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# Process Performance

Increasing productivity, improving sustainability and maximizing profitability



- Advanced Process Control
- Inferential Modelling / Soft Sensors
- PID Loop Performance Monitoring

**ABB**



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# Introduction

Process Performance Industrial Software that controls, stabilizes and optimizes cement, mining, pulp and metals processes, is helping plant managers achieve profitability and sustainability targets, often with payback in less than six months.

ABB Industrial Software that incorporates advanced process control, AI/ML based inferential modeling, loop performance monitoring and integration with LIMS to optimize your plant. ABB Ability™ Expert Optimizer facilitates advanced process control to coordinate the setpoints of the different process stages and immediately detects deviations within the operations, thereby making accurate and consistent system decisions, pushing the plant closer to an economic optimum. It avoids the inevitable variations incurred when performance is controlled manually, thereby minimizing shift to shift variations and human workload. This releases operators to focus on other tasks.

AI/ML based inferential modeling through ABB's IMP Platform allows for soft sensor creation for difficult to measure states such as blaine / particle size, Kappa or NOx and sensor validation for faulty analyzers.

ABB's Loop Performance Monitoring allows for improved maintenance of the base level control system, ensuring PIDs are correctly tuned for improved process stability. Integration with LIMs for RMP and ABB's Knowledge Manager enables any required lab values to be ingested inside Expert Optimizer for closed loop control.

## **If you are looking to capture additional throughput, yield and consistent quality while reducing energy and consumables:**

- Push your process closer to constraints with Advanced Process Control and related technologies
- Benchmark your current process performance and then evaluate potential benefit improvements through ABB Plant Fingerprints
- Identify process models from data, capturing the intricate relations between various parameters
- Foster continuous improvement based on monitoring and fine tuning with ABB's remote collaborative operation center.

# Process Performance in Cement

The software modules cover kiln optimization, alternative fuel management, mill optimization and material blending.

## Kiln optimization

The kiln process is intrinsically unstable and influenced by long time delays and large perturbations. Expert Optimizer stabilizes the process before driving the key controlled variables to the process limits. EXPERT OPTIMIZER controls the kiln around the clock, 365 days a year, as effectively as the company's best operator. Depending on the kiln type, EXPERT OPTIMIZER provides:

- Kiln control module
- Calciner control module
- Cooler control module

	EO off	EO on
Throughput [t/h]	152.0	155.8 (+2.5%)
Specific energy consumption [kcal/kg]	870-880	850-860
EO utilization	-	> 95%

Expert Optimizer applied to a kiln unit in Turkey

## Features

- Burning zone temperature optimization
- Combustion optimization
- Alternative fuel maximization

## Benefits

- Reduced number of kiln stops
- Increased yield
- Reduced specific thermal energy consumption
- Reduced quality variability

	Unit	EO on
Reduction in temperature variation	Pre-Calciner	31%
Reduction in coal over alternative fuels	Pre-Calciner	58%
Reduction in litric variation	Kiln	41%
Reduction in UGPI variation	Cooler	43%
Reduction in UGP2 variation	Cooler	30%

Expert Optimizer applied to a kiln unit in Turkey

## Alternative Fuel Management

Burning alternative fuels can lead to instability in the clinker manufacturing process. EXPERT OPTIMIZER controls, mixes and monitors rates of several alternative fuel types to achieve consistent burning, whilst ensuring the kiln does not become unstable due to changes in fuel calorific value.

## Features

- Handling of numerous and complex alternative fuel lines
- Uncontrolled and controlled fuels
- Ratio or maximize functionality

## Benefits

- Maximum utilization of alternative fuels
- Steady energy input

## Material Blending

Stable and correctly proportioned raw meal is essential for energy efficient clinker production. Correctly blended cement is critical to ensure customers receive a quality end-product. EXPERT OPTIMIZER helps control raw material and cement blending.

## Features

- Mix control with laboratory samples and/or online analyzers
- Additives control

## Benefits

- Reduced fluctuations in blended material consumption
- Optimized material costs
- Improved kiln operation due to more homogeneous raw material

## Mill Optimization

Grinding is an energy intensive process and optimizing its efficiency has a significant impact on a plant's energy bill. EXPERT OPTIMIZER optimizes coal, raw material and finished cement grinding by increasing throughput and securing consistent output quality while lowering energy consumption.

