

Metso:Outotec

Fluid bed roasting process solutions

Unique pyrometallurgical process design/
build experience for a wide range of ores,
concentrates and tailings including testwork,
sustainable proprietary technology, products
and service support





Our fluid bed technology is based on half a century of experience in developing solutions for processing a broad spectrum of ores, concentrates and tailings. As a technological frontrunner to the industry, our fluidized bed solutions are the industrial benchmark for roasting and also incorporate the gas cleaning and acid plant process solutions.

Our tailored plant solutions consider all current aspects of safety and sustainability and are designed to maximize operational efficiency and reduce environmental footprint. We also offer a comprehensive range of service solutions to support your plant throughout its life cycle.

Benefits

- Suitable for concentrate and ore processing
- Low operating costs and waste generation
- High plant availability
- Heat recovery for power generation
- Production of sulfuric acid as a bi-product
- Maximise recovery levels at the leaching stage
- Full range of proprietary equipment and life cycle services
- Complete process chain from single provider

Metso Outotec roots in research and development

Our technologies are continuously developed using the capabilities of our world-leading in-house R&D center, which boast multiple fluidized bed units of different size/application. These facilities have a long record of successful fluidized bed technology developments and are equipped with state-of-the-art laboratories and pilot plants for the most demanding testing applications.

The R&D center located in Germany focuses on fluidized bed and sulfuric acid/off-gas technologies. We can test different feed materials to demonstrate the performance of a particular application or raw material. Process simulations (steady state and dynamic calculations) and mathematical modeling are key parts of our process development.

Benefits

- Half a century of fluid bed development and benchmark testing of whole ores and concentrates from around the world
- Significant scale-up experience from testwork to industrial plant

Portfolio

- Bench scale testing up to pilot plant testing, including test report and associated desktop studies
- Plant reconfiguration testing for revised feed materials/blends
- Development of next generation solutions for the industry



Overview of fluid bed process solutions

Metso Outotec technology portfolio includes roasting solutions for zinc, copper, pyrite, gold and precious metals concentrates, as well as whole ores and tailings from hydrometallurgical processing. Our solutions maximize heat recovery by using an integrated fluidized bed cooling system and a specially designed waste-heat boiler.

We have a strong track record in designing and implementing high-capacity plant installations with throughputs ranging from 100 to 5,000 tons per day, dependent on the processed commodity.

Metso Outotec roasting processes are highly effective at removing impurities such as chlorine, fluorine, arsenic, and mercury from concentrates and they feature high combustion velocity with low residual sulfur in the calcine. The value chain also encompasses process solutions for gas cleaning and sulfuric acid production.

Commodity	Roasting process	Process target	Feed material	End products
Zinc	Dead roasting	Total sulfur elimination	ZnS	Pure metal oxide, sulfuric acid, steam (power generation)
Non-ferrous metals, sulfuric acid, energy, iron oxide	Dead roasting, low temperature roasting	Total sulfur elimination	Pyrite, tailings, metal sulfides (e.g. Cu, Co, Ni, Zn sulfides), gold ores	Metal oxides (Ag, Au, Co, Cu, Fe, Ni, Zn), sulfuric acid, steam (power generation)
Copper, gold	Partial roasting, two stage roasting	Removal of arsenic and carbon, sulfur removed or reduced to target value (e.g. 20%)	As rich copper or gold concentrate	"As-free" concentrate or calcine, sulfuric acid, steam (low pressure)
Copper, cobalt	Sulfating roasting	Transformation of metalsulfides to metal sulfates	Metal sulfides, (e.g. Cu, Co sulfides)	MeSO ₄ (e.g. CuSO ₄ , CoSO ₄)

