

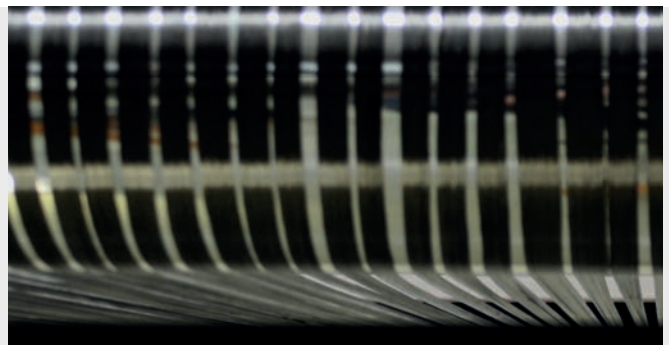
CARBON FIBER



CARBON FIBER – MATERIAL OF THE FUTURE.

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Oxidized PAN-Fiber.

Carbon Fiber lines – The complete solution

One source

Integrated solutions for Carbon Fiber production lines with proven, best-in-class equipment, from the world's premier Carbon Fiber equipment supplier.

Your benefit

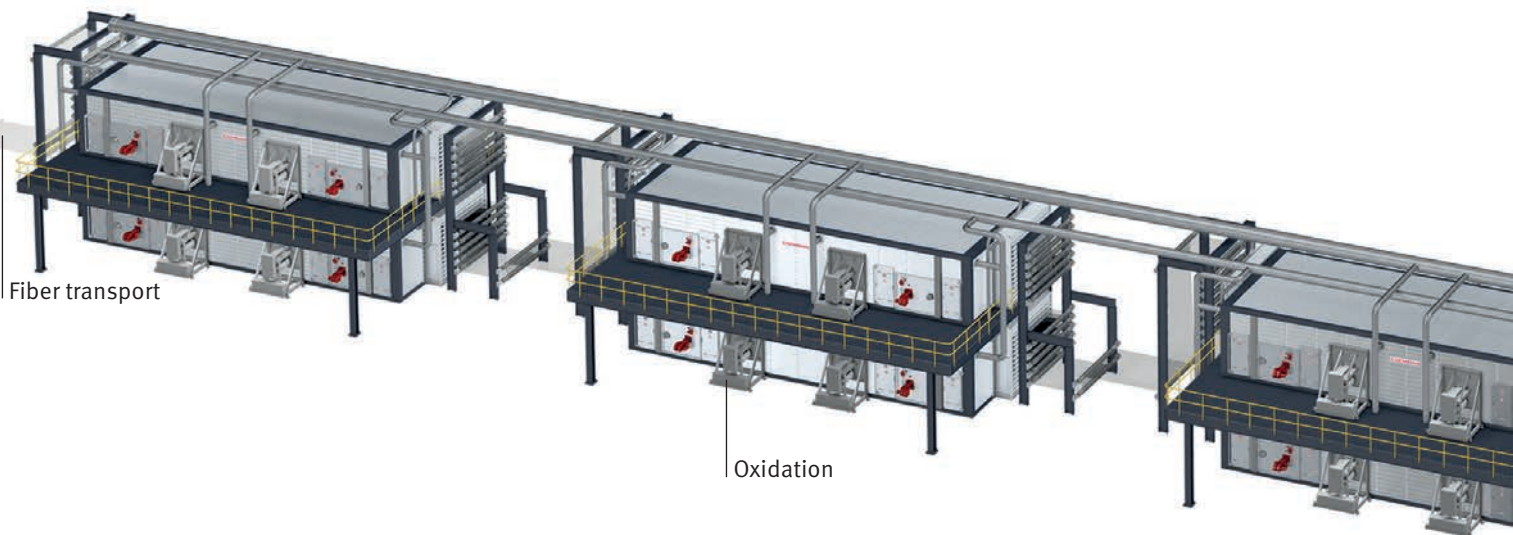
- Lower project costs through synergy effects in project planning, project management, installation and commissioning
- High reliability and productivity through perfectly synchronized equipment and interfaces
- Reduced planning efforts for the customer
- User friendly software integration for easy operation
- Fastest to the market and into production
- Lowest cost of ownership