## Features

- Mill load and throughput optimization
- Fineness control
- Temperature control
- Handling of mill start-up
- Automatic product type switching

## Benefits

- Reduced number of mill stops
- Increased output
- Reduced specific power consumption
- Reduced quality variability

## Emission Control

Tight control on emission release such as SO<sub>2</sub> is a manually intensive task. It is critical to maintain emission levels below regulatory limits. Expert Optimizer and IMP ensures tight control over emission levels such as SO<sub>2</sub> whilst minimizing hydrate consumption, raw material and cement blending.

## Features

- Optimize short-term emission targets, such as SO<sub>2</sub>
- Control multiple chemical feeder points

## Benefits

- Reduced chemical consumption such as hydrate
- Run closer with more confidence toward emission limits
- Reduced operator workload





# Process Performance in Mining

Process Performance for mining combines advanced process control technologies with ABB's extensive mining expertise to stabilize processes and maximize profitability. This is achieved by optimizing all key applications including comminution circuits, flotation, clarification and pyro processing.

### Crushing

Optimizing the crushing process maximizes feed while stabilizing power, choke feed, bin and crusher levels. EXPERT OPTIMIZER minimizes variability in mill feed allowing for a more efficient and productive comminution circuit.

### Grinding

Grinding circuits present multivariable control challenges, whereby several inputs directly impact on various outputs. Ore variability means operators constantly need to strike a balance between required throughput and stable grinding. Grinding circuits are energy intensive which is a critical factor in determining a plant's efficiency. EXPERT OPTIMIZER's grinding optimization consistently maximizes throughput against process constraints such as grind size, cascade angles, liner wear, mill load, density and power draw.

### Thickeners

Standard thickener control suffers from long delays and slow process dynamics, making it difficult to maintain desirable targets. Large swings in underflow density, bed mass and high torque are common. EXPERT OPTIMIZER, with its moving horizon estimation, exploits the long delays and interactions to predict and drive the thickener toward the optimum achievable constraints. EXPERT OPTIMIZER's thickener optimization minimizes additives such as flocculent whilst stabilizing bed mass, underflow density and rake torque.

### Flotation

Varying feed grade and mineralogy hinders achieving a consistent concentrate grade. Operators need to constantly intervene to achieve a high recovery at the target grade. EXPERT OPTIMIZER's flotation optimization minimizes reagent overdosing whilst maximizing valuable metals recovery.

### Pyro

Pyro optimization increases overall efficiency and production of valuable metals by stabilizing temperatures, matte and slag levels whilst minimizing fuel usage and environmental emissions.

### Summary of features

Features	Sabilization						Optimization					Enhancements			
	Level control	Particle/Ore Size control	Surge control	Density control	Product grade	Toe angle control	Maximized throughput	Minimized specific energy	Minimized liner wear	Maximized metal recovery	Minimized reagent consumption	Integration with image analysis	Soft sensor analytics	KPI Monitoring	Autopilot for operators
Crushing	●	●	●				●					●	●	●	●
Grinding	●	●	●	●		●	●	●	●	●		●	●	●	●
Flotation	●		●		●					●	●	●	●	●	●
Thickness	●			●							●		●	●	●
Pyro					●		●	●		●		●	●	●	●

# Process Performance in Pulp

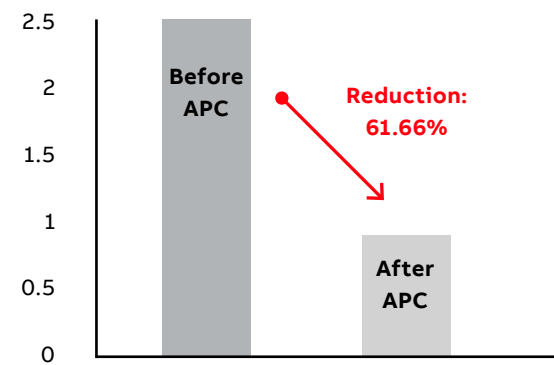
Expert Optimizer for Pulp is a complete Advanced Process Controls solution for the pulp industry. Focusing on stabilizing operations whilst seeking out opportunities to maximize yield and reduce consumables – including pulp brightness, liquor quality, steam, energy and more.

## Caust

Superior control and monitoring of the causticizing process. Stabilize white liquor quality and manage green liquor TTA, causticizing efficiency and production rate changes. Helping mill personnel improve process efficiency and quality.

