SIMETAL EAF Quantum
The future of efficient steelmaking

www.siemens-vai.com
The search for a new high-performance, low-consumption EAF concept

Your challenge:
Emerging countries in particular have an enormous and ever-rising demand for steel. Because raw materials like scrap iron are available, small EAFs are a perfect solution to the costly import of steel.

However, traditional EAFs are not suitable for this application. Their capacities are often too big, setup time too long, infrastructural demands too complex. Rather, what is needed are quick, feasible solutions with maximum flexibility. In view of weak power grids, low energy consumption is as important as low flicker. A variety of charging materials have to be processed. And conversion costs must remain within reasonable bounds. These conditions call for high utilization rates and the avoidance of extended standstills. Obviously, maximum efficiency in preheating, a continuous energy supply, and short power-off times are important influencing factors in achieving a fast and attractive ROI. Greater safety at work helps prevent accidents, and so further improves production sustainability. And of course, environmental compliance and offgas production have to be optimized to fulfill increasingly stringent regulations.

Market development and the consequences
- Rising demand for steel
- Rising energy costs lead to higher conversion costs
- Stricter environmental regulations
- Higher safety demands; better operation safety
- Weak power grids; lowest flicker
- Sustainable steel production
- To decrease conversion costs and receive an attractive ROI, the challenges are:
  - Demand for high utilization
  - Avoiding extended periods of standstill
  - Energy-efficient production
  - Different automation levels
  - High productivity: preheating, flat bath, continuous energy supply, and minimized power-off times
**Our solution:**
To meet these demands, Siemens VAI has developed a new furnace technology. It combines decades of experience in preheating technologies and electric steel-making with profound plant expertise based on nearly 200 operating EAFs. Nearly all components of the new concept have individually proven their industrial operation reliability in diverse installations around the world.

The new furnace delivers minimum conversion costs, maximized output, environmental compliance, and safety. Through the utilization of the furnace offgas during the heat cycle, 100% of scrap is preheated prior to final melting in the furnace vessel. This means significant energy and cost savings with a substantial reduction in tap-to-tap times (< 33 minutes).

In combination with a hot heel, the melting phase is reduced to a pure flat-bath operation with the lowest possible flicker. With an optimized and patented tapping system called FAST (furnace advanced slag-free tapping system), a renewed concept of scrap charging and retaining technology, the latest analyzing technologies, and a revolutionary design of the offgas processing system, this furnace is the melting aggregate of the future. An energy consumption of 280 kWh/ton together with reduced oxygen consumption speaks for itself.

**Advantages of SIMETAL EAF Quantum:**
- **Shortened tap-to-tap times** of only 33 minutes
- **Nearly no power-off time** through FAST tapping system and high hot heel
- **Process optimization** due to charging, tapping, and taphole refilling during power-on
- **Low energy consumption** of ≤ 280 kWh/ton
- **Reduced electrode consumption** of up to 30%
- **Increased productivity** of 1.35 million tons/year with a 100-ton EAF arrangement and a new charging concept
- **Direct energy recovery** resulting from 100% scrap preheating with smaller transformer installation
- **Highest electrical output** even with weak power grids, due to pure flat-bath operation; resulting in lowest flicker
- **No network disturbance** thanks to nearly pure flat-bath operation
- **Highest energy efficiency**
- **Optimized environmental compliance** due to revolutionary design of offgas processing
- **Reduced greenhouse gases emissions** of 30% compared with conventional furnaces
- **Safety-oriented concept** thanks to movement reduction, low dust emission, and process automation
From scrap to steel with optimized processes

Elevator system for highly efficient scrap charging
The new charging concept – an elevator system with chute for scrap transfer from a subsurface dumping station into the furnace – creates a defined and flexible charging logistic. A crane and bucket for scrap charging is not necessary. All process steps of furnace operation are fully automated, from scrap loading to tapping of liquid steel.

Benefits:
- Full-fledged automation concept is feasible
- Higher safety thanks to no charging crane or buckets
- Clearly defined charging process
- Standardized scrap loading

Redesigned preheating system
Efficient energy recovery, thanks to 100% scrap preheating, is responsible for energy consumption less than 280 kWh/ton. This is realized by means of a trapezoid-shaped shaft design in combination with a redesigned retaining system, which results in an optimized allocation of scrap and improved offgas routing for optimized heat transfer, and avoids scrap sticking and blocking inside the shaft.

After preheating the scrap, the fingers are opened for charging by pulling them out of the shaft's sidewalls, and the preheated scrap falls into a large heel. The lower shell is optimized to the needs of shaft operation. Thanks to this configuration, the fingers can close immediately after charging in order to place the next load of scrap into the retaining system for preheating. All this can be accomplished in the power-on state.

The entire finger system is placed on the fixed roof/shaft structure in order to guide the energy coming from scrap charging away from the water-cooled parts, and thus avoid the risk of water leakages.

Benefits:
- 100% direct scrap preheating
- Energy consumption less than 280 kWh/ton
- Optimized allocation of scrap and offgas guidance
- Homogeneous temperature level in preheated scrap
- Maximized preheating efficiency
- Reduced risk of ice explosions
Pure flat-bath operation and FAST tapping concept

Melting the scrap in a large hot heel leads to a pure flat-bath operation with the lowest possible flicker, and also supports preheating efficiency. The process is characterized by nearly continuous scrap preheating resulting from immediate shaft refilling after charging, efficient and process-related oxygen and coal injection, foaming slag control by means of roof lances, and no need for additional burner power installation. In combination with the furnace advanced slag-free tapping system (FAST) with a siphon design for slag-free tapping, the new furnace concept permits charging, tapping, and taphole refilling during power-on.

