Stainless Steelmaking Solutions

Technology, mechanical engineering, automation and electrical engineering from a single source – higher plant performance through our expertise in process optimization

Metals Technologies
The demand for stainless steel is continuously growing, however the prices for it remain stagnant. In order to remain successful on the global market despite these conditions, large optimization of the quality and productivity of stainless steel plants are necessary, with simultaneous operating cost reductions.

You expect ...

- Higher plant availability with regards to increasing production of stainless steel
- Increased modernization for higher plant performance
- Flexible technological updates in response to increasing quality requirements
- Optimized plant processes as an response to more stringent environmental standards
- Decreasing operating and maintenance costs to offset stagnant margins
Your challenge:
To increase productivity in a market with volatile margins.

Continuous growth
The production capacities for stainless steel grow every year in unison with an increasing consumption of 5-6%. The largest growth markets in this area are mainly in China and India. Since price levels are not keeping pace with this development, plant operators must increasingly invest in process optimization as well as expand their capacities to remain internationally competitive.

Increasing cost pressure
The raw materials for stainless steel are expensive, and the costs for energy and logistics are also on the rise. As a result, the value-added chain is shifting as many investors and operators are increasingly building their plants at locations near consumers, such as in India, China, the U.S. and Europe. Increasing environmental regulations and high disposal costs for residual products ultimately require increased investments in stainless steel plants, mostly in the recycling of by-products. These investments must pay off in the long term and be sustainable, while meeting both present and future environmental standards.

Increasing productivity and stable plant availability
In the future, plant operators will have to continue optimizing parameters in order to improve quality. In addition to the trend towards larger converters, reducing operating costs is also an area of focus. This is the only way for them to strengthen their market performance, even with low margins.

Optimization of plants
Whether for technical components, construction parts, chemical plants or in the food industry, requirements for product quality are continuously increasing and steel cleanliness must always be strictly guaranteed. If producers are to deliver this quality with seamless process reliability, they will have to continuously update their technology. Extensive savings potential can be realized in the area of operating costs, especially through the installation of technological components such as lance technology and bottom purging with EAF, or sublance technology and exchange concepts with converters. A maximum degree of automation is required to ensure process reliability and maintenance-free operation. This optimizes the interface between mechanical and electronic process components.

Flexibility in the market
In general, the more comprehensive your process expertise, the better you are able to meet your customer’s specific requirements with your expertise and products, and the more you are able to boost your presence in the market – a market that is becoming more complex and dynamic. We invite you to work together with us in meeting these new challenges.
Innovative technologies
The name Siemens VAI represents a permanent leader in innovation. We look forward to applying our innovative strength in order to optimize your stainless steel process throughout the entire life-cycle of your plant.

Automated solutions
Our automation packages allow you to react quickly to your customer’s requirements and achieve market-driven production. In conjunction with an integrated alarm system, they ensure the smooth running of your plant. If there are breakdowns, emergency programs prevent possible downtimes, while logical, simple process screens make it easy to maintain an overview and full control of the process.

Customized package
You might be looking for a complete solution or a stand-alone package for a duplex or triplex route. No matter what your needs, we offer you the complete range of all current stainless steel technologies. From enlarged EAF design and exchangeable converters to individual performance packages (bottom purging, sublance, tilting drive), noise protection and gas cleaning methods, our technology meets with your requirements. But that’s not all: continuous technology updates, immediate spare parts delivery and coaching of your employees round off our services.
As the only global full-line provider, we possess unique expertise. Backed by this extensive experience, we completely focus on process optimization – starting with fast converter exchange, and including tested lance technologies, dynamic process control, as well as sophisticated automation packages and sustainable solutions for slag recycling. In everything we do, we have one goal in mind: To increase the performance of your plant.

**Good reasons for Siemens VAI stainless steelmaking solutions:**

- Profit from the market leader, with many years of experience covering the entire iron and steelmaking value-added chain
- Optimization of your processes thanks to proven technology packages, shortened tap-to-tap times and tested automation solutions
- Fast return on investment through reduced operating and maintenance costs
- Boost your competitive edge with the technology of the market leader’s most powerful EAFs and the largest AOD converters worldwide (150-180 ton class)
- Higher plant performance through a life-cycle partnership for the entire life-cycle of your plant
- Professional project management – numerous repeat orders reflect our customers’ satisfaction
Our full-line expertise covers the entire process route of stainless steel production. From primary processes to final quality, for duplex or triplex route, you get comprehensive technological know-how from a single source.
Total turnkey expertise in stainless steel
Offering all standard process routes

Siemens VAI is one of the few companies in the world capable of supplying the entire, uninterrupted chain of stainless steel production technologies, from scrap melting to the finished product.