Typical Benefits:

- Increased causticizing efficiency by 0.5-1.5 units
- Decreased causticizing variation by up to 60%
- Improved white liquor quality and strength



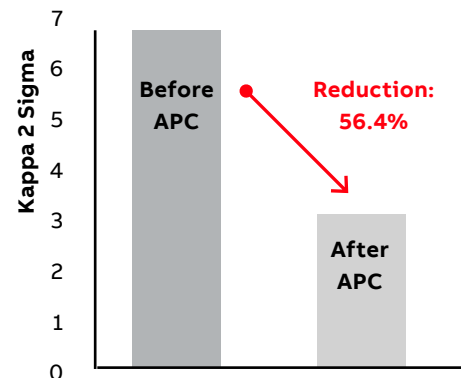
Expert Optimizer helped a European kraft pulp mill reduce causticizing efficiency stability by 62%

## Cook/C

Control, optimize and monitor continuous digesters. Stabilize chip column movement and standardize cooking history for all chips. Directly reducing kappa variability and raw material consumption.

Typical Benefits:

- Increased production (1-5%)
- Reduced kappa variation (25-50%)
- Lower consumption of energy and bleaching chemicals



Expert Optimizer helped a European kraft pulp mill reduce Kappa variability by 56% and sustain it over 9 years

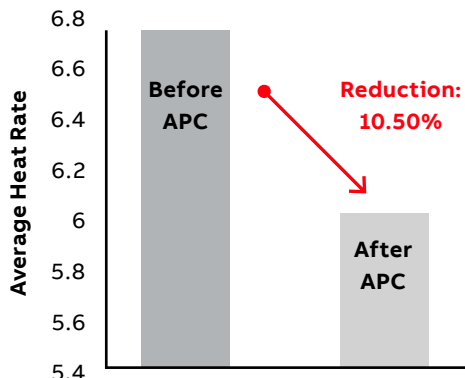
## Lime

Advanced control for lime production.

Automatically analyze residual carbonates during laboratory tests to optimize control targets. Improving uniform lime quality with low energy consumption and reduced emissions.

Typical Benefits:

- Reduced excess oxygen variation by up to 60%
- Reduced fuel consumption
- Improved re-burned lime quality



Expert Optimizer helped an Asian kraft pulp mill reduce the annual average heat rate (GJ/ton) by 10.50%

## Wash

Automatically control and maintain stable brown stock washing conditions and filtrate tank levels. Constantly seeks opportunities to reduce specific consumption of water, chemical and steam. Increasing overall production whilst decreasing environmental impact.

Typical Benefits:

- Increased capacity by 1-4%
- Lower soda/alkali losses
- Reduced wash water consumption by 1-5%

## Bleach

Stabilize and optimize bleach operations in real time. Tightly control Kappa reduction to preserve pulp quality, while minimizing consumables and formation of chloro-lignin compounds. Enabling you to consistently reach your brightness targets.

Typical Benefits:

- Reduced pulp brightness variation by up to 50%
- Reduced chemical consumption by up to 10%
- Improved pulp quality and yield

## Oxygen

Optimize oxygen/alkali charge ratios and H-factor. Balance the removal of maximum lignin in the oxygen stage while maintaining optimum pulp strength. Making it easier to produce high quality pulp at low chemical consumption and environmental impact.

Typical Benefits:

- Reduced outlet Kappa variations by up to 50%
- Reduced chemical usage in bleach plant by up to 10%
- Smoother grade changes

## Vapor

Control, optimize and monitor the multiple-effect evaporation plant. Multivariable model-based solution that controls the strong liquor production rate and dry solids content. Minimizing energy consumption and increasing evaporation plant capacity.

Typical Benefits:

- Increased production rates
- Removes bottlenecks
- Reduced strong liquor dry solids variations





# Process Performance in Metals

Several key areas in metals are identified as high potential for optimization through industrial software such as Expert Optimizer, PID loop monitoring and inferential modelling. Typical units would include raw material grinding, pelletizing and sintering, furnaces and some cold rolling.

