

Metso

Hydrometallurgical technologies

Benefits

- High recovery
- Low operating costs
- Low maintenance need
- Easy to control
- Low investment cost
- Flexibility and adaptability



Metso is known for its innovative hydrometallurgical technologies. Our expertise extends from laboratory testing through proven technologies to unbeatable service and support. We collaborate with our customers to ensure that they receive the complete hydrometallurgical technology solution.

Metso offers solutions covering a wide range of processes from leaching, purification and solvent extraction to metal production for various metal products such as copper, zinc, nickel, precious and special metals. In addition, our technology transfer packages include proprietary equipment, automation and services.



The best solutions for your process

Metso has a long track record in hydrometallurgy. We have experience both as technology provider and as plant operator. Thanks to such diverse know-how, you can be sure of receiving the most reliable and optimal solution.

Metso provides world-leading technologies, technology selection expertise based on laboratory test programs, feasibility studies, basic and detail engineering, technology specific equipment supply, training, erection supervision, start-up assistance, and follow-up and technical support services.

We strive to build long-term cooperation with our customers to ensure that they receive the very best solution for their operating environments, as we know that every plant is unique and has its own raw materials and requirements.

Furthermore, thanks to our extensive process and equipment know-how, we are able to provide you with process guarantees.

Metso offers you

- Innovative and proven technologies
- Laboratory and pilot tests
- Feasibility studies
- Basic and detail engineering
- Proprietary and key equipment supply
- Commissioning and start-up services
- Process automation
- Spare parts
- Shutdown maintenance services
- Process guarantees



Metso offers start-up assistance and training.

Metso etiquette

Metso is known for its innovative hydrometallurgical approach. A vast number of our processes has been patented, with the continuous research, experience and incentive of our personnel ensuring new improvements and innovations.

Environmental awareness and protection are also important features of all Metso technologies. We make effective use of raw materials and aim to reduce water and energy consumption. The production of residues is minimized, and the residues that are unavoidable for the process are stable or re-usable. Consequently, environmental protection is an integrated feature of our technologies.

Metso offers you the Best Available Technology, complying with local environmental requirements and the applicable legislation.

Tailored solutions through research and development

To begin, we analyze the customer's raw materials and needs as the basis for creating a process solution. We complete the process by proving the optimized performance. All of this is done with the aim of constructing the most economical solution for you.

Metso's unique research centers comprise state-of-the-art research facilities capable of piloting plants from bench to industrial scale. We also perform mineralogy studies of the customer's raw material and feedstock.

In addition to working in our modern research centers, we work closely with universities in developing and improving our technologies.

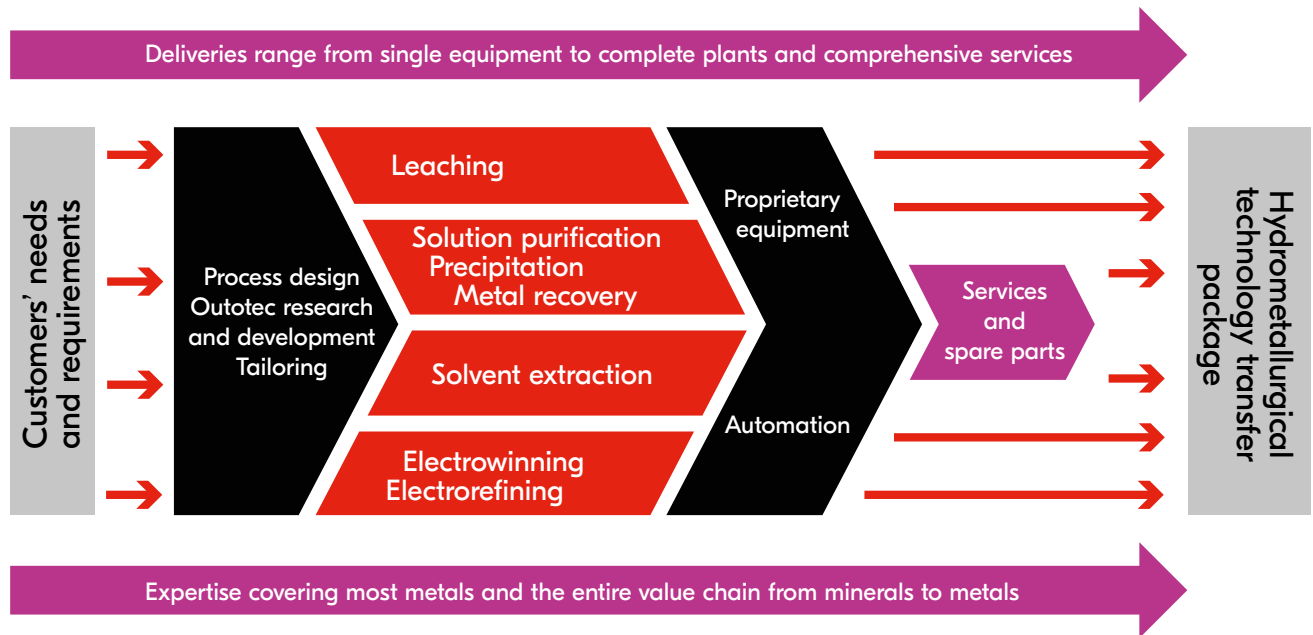
We tailor our standard processes, or make a new tailored process according to your process needs. In our projects, we use 3D computer aided design. This not only enables you to visualize the plant more clearly, but also improves the efficiency of project implementation.

