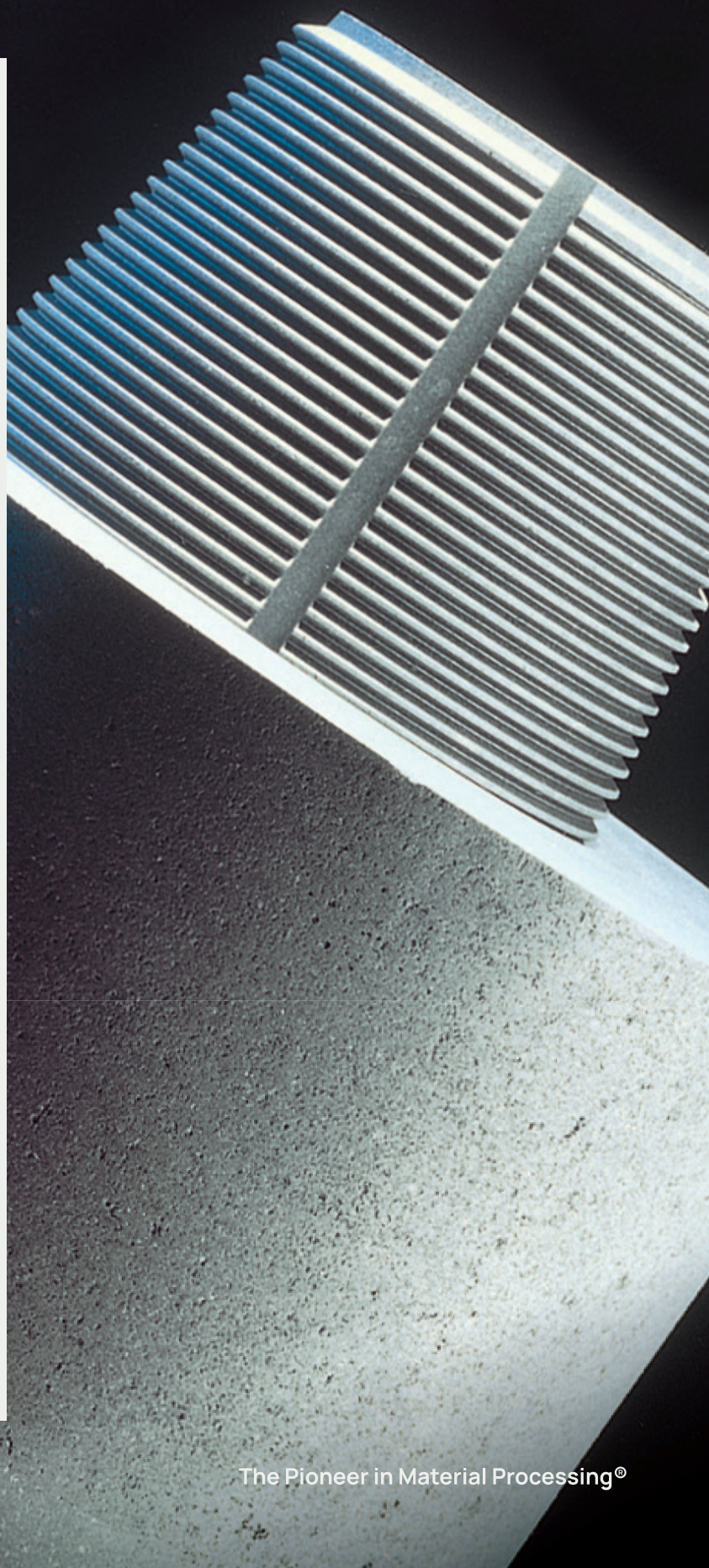
Preparation Technologies for Carbon Paste

For over 50 years, Eirich has been designing and constructing machines and complete plants for the carbon industry. Today, a growing number of renowned carbon product manufacturers worldwide rely on Eirich's state-of-the-art equipment to prepare their carbon paste efficiently and effectively.



EIRICH

The Pioneer in Material Processing®

Tailor-made solutions – effective and trendsetting

Eirich is a trusted partner in the carbon industry, offering tailor-made solutions to meet the unique needs of its clients. Our cutting-edge preparation technologies are designed to provide efficient and cost-effective solutions for the following core applications:

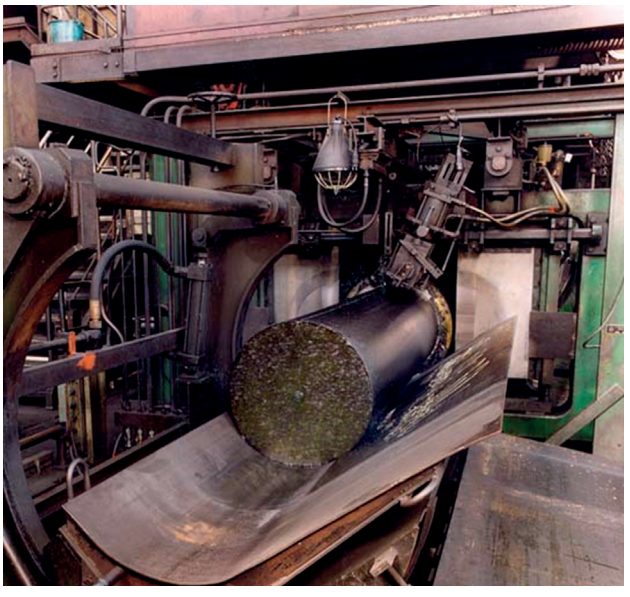
- Anode paste
- Electrode and cathode paste
- Metallurgical Soederberg paste
- Graphite specialties
- Preparation of coke

Our comprehensive product line includes advanced machinery and systems, as well as a full range of services, from consulting to start-up, to ensure the success of your project

Eirich has been building machines and complete plants for the carbon industry for more than 50 years and a constantly growing number of renowned manufacturers of carbon products all over the world use Eirich equipment. Established in 1863, our family-owned company has a long history of excellence in the industry. Today, our company headquarters in Hardheim, Germany, employs approximately 600 highly skilled professionals who work in our state-of-the-art in-house manufacturing facilities and plant engineering office.

When dealing with Eirich in the carbon industry provides:

- Experienced specialists
- Proprietary know-how
- Eirich test center for demonstration and verification tests
- Laboratory and pilot-scale equipment for in-house tests
- Full-service engineering, manufacturing and service
- All key machinery manufactured in Eirich workshops
- Outstanding reputation for reliability
- Worldwide presence and after-sales service



Worldwide success? Yes!