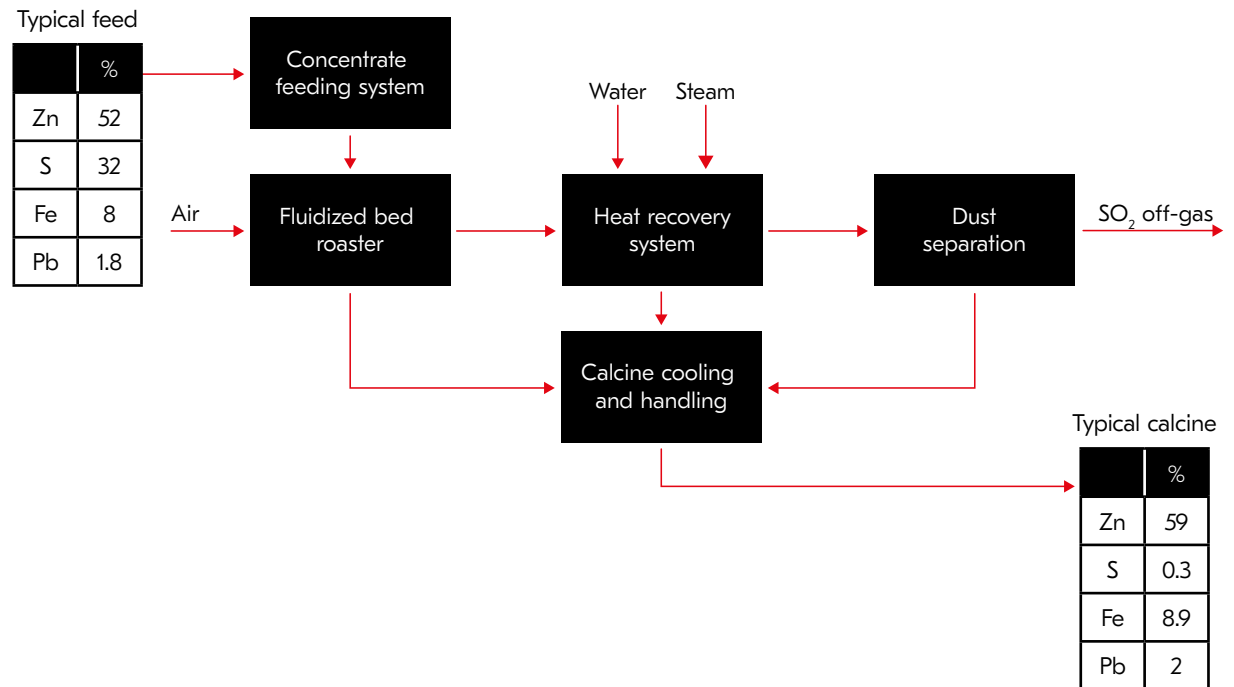
Dead roasting for zinc sulfide

Features

- Direct dry feeding of concentrate (with 6-12% moisture content)
- Suitable for a wide range of sulfidic concentrates
- Plant capacities up to 900 t/day
- High combustion velocity results in low residual sulfur in the calcine
- Maximized heat recovery in the fluidized bed in conjunction with an off-gas waste-heat boiler
- Chlorine and fluorine removed from concentrate during roasting

