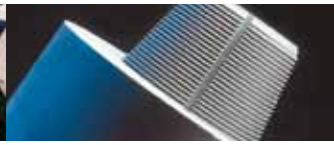
EIRICH

Preparation Technologies for Carbon Paste


Tailor-made solutions – effective and trendsetting

EIRICH is partner of the carbon industry and offers top preparation technologies for the economical preparation of the following core applications:

- **Anode paste**
- **Electrode and cathode paste**
- **Metallurgical Soederberg paste**
- **Graphite specialties**

The product line includes machinery and systems as well as a full range of services covering everything from consulting to start-up.
EIRICH has been building machines and complete plants for the carbon industry for more than 40 years and a constantly growing number of renowned manufacturers of carbon products all over the world uses EIRICH equipment.
The family-owned company was established in 1863. Today, approx. 600 employees work at the company's headquarters in Hardheim, Germany with in-house manufacturing facilities and its own plant engineering office.

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
- Engineering, manufacturing and service by one supplier
- All key machinery manufactured in EIRICH workshops
- An outstanding reputation for reliability
- Worldwide presence and after-sales service

Worldwide success

- **Up to now, EIRICH has delivered more than 200 machines to the carbon industry worldwide**
- **Today, more than 50 % of the world's paste production for prebaked anodes are prepared in plants with EIRICH equipment**

Front page pictures 2/5: SGL Group-The Carbon Company

Anode paste preparation
EIRICH Mixing Cascade (EMC®) Technology

The fundamental function of an anode paste plant is to heat up various coke fractions, to mix them with green scrap and pitch and to feed the easily moldable mix to the press.

Starting with trials in Switzerland in 1993, a pilot plant in Norway and the 15 t/h industrial-scale production unit in Cameroon, the international breakthrough was achieved in 2003. The EMC® is operational for capacities from 20 t/h up to 60 t/h.

The main technical objectives are:

- Consistent production
- High level of density
- Zero anode incident in the potline
  - no cracking by thermal shock
  - no dusting and mushrooms
- Low reactivity
- Excellent pot performance

The key element to achieve these objectives is a perfect mixing process

- Perfect homogenization of all ingredients
- Pitch penetration to fill the coke pores
- Even coating of coke grains

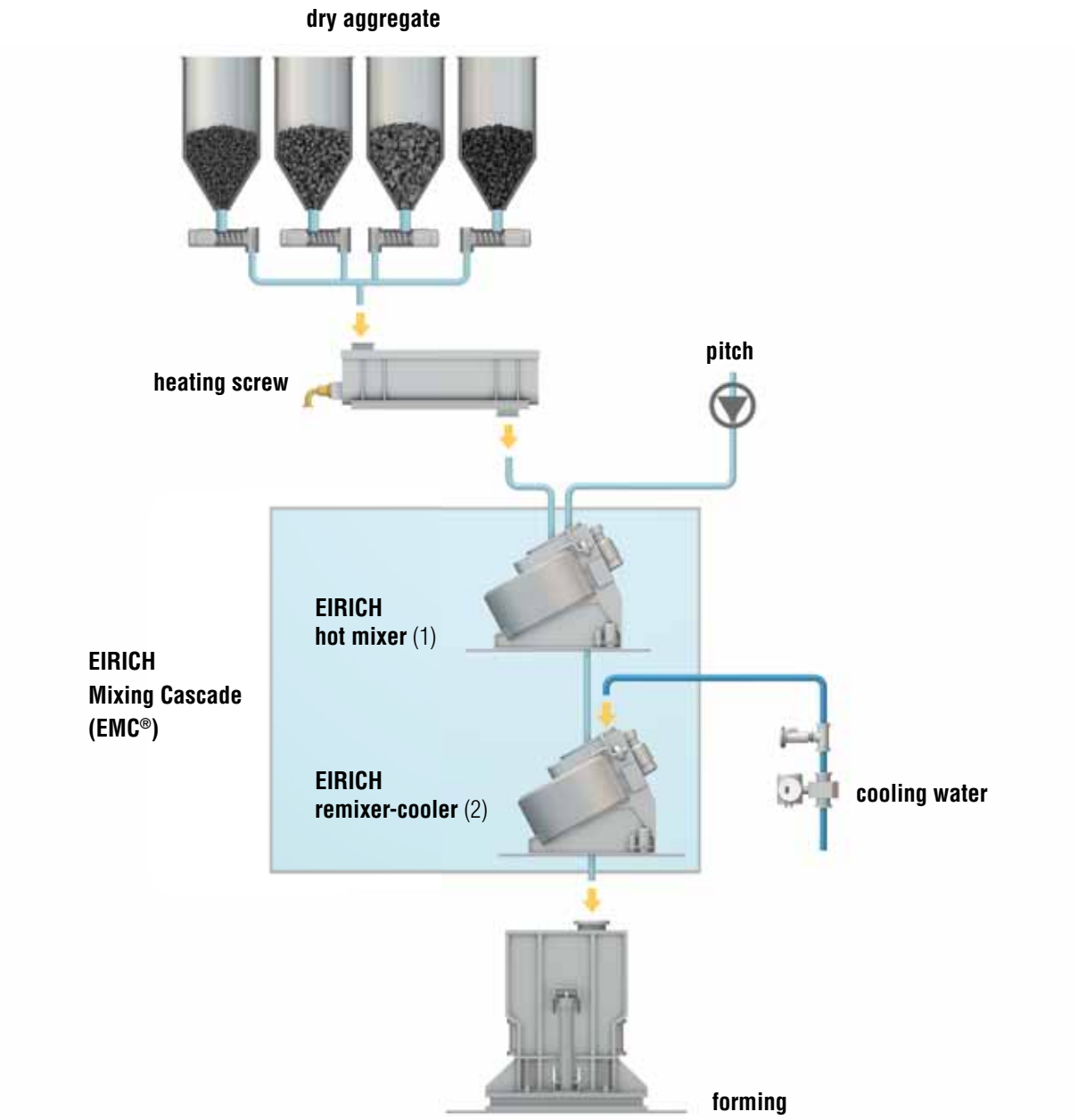
Mixing is more important than forming!