Eirich has achieved worldwide success in the carbon industry, with over 200 machines delivered to date. Additionally, more than 60% of the world's paste production for prebaked anodes is prepared using Eirich equipment in plants around the globe.

Anode paste preparation
Eirich Mixing Cascade EMC® Technology

Anode paste preparation requires heating various coke fractions, mixing them with green scrap and pitch, and feeding the resulting moldable mix to a press.
It was first tested in Switzerland in 1993, and later used in a pilot plant in Norway and an industrial-scale production unit in Cameroon capable of producing 15 t/h. Since its international breakthrough in 2003, EMC® has been used for capacities ranging from 20 t/h up to 65 t/h.

Eirich Mixing Cascade 35 t/h

Benefits of the Eirich solution:

- Low capital expenditure (CAPEX): savings of at least 40-50% per line
- Low operational expenditures (OPEX): savings of at least 30% per line
- Perfect adaptation to lower quality raw materials and property fluctuations
- Throughput rates of more than 65 t/h in a single line
- Low variation of retention time during mixing
- Optimum mixing and cooling conditions for excellent paste quality
- Simple machine design
- Vibrocompacting of anode paste up to 165 °C without vacuum system

The main technical objectives of anode paste production are to ensure consistent production of high-quality paste that meets the needs of the potline. These objectives can be grouped into different categories:

Safety:
- Zero anode incident in the potline
- No cracking due to thermal shock
- No dusting and mushrooming

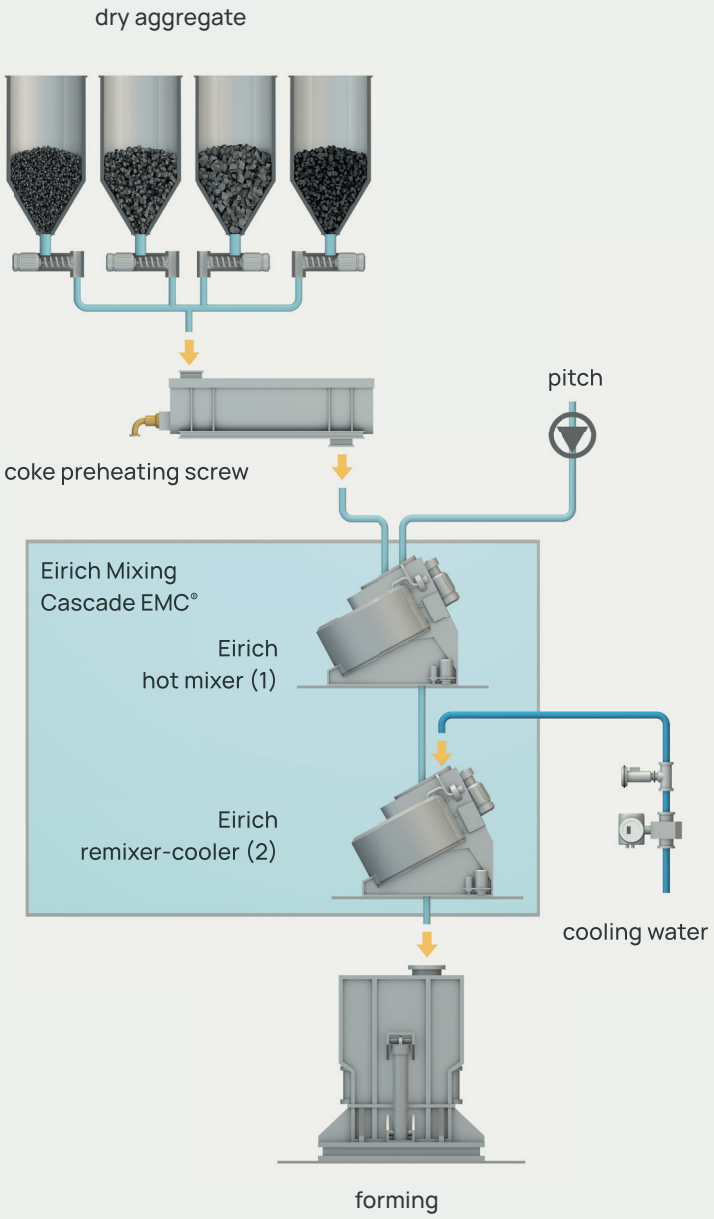
Quality:
- High level of density
- Low reactivity

Performance:
- Excellent pot performance
- High availability

Achieving the technical objectives of anode paste production requires a perfect mixing process. This is because mixing plays a crucial role in ensuring that the anode paste has the right properties and characteristics.

A perfect mixing process can help to achieve the following:
- Perfect homogenization of all ingredients
- Pitch penetration to fill the coke pores
- Even coating of coke grains

Mixing is more important than forming!
Sufficient mixing time, high mixing temperature and sufficient power input are the most important conditions to cope with the above mentioned requirements.



Process description
The preheated dry aggregate is fed, together with the binder pitch (in liquid or solid form), into the **hot mixer** (1) – the first key element of the EMC®. The intensive mixing effect replaces the traditional method of „short-time pitch penetration by means of kneading forces“ with „long-time pitch penetration by careful intensive mixing.“ Due to the special construction principle, the retention time in the machines is approximately twice as long as in a conventional kneader.

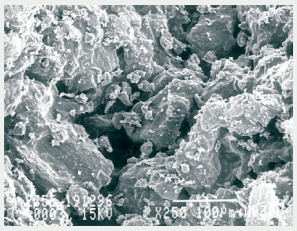
The paste coming from the hot mixer is then remixed and cooled simultaneously in the **remixer-cooler** (2). Effective cooling is achieved by injecting water into the anode paste, which then immediately evaporates. The discharge temperature is precisely controlled with a variation of less than +/- 3°C. Steam and pitch fumes are led to the exhaust air treatment center by means of saturated air flowing through the machine

Anode paste preparation
Eirich Remixer-Cooler for retrofitting of existing plants

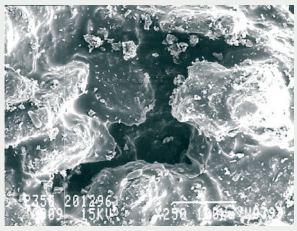
Based on long-term experience in anode paste mixing, it has been determined that only a plant with two different mixing stages (hot mixing and remixing-cooling) can optimally fulfill today's requirements. While normal paste coolers are only good for reducing the paste temperature, the Eirich remixer-cooler, with its special inclined machine design, can homogenize and cool the paste simultaneously.

