



SIMETAL^{CIS} BF VAiron

Blast furnace automation at its best

Metals Technologies

SIEMENS
VAI 

Optimized blast furnace operation with SIMETAL^{CIS} BF VAiron

The challenge

Ironmaking is one of the major cost factors for any integrated steel plant. In recent years there has been a growing awareness of cost cutting potential in hot metal production due to increased prices for raw materials and reducing agents. Productivity increase is an additional target in plant operation, especially with the current business climate of company mergers on the one hand, and on the other hand a pronounced growth of world steel production.

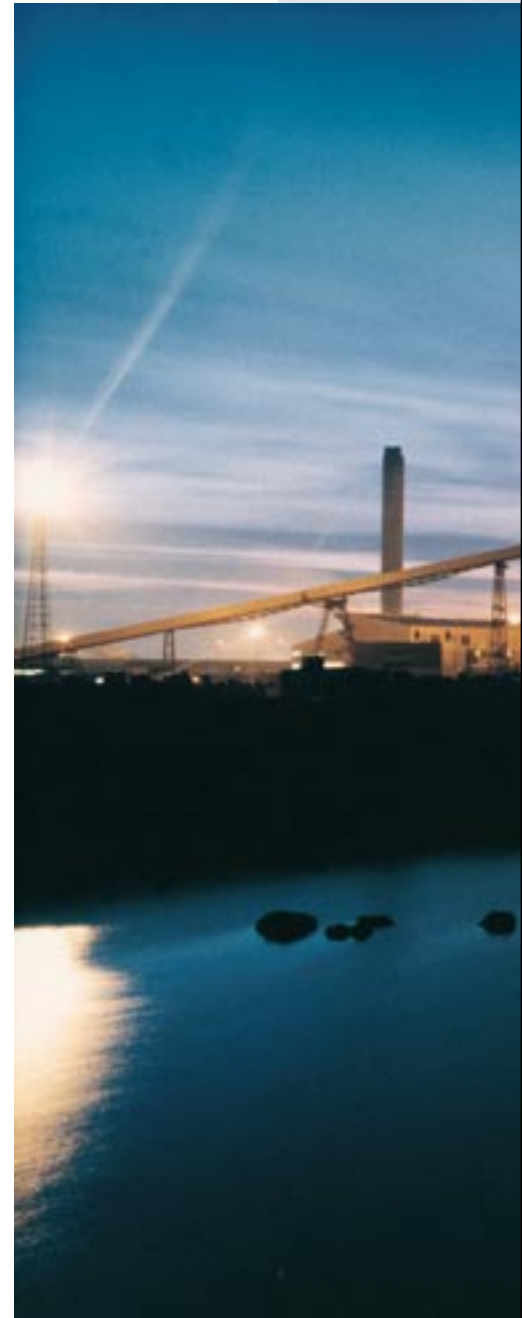
Our solutions

Siemens VAI, in close cooperation with the Ironmaking Division of voestalpine Stahl, both of Linz/Austria, developed the SIMETAL^{CIS} VAiron closed-loop optimization system to ensure high-performance and cost effective blast furnace operation. This technology unites the automation system with the world class blast furnace technologies developed by Siemens VAI in the UK over the past 100 years.

SIMETAL^{CIS} VAiron functions on the basis of advanced process models, artificial intelligence, well proven software applications, graphical user interfaces and operational expertise.

The automation system is developed for a wide range of plant setups and operational strategies. Therefore it can be easily configured without the need for programming. Proven results are excellent process performance and significantly lower production costs.

Unique features include the optimized "plug and play" SIMATIC components which are linked to the controllers, models for continuous optimization of the process, along with the flexibility to add or exchange these in the plant.



Burden control model



Good reasons for SIMETAL^{CS} BF VAiron

- **Higher operating efficiency –**
Reduction of specific hot metal costs
- **Comprehensive solutions –**
Combined technological, operational and automation expertise from one source
- **Closed-loop expert system –**
Fully automatic operation of key process parameters
- **Advanced process models –**
Substantial metallurgical insight into the process
- **Easy integration –**
Easy system integration into existing automation environment, based on decades of automation experience

SIMETAL^{CIS} BF VAiron blast furnace automation

10% of the world's hot metal output is supported by SIMETAL^{CIS} BF VAiron



Leading automation solutions ...