No missing links in the production chain
Today, about 90% of all stainless steel is produced according to the duplex or triplex route. The duplex route only includes the EAF and converter operations for the production of standard stainless steel grades (e.g. AISI 304 and 430). The triplex route includes the EAF, converter and VOD operations for the production of special stainless steels, such as extra-low carbon and nitrogen (ELCN) grades.

In the stainless steel projects completed since 1995, Siemens VAI has implemented a broad range of solutions for each of these routes, supplying more than 1/3 of the world’s additionally installed stainless steelmaking capacity during this time! Our customers are among the leading stainless steel producers in the world. All of the plants supplied by Siemens VAI were commissioned on time and within budget, and today produce highest quality products.

Siemens VAI’s scope of supplies and services in the field of stainless steel technology extends from steelmaking to the finished product. It includes rolling mill configurations for flat and long products, processing lines, finishing lines and integrated automation and environmental solutions.

Main benefits:
- Greenfield, turnkey project realization
- Comprehensive solutions for the entire stainless steelmaking production route
- Optimum linking of innovative and cost-saving technologies
- Combined engineering, metallurgical, operational and automation know-how
- Economic solutions for every plant size, from minimills to large-scale integrated production works, for both long and flat products
- Expert project management for the fastest project completion
- Transfer of stainless steel production know-how
- Guaranteed quality products from a single supplier

Siemens VAI's scope of supplies and services in the field of stainless steel technology extends from steelmaking to the finished product. It includes rolling mill configurations for flat and long products, processing lines, finishing lines and integrated automation and environmental solutions.
EAF for stainless steel

Optimized design – for high quality stainless steel

The ever-increasing worldwide demand for stainless steel can be met with the installation of melting units featuring the latest technologies and designs.

The Siemens VAI electric arc furnace for the production of stainless steel combines all of the advantages and benefits of the new ULTIMATE EAF concept with the special requirements for the production of stainless steel. Maximized power input and high productivity are the distinctive features of this furnace type.

Siemens VAI is the leading supplier of EAFs for the production of stainless steel.

Features:
- Power input to 120 MW
- Carbon and oxygen injection technologies
- Large furnace volume with consideration given to low density of stainless steel scrap (200 m³ and more)
- Tight furnace with minimum shell and roof openings
- Special spout design to enable fast tapping
- Special furnace design to allow tilting angle of up to 40°

Main benefits:
- Reduced consumption of electrical power and electrodes
- Additional productivity improvements due to minimized power-off times
- High metallic yield and power input, oxygen technology and foaming slag practice lead to low energy consumption

160 t EAF with doghouse at Carinox, Belgium
Converter for stainless steel

Optimized plant performance

Plant performance at its best
Siemens VAI supplies all converter technologies, related equipment and automation systems for steel refining, including AOD, K-OBM-S, CLU and also vacuum converter units (DB-VR).

AOD process
The AOD process features the use of mixed gas (O₂ + inert gas) top-blowing lances to achieve high decarburization rates even at low steel bath [C] contents. All converters are equipped with a specially designed gas regulation system for the tuyere shrouds. Each shroud is individually supplied with shielding gas which provides for separate cooling of the tuyeres in the converter. This unique solution means lower and more uniform refractory wear in the total tuyere area compared with conventional AOD solutions.

The most cost-effective converters for producing stainless steel are large AOD converters of around 180 tons. Due to faster decarburization than in the VOD process, cycle times of less than one hour are possible, and all with a much more economical operating method. These advantages allow the use of cheaper iron alloys (high carbon FeCr) instead of expensive raffinates in the upstream electric furnaces.