Furthermore, we utilize our groundbreaking Chemical Reaction and Equilibrium Software, HSC Chemistry® in our process simulations.

Collaboration with customers is an important part of Metso's technology development, and several joint development projects have been performed with customers in various fields of hydrometallurgy.



At our research centers, we analyze our customers' raw materials. Metso has the expertise and resources to design and develop hydrometallurgical processes.



Metso offers a total solution from a wide range of processes that can be customized to fit your needs.

Versatile leaching methods

At Metso, we provide versatile leaching methods suitable for your plant: from chloride to sulfate leaching and from atmospheric to pressure leaching. Our metallurgical knowledge and experience enable us to optimize design, process conditions and equipment. We can ensure that metal recovery is high despite limiting parameters.

Metso offers you leaching solutions for greenfield and brownfield plants. The flexibility and adaptability of our technologies ensure that our solution fits your requirements.

Health and safety issues are essential elements of Metso leaching technologies. We ensure that our technologies are easy to control and have a low maintenance requirement. Due to the importance of ferric content, acidity and various metal contents, OTI™ titrators can be implemented, either with or without the Courier® analyzer, to obtain more accurate results. Metso's leaching methods offer you an economically viable solution, which produces high-yield products efficiently.



Leaching technologies provided by Metso:

Zinc

- Zinc concentrate direct leaching
- Zinc oxide leaching
- Zinc calcine acid leaching
- Zinc calcine neutral leaching
- EAF dusts
- Zinc ore pre-treatment

Copper

- Copper ore leaching
- Copper concentrate leaching
- Copper matte leaching
- Copper fines leaching
- Copper FSF flue dust treatment
- Copper upgrade/pre-treatment
- Copper concentrate chloride leaching – HydroCopper®

Nickel

- Nickel concentrate autoclave leaching
- Nickel matte autoclave leaching
- Nickel laterite leaching
- Nickel EF and FSF matte leaching
- Nickel ore leaching/pre-treatment
- Tails leaching

Other examples

- Cobalt leaching
- Gold leaching
- Arsenic leaching
- Silver leaching
- Molybdenum leaching
- Manganese leaching
- Synthetic rutile leaching

Metso provided Cobre Las Cruces S.A. with a new atmospheric direct leaching process. To ensure high yields, low operating costs and the flexibility Cobre Las Cruces required, Metso built its own miniature copper plant in the laboratory.

This exceptional scale model proved the success of the new atmospheric leaching process beyond doubt. The Cobre Las Cruces plant is scheduled to be up and running in 2009.

Innovative solution purification and metal recovery technologies

Metso solution purification and metal recovery technologies have been successfully implemented worldwide. We provide sulfide precipitation, oxidative precipitation, neutralization, cementation and reduction technologies. Our precipitation and recovery technology can be fully integrated into the process. We strive to provide environmentally sustainable precipitation processes with the minimal consumption of additive agents.

The immaculate selectivity of Metso's processes ensures that the end product meets the strictest environmental norms. Metso also provides processes for the recovery of precious metals such as silver, gold and platinum. Furthermore, Metso has a wide range of common plant and reagent preparation technologies that further ensure the smooth running of your plant. Through a partnership with Metso, you will get the most out of your process.