Benefits

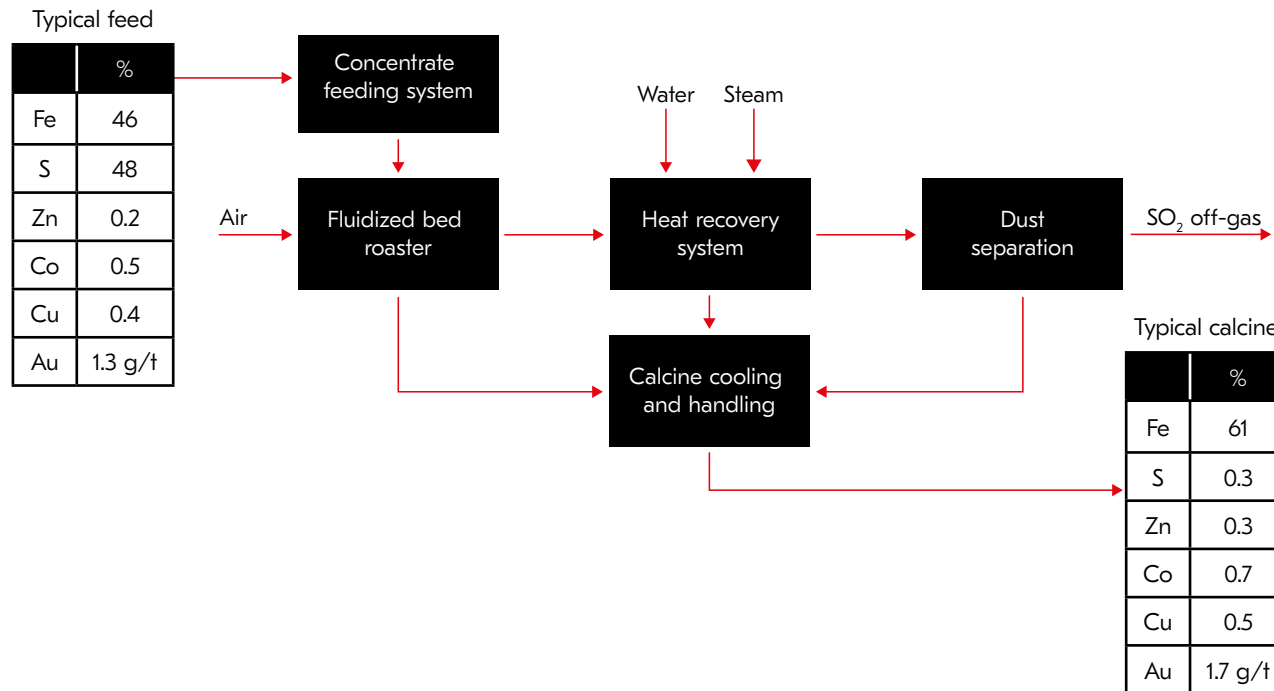
- Steam or power generation without CO₂ emissions
- Sulfuric acid production
- Complete process value chain (roaster – gas cleaning – acid plant) from a single technology provider



Dead roasting is the most commonly used roasting process and is mainly applied in our zinc roasters. When using a dead-roasting process for concentrates, the sulfides are completely transformed into oxides. The gas temperature in this type of plant is typically between 900 and 950°C. The hot gas generated in the process is used for heat recovery and is suitable for high-pressure steam production in a waste-heat boiler.

Our downstream gas cleaning and sulfuric acid plant solutions enable us to offer the complete value chain from a single technology provider.

Dead roasting for pyrite, tailings and gold



Features

- Direct dry feeding of concentrate (with 6 - 12% moisture content)
- Suitable for a wide range of sulfidic concentrates
- Typical plant capacities:
 - Roaster: 600 - 3,000 t/day
 - Acid plant: 900 - 4,500 t/day
 - Electrical power: 15 - 60 MW
- High combustion velocity results in low residual sulfur in the calcine
- Maximized heat recovery in the fluidized bed in conjunction with an off-gas waste-heat boiler
- Chlorine and fluorine removed from concentrate during roasting

Dead roasting is the most commonly used roasting process and is mainly applied in our pyrite roasters. When using a dead-roasting process for concentrates, the sulfides are completely transformed into oxides. The gas temperature in this type of plant is typically between 800 and 900 °C. The hot gas generated in the process is used for heat recovery and is suitable for high-pressure steam production in a waste-heat boiler. A variation of this concept is the low temperature roasting process with focus on Co and Cu recovery.

For large amounts of tailings treatment and sulfuric acid production based on alternative sources, high capacities can be treated in Metso Outotec's Circoroast process designed for best process control and optimum energy recovery, whilst reducing the need for multiple process lines.

