
TOMRA
SORTING SOLUTIONS
MINING
SOURCE
INTO
RESOURCE
Sensor-based ore sorting since 1988
English

WORKING UNDER HARSH CONDITIONS

Lower-grade ore reserves, higher energy and production costs, water shortages and increasing environmental regulations: these are the challenges facing the mining industry. Challenges that call for a reliable and innovative partner and for technology tailor-made for mining.

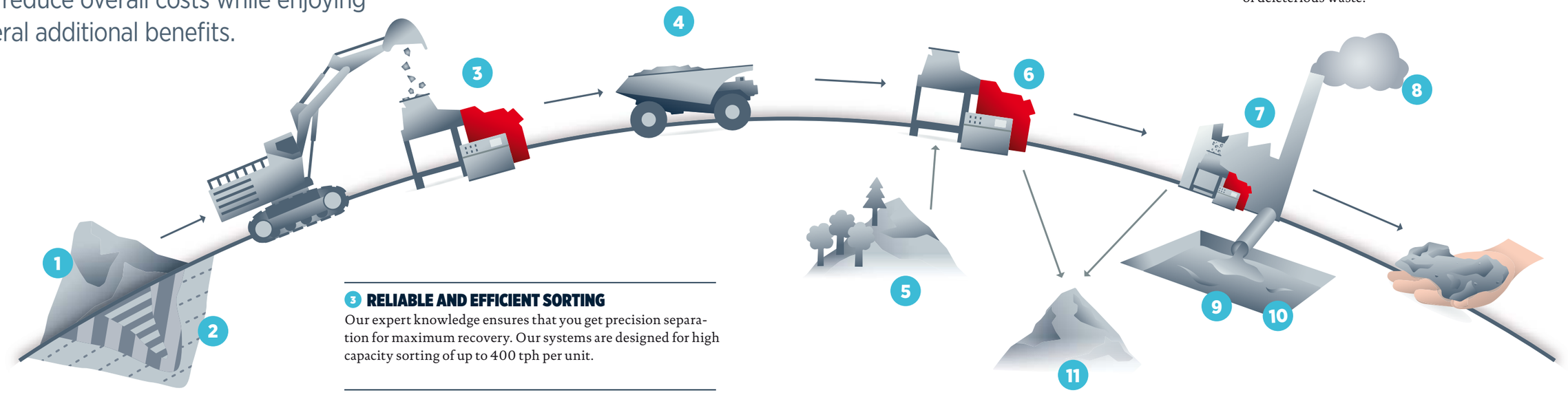
DOWN TO EARTH

For more than 20 years we've put all our efforts into engineering cutting-edge technology that daily proves in harsh mining environments. Our experience and commitment to quality and customer-driven innovation have made us world market leader in sensor-based ore sorting. As a trusted supplier with more than 200 installations around the world, TOMRA Sorting Mining continues to seek out and expand options for the beneficiation of ores and minerals.

As a member of the Oslo stock listed TOMRA Group (OSEBX:TOM) with 2200 employees, we are part of a strong, globally active company. TOMRA Sorting Mining, which originated from CommodasUltrasort, sets the bar for sensor-based sorting with its rigorous focus on quality and future-oriented thinking.

SENSOR-BASED TECHNOLOGY CREATES VALUE IN VARIOUS PARTS OF THE MINING PROCESS

Our sensor-based sorters make it possible to significantly increase the efficiency and lifetime of a mining operation. Integrating our machines into your beneficiation processes improves the whole system at various stages. You can increase output and product quality and reduce overall costs while enjoying several additional benefits.



1 DECREASE YOUR MINING COSTS

Mine development costs and mining costs can be significantly brought down by reducing dilution with sensor-based sorting.

2 INCREASE YOUR DEPOSIT EXPLOITATION AND LIFE-OF-MINE

Your life-of-mine can be significantly increased by exploiting diluted and lower-grade mining blocks.

3 RELIABLE AND EFFICIENT SORTING

Our expert knowledge ensures that you get precision separation for maximum recovery. Our systems are designed for high capacity sorting of up to 400 tph per unit.

