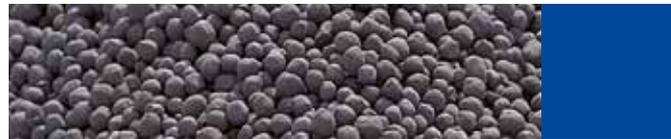


EIRICH TowerMill

Vertical agitated media mill

Energy efficient
Low operating costs
Proven and robust



EIRICH TowerMill

A proven vertical agitated media mill ...

High-growth markets in copper, iron-ore, gold, lead-zinc ores, mineral sands and rare-earth metals drive increasing demand for fine grinding to maximize recovery.

As richer ore reserves are exhausted, finer-grained resources need to be economically processed to satisfy market demands worldwide.

To provide an economical solution for modern ore beneficiation plants, EIRICH offers the **TowerMill** - a proven vertical agitated media mill which combines the benefits of:

- energy efficiency,
- high throughput,
- high availability even in abrasive applications,
- reduced operating costs.

With the EIRICH TowerMill both energy and media consumption are reduced considerably in the ore concentration process.

EIRICH – The Pioneer in Material Processing

The worldwide EIRICH Group is a technology leader and innovative equipment manufacturer, headquartered in Hardheim, Germany.

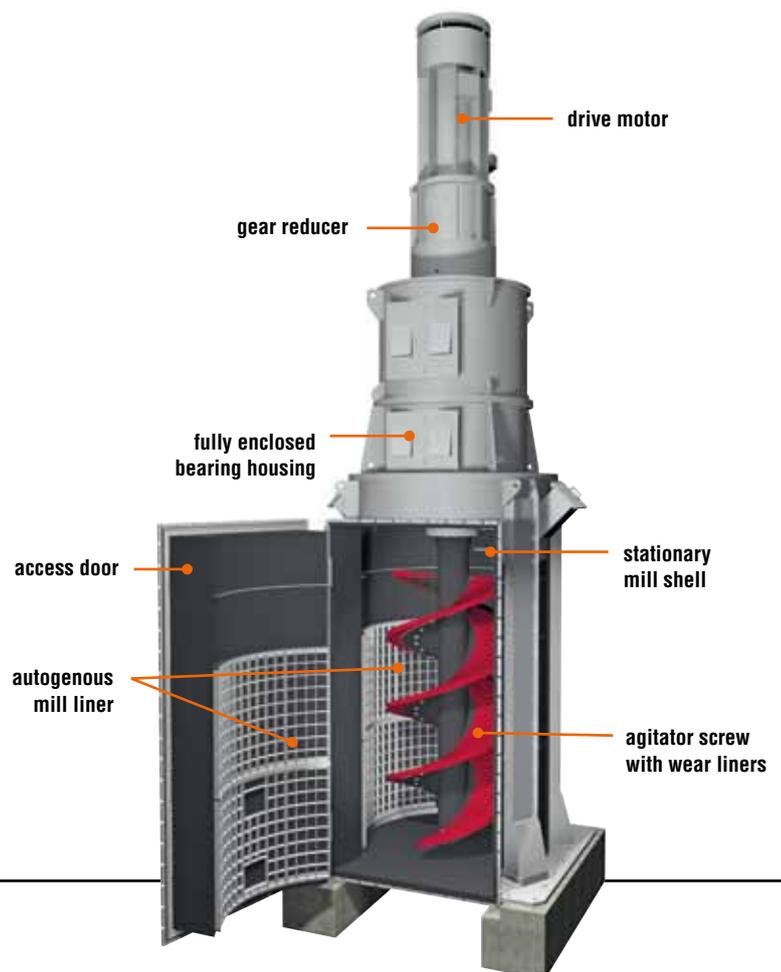
The TowerMill has been included in their global product offering, combining ore beneficiation with market-leading mixing equipment for metallurgical pellet and briquette production, as well as numerous materials processing applications in other markets.

The basic elements at a glance

The TowerMill is a vertically-oriented agitated media milling machine comprised of a top-mounted **drive motor**, located above the **gear reducer**, in turn located above the closed upper drive shaft **bearing housing**, which is finally followed by the mill **grinding chamber**, in which the vertical **agitator screw** is located, together with a charge of grinding media and grinding material in slurry form.

TowerMill History – From INVENTION to global SUCCESS

- *The vertical stirred agitated mill was originally invented in Japan in the 1950s. The horizontal ball mills typically used at that time in minerals and ceramics industry were not capable of producing extremely fine product size and high material throughput.*
- *Mr. Iwasaki Isokichi originally had the idea of rotating the horizontal chamber of the tumbling ball mill into a vertical position, while adding an agitator screw to improve energy transfer to the grinding media and keeping the grinding chamber stationary. This design proved successful in achieving small product sizes with reduced energy consumption. The TowerMill quickly found applications in both wet and dry grinding plants.*
- *Brought to the market by the Japan Tower Mill Co., Ltd. in the 1950's, thereafter it was manufactured and marketed by the Kubota Corporation, from whom it was transferred to Nippon Eirich, Japan in 1999.*



... for energy efficient fine grinding

Features

The EIRICH TowerMill product family ranges in installed power from 10 hp to 1,500 hp / 7.5 kW to 1,120 kW with throughputs from **0.5** up to **400** metric tons per hour*

**depends on reduction ratio and material properties*

Fresh feed size:

3,000 microns (hard rock ores)

10,000 microns (soft ores e.g. limestone)

Product size down to 15 microns



EIRICH TowerMill

Robust design

The TowerMill's main components are the **grinding chamber** and the **agitator screw**.