### Pellet Indurating Machine Burner

- Prevent bed height variations
- Maintain a stable burn through pellet temperature
- Minimize pellet quality variability
- Reduce energy consumption.
- Increase pellet yield with pellet strength inferential measurement and advanced process control

### Gas Cleaning

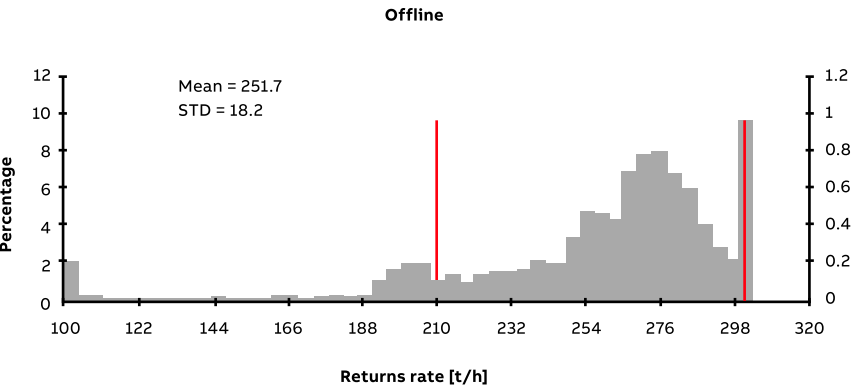
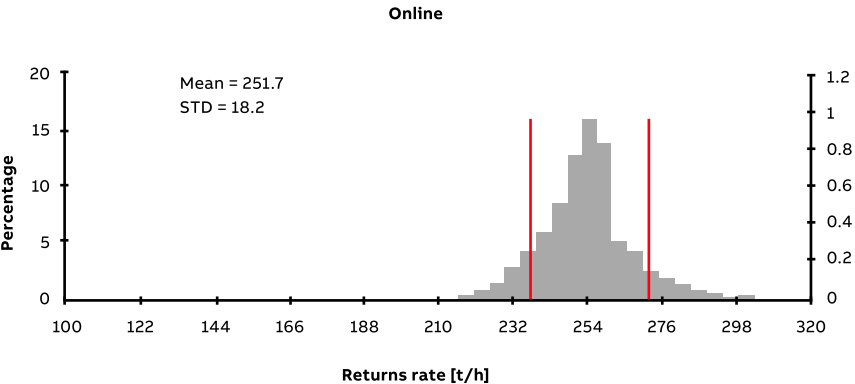
- Reduce lime slurry consumption
- Stabilize reactors temperature
- Stabilize dust recirculation
- Tighter control SO2 emissions
- Reactors in parallel / shutting down one reactor

### Raw Material Grinding

- Increase throughput
- Reduce energy consumption
- Reduce returns and operating standard deviation

### Pellet Plant Dryer

- Maintain the outlet temperature of the iron ore dryer at the desired setpoint
- Minimize intermittent disturbance in feed rate and process delays



### Example study In ball and vertical mills

**4%**  
production increase

**3%**  
energy savings

**60%**  
reduction of returns standard deviation

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# Integration with ABB Ability™ System 800xA

Expert Optimizer can be integrated directly into ABB Ability™ System 800xA distributed control system (DCS) or as standalone application, connecting to any other third-party PLC or DCS. Integrating directly into System 800xA provides the same usability and interface as the rest of the control system. Cyber security is strengthened while ensuring less hardware to maintain and introducing a common historian and information management system.

**The major tools and technologies used are contained in ABB's Process Performance Portfolio**

Fuzzy Logic

Model Predictive Control

AI / ML driven Inferential Modelling Platform / Soft Sensors

Performance Optimization for Control Loops

RMP LIMS Integration Module

Other ABB technologies, such as the secure re-remote access platform (RAP) and KPI monitoring enhances the collaboration between user and ABB, making it easier to maintain applications during process and optimization strategy alterations



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# Customer-oriented delivery

Every plant's advanced process control system needs to be tailored to that facility's specific production needs. Process Performance software brings the flexibility to adapt to each plant. As such, an end-user only pays for what they really need.

## Software Only

Process Performance software licenses can be purchased by those that prefer to build their own application

## Turnkey Solution

Get Process Performance software with your selected applications from the ABB portfolio including engineering and commissioning and benefit from ABB's proven applications for the cement industry.

In either case, users can purchase a single license or sign up for software license subscription which automatically benefits from the latest functionalities and software improvements at a fixed annual fee.