4 DECREASE YOUR HAULAGE COSTS

Reducing the amount of transported material significantly decreases not only your transportation costs but your carbon footprint as well. The capacity you free up can be filled with additional production.

5 RECLAIM OLD WASTE DUMPS

Many waste and mine development dumps are marginal reserves. By implementing sensor-based sorting, dumps can be effectively treated—and value recovered—at low costs.

6 DIVERT YOUR ORE TYPES

You treat different types of ore in the same plant? Our sorters allow you to separate different lithologies, significantly increasing recovery.

7 INCREASE PRODUCTION

Overall production can be significantly increased by rejecting waste before it enters your plant. At the same time, your specific capital expenditures and operating costs decline while your overall recovery increases through the efficient rejection of deleterious waste.

8 REDUCE ENERGY CONSUMPTION

By rejecting hard and abrasive waste before it gets to the mill or the pebble circuit, you decrease your specific energy consumption and carbon emissions, contributing to a more sustainable mining operation.

9 REDUCE WATER CONSUMPTION

Using dry sensor-based sorting technology reduces your specific water consumption, which reduces competition with other stakeholders like farmers and eases licensing.

10 REDUCE THE AMOUNT OF FINE TAILINGS

Fine tailings have a high reactive surface and dams are expensive to maintain, especially when space is limited. The specific amount of fine tailings dumped is reduced, minimizing overall surface impact.

11 SELL A COARSE PRODUCT

Sensor-based sorter products often achieve final product specification at low costs. Once separated, coarse waste can be sold as aggregate to local markets, offering an additional source of revenue and maximizing your profits.

GETTING EVERYTHING SORTED

Our variety of sensor-based sorters offer specialized solutions for various minerals and rocks, particle sizes and sorting tasks. Robust designs derived from many installations ensure easy operation and high availability: the removal of low value or hazardous waste increases the recovery and productivity of your operation while decreasing your specific costs.

INDUSTRIAL MINERALS

Contaminant removal: Contaminants can be removed at an early stage in the beneficiation process, further reducing crushing and classification costs and increasing recovery.

Product upgrade: Higher final product quantity at increased quality can be achieved, increasing revenue.

SLAG

Free metal recovery: The effective separation of non-magnetic liberated metallic particles increases revenue while keeping costs low.

Disseminated metal concentration: Concentrating metal-containing slag particles before crushing and jigging protects crushers at low cost.

Disseminated metal removal: A decrease in metal content through effective sensor-based sorting enables the sale of safe slag products as aggregates and grinding media.

FERROUS METALS

Low-grade removal: Separating coarse low-grade material before it enters the comminution and beneficiation processes significantly decreases costs and increases productivity.

Lumpy ore production: The effective creation of a lumpy product at low costs with flexible plants results in improved cash flows and high margins.

COAL & OTHER FUELS

Dry, cost effective ash removal: Sensor-based sorting is a flexible, cost-effective dry-processing technique that can be applied to tasks like de-stoning coarse raw coal in pit.

Heavy-metal removal: The detection technology enables the discrimination and separation of pyrite and heavy metal inclusions from coal.

GEMS

High recovery: Our sorters find more gems including coated and low/non-luminescent diamonds. Large diamonds can be recovered prior to the secondary and tertiary crushing stages.

Effective concentration: Cost-effective and precise concentration of kimberlite prior to liberation and recovery increases productivity and decreases costs.

NON-FERROUS METALS

Waste rejection for increased productivity: Low-grade material is separated so that the beneficiation process is applied only to higher-grade material. This increases the mining rate and recovery, significantly increasing productivity.

Contaminant removal: The effective removal of contaminants impeding the flotation or leaching processes accelerates recovery and thus increases revenue.

WE GUIDE YOUR PROJECT STEP BY STEP

Can sensor-based sorting solve my sorting task? How can I ensure that the system works in my environment? TOMRA Sorting Mining supports your projects, advising and accompanying you from the concept phase to your own perfectly functioning solution.