Sufficient mixing time, high mixing temperature and sufficient power input are the most important conditions to cope with the above mentioned requirements.

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 %
- Perfect adaptation to low raw material qualities and property fluctuations
- Throughput rates of more than 60 t/h in one 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



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 "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 approx. twice as long as in a conventional kneader.

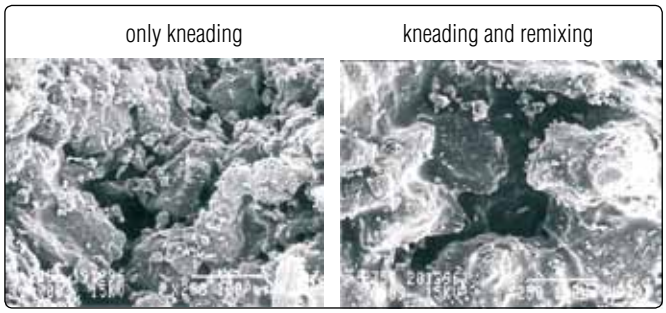
The paste coming from the hot mixer is remixed and cooled simultaneously in the **remixer-cooler** (2). The effective cooling is achieved by injection of water into the anode paste and subsequent immediate evaporation. The discharge temperature is precisely controlled with a variation of less than +/- 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

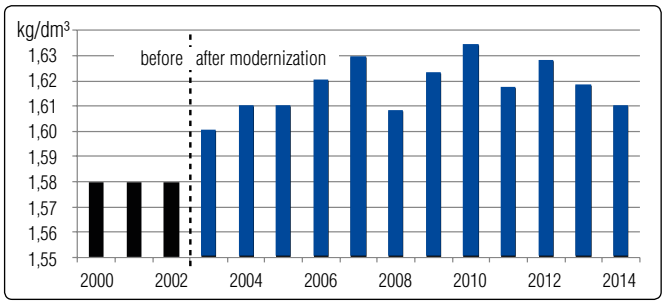
Based on the long-term experience in anode paste mixing, only a plant with two different mixing stages (hot mixing and remixing-cooling) can fulfill today's requirements in an optimum way. Whereas normal paste coolers are only good to reduce the paste temperature, the EIRICH remixer-cooler with its special inclined machine design realizes homogenizing and cooling of the paste simultaneously.