Sustainability

- Excellent energy efficiency in each production component
- Integrated energy recovering solutions
- Eco-friendly production methods
- Energy efficient exhaust gas purification systems

Performance

- Well balanced equipment ensures continuous operation and reduced down time
- Every single equipment offers best-in-class performance



Planning

- Concept
- Feasibility study

Engineering

- Basic engineering
- Detail engineering
- Interface management
- HAZOP analysis

Sourcing

- Manufacturing
- Purchase

Installation

- Delivery
- Assembly
- Commissioning
- Training

Operation

- Start-up support
- Process improvement
- Maintenance/Services
- Spare-Parts

Supported steps to complete Carbon Fiber lines.

Extensive experience

A global network with more than 50 years experience with project management, planning, assembly and commissioning in system integration across many industries including automotive, chemical and ceramic.

Close to you

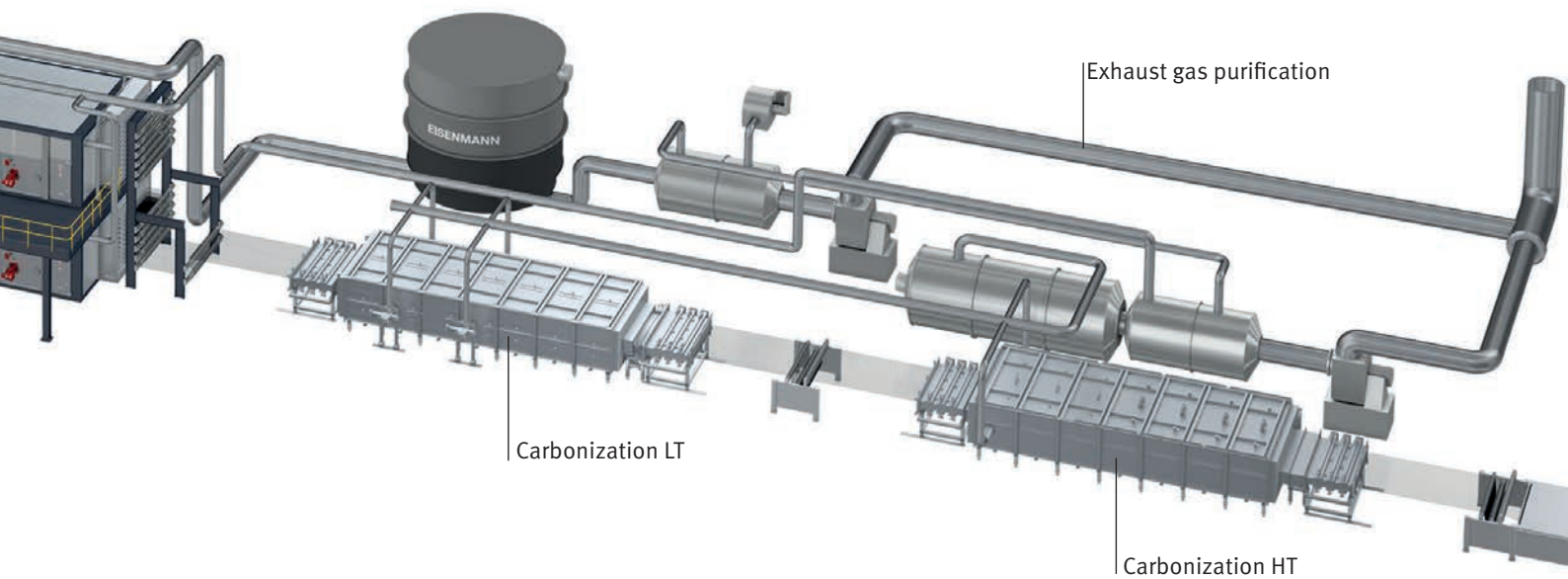
- Sales, Engineering and Service departments in Europe, North and South America, Russia, South and East Asia
- Production locations in Germany, China, Brazil, Mexico and India
- Global sourcing