In addition, the continuous input of electrical energy not only improves productivity, it is also important for the energy infrastructure with respect to flicker problems in the region’s power grids. The nearly constant heat load extends refractory durability and minimizes equipment wear, thanks to reduced thermal stress.

Benefits:
- Highest productivity with lowest tap-to-tap time
- Reduced power system perturbation/flicker
- Nearly no power-off time
- Lower consumption of ladle additions
- Maximized heat recovery for optimized power consumption figures
- Higher durability due to lower refractory consumption and equipment wear
- Siphon design for slag-free tapping
- Tilting angle of only four degrees
- Charging, tapping, and taphole refilling during power-on
- Best solution for continuous flat-bath operation
- Enhanced alloy yield and desulfurization performance

Furnace movements

The Quantum furnace is distinguished by its minimized furnace movements. Only the shell must be manipulated for tapping and deslagging. The gantry and the roof/shaft structure are fixed. This is possible due to a base frame with cylinders and guides that allow the shell to be tilted in both directions – to the tapping and slag side.

With respect to maintenance, a simple shell transfer and moving concept reduces furnace movements and improves system maintenance, thanks to quick shell exchange.

Benefits:
- Maximized leak tightness of furnace system
- Minimized furnace movements
- Improved maintenance due to quick shell transfer
- High reliability with optimized safety conditions
- Reduced equipment stress
Optimal environmental compliance – the new offgas processing system

New offgas treatment for maximum environmental compliance
SIMETAL EAF Quantum is well-prepared for increasingly stringent environmental requirements. Its offgas processing with automated offgas stream modification between charging and melting leads to maximized furnace tightness. During charging, a specially designed hood manages dust and offgas emissions – fulfilling today the environmental regulations of tomorrow. In addition, the new design requires less space for the canopy installation. The size of the dedusting system can therefore be reduced tremendously.

Benefits:
- Ready for future environmental regulations
- Compact, space-saving design
- Smaller secondary dedusting system
- Dust emission reduction based on revolutionary offgas treatment
- Reduced canopy installation
- Improved furnace tightness
- Almost 30% lower CO₂ emissions
- Lowest noise emissions

Environmental compatibility
Most of the energy lost during electrical steelmaking occurs in the waste gases. Therefore, the most efficient way to cut these losses is to recover the energy contained in these gases. Shaft furnace technology offers an ideal method for direct heat recovery, and has been in ongoing development. In addition, with a nearly constant offgas temperature level, the installation of a heat-to-power solution is possible. The reduced consumption of electricity and electrodes results in an almost 30% reduction in CO₂ emissions: that’s 65,000 tons of CO₂ based on an annual production of 1.3 million tons.
<table>
<thead>
<tr>
<th>Type of furnace</th>
<th>Conventional EAF</th>
<th>Quantum</th>
<th>Conventional EAF</th>
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<tbody>
<tr>
<td></td>
<td>same heat size</td>
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<td>same productivity</td>
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<tr>
<td><strong>Main data</strong></td>
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<tr>
<td>Heat size, average</td>
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<td>100</td>
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<tr>
<td>Hot-heel size</td>
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<tr>
<td>Diameter lower shell</td>
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<td>Height upper shell</td>
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<tr>
<td>Number of charges per heat</td>
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<td>Transformer rating</td>
<td>MVA</td>
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<td><strong>Injection technology</strong></td>
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<tr>
<td>Oxygen injection capacity</td>
<td>Nm³/h</td>
<td>4 x 1,800</td>
<td>2 x 400 PC</td>
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<td>Carbon injection capacity</td>
<td>kg/min</td>
<td>3 x 20 to 60</td>
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<td>Burner power (RCB + burner, FAST)</td>
<td>MW</td>
<td>5 x 3.5</td>
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<td>Burner power during afterburning</td>
<td>MW</td>
<td>–</td>
<td>4 x 4</td>
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<td><strong>Time balance</strong></td>
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<tr>
<td>Power-on time</td>
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<td>Power-off times</td>
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<td>• Charging (Quantum under power-on)</td>
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<td>• Tapping and taphole refilling</td>
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<td>• Delays (electrode slipping, etc.)</td>
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<td>Tap-to-tap time</td>
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<td>Productivity liquid steel</td>
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<td>Productivity per year with 7,500 h</td>
<td>t/a</td>
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<td><strong>Consumption figures for tapping temperature</strong></td>
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<tr>
<td>Electrical energy, up to</td>
<td>kWh/t</td>
<td>370</td>
<td>280</td>
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<td>Electrode consumption, up to</td>
<td>kg/t</td>
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<td>Oxygen, up to</td>
<td>Nm³/t</td>
<td>40</td>
<td>25</td>
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<tr>
<td>Natural gas postcombustion and FAST, up to</td>
<td>Nm³/t</td>
<td>6</td>
<td>4</td>
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<tr>
<td>Total carbon (charged and injected), up to</td>
<td>kg/t</td>
<td>25</td>
<td>25</td>
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<tr>
<td>CO₂ emission (based on German energy mix)</td>
<td>%</td>
<td>101</td>
<td>73</td>
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</tbody>
</table>
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