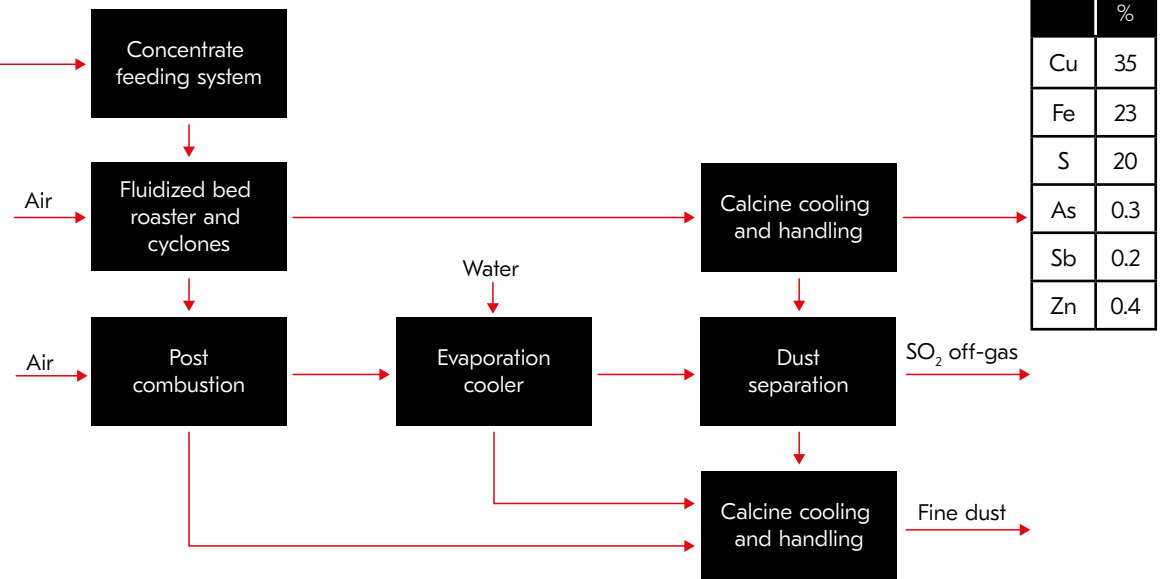
Benefits

- Steam or power generation without CO₂ emissions
- Sulfuric acid production
- Recovery of valuable metals such as gold, zinc, copper, and cobalt

Partial roast of arsenic rich concentrates for copper and gold

Typical feed

	%
Cu	30
Fe	21
S	35
As	4
Sb	1
Zn	0.4



Typical calcine

	%
Cu	35
Fe	23
S	20
As	0.3
Sb	0.2
Zn	0.4

Features

- Elimination of arsenic from concentrate: 12 % to < 0.3 %
- Elimination of antimony from concentrate: 1.2 % to < 0.2 %
- Feed capacity up to 600,000 tons per annum