Reliability

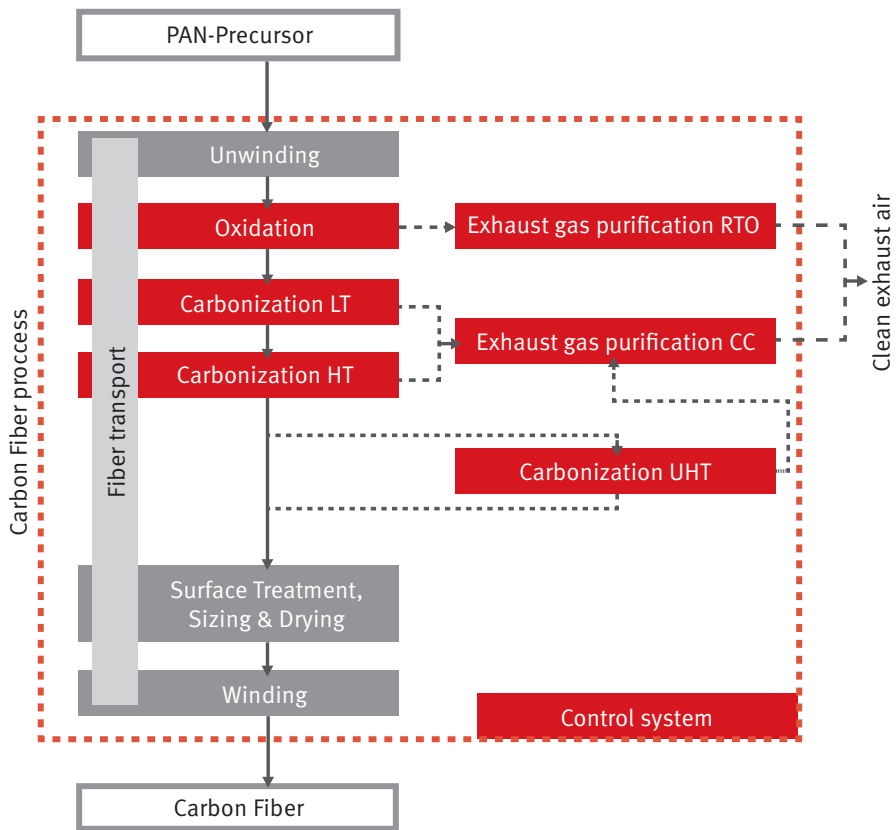
- German engineering ensures state of the art equipment with proven quality and reliability
- Closely connected partners for creels, winders, material handling, surface treatment and sizing

Service

- Extensive range of services, tailored individually to customer needs
- 24 hours, 7 days on-call service for inspection, service, repair and spare part management



Portfolio



Complete based Carbon Fiber process.

Type	Oxidation Oven			Carbonization			Exhaust air purification		Control system	Winding unwinding	Fiber transport	Surface treatment, sizing & drying
	Center-to-End	Vertical-Down	Horizontal-Crossflow	LT	HT	UHT	RTO	CC				
Laboratory line		●		●	●	●		●	●	●	●	●
Pilot scale	●	●		●	●	●	●	●	●	●	●	●
	● Combined			●	●	●	●	●	●	●	●	●
Production scale	●	●	●	●	●	●	●	●	●	●	●	●
● Eisenmann										● Partners		

Eisenmann product range for Carbon Fiber lines.

