlessly transferred to gas quench technology during several years of development work. The new process has been successfully launched as HICON/H₂Q® Technology (= High Convective Hydrogen Quench).

Schematic diagram of a martensite bright hardening and tempering line with HICON/H₂Q® quenching technology.

1. tension stand
2. inlet seal with integrated safety system
3. austenitizing furnace
4. HICON/H₂Q® hydrogen quenching unit
5. outlet seal with integrated safety system
6. martensite cooler
7. leveling furnace
8. HICON® tempering furnace
9. HICON® process atmosphere jet cooler
This technology has already given many facility operators numerous new opportunities, allowing them to process their existing product range with improved surface quality, expand their range with additional sophisticated materials, and to supply new industries.

The lead/bismuth quenchant alloy is completely eliminated.

This makes it possible to offer a completely new premium product - "lead-free hardened and tempered steel strip" - for the food industry, automotive industry, etc.

Environmental guidelines and customers with special requirements of even lower lead residue levels are no longer an issue.

Hardening and tempering with hydrogen carries lower operating costs than the molten metal method, since far fewer wear parts are necessary.

The hydrogen is blown symmetrically onto the strip from above and below by a gas-tight high-capacity circulation blower. Special adjustable nozzles with infinitely variable covers ensure an extremely high and uniform cooling rate allowing the temperature of the strip to be rapidly reduced and controlled at the desired level.

The gas is cooled in a heat exchanger and recirculated, requiring very little fresh gas.

The inlet and outlet seals are designed as safety seals and integrated into the higher level safety system.

Process steps such as grinding or polishing, which are currently necessary to remove lead residue, become unnecessary and the nice cold-rolled surface finish is preserved. If a ground or polished surface finish is desired, it can be produced with significantly less effort.

Strip can move through the quench either horizontally or vertically, without needing to be deflected. The chance of a strip break approaches zero and facility uptime increases.

Special processes in the quenching system and supplementary equipment also permit isothermal transformations such as austempering and patenting.

Another technological advantage over the molten-metal quench is the significantly shorter distance from the exit of the hardening furnace through the jet system (first cooling stage), and on to the martensite transformation section (second cooling stage).

This second cooling stage can be carried out with the revolutionary FLEXFLAT® system. This special leveling system uses a cooling plate with an infinitely variable shape to directly influence strip geometry during martensite transformation. Perfect flatness can be easily reproduced.

The quick reaction time of the HICON/H2Q® quench and the use of the FLEXFLAT® system make a combination with a flatness measuring system possible. This enables quick modifications to the flatness parameters and soon, automatic optimization of strip flatness.

The combination of the two technologies sets new standards in terms of achievable surface quality, flatness and productivity.
Comparison of productivity and operating costs of HICON/H₂Q® technology vs. molten metal quench technology at a mid-sized facility (type BVHg 65/25/1100 M).

###ADVANTAGES / DISADVANTAGES HICON/H₂Q® vs MMQ

<table>
<thead>
<tr>
<th>Type of quenching technology</th>
<th>Molten Metal Quenching (MMQ)</th>
<th>HICON/H₂Q® Hydrogen Quenching</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comparison of productivity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average operating hours per year [h/a]</td>
<td>7,000</td>
<td>7,500</td>
</tr>
<tr>
<td>Average throughput capacity [kg/h]</td>
<td>800</td>
<td>800</td>
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<tr>
<td>Average yield factor [%]</td>
<td>96.4</td>
<td>96.1</td>
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<tr>
<td>Average net output per year [t/a]</td>
<td>5,060</td>
<td>5,769</td>
</tr>
<tr>
<td><strong>Comparison of operating costs (1st year)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of consumables per year per ton [EUR/a] [EUR/t]</td>
<td>268,278 53.0</td>
<td>121,733 21.1</td>
</tr>
<tr>
<td>Cost of media (NG, H₂, N₂, HN-mix, electric) per year per ton [EUR/a] [EUR/t]</td>
<td>258,557.7 51.1</td>
<td>339,476.3 58.9</td>
</tr>
</tbody>
</table>

###MODERNIZATION OF EXISTING FACILITIES

The HICON/H₂Q® hydrogen quench can also be integrated into existing facilities to replace a molten metal quench. This technology can also be integrated into non-EBNER facilities, with careful consideration of each individual case.

