Advanced automation solutions for cokemaking

Optimized process control for increased productivity, safety and environmentally sustainable cokemaking operations

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Highly efficient coke production – reduced costs and environmental sustainability

Your challenge:

Technical innovations for improving environmental protection and fulfilling legal requirements play a significant role in coke production today. There is still considerable potential for cutting energy consumption and CO₂ emissions at many cokemaking plants. By minimizing the environmental impact and assuring a higher degree of independence from rising energy prices, steel companies can pave the way toward long-term and sustainable growth.

The main goals of coke plant operators are still to keep the process stable and fault-free, to reduce operational costs, and to produce coke of the highest quality. Cost-cutting measures create an additional demand to implement new management tools for particular maintenance functions and for the efficient control of equipment.

These different objectives can be realized by applying constant and effective coking process control and optimization.

Our solution:

Efficient and environmentally sustainable cokemaking is unthinkable without sophisticated automation. The solutions from Siemens VAI are specially designed for the demanding conditions of a cokemaking environment. The results are the highest possible degree of stability for the coking process, coke of highest quality, and the safe achievement of environmental goals.

Decades of a combination of engineering, plant-building, operational, metallurgical, and automation experience have allowed us to develop state-of-the-art Level 2 control systems for dynamic scheduling of coke-oven machine operations and optimized heating control of the coke-oven battery. Reliable positioning and interlocking of coke-oven machines using the well-proven RaDiPoSi tool is an important part of the integrated control system.

Additional support is provided by the Coking Process Management System for various process-related calculations and the new camera-based coke-oven monitoring system PUMAS for improved productivity and safety.

These systems are in operation at coke batteries worldwide, ensuring high-performance and cost-effective cokemaking. Our proven automation solutions help you meet the ever-rising productivity demands of blast furnaces with the highest possible efficiency.

Cokemaking automation

| CPMS – Coking Process Management System |
| PUMAS – PUshing MAnagement System     |
| Coke dry quenching automation        |
| Coke-gas treatment process optimization |
Advantages of Siemens VAI cokemaking automation:

- Sustainable cost savings – from reduced external energy requirements to increased productivity and all the benefits of postponed battery maintenance and upgrading
- Higher productivity – due to an increased rate of production
- Improved safety – optimized process control of the coke-oven battery
- Improved coke quality – resulting from uniform final coke temperature
- Fulfillment of environmental regulations – reduced CO₂, dust and wastewater emissions
In coke battery control, the main objective is to maintain a stable and disturbance-free coking process while also producing coke of superior quality. These priorities must be fulfilled while at the same time ensuring minimized energy costs, increased productivity, and maximum battery service life. These goals can be achieved by employing the Coking Process Management System (CPMS), a state-of-the-art control system for both stable and unstable battery conditions that makes the operator’s work more efficient and optimizes process control of the battery.

CPMS is designed for the real-time processing of measured data, for process model calculations for optimizing process functions, and for reporting and monitoring. The system also provides data collection and storage. With these functions, CPMS can supply fast, on-line information on the status of the coking process, enabling a more stable and efficient control of the battery. The main tasks of CPMS are scheduling the coke-oven machine operations and optimizing battery heating.

Siemens VAI has developed advanced and specialized instrumentation for observation of the coking process. Special analyzing devices, temperature measurement, and raw-gas pressure control play a key role in obtaining representative, precise, and on-line process data for effective process control.

Key features:
- Manual/dynamic scheduling model for scheduling the coke-oven machine’s operation
- Temperature evaluation model for maintaining battery temperatures
- Battery heating control model for optimizing heat input to the battery
- Monitoring of the heating walls’ temperature distribution
- Oven condition-monitoring system
- Monitoring and reporting (operational parameters)
- Laboratory interface

Main benefits:
- Stabilized coke battery operation
- Operators are able to focus on crucial tasks
- Reduced energy consumption
- Reduced emissions
- Improved production rate
- Improved coke quality
- Increased battery service life
PUMAS (Pushing Management System) originally developed by Finnish steel producer Ruukki (Rautaruukki Oyj) and a technology partner is a new camera based coke oven monitoring system. This innovative solution contributes to improved productivity and safety in cokemaking. Various criteria are measured, examined, and documented during the coke-oven pushing sequence. The system incorporates an optimized battery-machine positioning and interlocking system from Siemens VAI, which now offers Pumas technology on a worldwide basis.