AOD converters and the Siemens VAI-Fuchs EAF form a unbeatable team. Often there is also the effective combination with a ladle furnace, which sets the exact target analysis and temperature, thereby relieves the converter and assumes an important buffer function in the stainless steel mill. The use of an AOD converter indirectly saves costs for argon and refractory costs for the ladle due to load reduction or the elimination of the VOD unit.

Main benefits:
- Optimized design and geometry (influences from the advantages of the LD geometry)
- High-tech materials for highly stressed parts
- Single nozzle control for long service life
- Modern quick-change technologies
- Optional process tools (sublance or offgas analysis etc.)

A perfected automation system makes the AOD converter a high performance system that is easy to operate. To keep emissions as low as possible, Siemens VAI has developed gas cleaning systems which meet the highest environmental requirements.
Secondary metallurgy

Outstanding product qualifying

Siemens VAI supplies all secondary metallurgical facilities for the production of stainless steel. Ar-stirring stations are offered for steel works where the duplex process route is applied. Steel tapped from the converter is treated under atmospheric conditions and the following metallurgical work is performed:

- Fine adjustment of steel analysis and temperature
- FeTi and FeB wire injection for austenitic grades
- Al and CaSi wire injection for several ferritic grades
- FeTi additions for Ti-stabilized grades

At steel mills where a large percentage of extra-low carbon and nitrogen grades are produced, the triplex process route, including a VOD facility, is the most economical solution.

The installation of a ladle furnace in a stainless steelmaking plant provides higher alloying capacities and ideal preconditions for sequence casting. With a vacuum converter (VODC), the advantages of converter and vacuum treatment are combined in the same vessel, especially for small-size minimills, foundries and forging shops.

**Main benefits:**

- Economic production of ELCN (extra-low carbon nitrogen) grades (C+N < 150 ppm)
- Operation is possible with varying initial carbon contents
- Low chromium oxidation losses resulting from low CO partial pressure
- High rate of chromium recovery through optimized slag metallurgy
- Low final dissolved gas contents
- Improved steel cleanliness
- Adjustment of exact compositional values

**DB-VR converter process**

The DB-VR converter process combines the advantages of diluted blowing and vacuum refining of stainless steel melts in a single vessel. The converter is equipped with tuyeres for submerged blowing of oxygen and inert gas, an O₂ top-blowing lance, as well as a specially designed vacuum cover.
VAI-CON Quick suspension system

Short exchange times for steel mills with interchangeable converters are of elementary significance. With the VAI-CON Quick system, Siemens VAI offers a solution that combines the advantages of a non-distorted suspension with the functionality of a U-shaped suspension ring. The system works perfectly when combined with a hydraulic lift table that is set on the ladle car. In this way, the existing standard components are used with supplementary tools for special work – a very economical solution. After the new vessel from the lift table is placed in the correct position, it is secured with six over-dimensioned bolts and the media connections are made with quick-couplings.

The VAI-CON Quick suspension ring, just as closed support rings, fits with our proven drive systems. Intelligent design using finite element analysis takes into account all operating conditions and is the basis for a long life-cycle and maintenance-free function. Our latest development is hydraulically activated locking for securing the interchangeable converter, which again reduces the already low exchange times and reduces the load on personnel.

Converter drives with excellent reliability and precision

Tilting drive

Our converter drives offer excellent reliability and precision. Depending on the converter size, up to four motors are used that act on the converter trunnions over gear drives. Interaction with the individual brakes enable secure fixation in every desired position. High speeds enable a fast tip back after tapping to prevent escaping slag.

The ample dimensioning of the drive are designed for all imaginable operating conditions; with 4-motor drives the full function is still given with 3 motors. In an emergency, our drive has 2 integrated pneumatic emergency motors that are able to set the converter down or to tip it independently of the electric power supply. If requested, all important parameters are displayed on the screen.
Process gas systems
Siemens VAI offers blowing systems for all converter types, including the patent-protected bottom blowing converter, which is suitable for carbon steel and stainless steel. For stainless production, the AOD converter is the first choice, whereby bottom blowing converters also have numerous benefits. The ring gap nozzles with inert protective gas in the outer tube excel due to their long lifetime. A top lance supports the decarburization during the first minutes of blowing.

Valve station
Efficient pressure and flow monitoring ensures reliable operation, and the single-nozzle control ensures uniform distribution. The valve station is built in modular design and is already premounted and pretested for fast assembly. Normal operation is completely automatic, whereby the manual access to each parameter is possible via the process screen. Rotary joints ensure conveyance of gas to the converter without limiting its rotational capability.