The grinding chamber

The vertical cylindrical grinding chamber is the heart of the TowerMill where comminution of mineral-bearing ores takes place. Like all agitated media mills the grinding chamber is charged with spherical grinding media. The media can be either steel or ceramic balls, depending on the downstream process and end product desired. The grinding media is used by EIRICH's unique and cost-effective autogenous grid liner system to prevent wear on the inner surface of the grinding chamber. The grid liners, available in carbon steel, acid-resistant steel alloy, or wear-resistant polyurethane, make use of the centrifugal forces and hydrostatic pressure within the mill chamber to trap and hold an outer layer of grinding balls. These stationary balls protect the mill against abrasion by the balls that are in motion.

The agitator screw

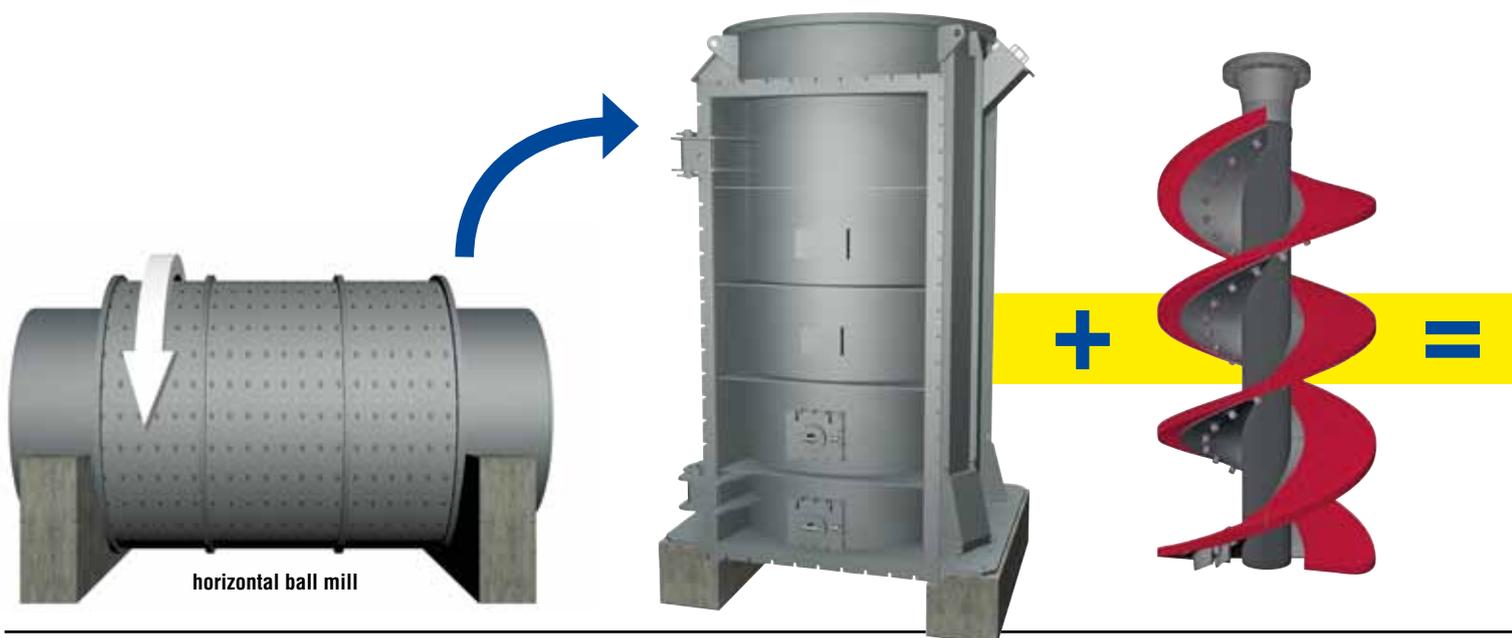
The agitator screw brings the media charge in the grinding chamber into motion. The screw is rotated at an application-specific speed by means of a premium-efficiency electric motor coupled to a planetary gear reducer and a vertical drive shaft,

all located above and external to the grinding chamber. This means that the agitator screw is the only machine component in the grinding chamber which is in motion.

Robust steel castings (shown in red in the illustration) prevent wear on the screw. These high-chrome cast liners have an unsurpassed hardness and durability, keeping downtime to a minimum. The lifetime of EIRICH's quality castings depends on the material processed and its composition, but can achieve up to 2 years in some applications.

Benefits of the vertical design

- All roller bearings are submitted to symmetrical loading, both during operation and shut-down periods. This reduces maintenance efforts and maximizes bearing life.
- Grinding media wear is reduced to a minimum because it is only rotated and circulated vertically with minimal impact forces.
- Significantly lower foundation costs due to low dynamic loading
- Less installation time due to the building-block style assembly. EIRICH's largest TowerMill, the ETM-1500, can be mechanically installed within 5 days.