Paste quality improvement by continuous remixing

only kneading

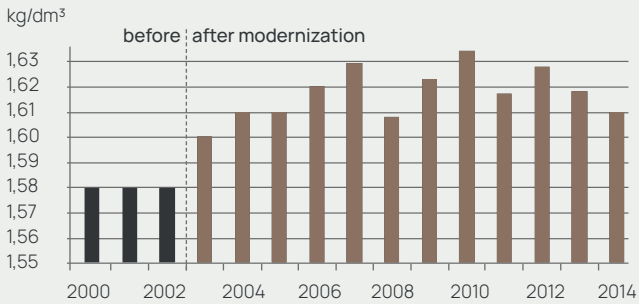


kneading and remixing

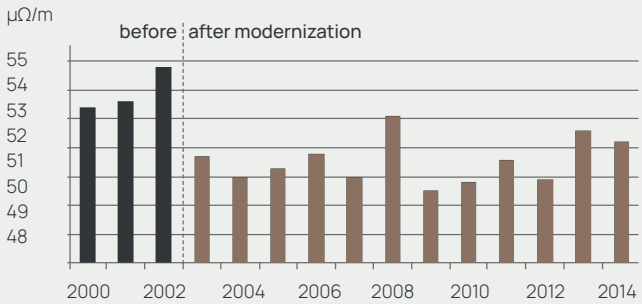


Reference: Norsk Hydro Research, Porsgrunn - Norway

Comparison of important paste properties



Baked apparent density before/after installation of a remixer-cooler



Specific electric resistance before/after installation of a remixer-cooler

Benefits of the Eirich solution:

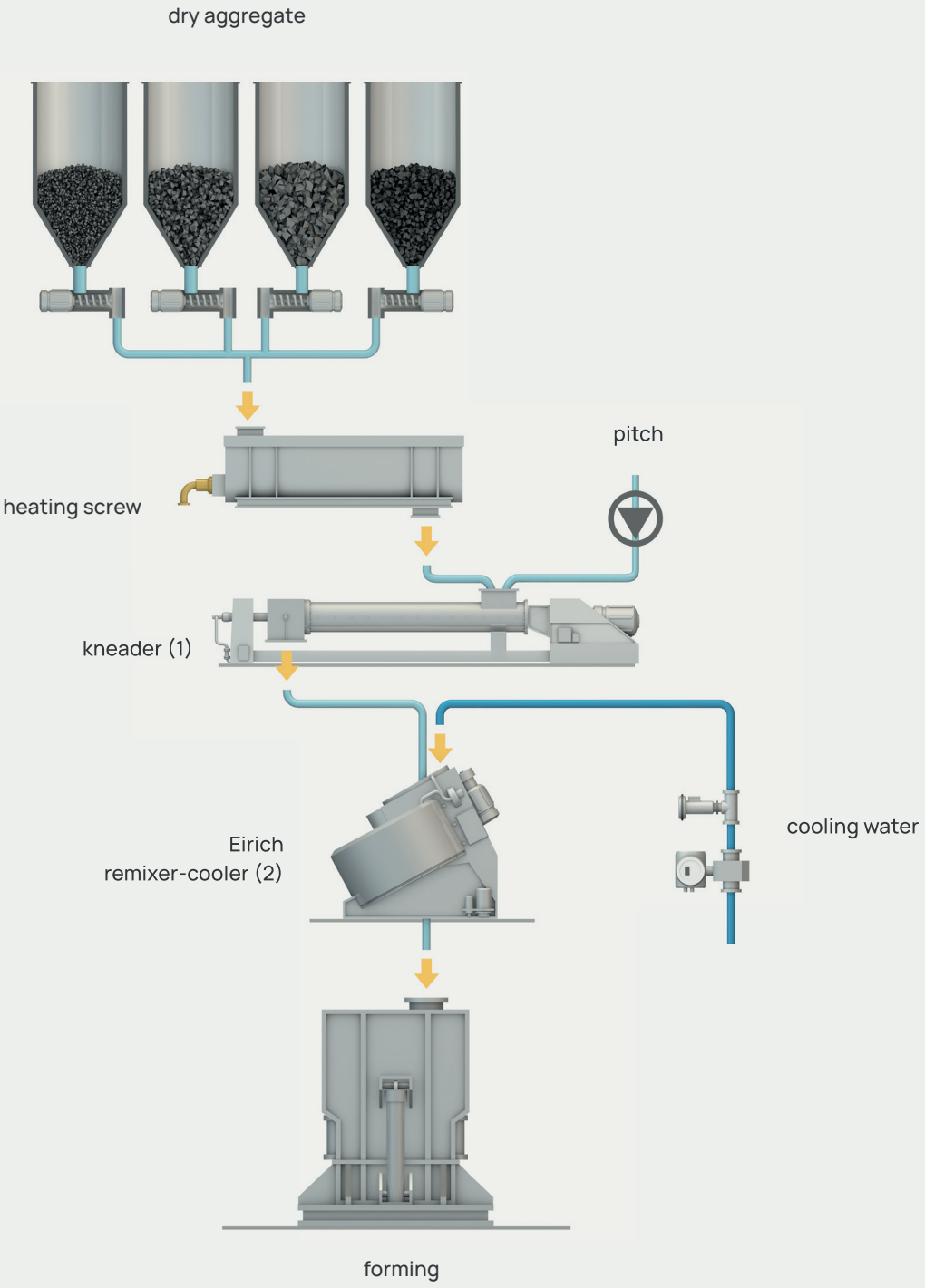
Efficient paste cooling
- The most efficient paste cooling system
- Free choice of final temperature
- Maximum temperature variation at paste discharge: +/- 3 °C

Improved paste properties
- Low paste porosity = high paste homogeneity
- Higher green and baked density

Higher anode quality
- Lower anode resistivity
- Lower pitch content (typically 0.5-0.7 % absolute)
- Fewer rejects

System advantages
- Proven technology with numerous references worldwide
- Simple machine design with low maintenance costs
- Easily adaptable to varying operating conditions
- ROI in less than 3 year

Courtesy of: Talum, Kidricevo - Slovenia



Process description

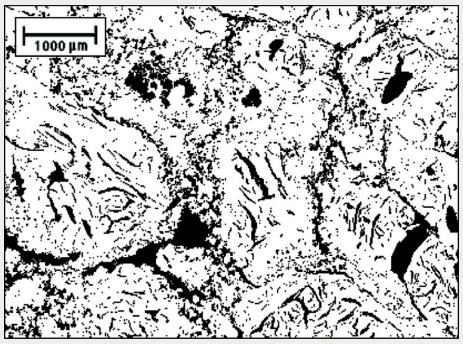
The paste is continuously fed from the **kneader (1)** to the downstream **Eirich remixer-cooler (2)**, which is equipped with weighing devices for mass flow control and an infrared temperature measuring system. Due to the additional mixing energy input and retention time, the final paste has a constant high quality. To cool the paste, water is injected and evaporated, with the amount added dependent on the paste's temperature measured by the infrared temperature measuring system. The cooled paste is then continuously discharged.