Integrated energy recovery solutions

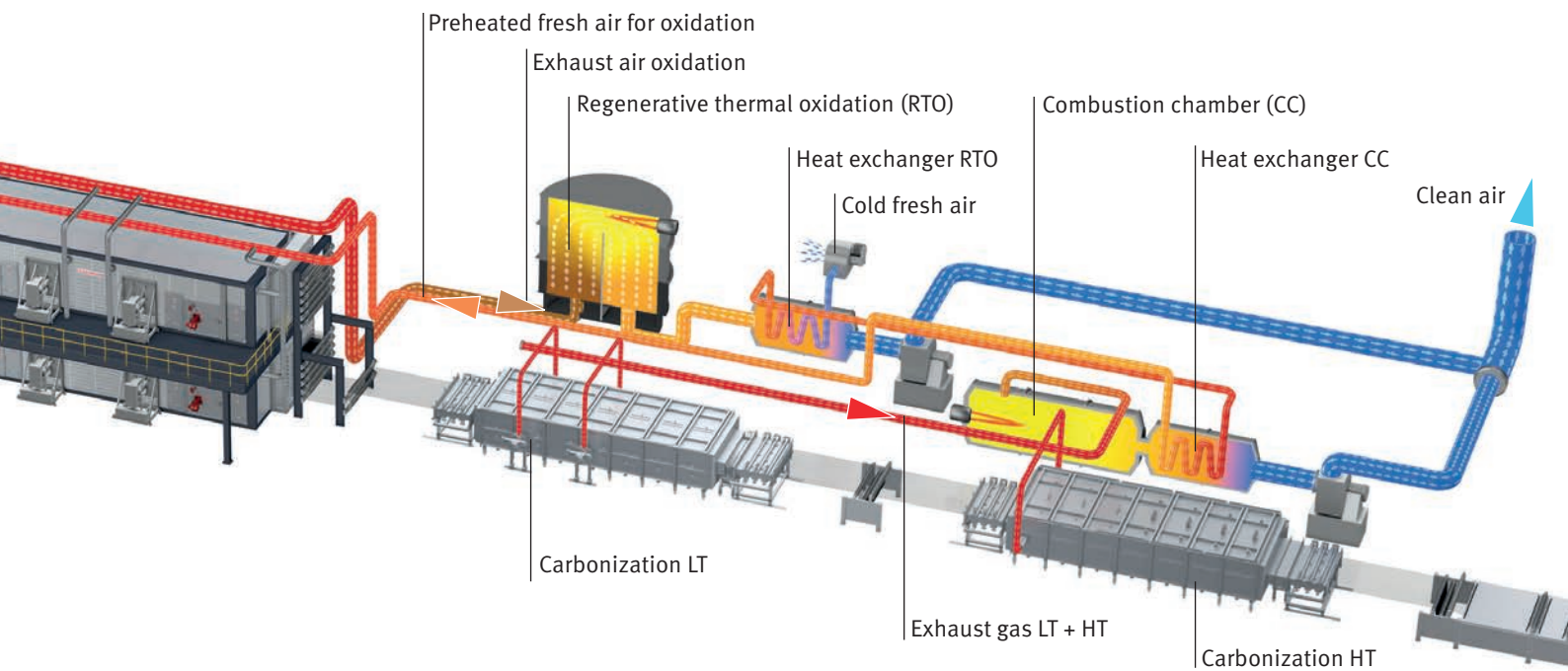
Eisenmann offers an excellent energy reduction strategy for the complete Carbon Fiber production line. This strategy includes reduced energy consumption in every single process step as well as integrated and customized energy recovery solutions, resulting in reduced operating costs and a smaller carbon footprint.

Heat recovery

- Integrated within the exhaust gas streams of the RTO and Combustion Chamber
- Air-air heat exchanger
- Air-gas heat exchanger
- Air-fluid heat exchanger (water, thermo-oil)

Highest energy efficiency

- Preheated fresh air for oxidation ovens
- Thermo-oil heated oxidation ovens
- Preheated nitrogen for carbonization furnaces
- Preheated process water or other process media
- Facility heating



Example of an integrated heat recovery system for preheated fresh air for oxidation.