Upgrading to hydrogen quenching technology involves the following modifications:

- new inlet seal with integrated safety systems
- various new parts for the austenitizing furnace
- new gas-tight HICON/H₂Q® quench unit
- new gas-tight high-performance cooling blower with heat exchanger
- new outlet seal with integrated safety systems
- new valve stand for hydrogen/nitrogen/cooling water/emergency water supply distribution
- new pressure control system for hydrogen / nitrogen
- associated electrical control center with safety functions

While modernization this part of the facility, other optimizations could also be considered. Some options include:

- new roller support system for the austenitizing furnace to improve strip surface results.
- new modular martempering section with a cooling plate with an infinitely variable shape (FLEXFLAT® system) for improved flatness.
- new directly electrically heated leveling furnace to improve temperature uniformity and flatness, as well as saving space, since the heat air heating duct from the austenitizing furnace to the leveling furnace is eliminated.
- new roller support system for the tempering furnace to improve strip surface results and flatness.
- new flatness measuring system implemented together with the flexible cooling plate (FLEXFLAT® system) for improved throughput and in-line quality assurance.

Upgrade of the oil quench of an existing facility to HICON/H₂Q® quenching technology for martempering unalloyed and low alloyed carbon steel strip.

###SUMMARY

An extensive package of facility concepts and modernization options are available in order to help our customers produce top quality hardened and tempered strip steel.

Modular facility design allows several technologies to be combined in a single facility, covering a broad spectrum of products.
Highest quality - best chances
The company philosophy prioritizes quality above all else. This was an influential factor in the choice of EBNER as a supplier. The new rolling mill was outfitted exclusively by western technology leaders.

EBNER supplies four pushers
Placing an order for four pusher-type furnaces at once, Shandong Weiqiao is one of EBNER’s largest aluminum industry customers. All the furnaces in Zouping are served by a single shared ingot handling system. Once again, EBNER proves that effective planning combined with state-of-the-art engineering result in major savings at high facility throughput. The technical challenge this solution represents is underscored by the fact that the aluminum ingots (up to 22 t / 35 USt each) are heat treated in the EBNER HICON® furnace with the temperature scatter of just +/- 3°C (ΔT 6°C/10.8°F). Each furnace can handle a charge of 25 ingots with dimensions of 2200 x 620 x 8650 mm (7'3" x 2' x 28'4"), representing a total charge weight of max. 800 t (881 USt) and a throughput of 83 t (91 USt) per hour for reheating. These parameters and dimensions can only be handled by facilities of the latest generation. EBNER’s overall concept won the customer over, combining trusted, proven technology with the specific requirements.

“When can we start with production?”
This is always the customer’s most important question, and EBNER heard it quite clearly during the quotation and planning phase. With the support of Shandong Weiqiao, the whole project was completed quickly and efficiently. The turn-key facility was installed and handed over on schedule. Projects on such tight schedules demand perfect coordination of EBNER’s locations in China and Austria. The EBNER specialists in Leonding took care of the planning and engineering, while our colleagues in Taicang manufactured the steel components and the electrical control center. The facility was installed by local installation contractors under the supervision of our experts.

But in addition to this interesting and highly-competitive market, the beverages industry is also booming with great demand for high-quality aluminum strip. Shandong Weiqiao Aluminium & Electricity Co., Ltd. saw this opportunity and decided to invest in a new rolling mill complex at their Zouping location, in the eastern Chinese province of Shandong.
EBNER heat treatment furnace facilities guarantee high-quality and economical products for a broad spectrum of materials and requirements at customers around the world.

Three teams - a dozen specialists
EBNER’s After Sales team includes specialists who know exactly what the customers need. The teams (Europe, Asia and America) are made up of experts for all types of heat treatment facilities as well as employees specializing in maintenance queries. The customer can choose between ordering spare parts via a direct enquiry, utilizing an existing contact at EBNER such as a commissioning or service specialist, or even working with a preferred contact person (such as the Sales manager or country representative).

Original spare parts
In addition to modernizing existing facilities, supplying quality spare parts is a major factor in ensuring smooth and effective production. Having original spare parts is especially important when it comes to key components continually being refined by our engineering department: longer services lives and maximum performance for your facility. The EBNER spare parts CD for every type of facility makes it quick and easy to find the required spares by component groups and spare part numbers.