In addition to engineering and technological expertise, Siemens VAI provides a complete range of automation solutions, from instrumentation and process automation up to sophisticated optimization packages and expert systems.

The SIMETAL^{CIS} VAiron closed-loop optimization system was a development of Siemens VAI in cooperation with the Ironmaking Division of voestalpine Stahl, both of Linz/Austria. A similar Expert System was implemented by the Finnish company Rautaruukki Technology. 10% of the world's hot metal output is produced by furnaces running one of these two systems. The decision was made to combine forces and to create a new advanced SIMETAL^{CIS} VAiron system that incorporates the strengths of the two systems.

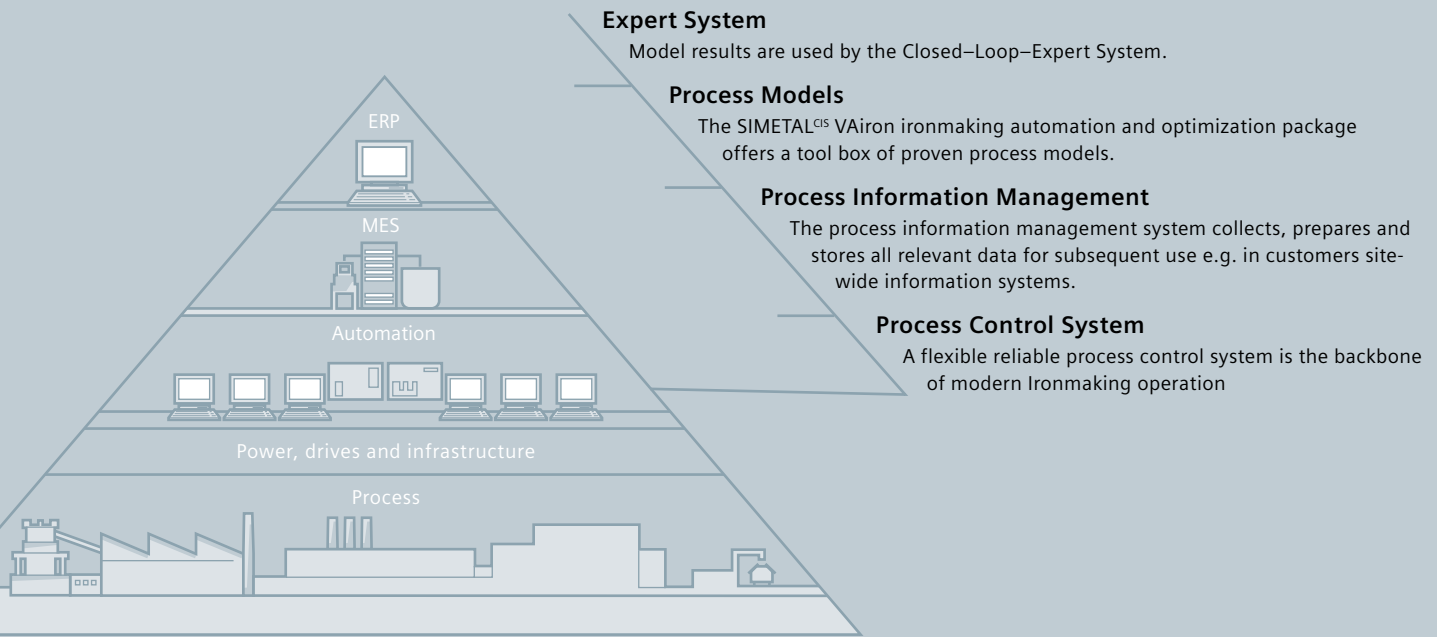
A milestone in process control

Siemens VAI has a long history of successful control and automation projects in the iron & steel industry, from turnkey equipment supply to unit packaged plant. Based on a unique blend of manufacturing and engineering excellence Siemens VAI can provide:

- Consultation for new projects or upgrades, feasibility studies or cost assessments
- Automation software from concept to factory (final acceptance) test designed in worldwide locations by highly qualified control engineers who are familiar with the process
- Full electric, instrumentation & computer turnkey capability, from design and procurement to commissioning and services
- Maintenance, training and on-going technical support

Structure of blast furnace automation system (as shown above)

- A flexible and reliable process control system is the backbone of a modern ironmaking operation
- The process information management system collects, prepares and stores all relevant data for subsequent use, for example in customer site – wide information systems
- The SIMETAL^{CIS} VAiron ironmaking automation and optimization package offers a tool box of proven process models
- The expert system utilizes model results to control key process parameters in closed-loop operation



... on all plant levels from the field to the management level

Benefits of SIMETAL^{CIS} BF VAiron

- Reduced overall production costs
- Higher productivity – optimized blast furnace performance
- Significantly lower standard deviation of silicon content and temperature of hot metal
- Stable process conditions, high plant availability
- Maximized charging of fines to the blast furnace
- Pay back period typically less than six months!



Blast furnace 5A, ArcelorMittal, Eisenhüttenstadt, Germany

High performance, low costs

Advanced blast furnace control



Blast furnace A, voestalpine Stahl, Linz, Austria

Process control systems

Siemens VAI software and process engineering specialists have produced successful solutions for all aspects of furnace operation, often within the framework of very tight construction or rebuilding programs, including:

- Furnace top control of skip or belt charged tops with complex charging patterns and burden distribution
- Stockhouse control of sequential batched materials with "in-flight" weighing and material layering
- Gas cleaning control
- Stove control for cyclic, parallel, lapped parallel and staggered parallel 4-stove operation
- Coal injection systems
- Casthouse operation and control
- Slag granulation
- Plant safety and shutdown design

Process information management

A multithreaded, threetier, client-server, realtime application is the basis for the SIMETAL^{CLIS} VAiron hardware and software configuration. The process information management system supplies an extremely flexible and powerful database for continuous improvement of process knowledge.

SIMETAL^{CLIS} VAiron interprets process data, performs model calculations and visualizes the results in windows or web based graphical user interfaces. Additional data analysis, interpretation and visualization tools can easily be connected to SIMETAL^{CLIS} VAiron (COM, ODBC).

Process models

Precise control of the blast furnace, with all associated process and production benefits, is possible using the advanced process models (below), examples of which are outlined in more detail on the following pages.

Maintenance

- Material & energy balance
- Plausibility check
- Hearth lining monitoring
- Hot stoves maintenance

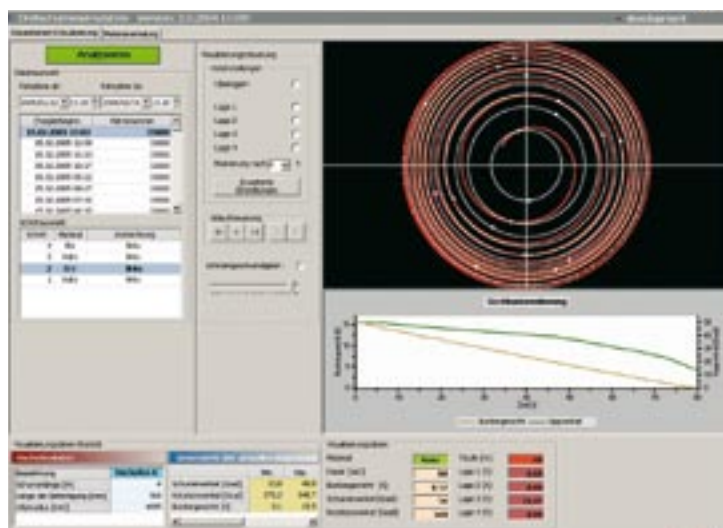
Research

- Burden optimization
- Blast simulation
- Mass and energy balance
- Kinetic process simulation
- Fuel injection
- Minimum fuel consumption
- Neural system