Electrode and cathode paste preparation
Eirich batch-wise operated systems

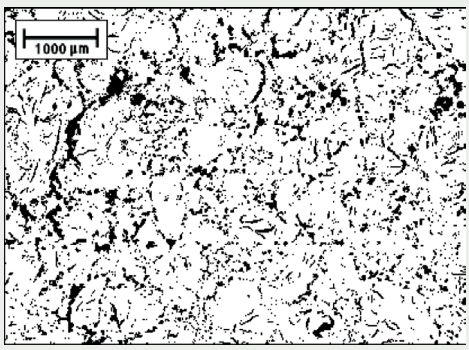
The Eirich batch-wise system for electrode and cathode paste preparation includes coke heating, paste preparation, and a control system. This system, which uses one Eirich mixer, can replace up to 8-12 conventional batch-wise machines, leading to a significant increase in productivity of up to 200% in the green production of graphite electrodes

The control system is responsible for monitoring the current state of all processes in the preparation plant, adjusting the required energy amount at the electric resistance heater, handling and storing important plant operation data, and indicating and logging all faults that occur.

Comparison of paste quality



Batch mixing with Sigma blade mixer



Batch mixing with Eirich mixer

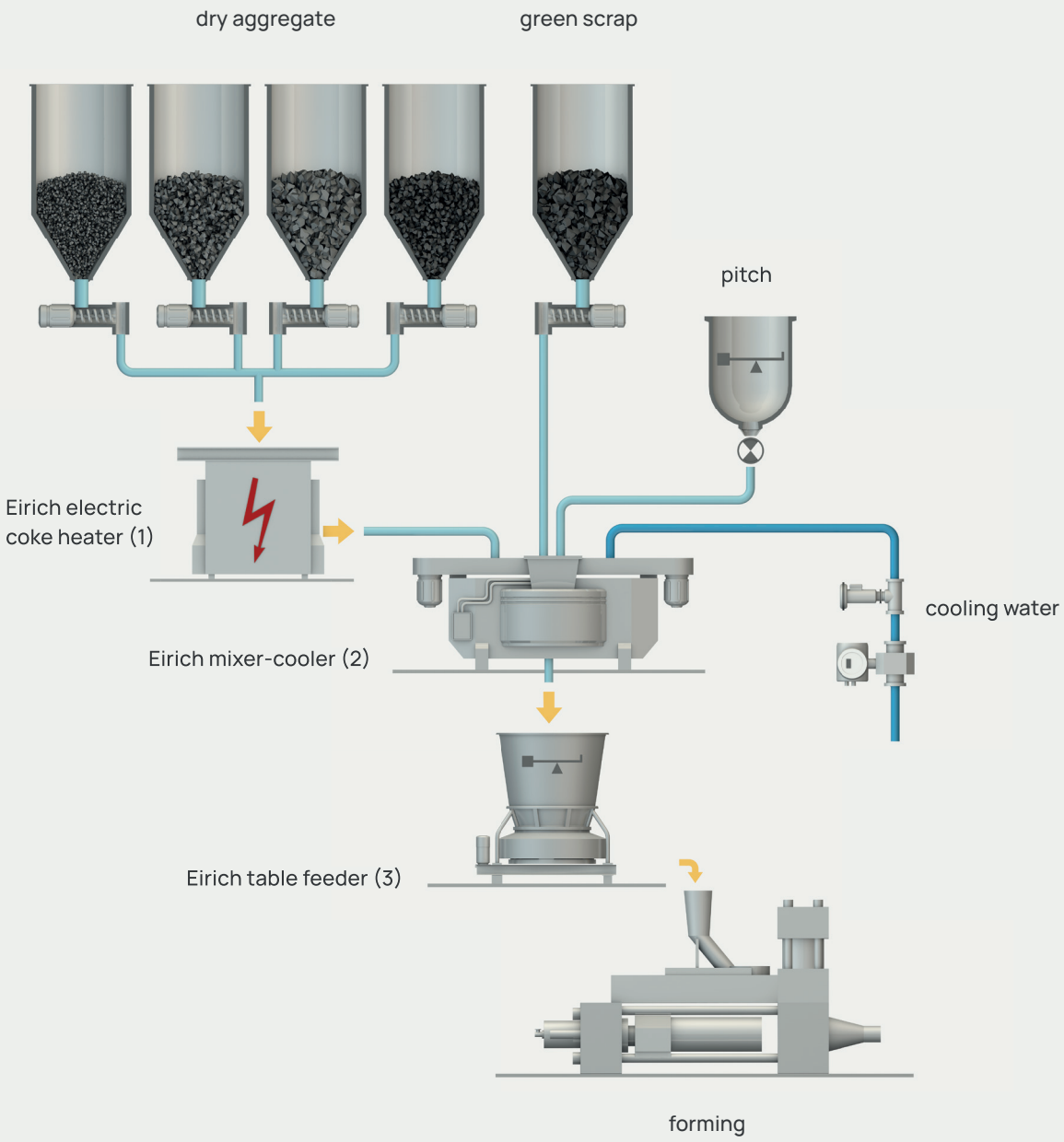
Reference: NTNU Trondheim - Norway

Benefits of the Eirich solution:

Coke heating
- Fully electric coke heating equals the most elegant solution on the market
- Rapid and accurate adjustment of the coke temperature
- No Hot Thermal Fluid (HTF) heating system required, i. e., no risk of fire, self-ignition, leakage, etc.
- Reduced energy consumption

Mixing
- Reduction in pitch consumption of 2-5 %
- Simple machine design
- Easily exchangeable wear and spare parts
- Insensitivity to varying operating conditions

Plant design
- Investment and maintenance costs up to 30 % lower
- High and freely selectable temperature level of the preparation process thanks to direct electric heating and evaporative cooling
- Compact tower system close to the press
- Fully automatic plant operation



Process description

The process starts by feeding coke fractions into the Eirich direct **electric coke heater (1)** either from a specially designed receiving hopper or a central coke weigh scale. Coke preheating occurs simultaneously with the paste preparation in the **mixer-cooler (2)**. The system automatically turns off after a precalculated amount of electric energy is introduced into the coke, and it waits for the discharge request from the mixer-cooler.