Paste quality improvement by continuous remixing

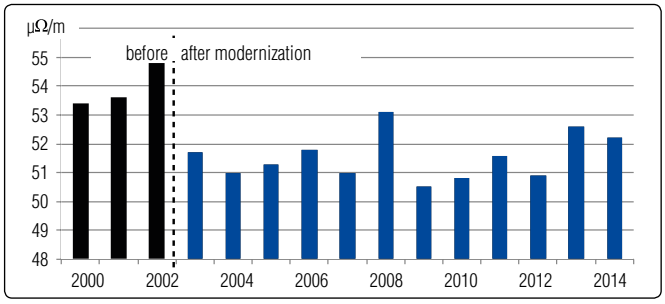


Reference: Norsk Hydro Research, Porsgrunn - Norway

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

By courtesy of: Talum, Kidricevo - Slovenia

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

Better paste properties

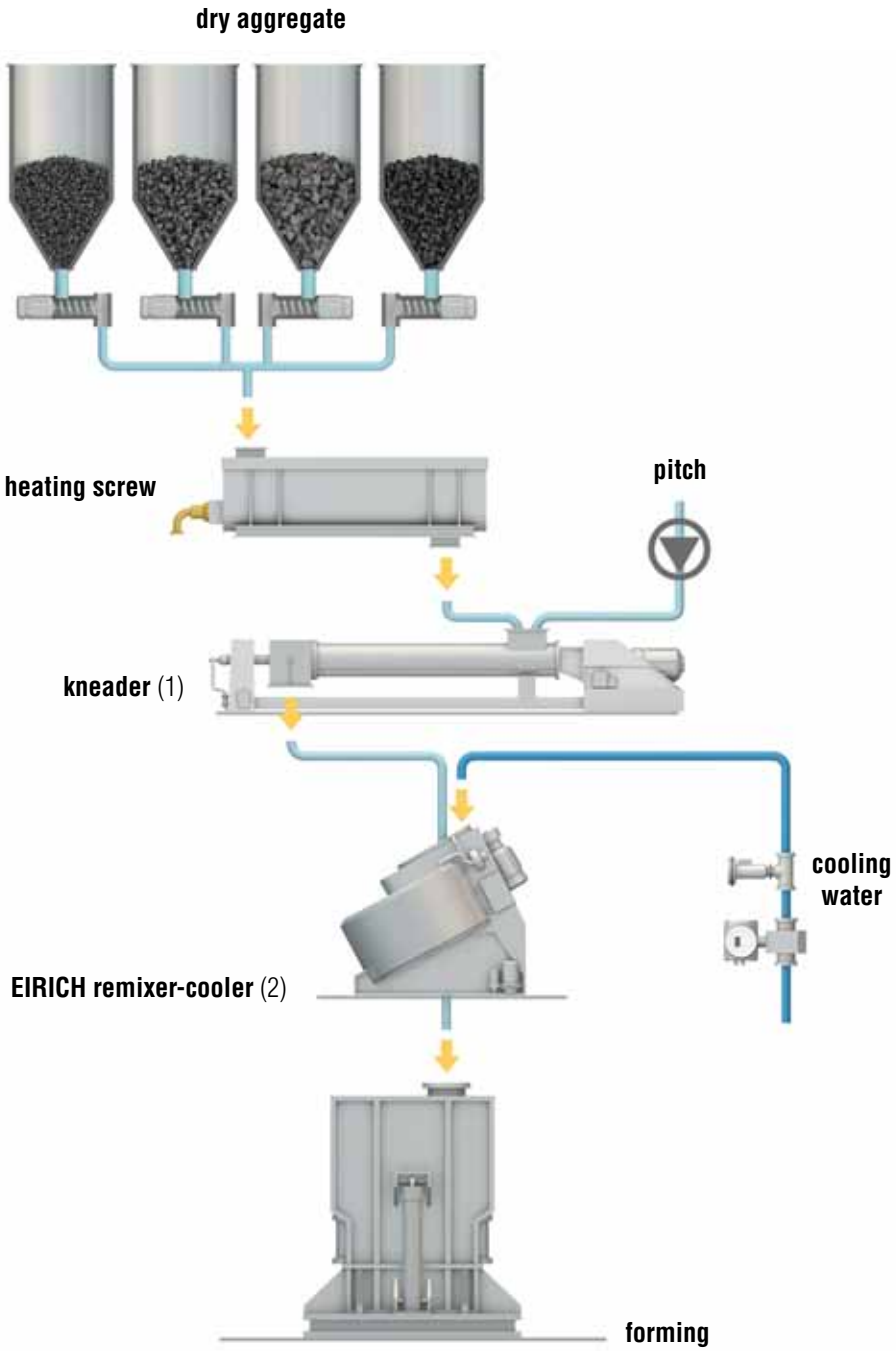
- Low paste porosity = high paste homogeneity
- Higher green and baked density

Raised anode quality

- Lower anode resistivity
- Lower pitch content (typically 0.5-0.7 % absolute)
- Less rejects

System advantages

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



Process description

Paste prepared in a **kneader** (1) is discharged continuously into the downstream installed **EIRICH remixer-cooler** (2)**.** The machine 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 is of constant high quality. Paste cooling is realized via evaporative cooling with injected water. This is added dependent on the temperature of the paste which is measured via an infrared temperature measuring system. The cooled paste is discharged continuously.

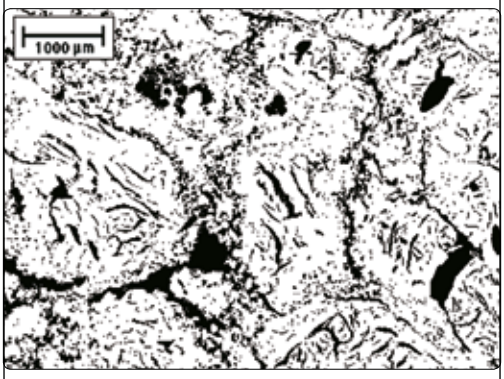
Electrode and cathode paste preparation
EIRICH batchwise operated systems

The EIRICH preparation plant concept comprises coke heating, paste preparation and control system. This system with one EIRICH mixer may replace 8-12 conventional batchwise operated machines. Thus, productivity increases up to 200 % in the green production of graphite electrodes.

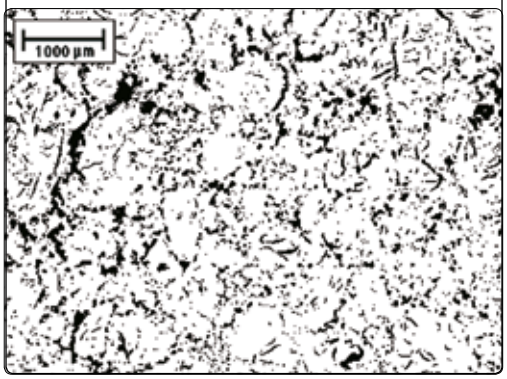
The control system monitors the momentary sequences of all processes in the preparation plant as well as the adjustment of the required energy amount at the electric resistance heater, the handling and storing of all important plant operation data as well as the indication and logging of all faults.