Good as new
Because EBNER maintains long-term relationships with our customers and facilities are often installed in several stages, advances in technology and efficiency are immediately noticeable when a new expansion phase is installed. The customer can experience the advantages first hand and compare different generations of facility. This tends to be the basis and motivation to modernize an existing facility. Another major advantage of EBNER: the production chain is upgraded to state-of-the-art technology completely seamlessly, securing the customer’s market position. Thanks to the close cooperation between the After Sales team, the Service department and the installation specialists, there is always someone available to consult the customer on every facility generation.

The newest and latest
The biggest possible technical advancement is undoubtedly upgrading the electrical control system from S5 to the current S7 generation. Features include a modern user interface and control system as well as quality assurance documentation. All relevant production parameters are collated at a standardized interface, allowing easy integration into existing process control systems. A fully digital visualization system on site at the facility rounds out the upgrade package (see HICON Journal 2014/1, “Visual Furnaces” special feature).

Looking to the future
Jürgen Ranner: “In the future, we would like to be even more active in providing our customers with relevant solutions, allowing them to get the most use and efficiency out of existing facilities. We are also planning on integrating modern process control systems in the booming aluminum sector, as well as expanding our team of specialists.”

Customers who decide on “made by EBNER” industrial furnace facilities appreciate the advantages of being able to enter new market segments and significantly increase capacity very quickly.

INFOBOX
New to the team
Jürgen Rubasch has been working in the After Sales team for the past year, focusing on After Sales in the American market. Beginning his career at EBNER as apprentice in 1992, Jürgen Rubasch is perfectly suited for this new challenge thanks to his many years at the company. Being able to see the big picture and knowledge of several facility generations are key qualities of an EBNER After Sales specialist.
The advantage of experience and comprehensive references

A superior, efficient facility layout, state-of-the-art technology and EBNER’s decades of experience were key factors in convincing the customer, especially since POSCO is familiar with the advantages and performance of other “made by EBNER” heat treatment facilities.

Every component and assembly group: high tech

The facility is designed with an inlet seal box and integrated dancer roll for precise strip tension control. The furnace section features a gas-tight welded muffle, allowing lowest dewpoints (below -60°C/-76°F) and the use of pure hydrogen as process atmosphere. Together with the latest generation of jets in the HICON/H2® cooling zone, the facility achieves top performance with best surface finish and strip geometry.

In order to further optimize the operating costs, the facility is fitted with a hydrogen recycling system. Process atmosphere consumption is extremely low without compromising product quality.

The material grade to be annealed is AISI 300 series (austenite) and AISI 400 series (ferrite), which are used in diverse applications such as exhaust ducts, heat exchangers, washing machine drums, pots and pans, and tanks for the foodstuff industry.

Korea meets Turkey: more than a cultural exchange?

Of course the location on the Bay of Izmit with excellent connection to the industrial harbor is an advantage. Since POSCO ASSAN TST receives its raw material directly from Pohang, the water route is a very important supply path. This ensures consistent raw material quality at a reasonable price.

The products are exported to Europe, the Arab region and Africa, making this location equally perfect for transporting the coils to the final customer.

The waterfront location: a competitive advantage?

Senior Product Manager Sascha Eppensteiner tells us more:

Author: Sascha Eppensteiner
A two-hour drive from Thailand’s capital of Bangkok takes us to the industrial area of Rayong, which has become a sought-after location in southwest Asia for many European industries.

With an impressive annual production volume of 200,000 t (220,000 US) of steel strip, the Thai company Starcore is already one of EBNER’s customers, despite having been founded only 6 years ago.

Starcore’s parent company, Saeng Thai Metal Drum, manufactures metal drums for a variety of uses, including lubricants, paints and chemicals. Increasing internal demand for steel strip prompted the foundation of Starcore and the erection of a new cold rolling mill to supply the required capacity. The first phase in 2012 comprised 5 workbases with 3 heating and 3 cooling bells. Less than 2 years after commissioning, the facility was expanded and the number of bases and bells was doubled. Starcore’s positive outlook and forward thinking is reflected in the fact that space is provided for a total of 14 workbases.

A proven size was selected for the EBNER HICON/H2 bell annealers: 190 cm (6’3”) in diameter and a charging height of more than 5 m (16’). The current expansion phase is an active step towards the export market. It ensures a continuous manufacturing process and high utilization.