Lance systems
In the first blowing phases, a top lance will support decarburization. Design features like copper tips and slide connections for the inner pipes compensate thermal expansion and ensure a long lifetime.

For a fast and easy lance exchange, Siemens VAI offers an automatic coupling system where the weight of the lance is used to fix the lance on the lance car. Self centering of the lance during lowering, and compensation of lance deviations at the male coupling parts on the car ensure easy utility connection. Manual activities are limited to checking the seals and tightening two swing bolts.
Stainless steel automation

Refining the quality of steel

Intelligent solutions
Siemens VAI steelmaking automation supplies the latest state-of-the-art solutions for highest performance and product quality in the entire stainless steel plant. Our solutions cover the production route from EAF to secondary metallurgy, including the complete range of available refining technologies in the area of stainless steelmaking converters. The unique advantage of this integrated approach covers all aspects of process stability, product quality and operational flexibility, while ensuring efficiency and profitability throughout the entire plant life-cycle.

Combining decades of steelmaking technology with automation experience provides the basis for highly advanced automation systems for every plant unit. Proven solutions for power supply, drives, technological packages and process optimization enable smooth production and the intelligent use of energy and raw materials. Service concepts with foresight ensure continuously high availability of plant and equipment.

Features:
- Modular, expandable, upgradable and user-friendly design
- Advanced solutions for new and existing plants
- Dynamic process models
- Reporting and statistics
- Remote monitoring and diagnostic options

Process control
According to different production units, process control systems include:
- Oxygen & stirring lance control system
- Converter tilting drive
- Bottom blowing – single line control
- Additive & alloy weighing & control
- Waste gas cooling & cleaning
- Gas recovery & analyzing
- Secondary dedusting
- Hydraulic & cooling system
- Transformer & switchgear
- Temperature & sampling device
- Injection devices & burners
- Electrode control system
- Vacuum generation
- Interlocking & alarm system
- Human machine interface
Main benefits:
- Consistently high and reproducible steel quality
- Reduced energy, material and refractory costs
- Increased productivity and yield
- Increased hitting rate for steel analysis and temperature
- User-friendly operation, full transparency and flexibility

Process optimization with dynamic models
SteelExpert is a comprehensive group of process models that perfectly images and optimizes the process of steelmaking in different production units.
SteelExpert Supervision, a set of online models, monitors the metallurgical and thermal process, cyclically calculating the actual condition of steel bath and slag. Thus the analysis and temperature of steel bath and slag are available at any time and setpoint model calculations are always based on the actual situation. The large group of setpoint models makes up the SteelExpert Setpoint, responsible for the determination of the required supply of raw materials, gas volumes and/or energy for different treatment steps.

SteelExpert Prediction simulates the complete production process – using the results of supervision and setpoint models. It provides a forecast of the progress and the final condition of the heat, predicts all required additions and actions and serves to optimize the production process.
The principle of SteelExpert combining the features of prediction, supervision and setpoint models for perfect quality is applied throughout the entire steelmaking automation, thus providing similar process guidance for all production units. According to the special requirements during different treatment phases, models are specially adapted to the respective plants with regard to optimized treatment with increased steel quality and reduced operating costs.
**Environmental competence**

**Zero-waste steelmaking**

Siemens VAI offers advanced Siemens VAI pulse jet filter technology for the highly efficient cleaning of primary and secondary emissions of stainless steelmaking plants.

**Waste gas cleaning systems**

A clean working environment inside the steel plant is beneficial for personnel and steel plant facilities and results in reduced maintenance costs. The environment benefits from lowest dust emissions at the stack.

Siemens VAI’s innovative technology of a forced draught cooler is a major advancement for stainless steelmaking plants. Forced draught coolers allow for effective gas cooling with low operating and maintenance costs.
Residuals recovery (Zero waste technology – ZEWA)

Large quantities of solid waste materials and residues are generated by the steel industry and other industrial sectors, with no or very limited possibilities for the direct recovery of potentially valuable inherent materials.