Oxidation ovens

Fiber quality

- Superior oxidized densities and fiber quality across the entire tow band by providing best-in class temperature and airflow uniformity over the entire process chamber
- Optimized fiber quality by matching the best airflow system for your precursor material

The airflow you need

Depending of your preferences, Eisenmann offers different kind of airflow systems:

- Vertical-Down flow – typically used for small tows
- Center-to-End flow – used for small and heavy tows

Design is Key

- Patented supply nozzle air delivery channels for the Center-to-End technology
- Patented state of the art end seal system
- Control system and software
- Thermo oil, electricity or natural gas as heating source
- Natural gas heat exchangers with the highest thermal efficiency in the industry

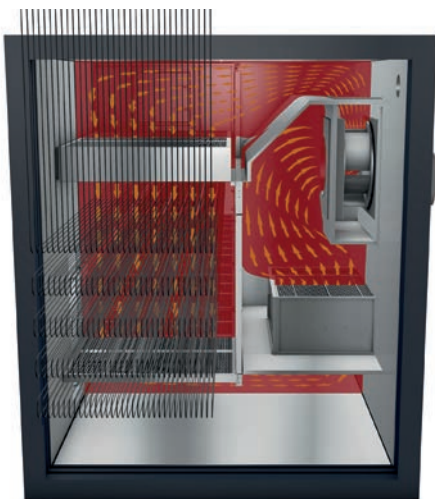
- Optional hybrid heating with two heating sources
- Online airflow measurement
- Maintenance – free, seal welded interior

Productivity

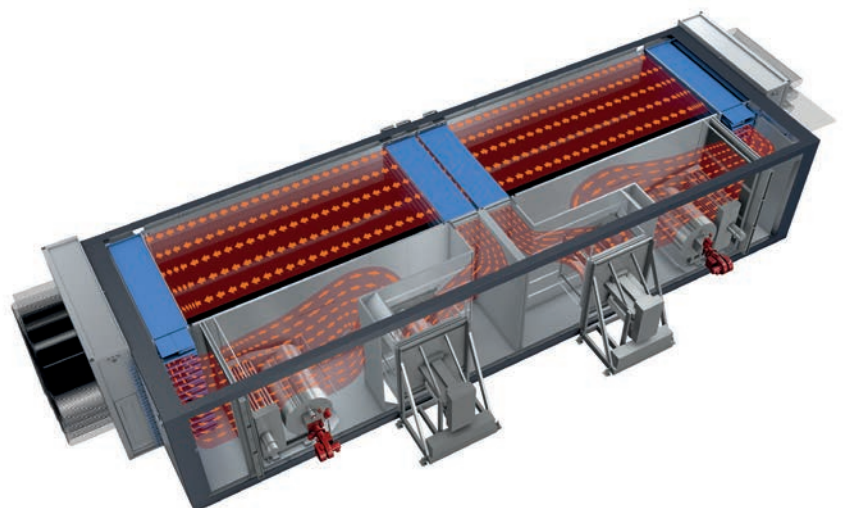
- Shortest oxidation times through best and safest control of the exothermal reaction
- Reduced maintenance time by providing complete access
- No down time is required for the cleaning of filters during operation
- Removable supply and return nozzles provide easy access for cleaning
- Short heat up time with hybrid heating technology

Efficiency

- Energy cost savings through minimized transmission losses and preheated fresh air for the end seal technology
- Lowest manufacturing costs per kg of Carbon Fiber
- Lowest expenses for energy using multiple heating sources
- Smallest footprint in the industry



Vertical-Down.



Center-to-End.

Environmental protection

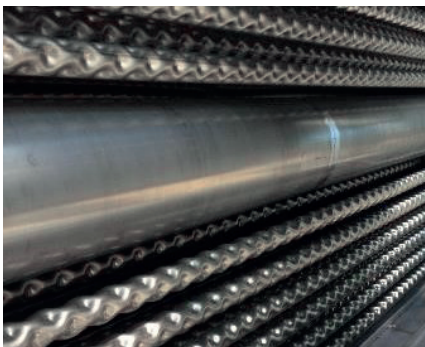
- Emphasis on operator safety through 100% prevention of process gas emissions by the patented multi stage air sealing system and seal welded housing

Technical Capabilities

- Comprehensive technical expertise of more than 60 years of experience in thermal processing technology
- Superior oxidation oven technology proven in pilot and large scale production facilities
- Preferred supplier for the oxidation process at established Carbon Fiber manufactures for high-end applications like aerospace

Customer support

- Customer focused world-wide sales support
- Short delivery times and efficient project realisation
- R&D oven for customer trials



Natural gas heat exchanger.