PROCESS CONSULTANCY

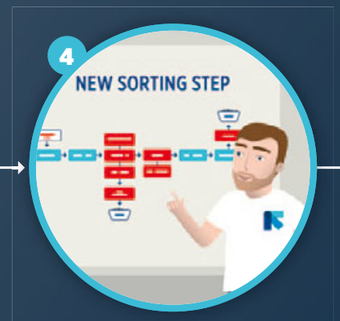
Our experienced mining experts calculate the technical and financial potential of sensor-based sorting for your process.

SINGLE ROCK TESTING

We select the optimal solution for your sorting task by testing your single rock samples with various sensors from our wide portfolio of advanced recognition technologies.

INDUSTRIAL SCALE BULK TESTING

Our application engineers test your bulk samples in our test center on an industrial scale sensor-based sorter that is equipped with the selected sensors. To determine the best possible configuration under authentic operating conditions, we carry out tests with different throughputs and size ranges.



SENSOR-BASED SORTING/ FLOW SHEET DESIGN

Based on your objectives and the project environment, we design the optimal sorting process for your project, integrating one or more machines.

PILOT TESTING

We can provide containerized systems, application engineers and operators for onsite large-scale feasibility studies that won't affect your running processes. As the installations run on electrical power and require little infrastructure, they can also be provided as semi-mobile solutions.

PROJECT EVALUATION

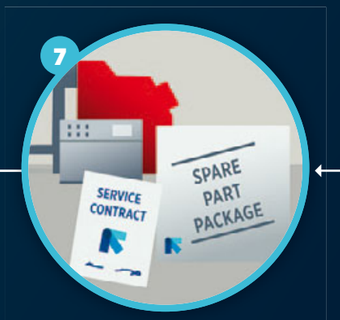
Based on the test results, we analyze how integrating a sensor-based sorting step affects your entire process and check whether alterations to the design flow sheets are necessary.

FULLSCALE PRODUCTION PLANT

Our project managers consult and assist in designing the optimal sorting process and ensure the smooth integration of one or several machines into your plant.

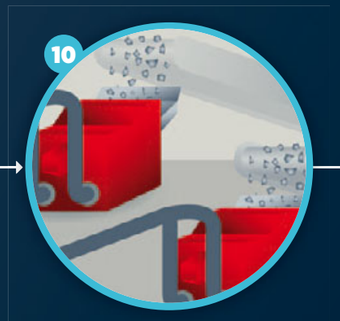
CONCLUSION OF CONTRACT

Based on your requirements, the test results and the flow sheet, we create an offer tailored to your special case. We guarantee that the test results will also be achieved onsite.



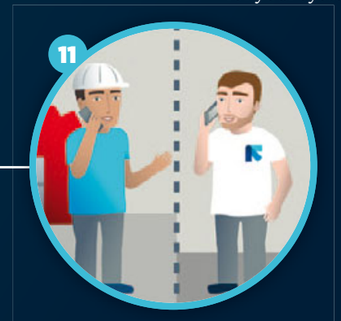
TAILORED PACKAGES

We provide you with a tailored package including machinery, delivery, spare parts, onsite training and first-class after-sales service. You also can take advantage of different service contracts that provide dependability for your system.



COMMISSIONING AND OPERATOR TRAINING

Our service engineers commission the sorting equipment and carry out functional testing. Sorting performance is optimized once the plant is set up. Our experts will train your staff in basic maintenance and proper operating procedures to ensure that your system runs at the highest performance level at all times.



AFTER SALES SUPPORT

We have established an international service network with multiple locations around the world and can assist you remotely or onsite in a minimum of time.

HIGHER YIELDS, LOWER COSTS, MORE VALUE

Our sorting machines aren't just the most efficient way to sort your coarse particles, they're also a smart way to invest in your business and increase your productivity, yield and quality.

OTHER BENEFITS

HIGHER RECOVERY

Our sorters offer many more separation criteria than conventional coarse particle separation technologies. The proven technology enables the sorting of a large range of particle sizes. Using TOMRA Sorting systems, for example, it is now possible to detect and effectively extract coated and low/non-luminescent diamonds, which elude conventional methods.

EASE OF USE

We design user-friendly, reliable and low-maintenance machinery. Our systems are robust and wear is limited to a small number of parts so that it's easy for your personnel to perform basic maintenance onsite. A secure modem connection enables online system inspection and software downloads.