Benefits of Metso's purification and recovery technologies:

- High product yield
- Fast kinetics resulting in compact reactor size
- Small footprint
- Low operating costs
- Highly selective
- High filtering properties



Effective solution purification and recovery technologies:

Iron removal

- Jarosite precipitation
- Hematite precipitation
- Goethite precipitation

Sulfide precipitation

- Copper sulfide
- Zinc sulfide
- Nickel sulfide
- Cobalt sulfide
- Iron sulfide
- Cadmium sulfide
- Selenium sulfide
- Antimony sulfide

Cementation

- Copper precipitation
- Chloride precipitation
- Cobalt precipitation
- Nickel precipitation
- Cadmium precipitation

Special recovery methods

- Hydrogen reduction

Neutralization

- Metal sulfate precipitation

- Metal hydroxide precipitation
- Metal carbonate precipitation
- Iron polishing

Other

- Indium recovery
- Gypsum removal
- Effluent treatment
- Magnesium bleed treatment
- Scrubber treatment

Common plant and reagent preparation

- Arsenic oxide preparation
- Lime milk preparation
- Flocculant preparation
- Zinc powder preparation
- Process water system
- Cooling water system
- Sealing water system

Metso provided Zhuzhou Smelter Group Co. with purification technology for its zinc plant in China. The technology design for this solution took the plant's urban location, existing process conditions and demand for a high-yield product into account. Metso equipment was implemented at the plant in 2008.



Benefits of VSF® technology:

- Minimum operating costs
- Flexibility
- Scalability
- Reliable and stable production



Metso has successfully implemented VSF® technology in Escondida, Chile. VSF® technology enables minimal entrainment levels without compromising reaction and settling rates, which has helped Escondida to obtain the world's largest train PLS flow capacity, over 5,000 m³/h/train.

Proprietary solvent extraction

Metso's unique and proven solvent extraction technology provides groundbreaking solutions for metals such as copper, nickel, zinc, cobalt, uranium, magnesium, calcium and manganese.

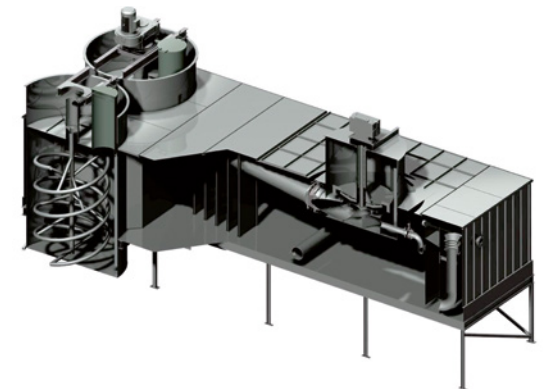
Our vertical smooth flow, VSF®, solvent extraction technology is the forerunner in the industry. It includes a DOP® dispersion overflow pump, SPIROK® mixers and a proprietary settler design including DDG® separation fences.

Since launching the VSF® technology more than a decade ago, Metso has become the leading provider of solvent extraction solutions. Over thirty copper plants have chosen Metso VSF® technology.

The basic idea behind VSF® technology is to have smooth agitation throughout the SX plant, in order to avoid the oxidation of organic material and the development of overly small droplet sizes in dispersion. Our SX plants can be run in widely varying conditions and our VSF® technology is suitable for plants of all sizes.

Solvent extraction settler design

- **AutoCompact™** is used to minimize the footprint and to simplify the flow sheet of an SX-EW plant
- **AutoTrack™** configuration is an option when the pregnant leach solution (PLS) tenor varies/drops
- **AutoReverse™** has in and out flow connections located on one side of the settler, which in certain cases lowers investment costs



Our **AutoCompact™** mixer-settler technology unit for cobalt, nickel, zinc and manganese production is suitable for train PLS flows ranging from 1 m³/h to 300 m³/h.



Advanced electrowinning and electrorefining plants

Electrowinning

Our continuous research and development work on tankhouse equipment and processes, as well as our own production experience, have led to a range of impressive new technology developments, specially designed for high performance and cost-efficient cathode production. Environmental protection and occupational health and safety are important aspects of our development work.

Metso is the right partner for building an efficient, productive and safe electrowinning plant with optimized cathode and cell sizes, current densities, busbars, and an automatic material flow of cathodes.