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

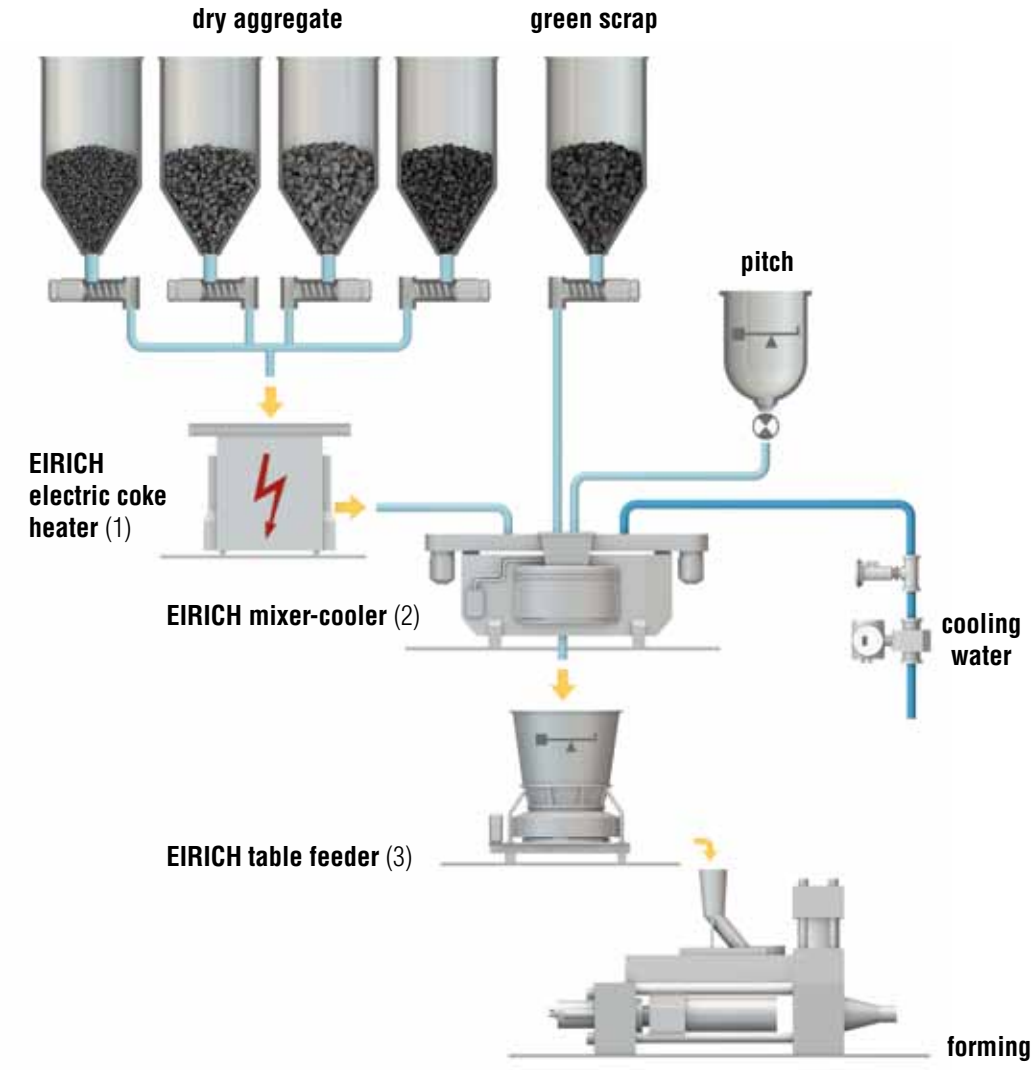
- Fully electric coke heating equals the most elegant solution on the market
- Rapid and accurate adjustment of the coke temperature
- No HTF heating system required, i.e., no risk of fire, self-ignition, leakage, etc.
- Reduced energy consumption

Mixing

- Reduction in pitch consumption of 2-5 %
- Simple machine design
- Wear and spare parts easily exchangeable
- 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

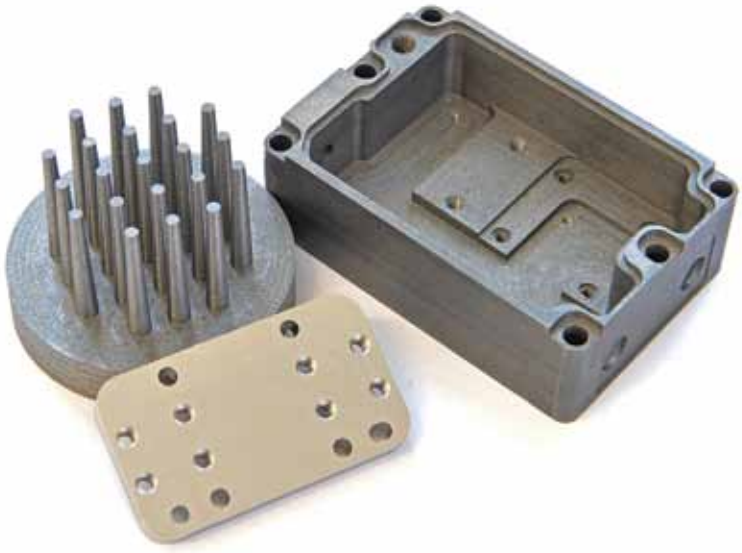
The coke fractions from either a specially designed receiving hopper (in case of existing fraction weigh scales and pneumatic transport) or alternatively from a central coke weigh scale are fed into the **EIRICH direct electric coke heater** (1).