PUMAS consists of the following functional features:

- RaDiPosi: coke-oven machine positioning and interlocking system
- Pushing parameter-measurement system
- On-line coke-oven monitoring system

Using wireless radio communication, the RaDiPosi system provides wireless, fast, accurate, and reliable positioning and interlocking of the coke-oven machines of a battery. This creates the basis for standardized shift operations, increased productivity, and reliable process functions. The plant’s operational safety is also enhanced due to the coordinated interlocking of all mobile machines.

PUMAS also registers important process data without interrupting the pushing schedule in coke production. The following continuous measurements are simultaneously performed during coke pushing:

- Coke end-temperature measurements
- Profile of coke-cake level
- Pushing and pulling force trends of the pusher ram

With the use of specially developed video cameras mounted on the coke guide car and pusher, PUMAS remotely inspects the inner condition of the oven during the coke-pushing sequence. Badly worn oven walls and soles can be identified and repaired before damage to the coke oven can occur. Maintenance intervals can also be better defined and coordinated. This results in improved heat transfer to the coking coal, reduced energy consumption, increased oven productivity, and prolonged battery service lifetime. Using WLAN communication, selected high-quality photos and videos are stored in a database for reference as well as for improving the operators’ evaluation and interpretation skills. It is therefore no longer necessary to manually inspect the inner oven conditions.

PUMAS can be easily incorporated within the CPMS. Together, these two systems form an integrated control and optimization system that offers a variety of benefits for reliable coking process operations and cost-efficient coke production. Both of the systems are currently in use at Ruukki’s Raahe Works coking plant.
Environmentally sustainable development is an important issue in coke production today. Pollutants and emissions are an inevitable by-product of the coking process. With good plant design and a disciplined operation, however, emissions can be cut to very low levels or eliminated altogether. Siemens VAI has opted for the coke dry quenching (CDQ) process and automation technology not just for its environment-friendly features, but also for the improved coke quality and enhanced energy efficiency that it provides.

The CDQ plant automation system typically includes controls for the following process areas and units:

- Hot coke transfer and charging
- Quenched coke discharging
- Quenching chamber
- Cooling gas circulation
- Waste heat boiler
- Dedusting

**Key features:**

- Unmanned hot coke transfer and charging
- Emission-free charging
- Improved coke discharging
- Coke-dust emission control and collection system (dedusting)
- Advanced waste-heat boiler solutions for power generation
- Advanced automation instrumentation

**Main benefits:**

- Reduced dust emission
- High quenching capacity
- High-pressure steam generation
- High coke quality
- Low coke moisture content
- Improved operational safety
- Reduced maintenance costs
- High quenching reliability
- Conversion of waste heat into electricity
All controls, gas treatment, and by-product process areas are particularly important when operators focus on the environmentally sustainable development of cokemaking. Today’s legal requirements allow fewer harmful compounds to be treated. Without modernization, plant shutdowns are more and more likely if operators cannot reduce emissions below these new legal limits.

Together with international cooperation partners, Siemens VAI is concentrating on services for coke by-product plant owners and operators. Our expertise encompasses all types of process technologies that are encountered in coke by-product plants. In addition to standard processing units for gas treatment, Siemens VAI can offer advanced solutions for coke-gas desulphurization, ammonium removal, and catalytic destruction as well as gas cooling.

Siemens VAI works with the client to select the optimal process method. We help you improve your process efficiency and cut operation and maintenance costs. In coke by-product plants, special attention is paid to the following factors:

- Efficient and safe processes
- Corrosion
- Long-term operational reliability
- Low-cost life-cycle operation
- Emissions reduction

Siemens VAI provides automation solutions and the equipment necessary to fulfill all requirements relevant to the above factors.

**Key features:**
- Data history and plant archive
- Maintenance and management
- Process and maintenance alarms
- Statistical process-control tools
- Laboratory interface
- SPC trends on-line
- Predictive models

**Main benefits:**
- Optimized process
- Fulfillment of environmental regulations
- Sustainable use of process gas
- Reduced emissions/leakage
- Increased equipment service lifetime
- Reduced chemical consumption
- Increased operational safety
- Increased gas quality
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