EBNER’s good name is a guarantee for the quality heat treatment facilities known globally. This is what convinced Starcore to work with the market leader right away during their first steps into a new market segment. The experiences gained in the first expansion phase allowed the second expansion phase to be installed smoothly and quickly. With the support of the EBNER India team, production started ahead of schedule and the required quality was achieved from day one.

We at EBNER certainly did not expect these lofty goals to be met in such a short time, either. But the Starcore team (which we very much enjoyed working with) showed us they mean business! All intermediate goals were met easily and we are proud of having been a part of Starcore’s success from the very beginning, as well as continuing to be active in this rapidly growing market.
Steel

Proven design

Fast start of production, reasonable costs and sufficient reference projects were the major factors that convinced the Koreans to place the order with EBNER. A new building was constructed to house the facility, allowing for optimal layout and placement of facility components. There are many parameters to be optimized when a new facility is installed, in order to guarantee consistently high quality. Because the plant in Ansan City receives its raw material from the main plant in Pohang, the raw material quality is very consistent, significantly shortening the time until the start of production. Among the annealed grades are AISI 304 austenitic steel and AISI 430 series ferritic strip. The cooperative spirit of the entire POSCO AST team is highly appreciated at EBNER. Many furnace components were manufactured at EBNER Asia and shipped from Shanghai to Korea.

Great material flexibility

Five gas-fired heating zones and the high performance HICON/H₂® jet cooling system are able to anneal strip up to 1300 mm (4’3”) wide and 0.1 to 1.5 mm (0.4”-0.6”) thick with best continuity. The thinnest 0.1 mm thick strips are particularly challenging for the bright annealing line to process. The dancer roll ahead of the tension control system and the gas-tight welded muffle ensure low hydrogen process atmosphere consumption.

Senior Manager Sales Franz Wiesinger sat down to talk to HICON Journal:

EBNER and POSCO have had a good partnership for years, was the order for the Ansan City facility more or less a given?

Oh no. Not at all! We were confronted with competition from Japan, this time, and it was our extensive experience with vertical strand annealers and our many references that finally convinced POSCO to place the order with EBNER again.

Has the customer given any feedback with regard to the facility?

POSCO is convinced that choosing EBNER was the right decision. The customer has told us: EBNER is always held to the highest standard - an honor!

Formerly Taihan Electric Wire, the company had specialized in narrow precision stainless steel strip (≤ 600 mm /24” wide) until it was bought out by POSCO several years ago. Recently, the installation of a new, modern HICON/H₂® vertical bright annealing line from EBNER has set the course for a highly productive future including wide precision stainless steel strip.

Long-term partnership

POSCO’s headquarters in Pohang are also home to an EBNER vertical strand annealer. Thanks to this long-term partnership on the best of terms, the odds were in favor of receiving the order from POSCO AST. In addition to the main facility, the alkaline degreaser and the entire strip handling section were also supplied, resulting in the installation of a complete production line. Twin pay-off reels for continuous operation and especially compact inlet and outlet loopers round out the facility.

Western South Korea is home to a POSCO AST Co. Ltd. plant specializing in stainless steel strip.

Author: Franz Wiesinger
In mid June of this year, just as the soccer World Cup was starting up, Linz hosted the annual meeting of CIELFFA (Comité International d’Étude du Laminage à Froid du Feuillard d’Acier), the international association of cold rolling experts. Nearly thirty guests from six countries took part in the two-day conference. The exchange of ideas and networking were rounded out with several lectures in both the economical (voestalpine Stahl GmbH) and technical committees. Peter Seemann of EBNER fascinated his audience with a very informative presentation on the subject of “New Emissions Limits”. Starting with the current regulations and limitations, the presentation touched upon new approaches to reducing NOx emissions in the heat treatment sector, before taking a critical look at the defined limits and units. Undoubtedly, technology and research must take not only economical aspects into consideration, but also ensure that EU guidelines and limitations can be met.

A sociable evening was had together watching the Germany-Portugal World Cup soccer game on the big screen. Another highlight of the conference was a lunch at the EBNER guesthouse and a tour of EBNER’s workshops and the company museum, before the visitors headed home again that evening, taking with them new information and ideas about current industry issues and memories of two days of Austrian hospitality.
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EBNER
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EBNER
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