Coke preheating works simultaneously with the ongoing paste preparation in the **mixer-cooler** (2). After the introduction of a precalculated amount of electric energy into the coke, the system switches off automatically and waits for the discharge request from the mixer-cooler. As soon as the preheated coke batch has been discharged into the empty mixer-cooler, a short dry mixing and homogenization phase starts before liquid pitch is added by means of a pitch weigh scale. Coke and pitch are intensively mixed and rapidly homogenized. For paste temperature measurement, the mixer is equipped with an infrared camera. Adding a precalculated amount of water starts the cooling process. The finished paste is discharged batchwise from the mixer into the downstream **table feeder** (3). Based on the press requirement, portions (by weight) of electrode paste are discharged from this table feeder into the press.

Carbon and graphite specialties
EIRICH batchwise operated systems

EIRICH supplies tailor-made mixers and plants for a great variety of carbon and graphite specialties such as isostatically molded and extruded semi-finished products, carbon fiber composites, carbon brushes, graphite heat exchangers, etc.

The standard operating temperature is up to 250 °C. Optional induction heating is provided for fast and highly efficient dry aggregate preheating.



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
- Significantly reduced cycle time
- Simple machine design, thus low maintenance costs
- Wear and spare parts easily exchangeable

Pictures: Schunk Hoffmann Carbon Technology AG

Thermographic picture of an induction-heated mixing pan

Mixer type RV16W

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

The results are currents of material with high velocity differentials and continually changing positions.
Mixing intensity can be modified and energy input can be optimized by either co-current or counter-current operating mode.
Paste cooling by water evaporation is available for both batch and continuous mixers.

Mode of operation

Batchwise operated machines

With a discharge gate in the center of the mixing pan and a swiveling wall and bottom scraper for rapid discharge

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 175 °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.