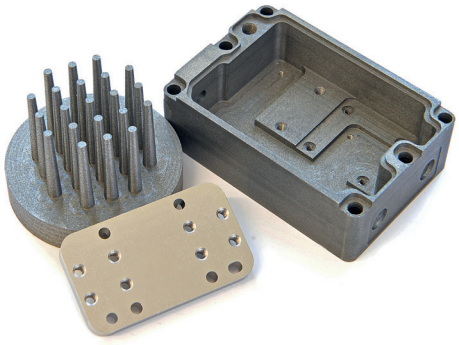
Once the preheated coke batch is discharged into the empty mixer-cooler, a short dry mixing and homogenization phase begins before liquid pitch is added using a pitch dosing system. The coke and pitch are mixed intensively and rapidly homogenized. An infrared camera equipped in the mixer measures the paste temperature.

Adding a precalculated amount of water starts the cooling process, and the finished paste is discharged in batches from the mixer into the downstream **table feeder (3)**. Based on the press requirement, portions (by weight) of electrode paste are discharged from the table feeder into the press.

Carbon and graphite specialties
Eirich batchwise operated systems

Eirich provides customized mixers and plants for various carbon and graphite specialties, including isostatically molded and extruded semi-finished products, carbon fiber composites, carbon brushes, and graphite heat exchangers.

The systems are designed to operate at standard temperatures of up to 250°C. Additionally, optional induction heating is available for fast and efficient preheating of dry aggregates.

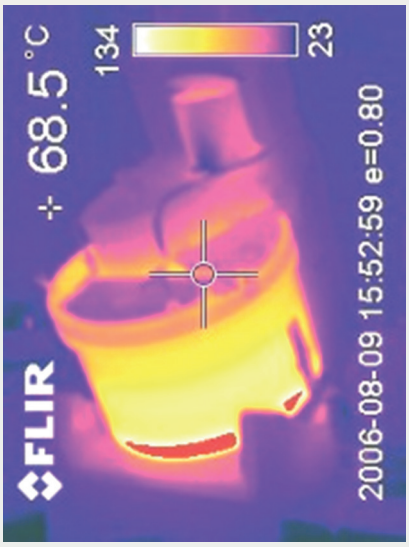


Pictures: Schunk Hoffmann Carbon Technology AG

Benefits of the Eirich solution:

- Dry aggregate heating, mixing and cooling (optional) in one single machine
- No HTF heating system required, i.e., no risk of fire, self-ignition, leakage, etc.
- Energy input easily adjustable via tool speed and mixing time
- Rapid homogenization
- vSignificantly reduced cycle time
- Simple machine design, thus low maintenance costs
- Wear and spare parts easily exchangeable

Mixer type RV16W



Thermographic picture of an induction-heated mixing pan

The standard operating temperature is up to 250°C

Machines and systems

The Eirich design provides optimum performance in both batchwise and continuous operation.

The excellent processing efficiency is guaranteed by

- a rotating mixing pan which transports the material continually to the rotating mixing tools
- rotating mixing tools: rotational speed and drive power are optimized for each application
- a multi-purpose bottom/wall scraper which prevents caking in the pan and accelerates the discharge of the material

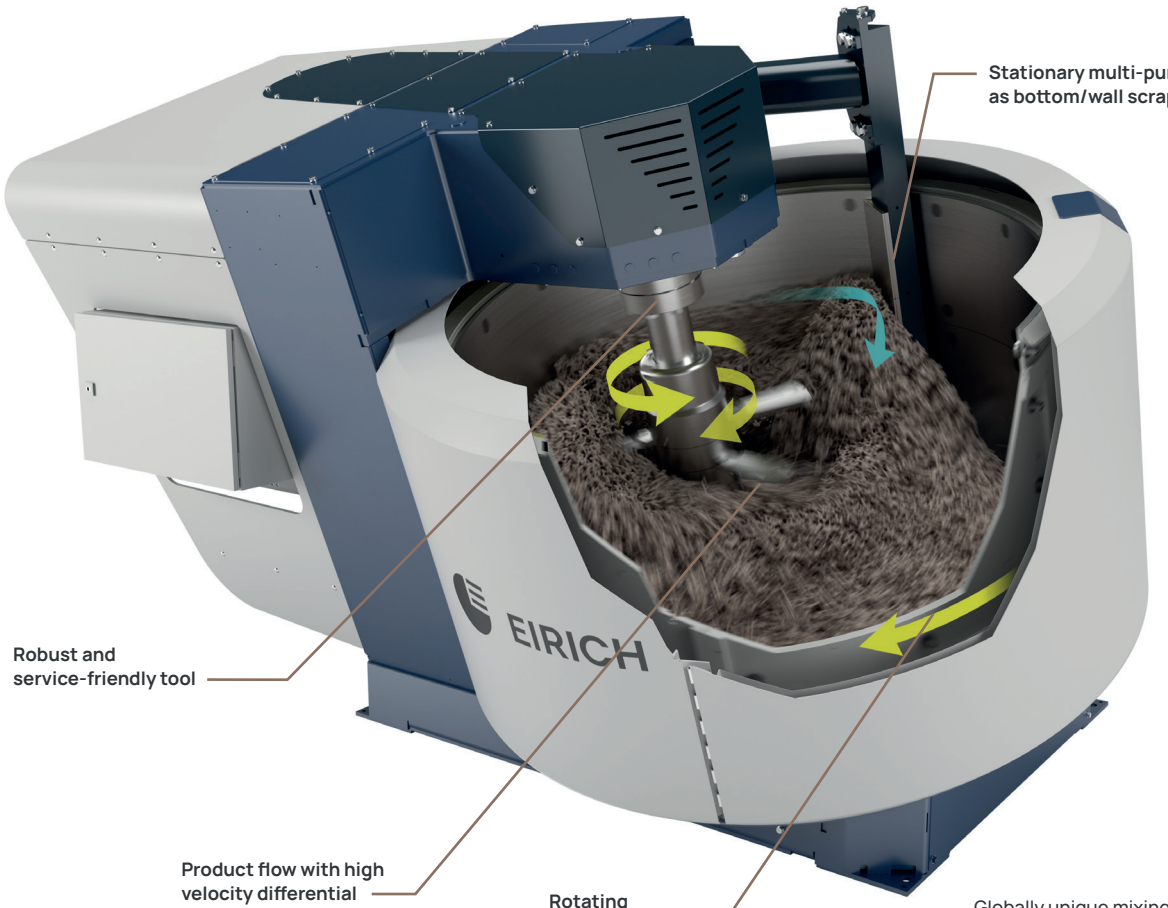
This design results in material currents with high velocity differentials and continuously changing positions, allowing for modifiable mixing intensity and optimized energy input through co-current or countercurrent operating modes.
Paste cooling by water evaporation is available for both batch and continuous mixers.