Control

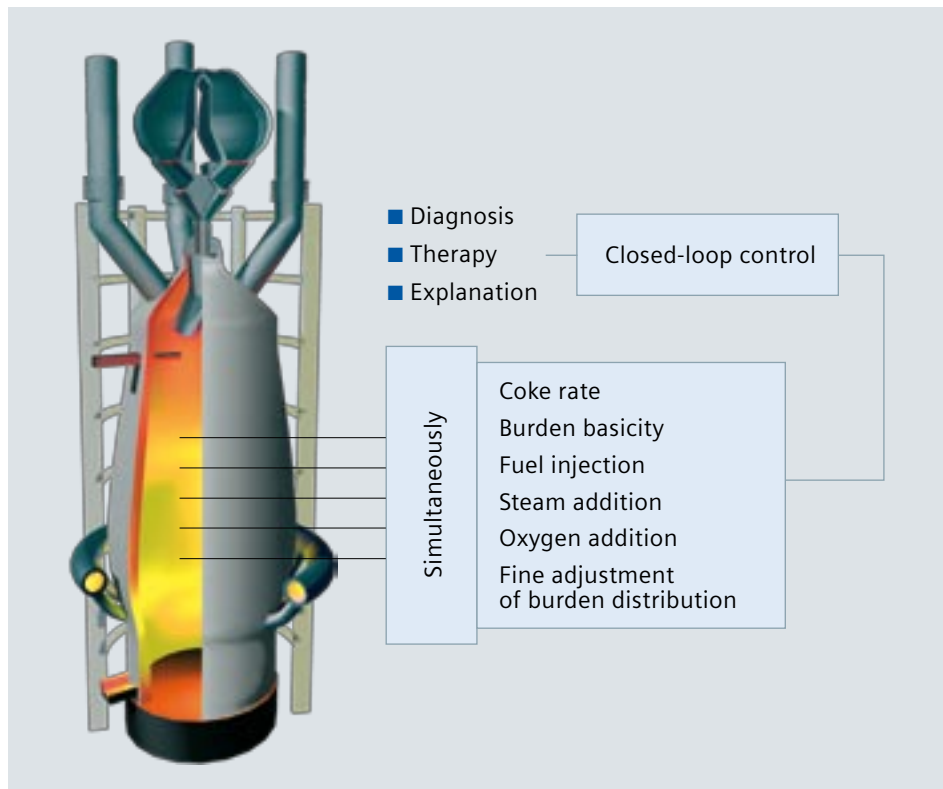
- Burden distribution
- Burden control
- Hot stoves optimization
- Blast furnace supervision
- Shaft simulation
- Tapping management
- Silicon prediction
- Temperature prediction
- Cohesive zone
- Indirect reduction
- Raceway simulation
- Flame temperature



Charging of high portions of fines

SIMETAL^{CIS} VAiron closed-loop operation

Full blast furnace transparency



Closed-loop expert system



Hot stoves HMI

Closed-loop expert system

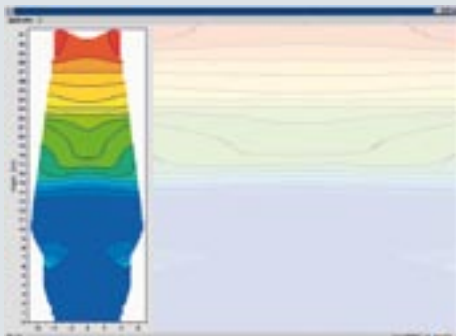
SIMETAL^{CIS} VAiron is the world's first expert system that allows the blast furnace to be operated without the need for operator interaction. For example, control of the coke rate, basicity and the steam-injection rate is simultaneously and automatically executed in closed-loop mode for stable and consistent process operation at low production costs.

- Optimized blast furnace performance
- Stable process conditions
- Lower overall production costs

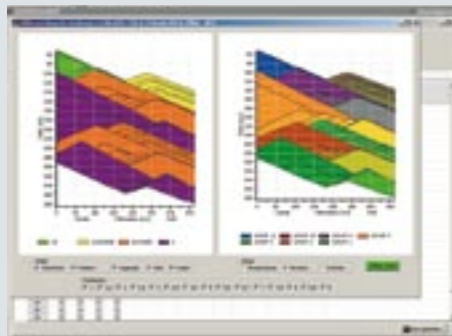
Hot stoves optimization

This model calculates the gas volume and the respective heating and blast duration setpoints online based on the maximum permissible dome temperature of the hot stoves. As a special highlight, this self-learning model automatically indicates measurement inaccuracies and compensates for them.