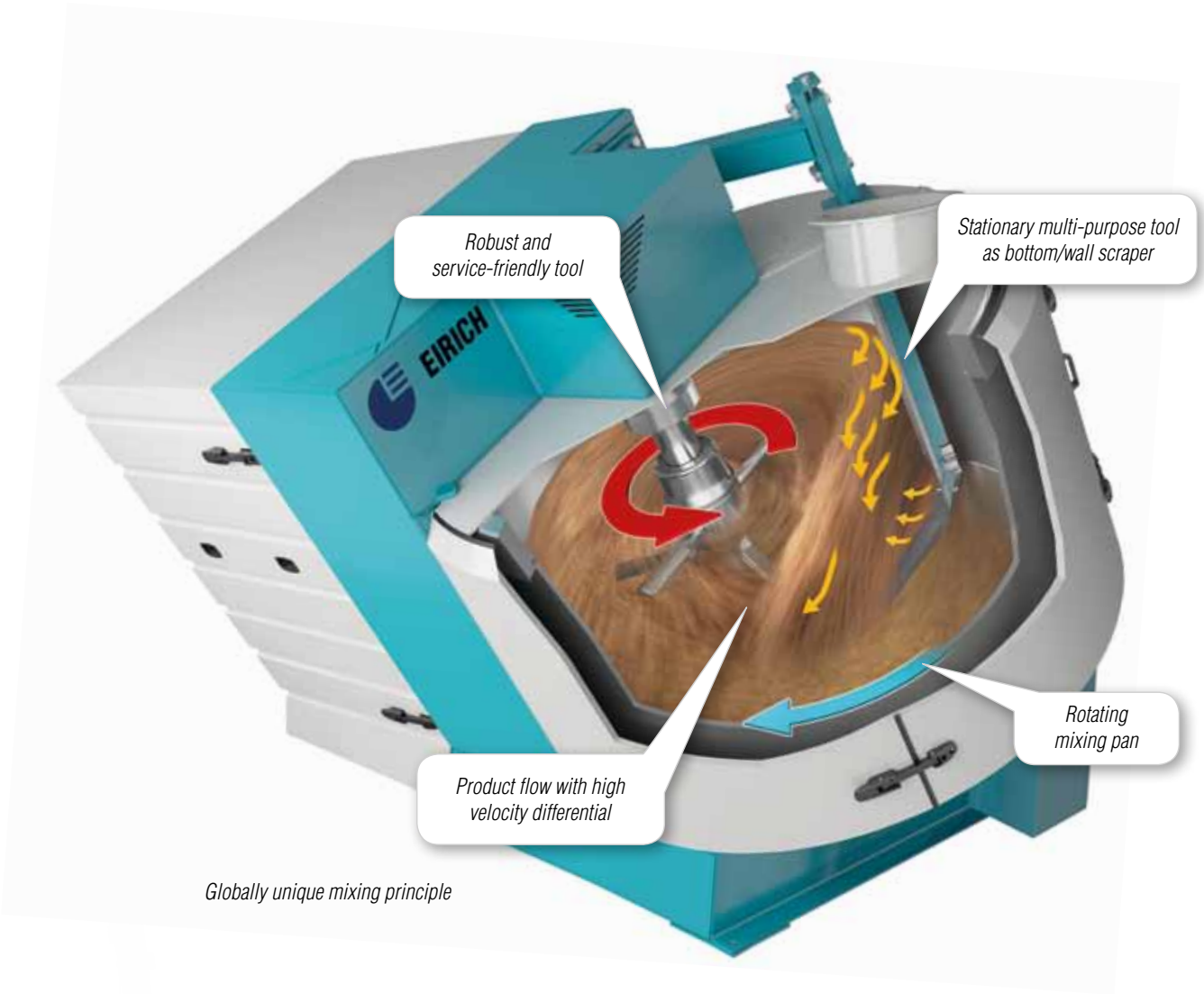
Highlights of the EIRICH technology

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
- Good access into the machine



Globally unique mixing principle

Mixer type RV28/RV33

Machine types

Just the right size for all performance classes

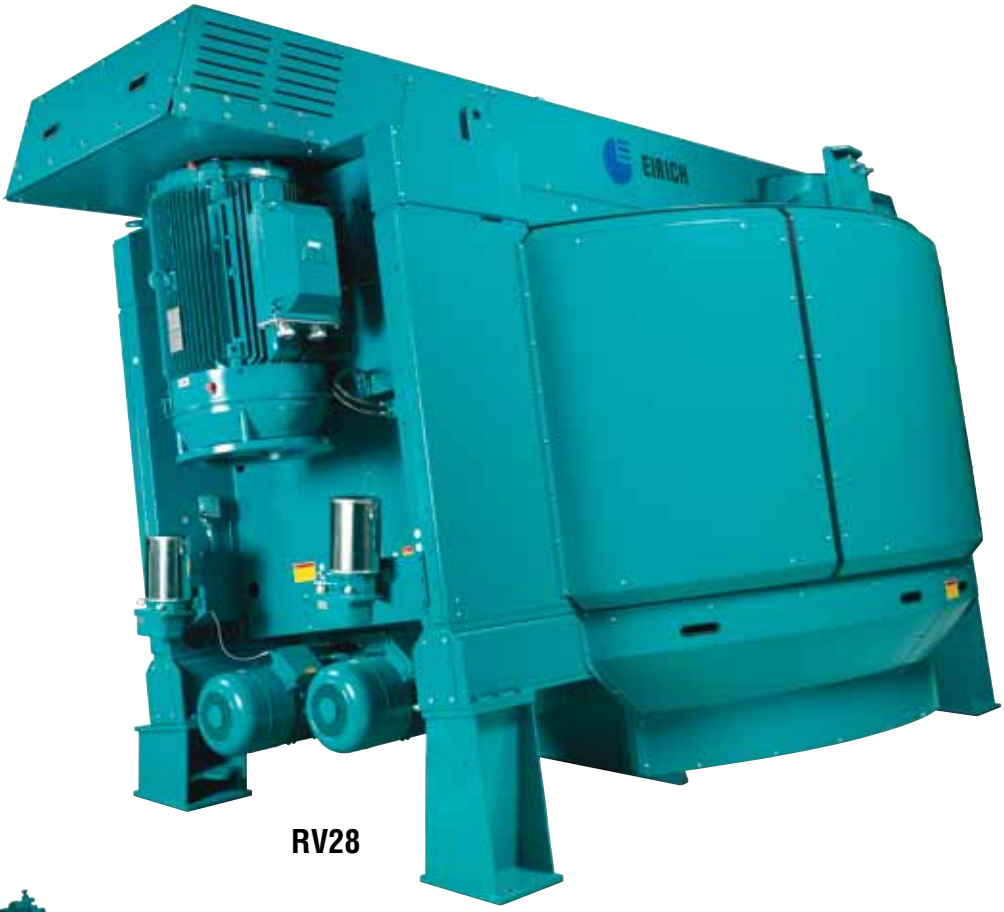
The EIRICH range of mixers covers all user-specific requirements with great efficiency. In many cases, various applications can be performed in succession, step by step, in one and the same mixer.

All machinery for carbon paste preparation is made for operation temperatures up to 200 °C – higher temperatures on request.

R&D equipment

For quality assurance and/or research and development applications, EIRICH offers laboratory mixers as well as complete laboratory systems for reliable scale-ups. The maximal standard operating temperature is 200 °C. High-temperature design for max. 300 °C is available as well.

RV02 **RV12**



RV28

RV24

Mixer types

Capacity ranges realized in existing plants	
Batch mixing: 60 - 4,200 kg/batch	Continuous mixing: 10 - 60 t/h

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 as 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 defined quantity and at the correct moment – this is the simple but indispensable condition for optimum utilization of the applied raw materials. EIRICH offers system components which have been especially developed to meet the demands of the carbon industry. The exact dimensioning is tailored to the local conditions.