COMPACT FOOTPRINT

TOMRA's sensor-based sorters are specifically designed to meet the uptime and robustness requirements of the mining industry. We make sure that they have a compact footprint and are easy to integrate into your processes.

LESS ENERGY AND WATER CONSUMPTION

Sensor-based sorters are cost-effective, as they require no chemicals and little water and no expensive water treatment system. They can reduce the specific energy consumption of your mills by up to 15%.

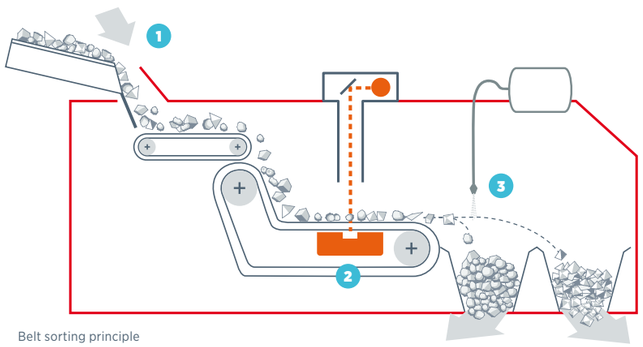
HIGH PERFORMANCE UNDER HARSH CONDITIONS

TOMRA Sorting systems are designed for high performance in nearly all weather conditions—wet, dry or freezing conditions hardly affect sorting efficiency.

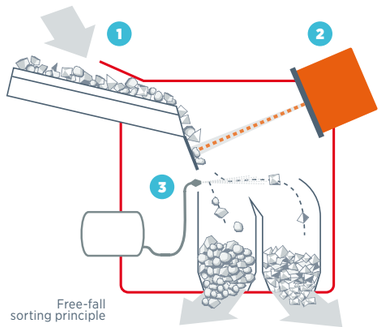
HOW DOES IT WORK?

SORTING PRINCIPLE

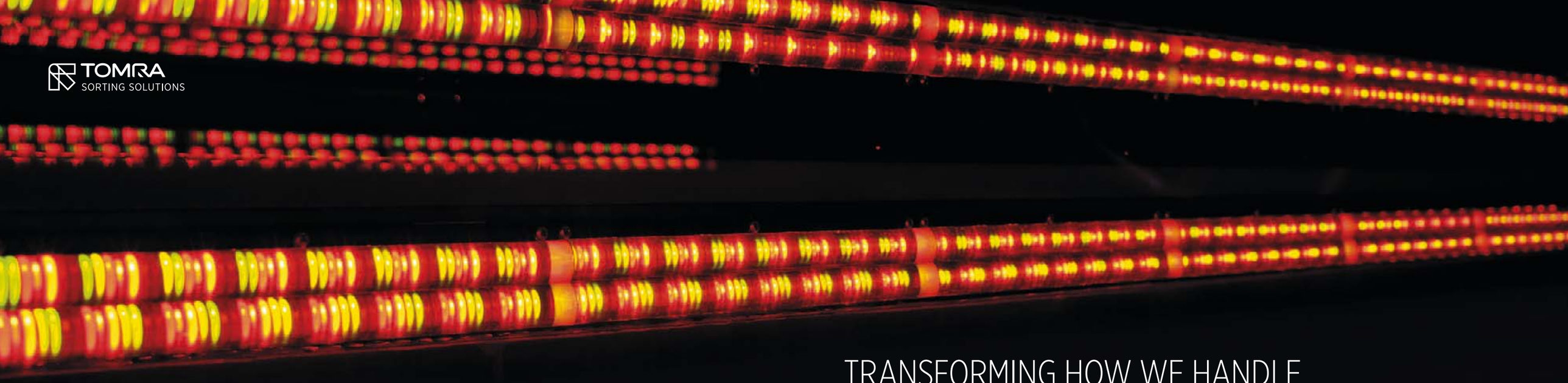
The unsorted feed material (1) slides down a chute or is transported on a belt and then scanned by our high-tech sensors (2). A few milliseconds later, the valuable mineral-bearing rock is selectively ejected into the separation chamber by a precise and powerful burst of air from the high-performance nozzle system (3), regardless of whether it's a small diamond or a heavy lump of iron ore.