Advantages at a glance

- Reduced energy consumption, from 25% to 50% savings compared with conventional mills
- Longer life of grinding media and wear items
- High operating availability, typically +95%
- Fully-enclosed housing ensures reliable performance in harsh outdoor environments
- Effective autogenous mill liner system requires less maintenance
- Vertical shaft and screw design ensures symmetrical bearing loads and long service life
- Less floor space required
- Fewer moving parts results in higher safety and less maintenance

Quality by Design

- State-of-the-art drive motor exceeds industry efficiency requirements
- Fully automatic motor lubrication option eliminates frequent manual service
- 2-stage planetary gear reducer with forced oil lubrication, either water or air cooled

EIRICH TowerMill

Operating principle

Comminution, or the process of size reduction, takes place in agitated media mills when the material to be processed passes through and dynamically interacts with the grinding media. Thousands of contact points between the media act as individual crushers, each further reducing the size of the grinding material. Brought into motion by the spiral agitator screw, the spherical grinding media's relative movement and spin, combined with evenly-distributed compressive forces only found in a vertical machine arrangement, crush and grind material particles between the spherical media by attrition.

The grinding process

- In wet grinding the material to be ground is mixed with water to form a slurry prior to entering the TowerMill, as mineral processing of base and precious metals almost always employs water as the transport medium for the desired product.
- Depending on the size and particle distribution, the feed slurry is either fed to the top of the mill chamber for coarse feeds, or to the bottom of the chamber for fine feeds.
- The spiral shape and rotation of the screw forces the material and ball charge into a vertically rotating upstream, which returns to the bottom along the inside wall of the chamber. The finer sized particles tend naturally to rise and are carried off the top section of the grinding chamber due to the slurry upflow. Material is ground and gravimetrically separated simultaneously in the vertical grinding chamber due to the slurry upflow.

The advantages

- Higher compressive forces resulting from the compact, cylindrical ball charge confine and force the material particles in an optimal way to contact the grinding media.
- The energy distribution within the vertical mill is constant for any given height and radius.
- These characteristics, combined with the fact that the TowerMill's shell does not need to be brought into motion, account for significantly reduced energy consumption.

Grinding media

Most fine grinding applications utilize high chrome steel balls for minerals processing. Iron-free grinding is feasible using ceramic media based on alumina-oxide composition, which is becoming readily available worldwide, and allows processing of ceramic slurries as well as precious metals.

Wear protection

Solid high-chrome cast wear liners protect the agitator screw from wear. The identical design of the flight liners allow interchangeability with less worn liners, which reduces operating costs. The autogenous grid liners make use of the physical forces inside the mill to trap several layers of grinding balls and material inside the rids. This effectively eliminates wear on the inside surface of the mill chamber in a cost-efficient manner.



autogenous grid liner segment

compressive media force and attrition grind material efficiently



during operation protective layers of grinding balls fill and remain inside the grid segments