Metering and measuring

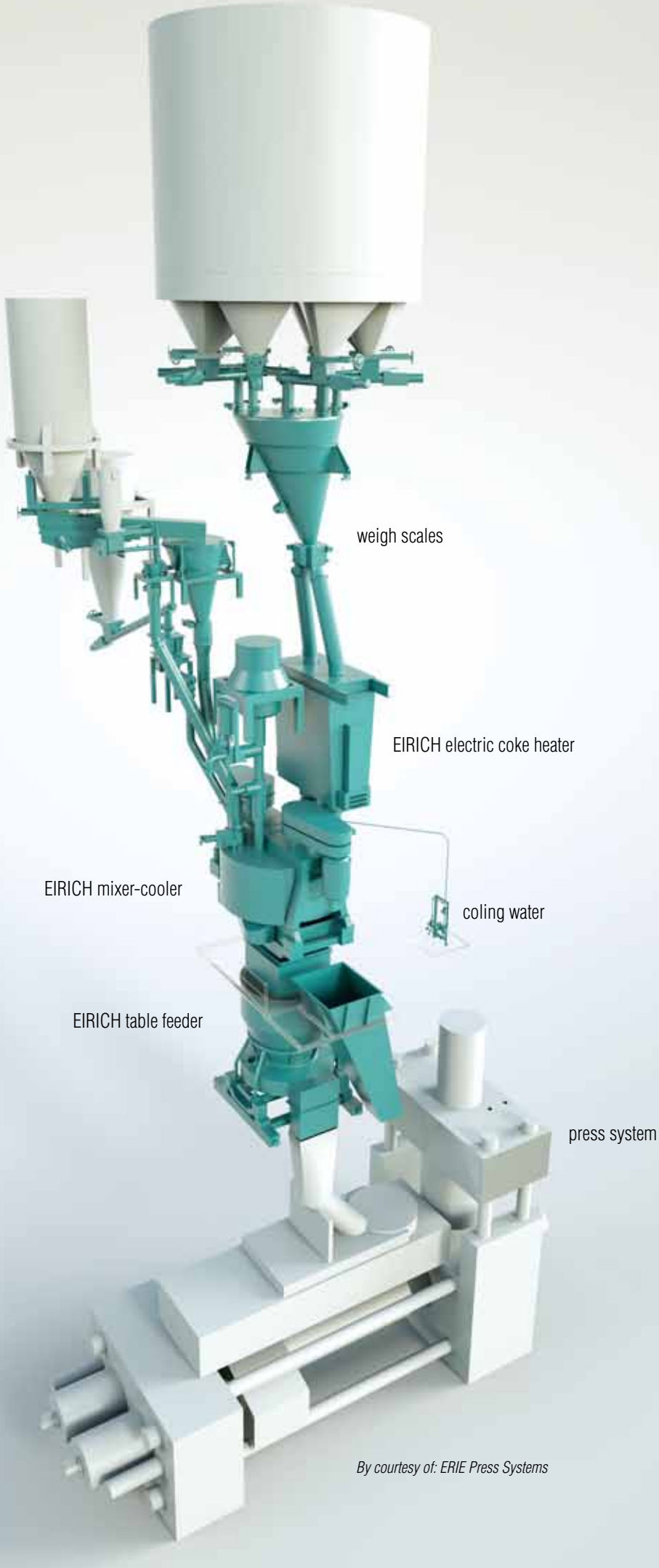
To match the particular production requirements and local conditions, EIRICH mainly uses hopper scales, belt weighers or loss-in-weight feeders. All the components can be connected to self-optimizing process control systems. All the crucial process parameters are scanned automatically.

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 covering everything from conventional keyboard control systems to special batch controllers in accordance with 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



By courtesy of: ERIE Press Systems

EIRICH LifeCycle Services

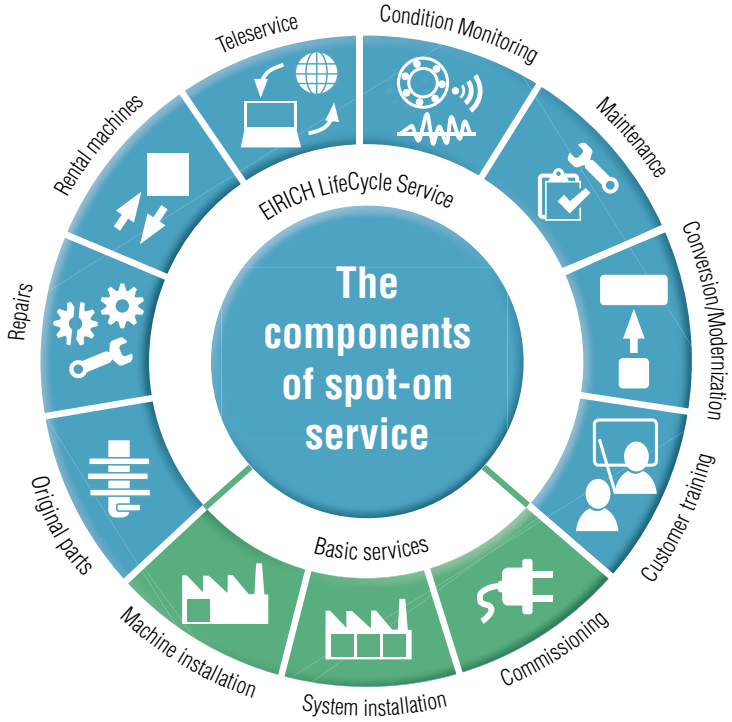
EIRICH offers a comprehensive range of after-sales services for the carbon industry worldwide: from the initial consultation to the planning and implementation of a preparation solution, reliable after-sales service and the dependable delivery of original spare parts.
This includes reliable customer service for EIRICH machinery and systems throughout the whole life cycle. **EIRICH LifeCycle Service** begins right with 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 out of your investment over the long term. It includes instructions concerning the system's operation, safety regulations, process optimization, maintenance intervals and repair work.