Belt sorting principle



Free-fall sorting principle



At TOMRA, our mission is:

TO CREATE SENSOR-BASED SOLUTIONS FOR OPTIMAL RESOURCE PRODUCTIVITY

TOMRA Sorting Mining is part of TOMRA Sorting Solutions, the global pioneer in sensor-based sorting for the mining, food processing, recycling and other industries. Our extensive expertise in different industries allows us to provide you with a broad range of advanced sensors with detection technologies for identifying and separating a wide variety of materials, such as ores, minerals, metals, plastics, paper, fruit, vegetables, nuts, dried fruit and more. You benefit from the power of our shared research and development. By combining proven and versatile technologies, TOMRA Sorting Solutions gives you access to new applications and new business opportunities.

TRANSFORMING HOW WE HANDLE THE WORLD'S RESOURCES

In these industries, sensor-based sorting can be a game changer:

+ Revenues can be significantly increased by the increase in purity, capacity, and yield.
+ Costs are reduced simultaneously by reductions in labor requirements, energy consumption, and wear and tear.
+ Less environmental impact as well as increased and consistent quality of the product are just two of the main benefits of this technology.

SUPERIOR SENSOR-BASED DETECTION

TOMRA Sorting Solutions provides a broad portfolio of cutting-edge sensor technology. Its versatile combination offers solutions for almost every sorting task in the mining industry.

XRT (X-RAY TRANSMISSION)

X-ray transmission technology enables materials to be recognized and separated based on their specific atomic density. This technology makes it possible to obtain a high purity level in sorting materials regardless of surface moisture or dust coating.

Typical application: It can be used to recover large coated diamonds before secondary crushing.

NIR (NEAR INFRARED)

Our near-infrared spectrometry sensor recognizes materials based on their specific and unique spectral properties of reflected light in the near-infrared region of the electromagnetic spectrum.

Typical application: It can be used to discriminate between calcite and magnesite, which can be difficult to detect with the human eye or standard cameras.

COLOR RECOGNITION

Our color cameras identify materials based on their color. Their capabilities go beyond the visible spectrum and include infrared, ultraviolet and other spectra.

Typical application: Our color sensors allow the precise discrimination of low grade and contaminant particles for talc, phosphate and many other applications.

EM (ELECTROMAGNETIC SENSOR)

The highly sensitive EM sensor sorts materials like nickel ores and metal slags based on electromagnetic properties like conductivity and permeability.

XRL (X-RAY LUMINESCENCE)

XRL technology detects materials based on their atomic characteristics.

Typical application: It can be used to recognize diamonds by their visible fluorescence.

PHOTOMETRY

The photometric (PM) sensor system is based on our monochromatic laser attenuation and photo multiplier reflectance measurement technology. The PM sensor sorts based on color, structure, size and shape differences. It is used as a supplementary detector to compliment other sensors in order to distinguish the particles from the background.

RADIOMETRY

This technology recognizes uranite and other naturally radiating ores based on their natural gamma radiation.

XRF (X-RAY FLUORESCENCE)

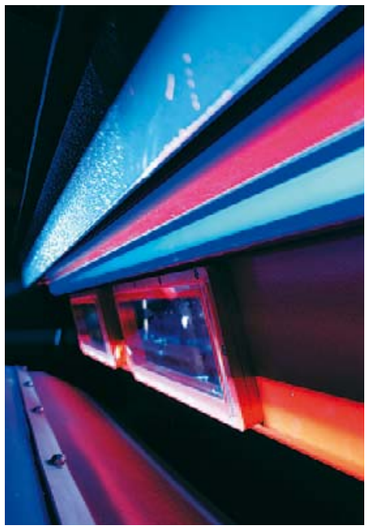
X-ray fluorescence technology detects materials by their atomic characteristics.

Typical application: The sensors can be used to detect metal ores.

VIS (VISUAL SPECTROMETRY)

Much more sensitive than the human eye, the VIS sensor is able to recognize all the colors in the visible spectrum for transparent as well as opaque objects.