The Eirich design provides optimal performance

Mode of operation
Batchwise operated machines
The machines operate in batch mode, where the mixing pan has a discharge gate in the center and a swiveling wall and bottom scraper that facilitates quick discharge of the material.

Continuously operated machines
Installed on load cells. The continuous mass flow through the machine is controlled by means of a swiveling discharge mechanism which keeps the filling level inside the machine constant.

Since the introduction of liquid pitch, the hot mixing temperatures have been raised to 180 °C or even higher to reduce pitch consumption. However, with the paste viscosity being lower now, conventional solutions bear the risk of particle degradation. Intensive mixers are well-known for their high homogenization effect which is based on a strong horizontal and vertical mass flow caused by the rotating mixing pan together with one or two rotor tools.

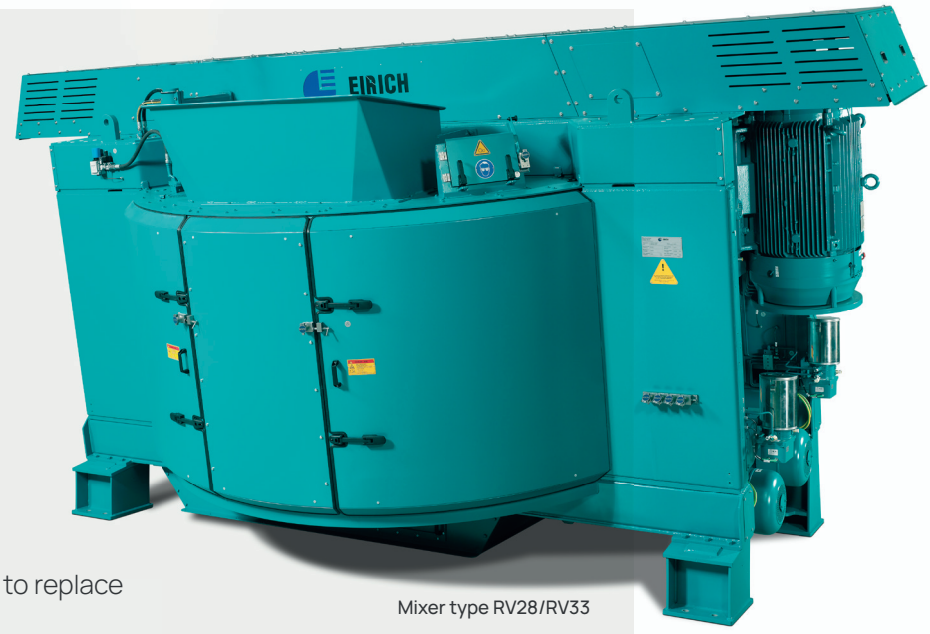


Process-wise

- Rapid homogenization
- Long residence time
- Variable energy input
- No dead zones in the mixer
- High-performance cooling
- Outstanding paste quality

Operational-wise

- Service-friendly design
- Ultra-high reliability
- Wear parts of simple design and easy to replace
- No rewelding inside the machine
- Short downtime for maintenance
- Easy to access the interior of the machine



Mixer type RV28/RV33

right size for all performance classes

Just the right size for all performance classes

The Eirich range of mixers can efficiently meet all user-specific requirements, regardless of the performance class. The mixers can perform various applications in succession, step by step, and are designed to operate at temperatures up to 200°C, with higher temperatures available upon request.

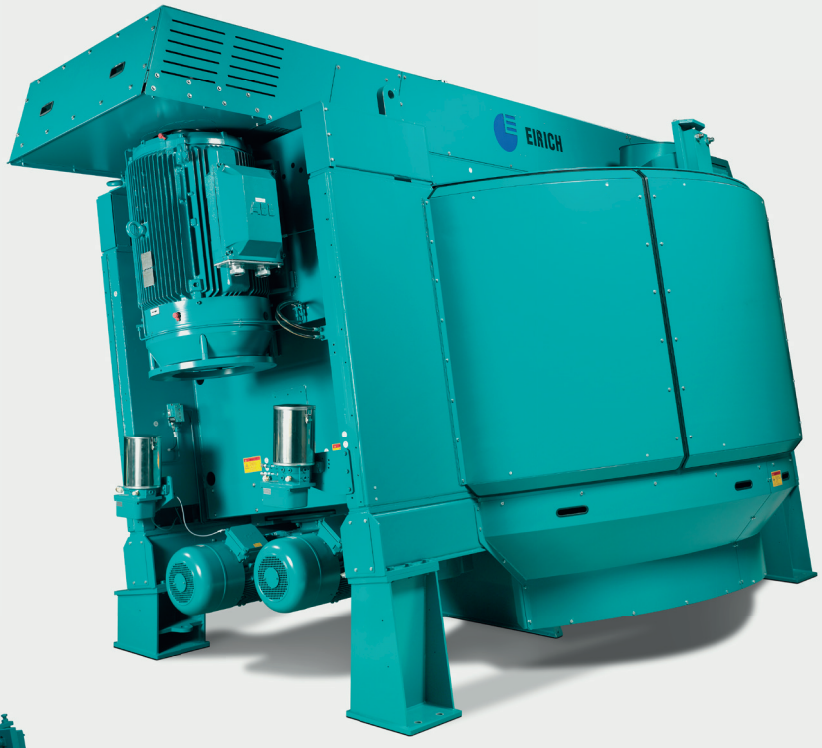
R&D equipment

Eirich offers laboratory mixers and complete laboratory systems for quality assurance and research and development applications. These systems are designed for reliable scale-ups and can operate at temperatures up to 200°C. High-temperature design options are also available, allowing operation at temperatures up to 300°C. These laboratory mixers and systems are intended to ensure the quality of the materials produced, as well as to develop new materials and optimize production processes.