high chrome cast wear liners

slurry up-flow

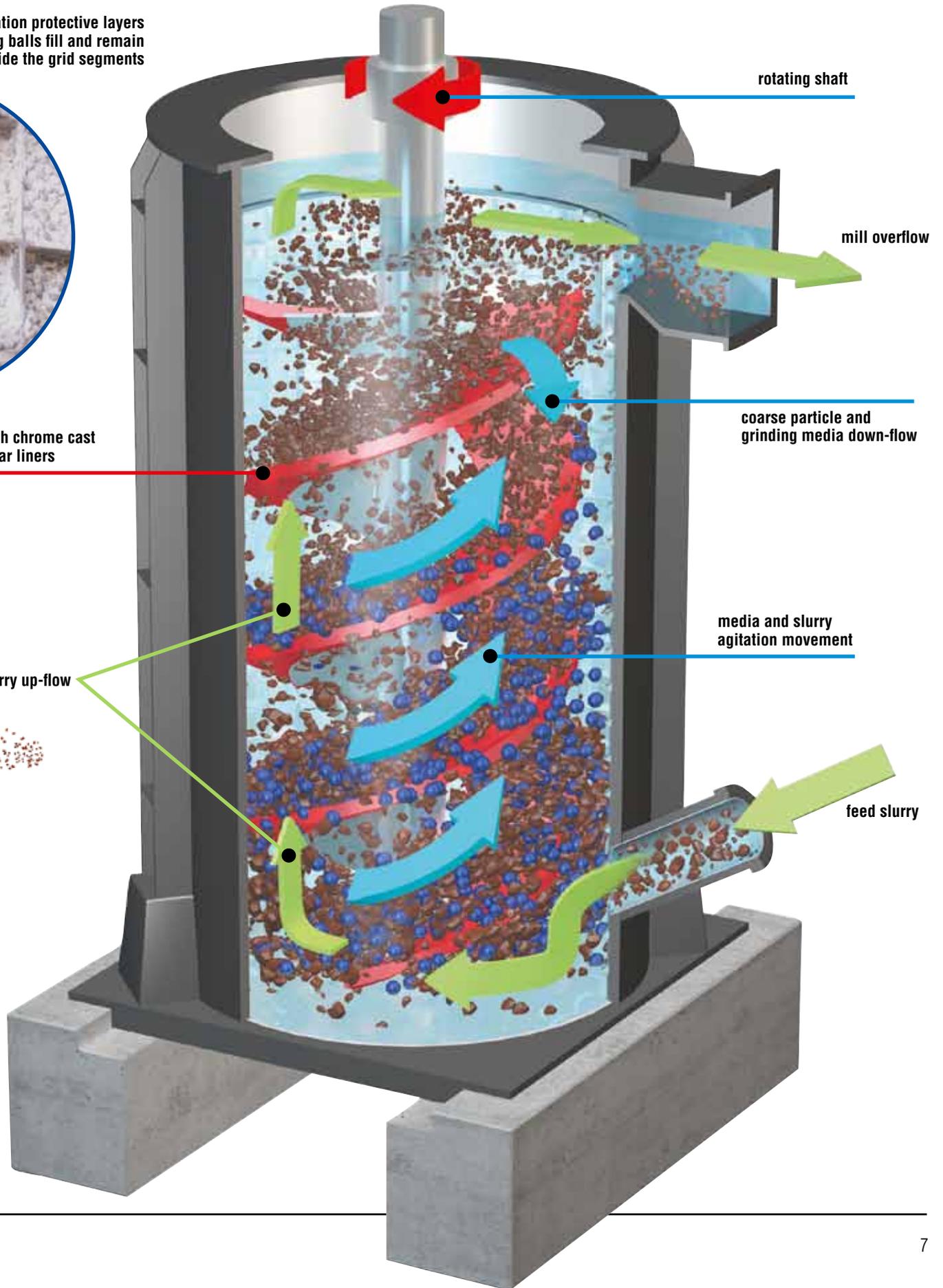
rotating shaft

mill overflow

coarse particle and grinding media down-flow

media and slurry agitation movement

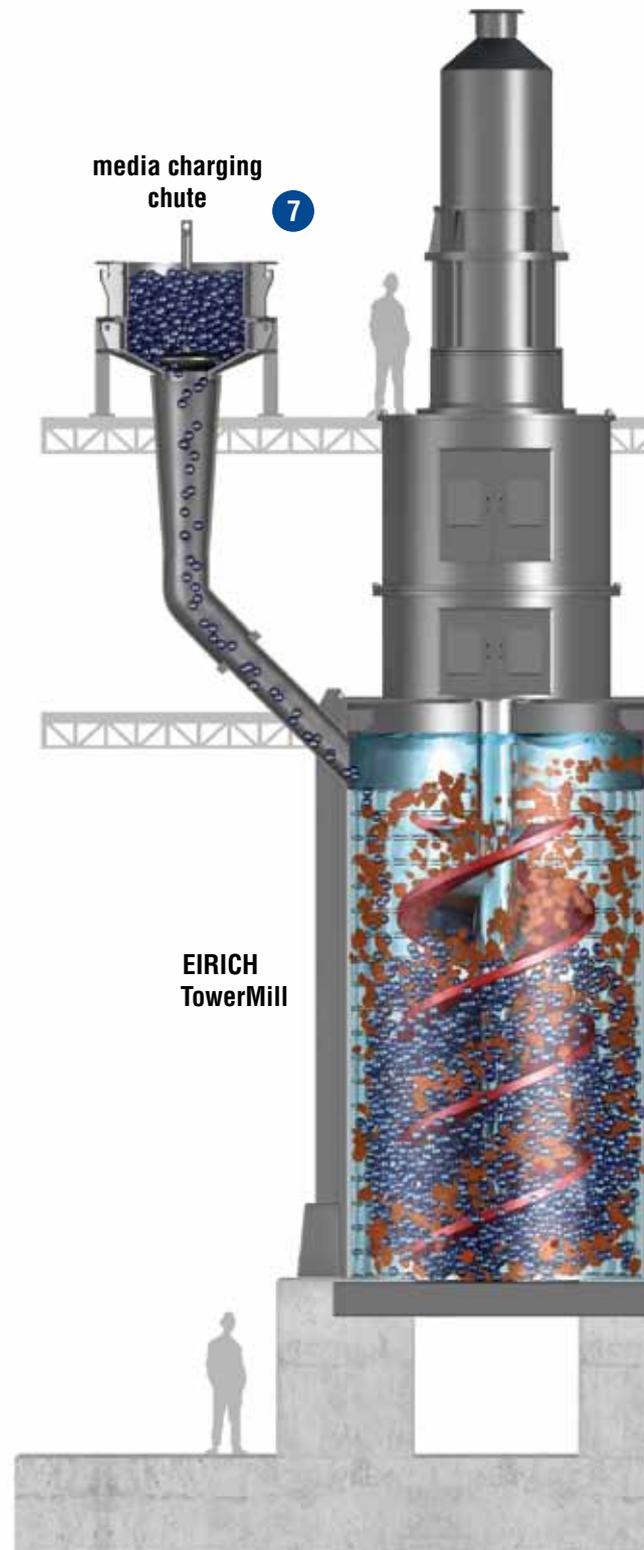
feed slurry

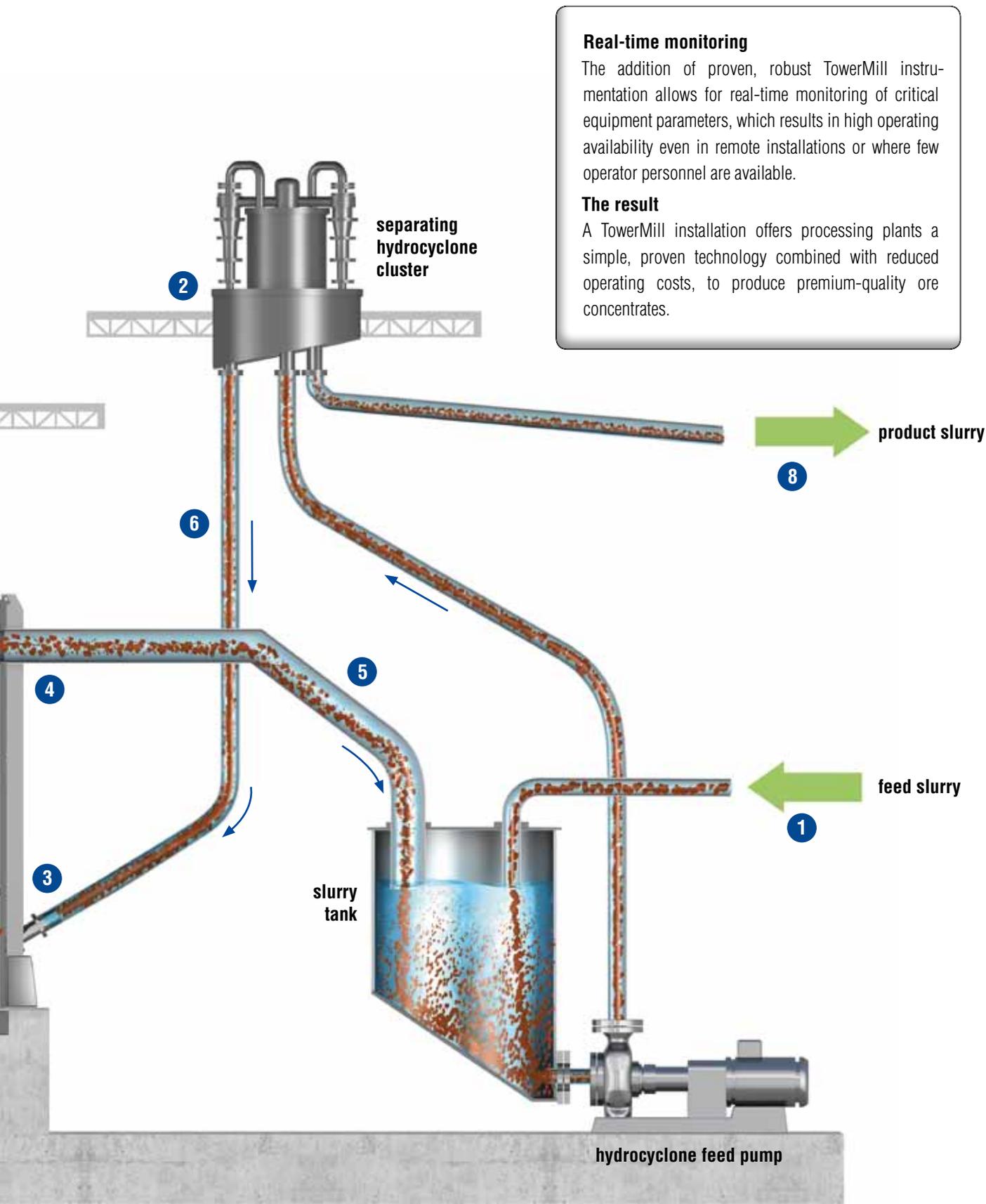


EIRICH TowerMill

Simple arrangement – Efficient operation

- 1** The TowerMill is most commonly placed downstream of either a traditional horizontal ball mill or, more recently, high pressure grinding rolls (HPGRs). The product exiting these mills is first fed to a slurry tank.
- 2** In a scalped-feed arrangement (see illustration) fresh material is pumped to a hydrocyclone cluster to separate the coarse and fine particles. Fines are directed downstream while coarse particles are sent to the TowerMill inlet flange.
- 3** The inlet can be located either at the top or bottom of the grinding chamber. For coarse feed, a top-feed is more efficient, and can be combined with EIRICH's integrated coarse classifier (see reference installation on page 12), which returns oversized particles directly to the mill chamber. For fine feeds conversely, a bottom-feed inlet is more efficient.
- 4** Once the coarse particles have been reduced in size, they are carried by the upward slurry movement to the mill chamber's overflow outlet flange.
- 5** A connecting pipe brings overflow material gravimetrically to the slurry tank, where product and feed materials are directed to the hydrocyclone cluster.
- 6** The hydrocyclone classifies overflow material into coarse and fine streams. Coarse particles are re-circulated back to the TowerMill feed inlet for regrinding. Fine particles are passed to downstream separation or drying circuits.
- 7** Grinding media is consumed during operation and is periodically refilled to compensate the worn media. EIRICH's media charging equipment allows easy, accurate recharging to maintain optimum performance.
- 8** Final ground product for downstream separation, flotation, or drying.





Real-time monitoring

The addition of proven, robust TowerMill instrumentation allows for real-time monitoring of critical equipment parameters, which results in high operating availability even in remote installations or where few operator personnel are available.

The result

A TowerMill installation offers processing plants a simple, proven technology combined with reduced operating costs, to produce premium-quality ore concentrates.