Typical application: VIS is used for upgrading industrial minerals.



CASE STUDY

Benefits of Waste Rock Reduction

Preconcentration of tungsten due to sensor-based sorting.

Tungsten plays a large and indispensable role in modern high-tech industry. Up to 500,000 tons of raw tungsten-ore are mined each year by **Wolfram Bergbau und Hütten AG** in Felbertal, Austria, which is the largest scheelite deposit in Europe.

With the installation of TOMRA Sorting technology, Wolfram Bergbau und Hütten took multiple steps towards increasing its production efficiency. TOMRA Sorting was chosen based on intense on-site testing. Since WBH requires a head grade of more than 0.3% for the plant to be economically viable, TOMRA Sorting provided a machine, tailored to the customers needs. Using X-ray transmission (XRT) sensing technology, it's now possible to detect scheelite inclusions and to selectively separate mineralized ore from the huge amount of worthless stone. Wolfram Bergbau und Hütten was so pleased with the initial success that they installed a second XRT based ore sorter.

"This solution was a milestone. The result is a greater concentration of tungsten from the same run of mine", explains mine manager Felix Gaul. "Now much less material needs to be ground and floated. That saves energy, chemicals and water." 80,000 to 120,000 tons per year do not need to be processed and disposed as fine tailings into settling ponds with limited capacity. The XRT-sorted waste rock can instead be sold as aggregates for road construction.

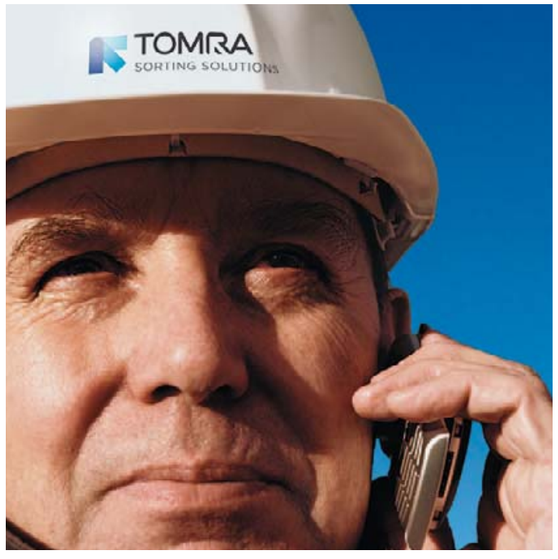
Since Wolfram Bergbau und Hütten was entering a complete new area of technology, the company was highly concerned with the issue of trust. The security fostered by having knowledgeable and experienced engineers on hand strengthened that sense of trust. "It has always been a pleasure working with the TOMRA Sorting team", says Felix Gaul.

TOMRA
SORTING SOLUTIONS

FIRST-CLASS CUSTOMER SERVICE, WORLDWIDE AVAILABLE

Having the best systems in the world is not enough without a dedicated service team to keep them running in top condition.

TOMRA Sorting Solutions provides a worldwide network of service engineers with in-depth experience in the mining, food and recycling industries. With extensive experience from servicing hundreds of comparable machines, our experts can accurately configure and adjust our high performance systems, ensuring maximum output and trouble-free operation. Our tailor-made service contracts ensure that your machine delivers the best performance over long periods, reliably contributing to the profit of your organization. We also provide special training courses so that it's easy for your employees to perform basic preventive maintenance onsite. Our mining engineers train your staff in proper operating procedures, preventive maintenance and troubleshooting because we know that tackling small problems the moment they arise is the best way to keep your business running smoothly. And when you need it, our first-class customer service department, supported by a network of local service engineers, is ready to offer the best aftersales service possible. We also offer assistance via remote access or direct phone. So no matter what happens or when it happens, we're here to help.



TAKE A TEST DRIVE

With more than a dozen test and demonstration centers around the world on each continent, TOMRA Sorting Solutions is at the forefront of hands-on innovation. At each location, our application engineers develop and test sensor-based technology specifically tailored to the mining, recycling, and food processing industries. Our customers benefit from a completely optimized experience—providing an opportunity to test our machines in an environment that simulates their own production processes.