Capacity ranges realized in existing plants

Batch mixing:
60 - 4,200 kg/batch

Continuous mixing:
10 - 65 t/h



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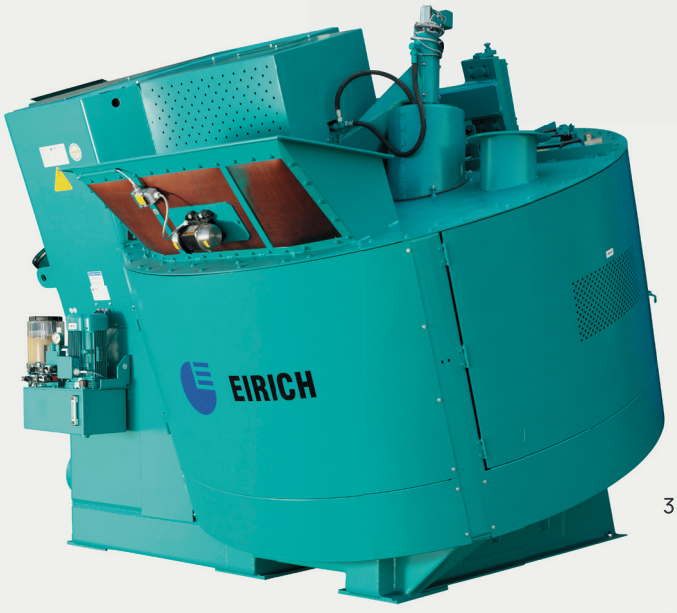

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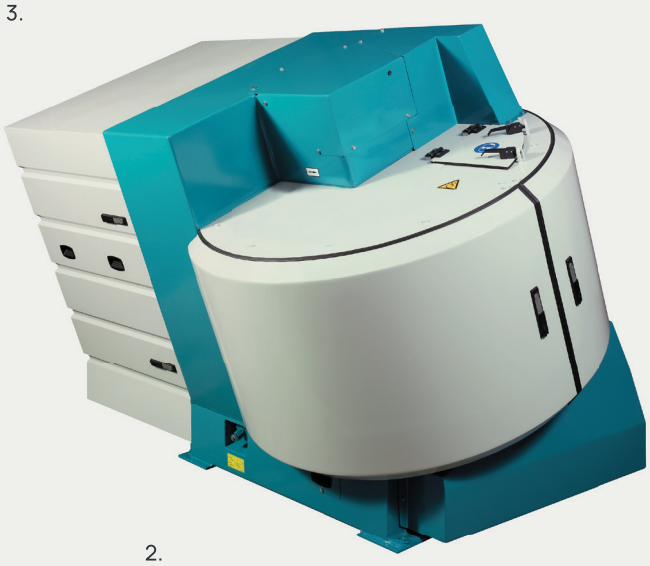

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Mixer Types

1. RV02
2. RV12
3. RV24
4. RV28

Eirich Plant Engineering

Consulting
Our experts are available to answer any question you may have about carbon paste preparation. They listen to your ideas, instructions and wishes, work with you to identify the performance requirements for your planned installation and develop useful alternatives.

Basic and detail engineering
All available information and the performance data defined jointly with the customer form the basis for a project-specific plant concept. Project execution is very efficient because the number of interfaces is kept to a minimum and we maintain a quality standard that is recognized all over the world. Only machines and equipment developed and built by Eirich itself and products from qualified and experienced partners are considered in the engineering and order handling stage.

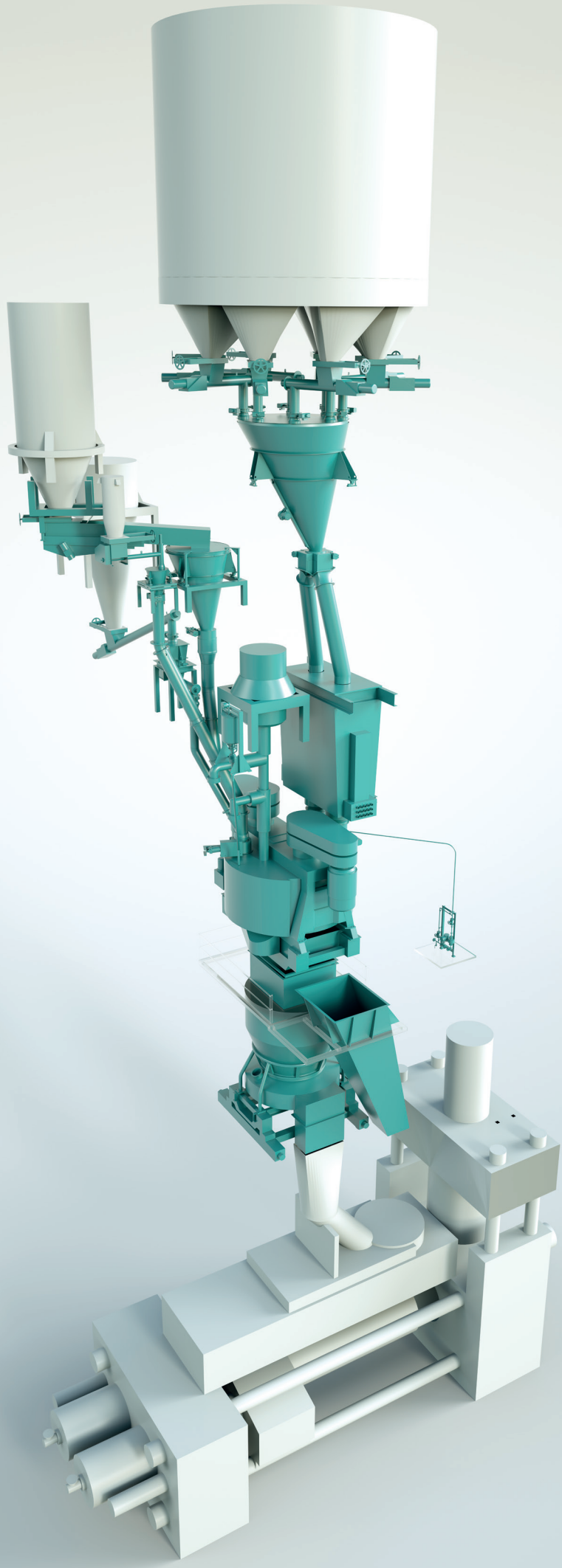
System modules
Storing, conveying, feeding
Each proportion of the formula in a defined quantity and at the correct moment is a simple but indispensable condition for the optimal utilization of raw materials. Eirich offers system components specifically developed to meet the demands of the carbon industry, with exact dimensioning tailored to local conditions.

Metering and measuring
Eirich offers hopper scales, belt weighers, and loss-in-weight feeders that are specifically developed to meet the demands of the carbon industry and can be tailored to local conditions. These components can be connected to self-optimizing process control systems, automatically scanning all crucial process parameters.

Process control
Eirich develops and builds its own machine and process control systems and instrumentation. The range covers new installations as well as the modernization or expansion of existing machines and preparation systems. All components are exactly configured in accordance with the user's needs. The results are tailor-made solutions ranging from conventional keyboard control systems to special batch controllers in according to formula management.