Electrorefining

Metso electrorefining technology covers all process steps in a copper refinery. We provide the tankhouse with an unbeatable combination of electrode handling system and innovative process technology including permanent cathodes. In addition to refining of copper, Metso has the leading technology for precious metals recovery from anode slimes.

Metso electrorefining-tankhouse packages include:

- Permanent cathodes
- Stripping machines
- Anode preparation machines
- Anode scrap washing machines
- Tankhouse cranes
- Polymer concrete cells
- Busbar systems
- CellSense™ system
- Automation system
- Precious metals plants
- Tankhouse Information Management System (TIMS)

Metso electrowinning-tankhouse packages include:

Copper

- Cathode stripping machines
- Permanent cathodes
- Lead anodes
- Tankhouse cranes and bales
- Polymer concrete cells
- DoubleContact™ busbar system
- Acid mist capture systems
- CellSense™ systems
- Process automation

Zinc

- Cathode stripping machines
- Anode cleaning machines
- Cellhouse cranes
- Aluminium cathodes
- Water-cooled busbars
- Highly efficient cooling towers
- CellSense™ systems
- Process automation

Nickel

- Cathode stripping machines
- Starting sheet machines
- Mother blanks
- Polymer concrete cells
- Busbar system
- Tankhouse cranes
- CellSense™ systems
- Process automation



Completing the technology transfer package with proprietary equipment

The technology transfer package combined with Metso proprietary equipment ensure smooth process operation by eliminating unnecessary bottlenecks and shutdowns.

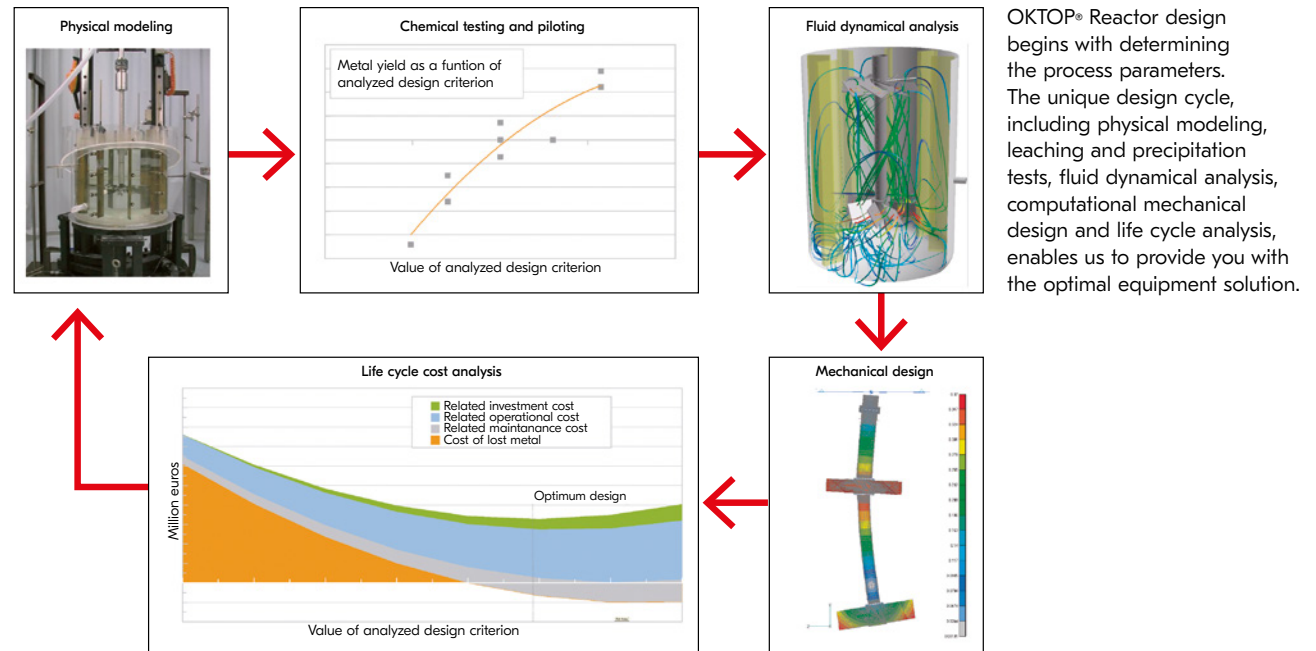
Metso equipment solutions are made to optimize metallurgical results and to ensure reliable operations. Metso's equipment are designed to be the most economical solutions for the entire lifetime of your plant. Furthermore, we can guarantee equipment performance.