EIRICH TowerMill

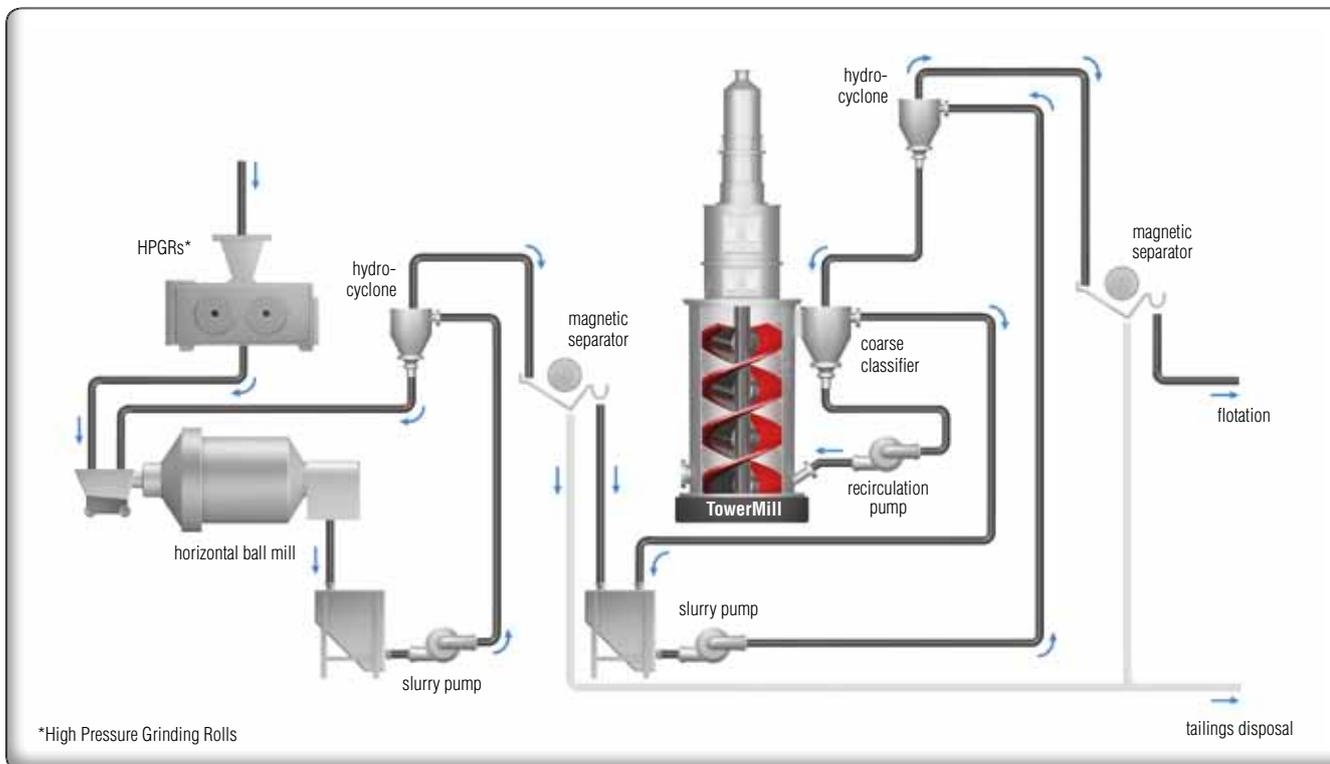
Powerful – Proven – Reliable – Robust

Over 200 plants worldwide have energy-efficient TowerMills for grinding over 40 different types of materials.

Typical markets are mining & minerals processing, recycling and environmental protection.

Application: Iron ore – magnetite

TowerMill Installation: Karara Iron Ore Project



5 units ETM-1500
 Installed power: 5 x 1.1 MW
 Karara Iron Ore Project,
 Western Australia

4 units:
Feed size: F80: 55 microns
Product size: P80: 35 microns
Throughput: 385 t / hr / TowerMill

1 unit:
Feed size: F80: 35 microns
Product size: P80: 25 microns
Throughput: 250 t / hr / TowerMill