Siemens VAI’s advanced Zero Waste technology (ZEWA) represents a new metallurgical process for the treatment of residues to generate valuable products. The treatment of residues from the stainless steel industry (e.g. slag) with the ZEWA technology is economically highly attractive with short payback periods.

Main benefits:

- Recycling of alloys, dust, mill scales and residuals from pickling-acid regeneration directly to the EAF without thermal pretreatment
- Recycling of iron and alloy-bearing process sludge to the EAF
- Sale of slag to external consumers (e.g. cement industry)
- Sale of enriched dust portions to non-ferrous metallurgical industry
- Minimum costs for disposal of process waste materials
Our stainless steelmaking services
Project support from the market leader

Project management with a future
Our life-cycle management revolves around proven project management. We work in close collaboration with you to develop the best possible solution based on your specific requirements. Siemens VAI offers you our experience from over 1,800 successfully completed projects around the world.

Our modern planning tools lead to a logistically perfected greenfield plant. Or, with often small modifications to your existing plant, we create unrealized optimization potential to generate maximum profit in the future. All of these complex projects are implemented on schedule and with the shortest possible run-up times.

In our customer relationships, we identify with each customer project in a way that is unsurpassed worldwide. Our on-site project teams work together perfectly, and are strongly rooted in the respective markets. They’re familiar with local market conditions, as well as with the language and culture of each region. Our project management is certified to ISO 9001:2000 and standardized, so that we can develop all project levels transparently and in an organized manner. Online data management enables a fast, worldwide exchange of knowledge and experience. And our project manager forum makes sure that experience and results from individual projects are forwarded and shared. Our employees are supported by an integrated apprenticeship and training program right from the start. You receive the knowledge and also the experience needed for successful stainless steelmaking projects.

Working systems and synergies
Our automation systems include the market-leading SIMATIC S7 and user-friendly interface SIMATIC WinCC. With an upgrade to the current SIMATIC PCS 7 system, you receive access to many new control functions. We analyze your drive systems and develop individual migration concepts.

In addition, we offer you our expertise for offgas cleaning system solutions in order to return older plants to compliance with the most stringent environmental regulations.

Our specialists for transport systems, cranes and media work closely with our partners in building and steel construction, as well as process technology. This allows for flexible and quick reactions to changing market conditions.
Life-cycle management

Partnership never ends

Siemens VAI Life-cycle Services
As a plant operator, you have conflicting needs. On the one hand, your performance is measured each quarter against short-term profitability expectations. On the other hand, you have to think on a totally different timescale than the capital market. Depending on the lifetime of your plant, you have to take 15 years or more into account. At the very least, that’s 60 full quarters.

But thanks to our comprehensive expertise and integrated approach to solutions, you benefit both in the short and long term from our life-cycle services.

In the short term: Backed by our extensive experience with many reference plants, we provide you with the certainty of fast, dependable production start-up and shorter amortization periods.

In the long term: Our master plan guarantees competitive performance for your plant in every phase of its life-cycle. Whether we’re providing 24/7 technical support, optimizing maintenance, or making permanent plant improvements, we’re always working to ensure the cost-effective operation of your plant.
Expertise from experience: Selected success stories with stainless steel technology

Competence in figures – especially in the field of stainless steelmaking, where increased productivity, higher capacity, lowered operating costs and reducing emissions count more than anything. These are results with which our customers can measure their success – and ours as well. Take a closer look at our successful projects and decide for yourself.

**The moving vessel**
- **Customer:** Posco, Zhangjiagang, China
- **Type of system:** AOD meltshop, 800,000 t/a
- **Our solution:** 150 t EAF, AOD, treatment stand, caster
- **The result:** Integrated converter car moves vessel into crane hook approach for faster converter exchange thereby leaving more time available for operation

**The leading stainless producer in China**
- **Customer:** Taiyuan ISCO, China
- **Type of system:** AOD meltshop, 2 mio t/a
- **Our solution:** 2 x 180 t EAF, AOD, LF, caster
- **The result:** Siemens VAI’s largest stainless meltshop reference

**Biggest single line meltshop**
- **Customer:** Carinox, Ugine & Alz, Charleroi, Belgium
- **Type of system:** ADO meltshop, 1 mio t/a
- **Our solution:** 180 t EAF, AOD, LF, caster
- **The result:** Excellent competitiveness of Arcelor’s stainless production
AOD replaces LD
Customer: Acesita, Timoteo, Brazil
Type of system: AOD converter
Our solution: 80 t AOD converter and process control
The result: High performance AOD meltshop, for both scrap and hot metal