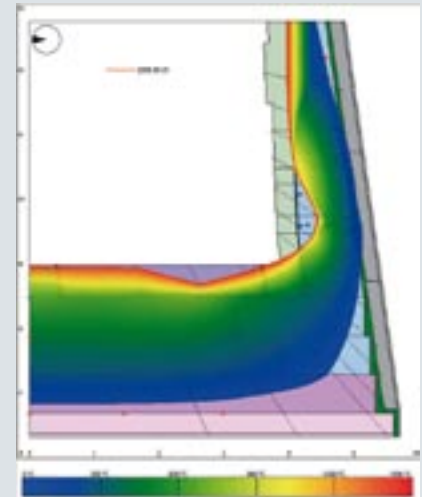
- Minimized fuel gas consumption
- Lower maintenance costs
- Longer lifetime of hot stoves



Calculated phenomena Kinetic Process Simulation



Burden distribution model



Hearth lining

Kinetic process simulation

Full transparency of the entire blast furnace process is made possible using the unique kinetic process model.

At each point of a finely meshed coordinate grid within the furnace, key process parameters are calculated to enable the following:

- Determination of the burden influence on the overall process behavior
- Simulation of the blast furnace process under varying conditions
- Analysis of internal blast furnace conditions
- Raw material optimization
- Overall process optimization

Closed-loop burden charging and distribution control

In addition to a cost-optimized burden selection, this model achieves an ideal burden distribution within the furnace based on closed-loop control. With the unique spiral-charging technique the portion of fines (less than 4 mm grain size) that can be charged directly into the blast furnace can be increased significantly.

- Charge ore and coke fines
- Improved gas utilization
- Lower raw material costs
- Increased refractory lifetime

Hearth lining monitoring

Continuous monitoring of the hearth refractory lining assures that furnace breakouts do not occur. By using thermocouples installed in the hearth, the hearth lining monitoring cyclically calculates the refractory thickness profile. The presence of slag on the lining surface is taken into account in the model calculations.

- Exact knowledge of lining state
- Extended blast furnace campaign

Achieve the full potential of your plant



Blast furnace 3, CSN, Volta Redonda, Brazil

Siemens VAI provides a full spectrum of services to assure that automation systems operate at a constantly high performance level over the entire life-cycle of a plant.

Individually customized service packages are combined to assist metal producers in utilizing the full potential of their plants. In the worldwide Siemens network a team of highly skilled Siemens VAI engineers is available to support the customer's automation staff.

As part of a global metals service organization, Siemens VAI focuses on

- Operational support
- Maintenance services
- Plant modernization & optimization

Metals support centers, located close to our customer and directly connected with the Siemens VAI headquarters, provide a first contact for all service issues in order to give fast and efficient support.

Operational support

Our customers can benefit from our many years of experience and make use of Siemens VAI's consulting & condition services, as well as comprehensive training programs.

Long term service contracts, which can be arranged on an individual basis, ensure that highly qualified ironmaking automation specialists are on-hand to assist, evaluate and solve any automation related issue.

Siemens VAI spare parts services range from the supply of single spare parts to acting as a single source for the entire spare parts supply.

Siemens VAI's in-depth expertise also guarantees optimal replacement solutions for obsolete components.



Blast furnace 3, Corus, Port Talbot, UK

Blast furnace 5A, ArcelorMittal, Eisenhüttenstadt, Germany

Maintenance services

Siemens VAI is the leading company for metallurgical maintenance services, ranging from on-line / off-line services of machines through complete plant maintenance. Siemens VAI developed maintenance tools specifically designed for the needs of the metals industry, which perfectly interact with the implemented automation systems.

Plant modernization & optimization

To keep the plant at the maximum performance level and to ensure the latest technology available for implemented systems, Siemens VAI offers economic upgrading packages reflecting state-of-the-art solutions. The upgrades are carried out by highly qualified specialists in order to achieve the best performance for the automation systems over the entire life-cycle of a plant.



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