Metso proprietary equipment include OKTOP® Reactors, OKTOP™ Cooling Towers, scrubbers, SUPAFLO® thickeners, TankCell® flotation cells, cathode stripping machines, permanent cathodes, bales, DOP® pumps,

SPIROK® mixers, settlers and DDG® separation fences. Metso has installed hundreds of reactors for a range of hydrometallurgical applications, from leaching to precipitation.

We tailor our proprietary equipment according to the customer's process requirements. We utilize our experience and expertise from numerous implementation projects in customizing our equipment to your process conditions.

A complete technology transfer package with proprietary equipment from Metso ensures that you get a coherent process with a maximal financial return.



OKTOP® Reactor Family

OKTOP® Reactor 1000 Series



Multipurpose OKTOP® Reactor is suitable for a wide range of hydrometallurgical applications due to high configurability and infallible functioning. Metso has a number of successful implementation references.

Benefit: Number of references and reliable operation.

OKTOP® Reactor 2000 Series



Gas-liquid-solid OKTOP® Reactor is specially designed for three phase processes where gas dispersion rate is the limiting factor of the reaction rate.

Benefit: High gas utilization rate not only lowers equipment investment costs, but also increases savings in gas compression production and scrubbing costs.

OKTOP® Reactor 3000 Series



Low shear OKTOP® Reactor is specially designed for low shear applications. The reactor enables uniform energy distribution and very efficient axial flow. The self-supporting structure increases fatigue resistance.

Benefit: Lower operating costs due to lower energy requirements.

OKTOP® Reactor 4000 Series



Helical OKTOP® Reactor is specially designed for uniform and non-abrasive mixing.

Benefit: Better product recovery in quantity and quality. Cuts on solid separation investment and operation costs. Furthermore, it is highly available in maintenance intensive gypsum processes.

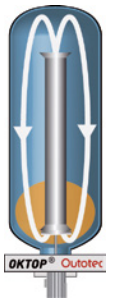
OKTOP® Reactor 5000 Series



Vertical fluid flow OKTOP® Reactor is specially designed for particle diffusion rate limited leaching processes. It achieves maximal agitation power and exceptional gas-mass transfer as well as excellent solid suspension properties.

Benefit: In challenging applications it may be the only option for receiving viable leaching yields atmospherically and in less challenging applications it allows lower total operating cost due to lower grinding and filtration costs.

OKTOP® Reactor 9000 Series



Special OKTOP® Reactors are applicable for unique applications which require totally individual approach.

Benefit: Specially designed for its application. Novel approaches possible. All the benefits and advantages are case specific.

OKTOP™ Cooling Towers

Metso has developed a new cooling geometry solution in its cooling towers by applying a horizontal gas flow exit and demisters based on computational fluid dynamics (CFD) and plant testing. The unique top structure enhances effective cooling.

The OKTOP™ Cooling Tower is categorized into series according to the cooling effect. We supply cooling towers for processes requiring minor cooling duties, such as chloride removal, or for processes with large cooling requirements, such as cooling in zinc electrowinning.

OKTOP™ Cooling Towers offer you immense benefits. Our cooling towers have a more compact size than conventional cooling towers.

Thanks to the horizontal demister technology, emissions into the environment are clearly lower than for conventional technology. In addition, the horizontal demister technology allows double air flow rate through the tower, which reduces the number of required cooling towers, lowering cooling process investment cost.

Moreover, the exceptional top structure enables easier access for housekeeping, which can be applied even when the tower is in use.



Stable process operation with Metso automation

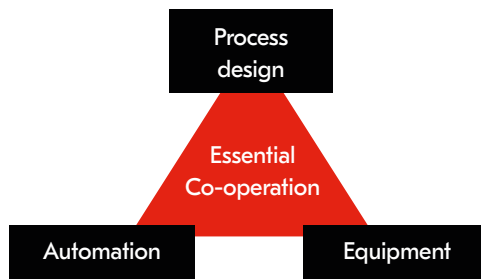
Our vast experience tells that a close link between process and automation design is vitally important to ensure a smooth process operation.