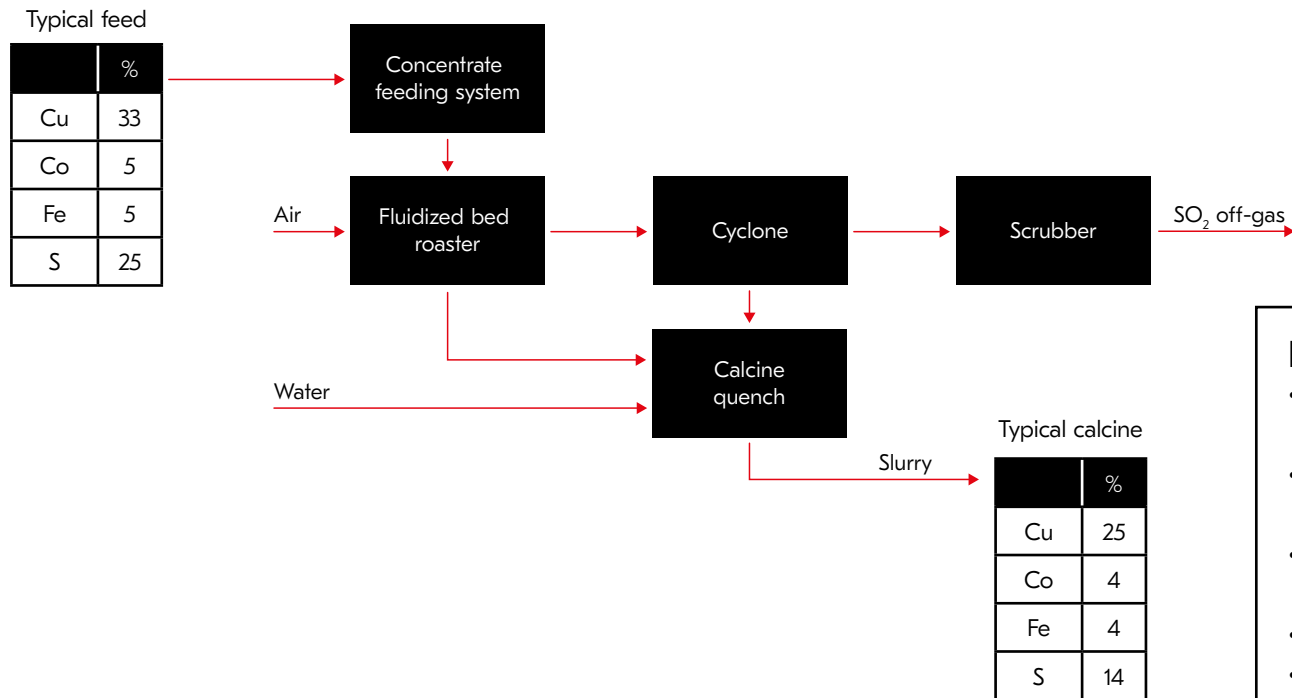
Benefits

- Sulfuric acid production
- Ability to process/upgrade lower quality ores
- Recovery of valuable metals, e.g. antimony
- Increased gold recovery

Metso Outotec partial roasting process is used for removing impurities from feed material. In this process the sulfur is only partially roasted, with the quantity depending on the concentrate analysis and the desired calcine grade. In some cases, partial roasting is used to remove almost all unwanted elements – such as arsenic and antimony – this will be removed in the wet gas cleaning stage to a stable product for storage. The resulting calcine is then further treated in the flash smelting process.

Two stage roasting is used for treating double refractory gold concentrates and combines partial roasting in the first stage with dead roasting in the second stage. The first stage is used as a de-arsenifying process in an oxygen-deficient atmosphere, whilst the second stage operates in an oxidizing atmosphere to fully transform the metals into their oxide form.

Sulfating roasting for copper and cobalt



Features

- Proven technology for cobalt and copper production
- Optimized for small/medium sized plant capacity (30-50,000 t)
- Autothermic process operating at medium temperatures
- Insensitive to concentrate impurities
- Roaster concept based on dry or slurry feed to achieve autothermal conditions

Benefits

- Process optimized for cobalt recovery
- No additional fuel required even with low sulfide levels in concentrate
- Operates with ambient air, with no need for an oxygen plant
- Increased profitability for small and medium sized plants