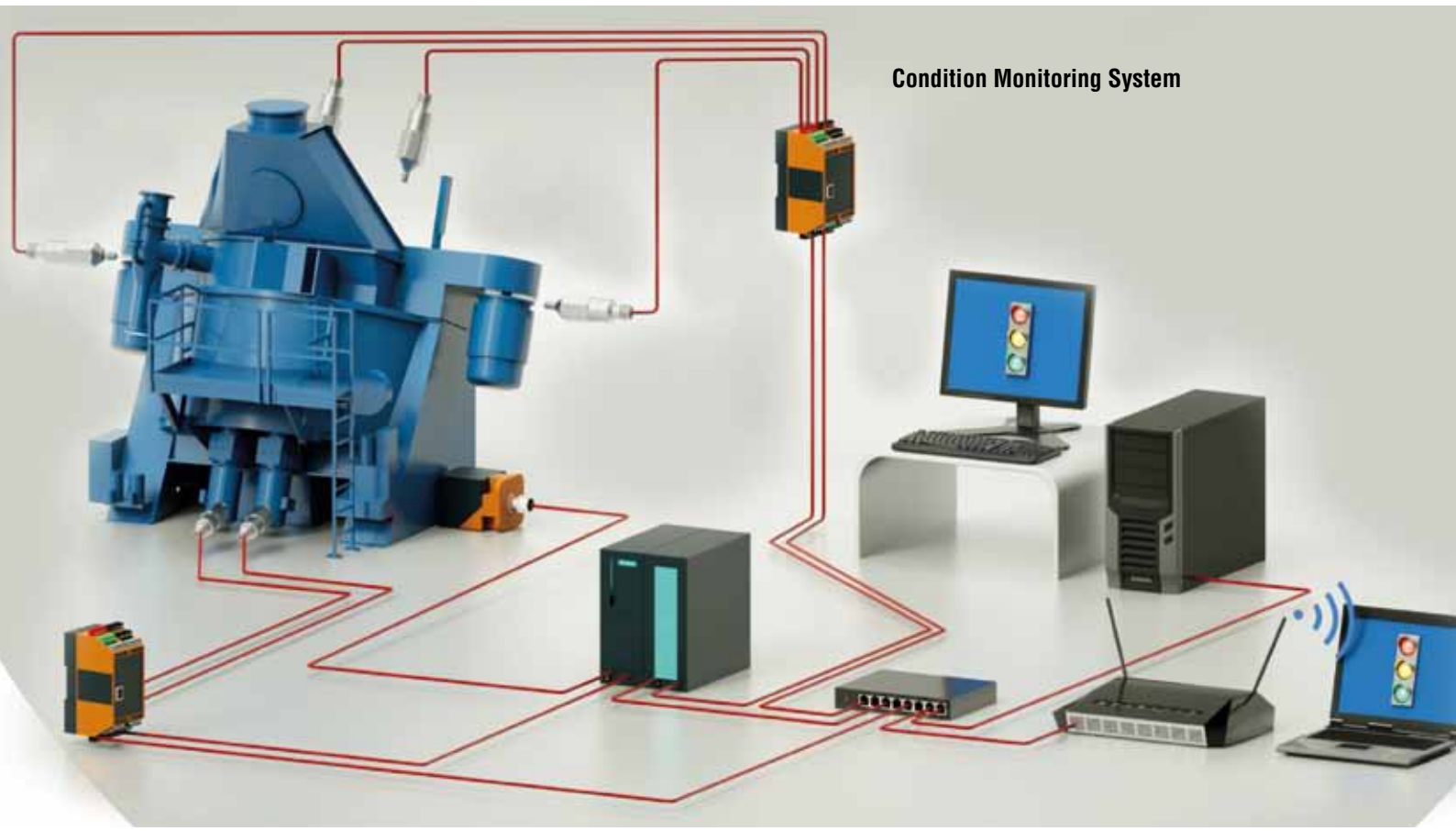


Customer service

EIRICH after-sales 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 fault 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 which helps to maximize machine availability.



Condition Monitoring System

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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The Pioneer in Material Processing®

KM 1895-0-**en** 11/16 Printed in Germany. Subject to changes.