The important aspects of automation in hydrometallurgical processes are the ability to stabilize processes and gain an overall view of production. Our automation solution provides a long and short-term view of all processes. Safety issues with respect to operation, equipment, the environment and personnel are improved in an easy and convenient manner.

These benefits are gained with smooth equipment performance and ensuring that the consumption of additive agents and chemicals is diminished and variables such as impurity levels, process temperatures and element

balances are fully controlled. PROSCON® Hydro is a process automation package for transferring our knowledge and experiences to our customers. The application includes a process control system, process instrumentation and process electrification with all of the required services. Metso uses modern, renowned and respected hardware and software manufacturers.

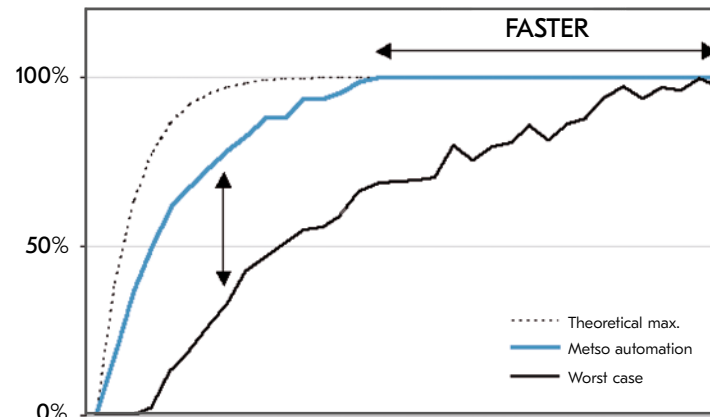
Tankhouse Information Management System (TIMS) is a new and modern data collection, reporting and management system to integrate Metso's material handling machines, CellSense™ monitoring and process control systems. Significant benefits are gained in increasing the energy efficiency, product quality as well as improving maintenance and safety.



Benefits of Metso automation:

- Link between process know-how and automation
- Process operated as designed
- Rapid production ramp-up
- Continuous and stable process
- Automation system pretested before installation at plant
- Smooth equipment performance
- Safety of operation, equipment and personnel
- Easy and convenient operation

Production ramp-up



Metso automation ensures that production ramp-up is performed faster and more effectively, enabling a stable and continuous process.

Automation products by Metso:

PROSCON® Hydro

- Process control system
- Process instrumentation
- Process electrification

Process analyzers

- Courier®
- OTI™ titrators
- Metso sampling systems

Material management system for electrolysis CellSense™ to improve efficiency of electrolysis

Tankhouse Information Management System

Reporting systems



Metso services improve your process performance

Metso's comprehensive technology transfer package can be completed with expert services and support. Our customer service operates through a global network of local units that offers not only assistance meeting the customers' needs but also a commitment to providing advanced customer support whenever needed.

Our service experts provide punctual spare parts logistics, maintenance, training, assessment and consulting services that generate a competitive advantage for you.

We can tailor services efficiently to your specific needs, when considering the necessary operational and maintenance services already from the beginning of the project. As your trusted service partner, Metso ensures an optimized operation for the entire lifetime of your plant.

Equipment services

Obtaining all spare parts and maintenance from the same organization as process and equipment design ensures that your plant runs optimally. We make sure that you receive only the highest quality parts, consumables and upgrades, that can be seamlessly integrated into your plant.

Plant and process support services

Metso's advanced plant and process assessment, ef-X® Efficiency Explorer, identifies the areas for potential improvements, e.g. equipment, automation systems, metallurgical processes and complete plants

What is more, we can make it much easier for you to fulfill current and future legislation, by ensuring that your plant and processes are running as efficiently as possible, and that maintenance is being carried out proactively.

Total service package from Metso:

Equipment services

- Spare parts and spare parts management
- Equipment inspections and maintenance
- Training

Process support services

- Process assessment
- Process control analysis

Plant services

- Plant assessments
- Operation and maintenance support services
- Upgrades and modernizations
- Shutdown maintenance services

Benefits of Metso services:

- Critical original spare parts in stock
- Process and equipment know-how
- Minimize downtime and unscheduled stoppages
- Maximum operating performance

Metso is a frontrunner in sustainable technologies, end-to-end solutions and services for the aggregates, minerals processing and metals refining industries globally. We improve our customers' energy and water efficiency, increase their productivity, and reduce environmental risks with our product and service expertise. We are the **partner for positive change**.

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