FOCUSED ON MINING

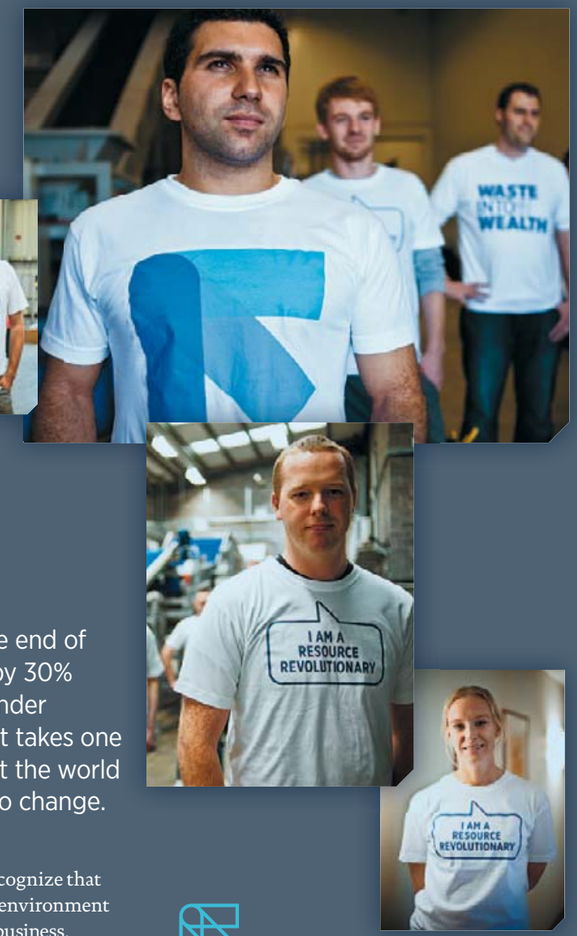
Five of our fifteen test centers are solely focused on mining, each providing different testing possibilities—the center at our mining hub in Hamburg (Germany) and one test center each in Sydney (Australia), Johannesburg (South Africa), Vancouver (Canada) and Moscow (Russia). All of our testing locations are close to international airports, making it easy to get in and out. So when you're ready to put us to the test, we're here to make that process as easy as possible.

TOMRA

FROM PURPOSE INTO PROFITS AND PROFITS INTO PROGRESS, TOMRA IS **TRANSFORMING** WHAT IT MEANS TO BE RESOURCEFUL.

The Resource Revolution is about transforming how we obtain, use, and reuse resources for sustainable economic growth and improved quality of life for all. TOMRA's solutions help our customers increase their financial results and reduce their environmental impact. Together, we are

LEADING THE RESOURCE REVOLUTION.



We know that as a planet, we're running to the end of our leash. The world population will increase by 30% in the next forty years. Global resources are under unprecedented pressure. For example, today it takes one and a half years to reproduce the biomass that the world consumes in just one year. Something needs to change.

Resource productivity and optimization are the best ways of ensuring sustainable development today and in the future. That's why we're focused on transforming how the world obtains, uses, and reuses its precious resources.

From the invention of the world's first reverse vending machine in 1972 to the creation of the most innovative sensor-based sorting solutions today, we are proud to be among the first to recognize that what's better for the environment can also be better for business. TOMRA is now taking an even larger role in leading the Resource Revolution by extending our reach into food sorting, mining, compaction, recycling, and material recovery. The more we collaborate, innovate, and transform together, the more powerful and positive our impact will be on the future.

TOMRA's solutions, in use around the globe, helped keep **20 million tons** of CO_2 from being released into the atmosphere in 2012, equivalent to the annual emissions from **14 million cars** driving 10,000 km. This allows our customers to increase their financial results while reducing their environmental impact.

You are a Resource Revolutionary.

TOMRA Sorting Mining is the world market leader in sensor-based ore sorting. Turning source into resource, yield into usage and profits into progress, TOMRA transforms the way the world obtains, uses and reuses its resources.

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ISO 9001 certified

We print on 100% recycled paper to reduce our carbon footprint. You can reduce yours by using our sensor-based sorting equipment.

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