Oxidation oven vertical-down.

Carbonization furnaces

Fiber quality

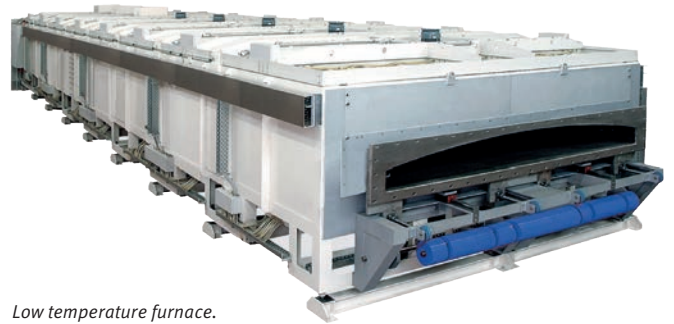
- Superior carbonization quality across the entire tow band by providing best-in class temperature uniformity inside the whole muffle

Low temperature furnace

- Carbonization temperatures up to 950 °C
- Natural Gas or electric heating
- Patented muffle bearing system
- Steel muffle with the longest lifetime in the industry
- One of a kind exhaust ports cleaning capabilities
- Gas distribution, measuring and control stations
- Control systems and software

High temperature furnace

- Carbonization temperatures up to 1,800 °C
- Electric heating
- Thoroughly designed graphite muffle
- Graphite heating cage with 75% reduced lead-throughs
- Significantly reduced risk for oxygen infiltration
- Gas distribution, measuring and control stations
- Control systems and software



Low temperature furnace.

Ultra high temperature furnace

- Carbonization temperatures up to 3,000 °C
- Electric heating
- Gas distribution, measuring and control stations
- Control systems and software



Sealing boxes

- Insulated inlet sealing boxes with adjustable distortion free orifices
- Multifunction outlet sealing boxes with integrated cooling
- Gas preheating systems
- Cooling water distribution stations

Productivity

- Reduced down time through the best in class durability of muffles and heaters
- Minimized condensation of tar at the inlet area of the muffle

Energy efficiency

- Low transmission losses
- Minimized consumption of protection gases

Reliability

- More than 100 years of experience in high temperature technology up to 3,000 °C
- Over 25 years in the carbon industry
- Specialist for heat-treatment plants with protective-gas and reactive gas atmospheres
- Preferred supplier for the carbonization process at established Carbon Fiber manufacturers for high-end applications like aerospace

Customer support

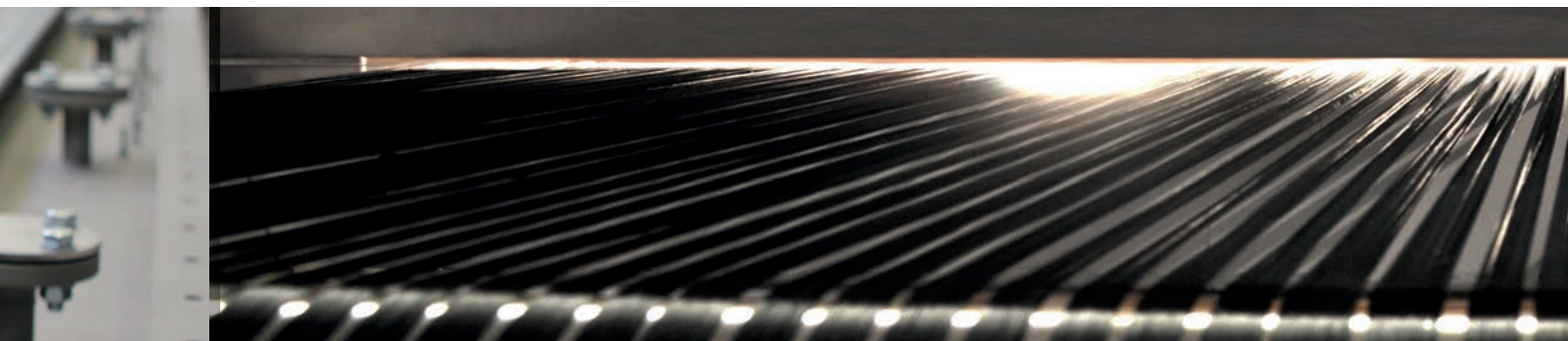
- Customer focused world-wide sales support
- Short delivery times and efficient project realisation