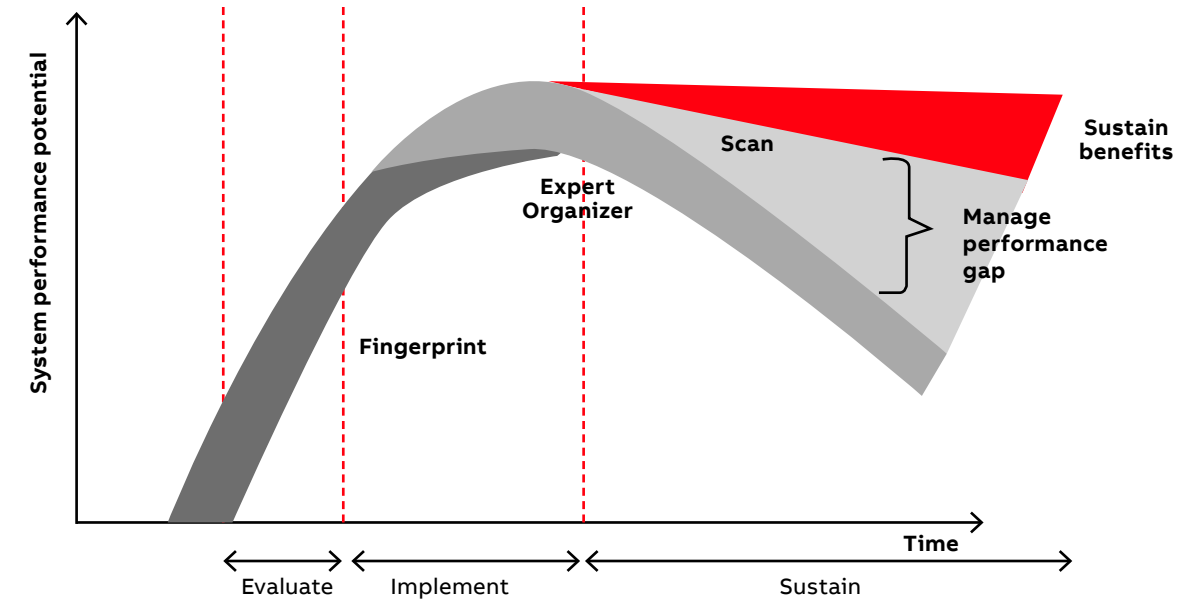
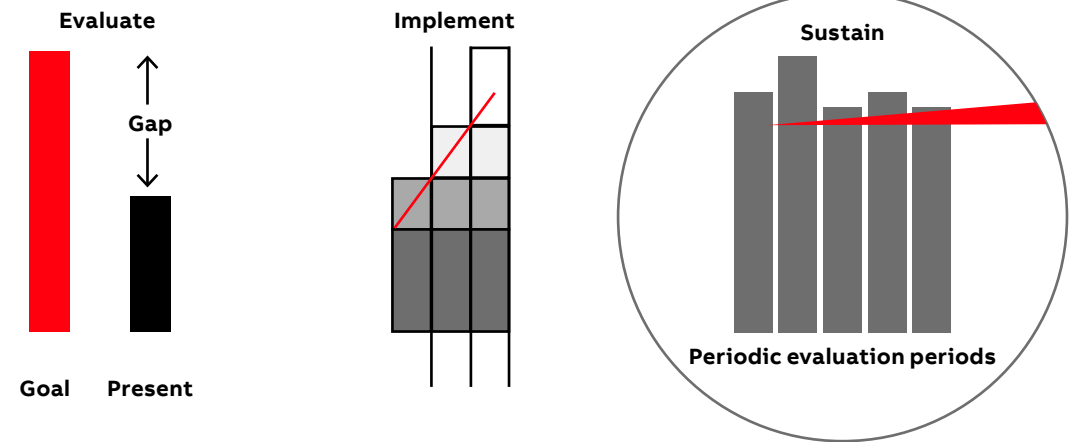




# A road map for successful installation

**Fingerprint:** ABB collects various information on-site to ensure smooth engineering and implementation. Potential applications are identified based on current performance, base level health and plant eco-nomics. A baseline and road map for digital applications is then defined. This forms the business case for implementation where applications with the fastest return on investment are scheduled first.

**Implementation:** ABB engineers model the process using plant knowledge, historical and step test data to construct the multivariable controller. The controller is then tuned to exploit the plants' constraints to maximize profit and minimize cost. Commissioning is performed on-site together with operators and process engineers to ensure a successful change management.



**A B B**