Specific software functions of the control system

- Assurance of product quality and its reproducibility
- Monitoring and controlling of maintenance intervals
- Assurance of plant availability
- Visualization of process sequences and operating conditions
- Documentation of all important process parameters



Eirich LifeCycle Services

Eirich offers a comprehensive range of after sale services for the carbon industry worldwide: from the initial consultation to the planning and implementation of a preparation solution, reliable after-sales service and the dependable delivery of original spare parts.

This includes reliable customer service for Eirich machinery and systems the entire life cycle. Eirich LifeCycle Service begins at the very start of the machine design and systems planning stage.

Installation and commissioning
An experienced service team is available for installation and commissioning. Local partners assist us, and the customer's personnel are instructed in the course of the work.

Training
Training for your operating and maintenance team is provided by expert instructors to ensure that you get the most long-term value from your investment. This includes instructions concerning the system's operation, safety regulations, process optimization, maintenance intervals and repair work.

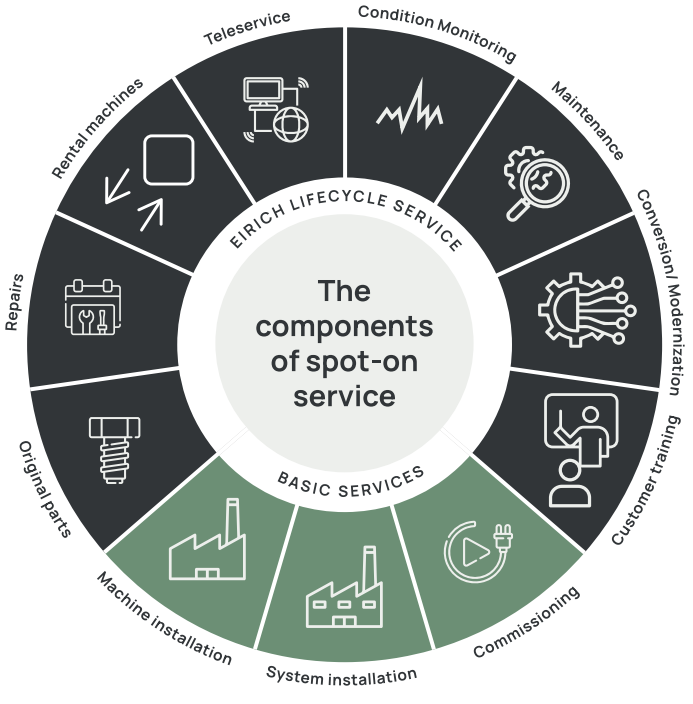
Customer service
Eirich after sale service is your guarantee of expertise, high availability and comprehensive support. The portfolio includes the worldwide supply of genuine Eirich spare parts, rapid response to production stoppages and fast machine / system repairs.

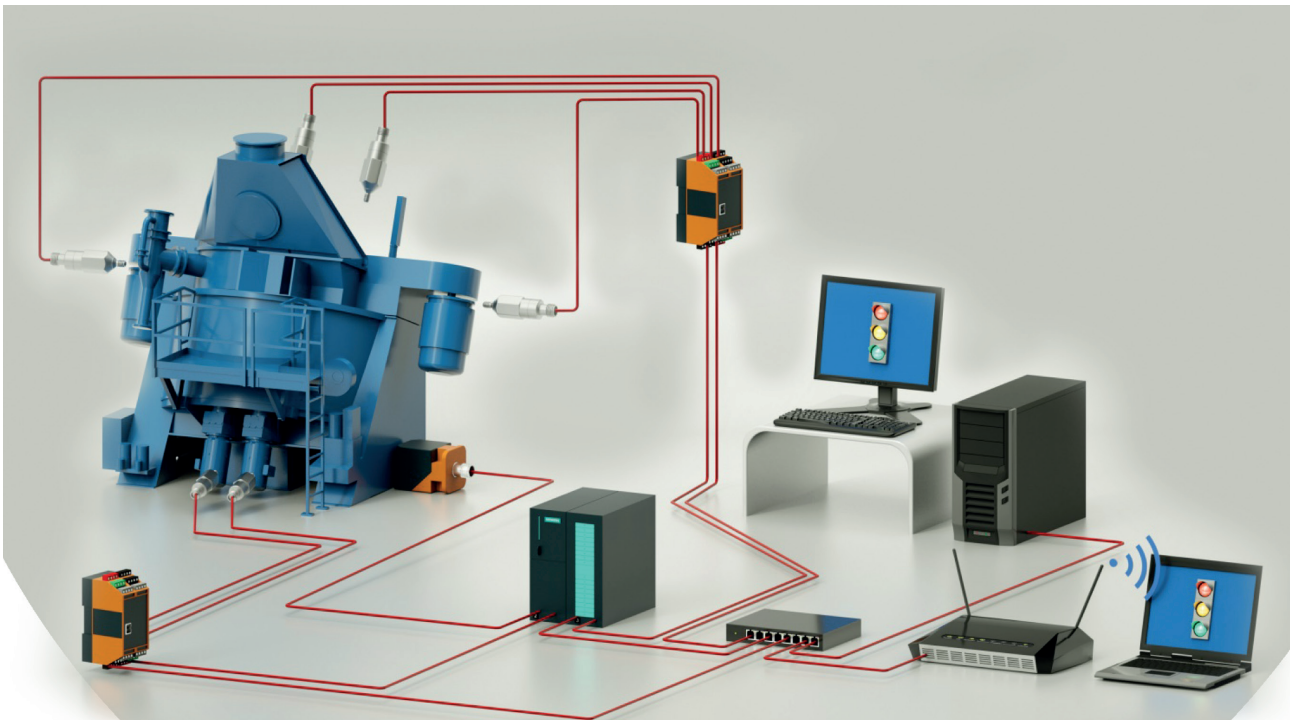
Particularly beneficial options are:

- Teleservice
  Remote diagnosis via data link. This is guaranteeing fast, low-cost support when problems occur.

- Condition Monitoring
  Sensors mounted on key functional elements send data in real-time to a central analysis system in order to detect component degradation before a major error occurs. This can enhance machine availability and reduce maintenance costs.

- Maintenance software packages
  The software ServiceExpert ECD provides simple access to engineering drawings, images and photos to quickly identify even very small parts, including a shopping basket function. With the ServiceExpert ECS a tailored, comprehensive, state-of-the-art maintenance management software solution is available helping maximize machine availability.





Condition Monitoring System

EIRICH

The Eirich Group, with the Gustav Eirich machine factory as a strategic center in Hardheim, is a supplier of machines, systems and services for mixing technology, granulating/pelleting, drying and fine grinding. Our core competencies are procedures and processes for the treatment of loose materials, sludge and mud. We are a family-run company with 15 locations worldwide.

More information at:
www.eirich.com

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