Delivery date: 2010



5 units ETM-1500
Karara, Western Australia

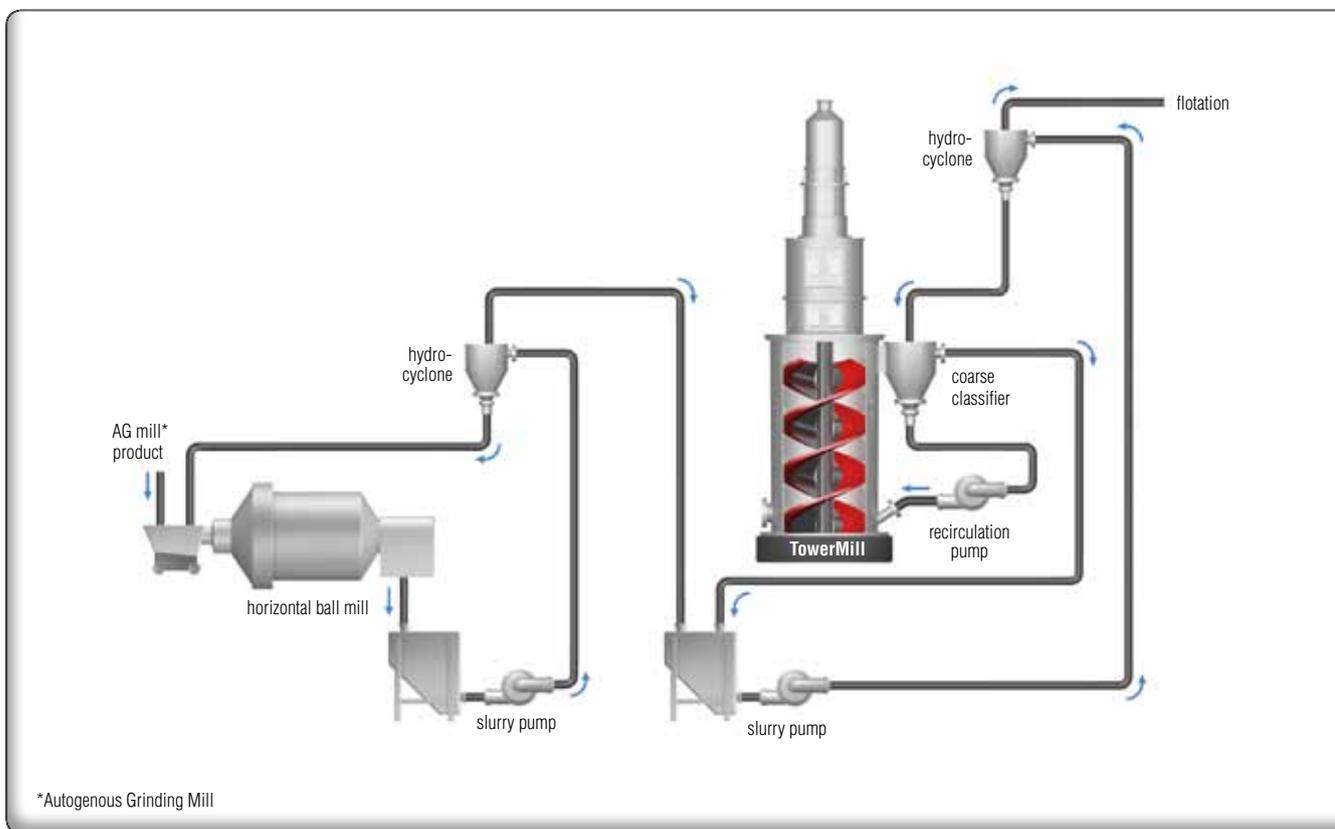


5 units ETM-1500
Western Asia

EIRICH TowerMill

Powerful – Proven – Reliable – Robust

Application: Gold ore
TowerMill Installation: Shandong Gold Project



1 unit ETM-1250
Installed power: 1 MW
Shandong Province, China

Feed size: F80 = 130 microns
Product size: P80 = 15 microns
Throughput: 63 t / hr / TowerMill
Delivery date: February 2011



TOWER MILL
EMEC

TOWER MILL
EMEC

ETM-1250 Shandong Gold,
China installed 2011

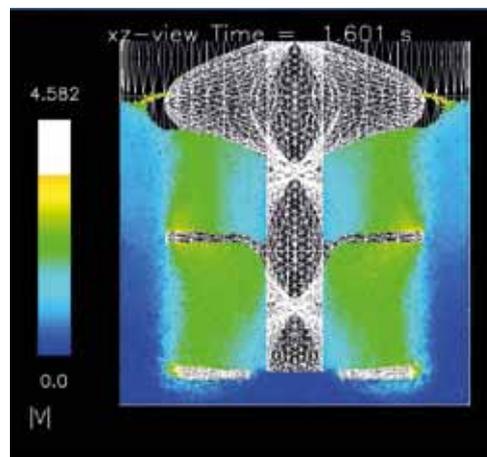
Accurate engineering and laboratory testing

EIRICH drives technology advancement. Our successful and respected Japanese and German engineering team has advanced and optimized grinding circuit design to offer on-target equipment for each customer's needs.

Our modern test facilities in both Japan and Germany offer material analysis, pilot plant grinding test capabilities and accurate scale-up procedures for state-of-the-art industrial scale plant designs. A minimum amount of sample material is required by our test labs to measure energy consumption, throughput and particle size distribution for any grinding task within the TowerMill's performance range. A full technical report is made available after each test.



State-of-the-art test methods and modern simulation methods are EIRICH's tools for accurate plant engineering



Discrete Element Method simulation of media charge total velocity in the EIRICH TowerMill

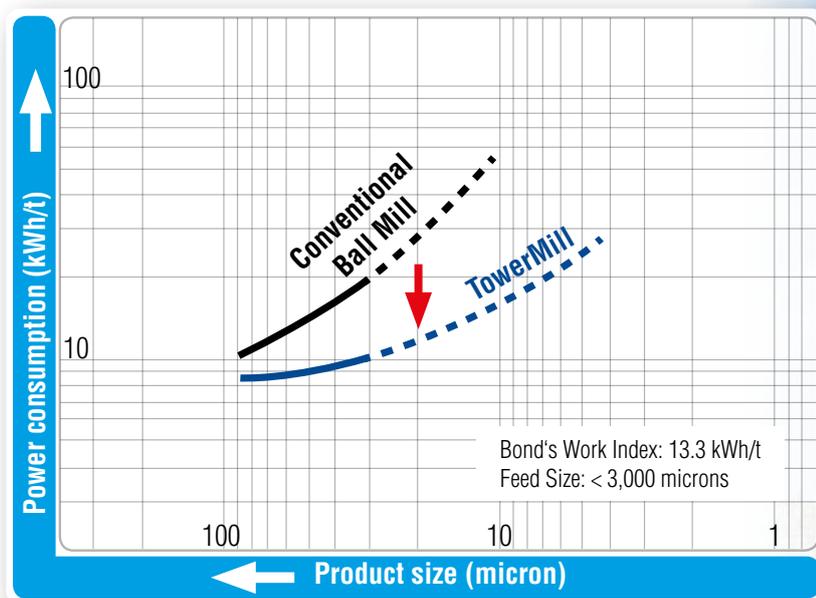
Environment – Energy – Sustainability

In times of increasing energy prices and threatening climate change there is an increasing demand for solutions providing substantial energy efficiency and reducing environmental impacts.