Further customer benefits

- Symmetric loading of electrical network system
- Spare of expensive electric compensation



High temperature furnace.



Exhaust air purification

Eisenmann has developed customized concepts to purify contaminated exhaust air for more than 40 years. Our systems are known for their simple and robust design, low investment and low operating costs. Eisenmann has hundreds of systems installed in all industrial sectors operating to keep the emissions within the implemented pollution guidelines.

Solutions for Carbon Fiber production

Exhaust air from oxidation:

The low concentrated and high volume air streams from oxidation are typically purified in a regenerative thermal oxidation (RTO) with an integrated heat recovery system for low energy consumption.

Exhaust gas from carbonization:

The smaller volume and higher concentrated exhaust gases from carbonization are purified by a high turbulence combustion chamber (CC).



Regenerative thermal oxidizer.



Combustion chamber.

Service

Energy balance

- Plant analysis by our process specialists
- Energy flow analysis to identify heat losses
- Establish thermal, furnace and heat transfer efficiency
- Analyze specific losses for your given product throughput
- Providing strategies for optimization
- Joint cost /benefit assessment of the proposed performance improvements strategies
- Technical and cost effective evaluations
- Action plan and implementation options

Inspection and maintenance

- Annual inspections by our specialists
- Identify and rectify potential points of failure at an early stage
- Inspection report with our recommendations to your hands
- Assessment of insulation, refractory linings and the furniture employed
- Inspection, repair or replacement of mechanical components such as conveyor systems, pneumatic components, gates and feeders
- Inspection, repair or replacement of process equipment such as gas burners, burner nozzles, gas supply systems, heating elements and thermocouples

- Inspection, repair or replacement of fans and air systems such as fans for combustion air, exhaust gas, cooling air and circulation air, piping for exhaust gases, exhaust air and cooling air

Mandatory furnace safety inspections

We can perform mandatory safety inspections for you at regular intervals – ensuring your plant complies fully with all operational safety regulations.

Safety inspections include

- Functional testing of all safety components
- Testing of emergency shutdown mechanisms
- Checking the current status of the facility and its functions against applicable standards and legislation
- Detailed post-inspection report and documentation of the findings