The first of the new powerful EAFs
Customer: Outokumpu Stainless, Tornio, Finland
Type of system: AOD melshop 850,000 t/a
Our solution: 150 t EAF, AOD, Twin-LF, caster
The result: A successful challenge set a milestone in economic steelmaking

Optimization of production route
Customer: Böhler Edelstahl, Kapfenberg, Austria
Type of system: AOD converter
Our solution: 50 t AOD converter to complete the VOD based meltshop
The result: Increased capacity and economy, lower production time

AOD replaces LD
Customer: Taiyuan ISCO, China
Type of system: K-OBM-S converter
Our solution: 60 t converter for stainless & carbon
The result: Excellent flexibility in production program

The bottom blower
Customer: Taiyuan ISCO, China
Type of system: K-OBM-S converter
Our solution: 60 t converter for stainless & carbon
The result: Excellent flexibility in production program

10 successful years
Customer: Columbus, Middelburg South Africa
Type of system: Stainless meltshop
Our solution: 2 x 110 t AOD converters
The result: After 10 years of successful operation, the two CLU converters at Siemens VAI’s first stainless turnkey meltshop were replaced with Siemens VAI AOD quick-exchange converters.
Completely Integrated Solutions with Siemens VAI
Integrated offerings for higher plant performance

Optimized processes
We lay the foundation for optimized processes with proven, leading products worldwide, including mechanical and technological engineering for metal production, rolling and strip processing as well as process control engineering, drive engineering and power supply. Integrated online and offline process models reflect decades of practical experience and help to ensure reliable, reproducible quality. Our process engineering expertise fuses these products into complete plant solutions that also accommodate the upstream and downstream processes. These solutions are the basis for optimal resource use, minimized waiting times and reduced maintenance and spare parts costs, as well as wide flexibility with respect to raw materials and the resulting products.

Efficient production control
A further factor for competitive production is the quality of information processing. Production data must be consolidated and compared with planning data to ensure optimal production flow. As a leading supplier for the metals industry Siemens VAI offers integrated information technology across all automation levels – from the sensor to the Enterprise Resource Planning system. Patented solutions, such as for smelting reduction plants, electric arc furnaces, hot strip mills, profile rolling or processing lines, enable systematic quality assurance, efficient logistics, flexible production planning and scheduling, end-to-end tracking and tracing from raw materials to the end product and back, and much more.

Maximized life-cycle returns
Services from Siemens VAI help to ensure high profitability for your plant throughout the entire life-cycle. Reliable project implementation by our specialists sets the course for quick start-up and repayment of funds as scheduled. During the operating phase, preventive maintenance, standardized components and component design that meets the requirements of steel plants help keep maintenance costs low. A reliable spare parts supply – with in-house workshops for key components – ensures high availability. And modernization at the right time guarantees a high level of competitiveness and compliance with environmental regulations in the future.
Completely Integrated Solutions from Siemens VAI – your benefits from an integrated concept:

- High process quality, lower energy costs and increased throughput – by taking all process steps into account
- Reproducible high product quality and efficient use of charging materials – thanks to integrated process models
- High enterprise quality, low life-cycle costs and unique investment protection – through flexible production based on metal-specific MES systems, intelligent plant design and integrated planning.

Completely Integrated Solutions offer a comprehensive range of products and services, tailored and refined to the specific requirements of your plant. The key to this approach is the close interlinking of plant construction, process engineering, electrical and automation engineering, sensors and actuators, as well as information technology and life-cycle services, seamlessly integrated by Siemens VAI.
For further information, please contact:

Siemens VAI
Metals Technologies GmbH & Co
P.O. Box 4, Turmstr. 44
4031 Linz, Austria
Phone: +43 (0)732 65 92 8580
E-mail: stainlesssteelmaking.metals@siemens.com

The information provided in this brochure contains merely general descriptions or characteristics of performance which in actual case of use do not always apply as described or which may change as a result of further development of the products. An obligation to provide the respective characteristics shall only exist if expressly agreed in the terms of contract.