The EIRICH products meet these requirements while simultaneously satisfying the highest demands on economic efficiency. The pronounced EIRICH goal is to offer innovative and groundbreaking solutions to the customer featuring outstanding sustainability and resource conservation at the same time.

Offering the potential for energy savings of up to 50 %, the TowerMill shows how goals in terms of energy efficiency can ideally be combined with a highly cost effective use – both for the benefit of the user!

Up to 50 % less energy consumption



The market needs choices

The EIRICH TowerMill has been met with great acceptance since its introduction and continues to gain new users and returning customers due to its ability to reduce operating costs. Today's expanding economies and developing markets require multiple sources for reliable, efficient grinding equipment to meet raw material demands. Excellent responsiveness, after-sales service, low CAPEX and OPEX costs, readily-available spares and

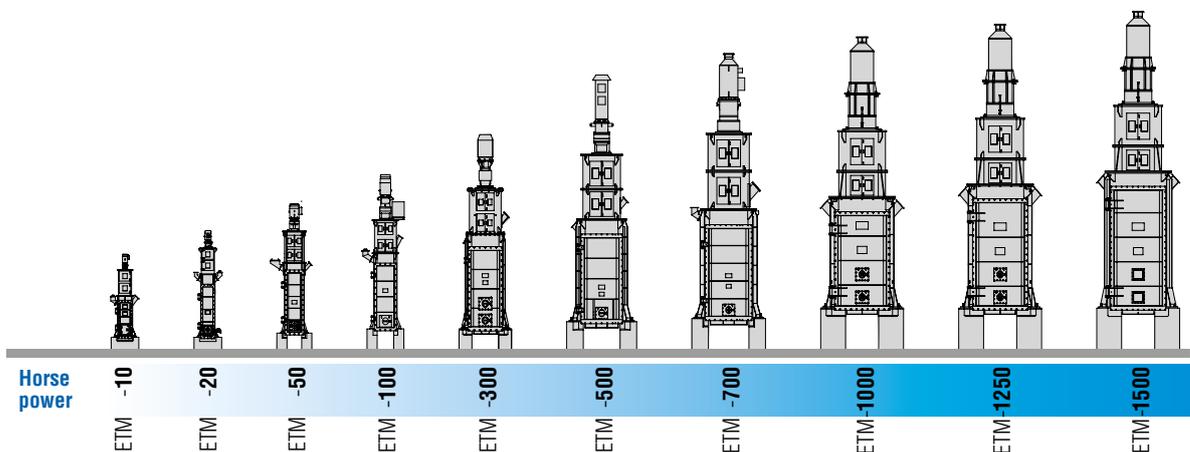
short lead times have contributed to EIRICH's success in ore beneficiation applications, from Australia to the Americas. EIRICH offers proven, developed technology at competitive prices. Just what the market needs.

Alone in the last 5 years over 1 dozen ETM-1500 TowerMills have been delivered to cutting-edge ore beneficiation plants worldwide.

TowerMill Reference Materials

Alumina	DXN reactor	Manganese ore	Quick lime
Brown coal	Ebonite	Magnetite sand	Red phosphorus
Bottom ash (civil waste)	Ferrite	MC alloy	Slag
Blast furnace slag	Ferro alloy	Metallic silicon	Sericite
Bariun titanate	FRP	Mica	Silica sand
Barrite	Gold ore	Nickel ore	Silica rock
Copper ore	Graphite	Nickel slag	Sulphur slag
Clay	Halite (rock salt)	Oxide ore	Sulphur residue
Clay slag	Illmenite	Olivine	Tungsten
Clinker	Iron ore	Oil sand	Uranium ore
Copper slag	Kaolin	Pet coke	Zinc slag
Coke	Lab. use	Pottery stone	Zinc ore
Coal Water Mix	Limestone	Phosphate rock	Zircon sand
Cement	MgO	Pyrite	Zinc lead ore

TowerMill Range: For each application the size that fits





PRECAUCION
AREA
DE
RUDDOS

ETM-700 El Teniente, Chile
copper concentrate re-grind,
installed 1994

Industrial Mixing and Fine Grinding Technology

Tradition and innovation since 1863

EIRICH stands worldwide for a comprehensive range of products and services in the field of preparation technology. Its particular focus is on mixing and fine grinding technology, with know-how developed over 150 years of close cooperation with industrial users, universities and research institutions.

Pursuing a corporate philosophy of operating internationally and thereby ensuring close proximity to every customer, the EIRICH Group has secured its place in all the key economic regions of the world.

The focus is on innovative technology for machinery and systems engineering designed to offer solutions for high-standard preparation tasks from a single source.

Applications and process technology with own test centers, a high vertical range of production and comprehensive after-sales service provide the ideal basis for the development of modern and economical processes for a multitude of industries.

**Building materials – Ceramics – Glass – Carbon paste – Battery paste
Friction linings – Metallurgy – Foundries – Environmental protection**

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Eirich East Europe GmbH
Representative Kazakhstan
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Jandira S.P., Brazil



Nippon Eirich Co. Ltd.
Nagoya, Japan



Nippon Eirich Co. Ltd.
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