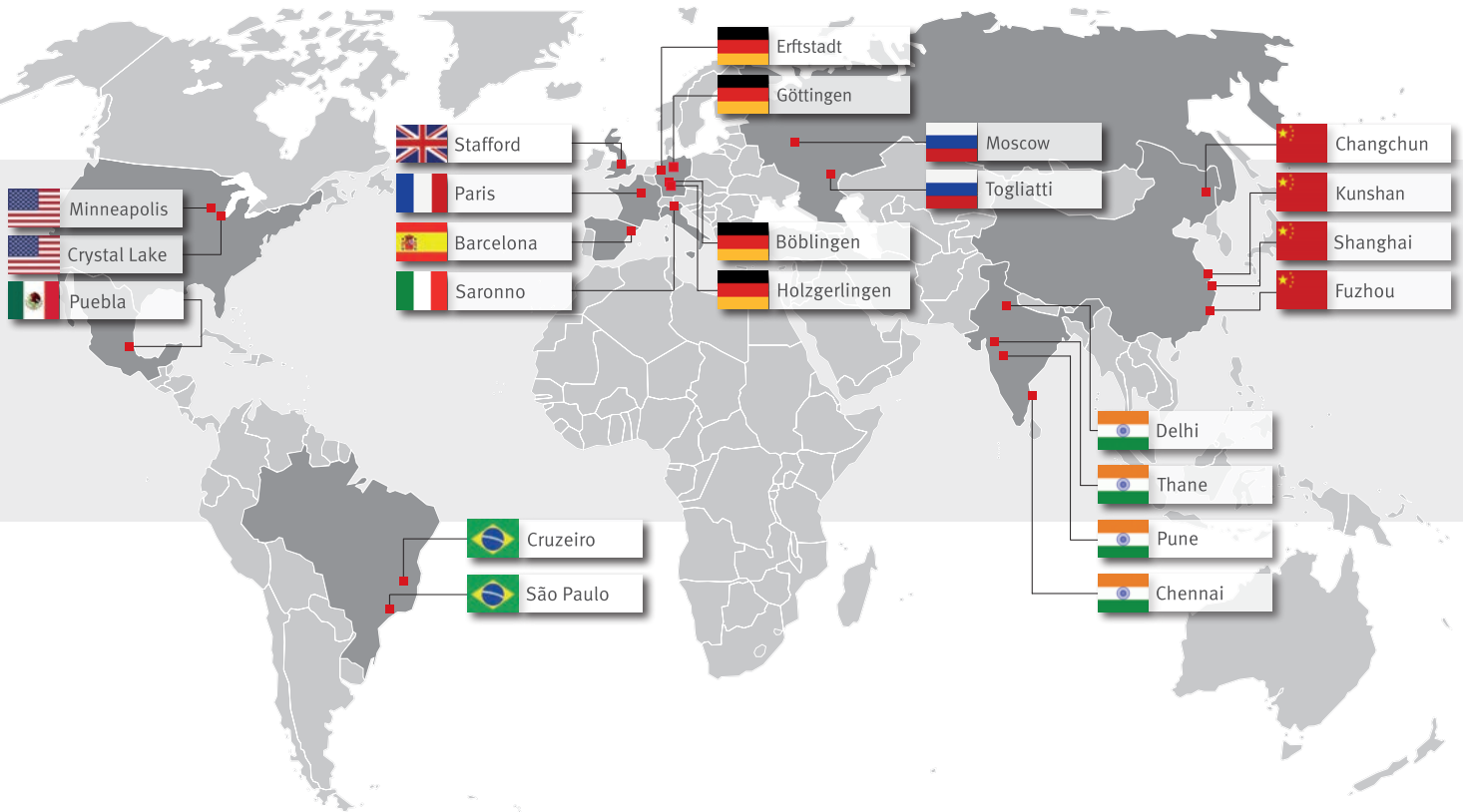
This is Eisenmann

Eisenmann is a leading global industrial solutions provider for surface finishing, material flow automation, environmental engineering and thermal process technology. One of our core competences is the delivery of thermal process equipment for the oxidation and carbonization of Carbon Fiber as well as related exhaust air purification systems. On request Eisenmann also supplies entire Carbon Fiber lines as general contractor.

The family-run enterprise is headquartered in southern Germany and has been advising customers across the globe for more than 65 years. Today, Eisenmann has a workforce of approximately 3,600 worldwide (2015), with subsidiaries in Europe, the Americas and the BRIC countries. In 2014, Eisenmann generated annual revenues of 753 million euros.



Technology Center in Holzgerlingen, Germany.



Carbon Fiber equipment by Eisenmann

Lowest risk supplier!

Best-in-class
performance!
Superior quality!

Complete thermal solutions from a single source!

Energy saving concepts
for lowest cost of ownership!

Energy saving concepts
for lowest cost of ownership!

Contact us

carbonfiber@eisenmann.com
or via our offices in the United States, China and Germany.



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