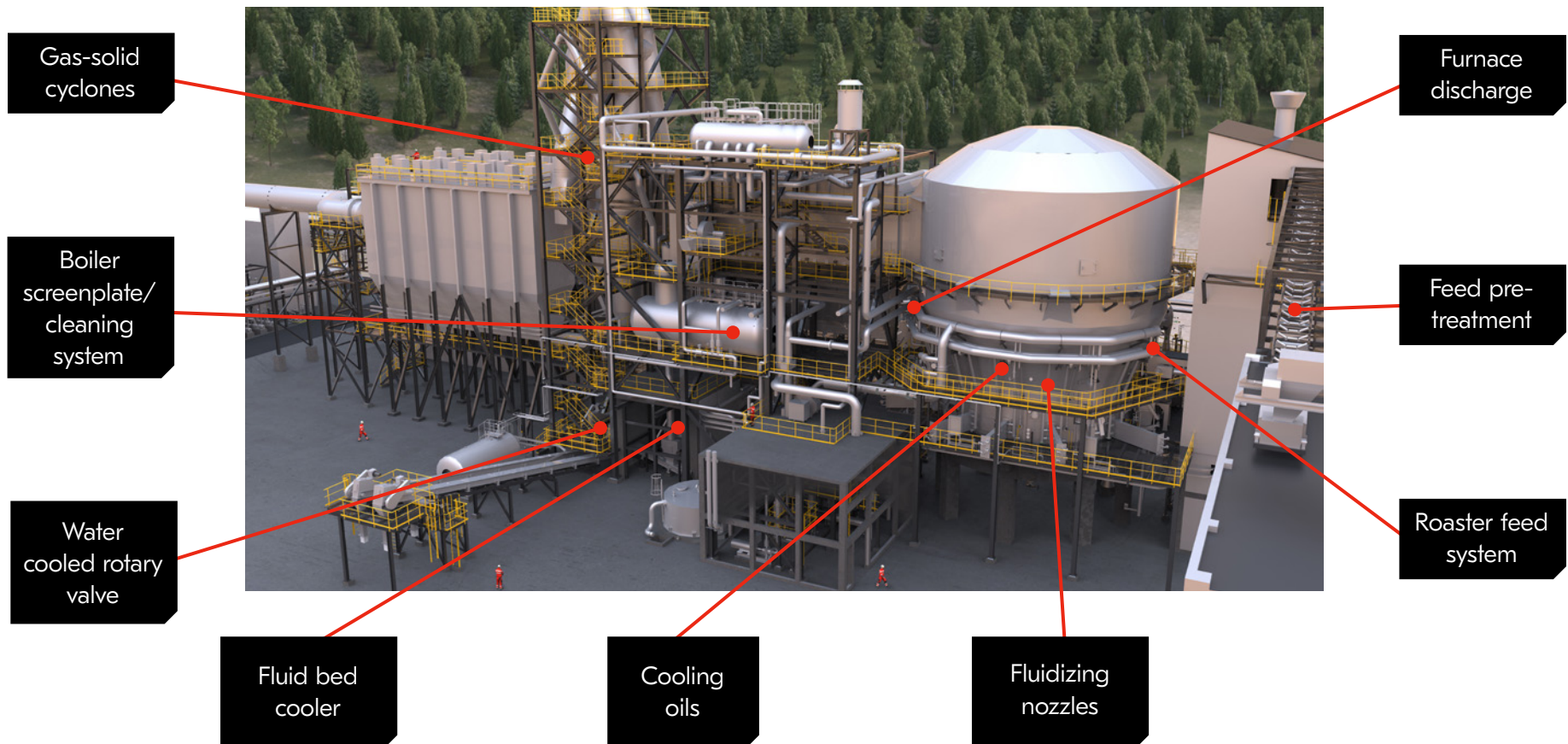
Sulfating roast is generally used for processing copper/cobalt concentrates in combination with electrowinning. The copper sulfide is transformed into water-soluble copper sulfate and the iron sulfide into insoluble iron oxide. Standard sulfating roasters run with a slurry feed and do not require a waste-heat boiler system in the off-gas stream.

The produced roaster off-gas has a lower SO_2 concentration than compared to other roasting processes, but still high enough to be treated in a stand-alone or integrated into an existing sulfuric acid plant.

Plant upgrades and proprietary equipment

Over recent decades Metso Outotec has built up an impressive palette of roaster plant upgrades based on feedback from the industry and to counter the aspects of declining ore grade feed to the plant. These standalone products and intimate knowledge of the process plant enable the roaster to meet the operational KPIs demanded of it in the future.

The plant equipment upgrades usually entail a review of the plant design basis, enshrine the future expectations of the operator and are backed by Metso Outotec, who are still pushing the design boundaries of this key pyrometallurgical solution.



Digital tools to improve safety, efficiency and productivity

The driving forces behind and benefits of digitalization are common across all industries. Demands for improved efficiency and productivity, predictive analytics capability for equipment failure prevention and improvements in environmental compliance.

Typically, large amounts of data are collected and made available through existing plant instrumentation, but operators lack tools that enable them to fully analyze the data to observe operating trends or identify potentially hazardous situations.

Adequate training is key to safe and efficient plant operation. Our plant simulators are used to improve and speed up training of plant operators, as well as provide them with a deeper understanding of processes.

Benefits

- Compare theoretical versus actual KPIs
- Online monitoring and analysis of actual KPIs
- Identify potential causes of process disruptions
- Increase plant operators' awareness of potentially hazardous situations
- Simple, intuitive system





Life cycle service solutions

Our sustainable and reliable life cycle solutions are tailored for your specific application and help to ensure that you get the best return on your investment. You benefit from unparalleled expertise that you can rely on to maximize equipment performance, environmental efficiency, reliability, and safety. Our goal is to help you optimize total cost of ownership, minimize equipment downtime, and maximize production efficiency.

We offer a comprehensive range of services that can be combined into a tailored solution to meet your precise requirements and asset needs, including spare and wear solutions, maintenance and operational services, shutdown project services, modernizations, and a wide range of off-the shelf and customized training services.

Further information:

