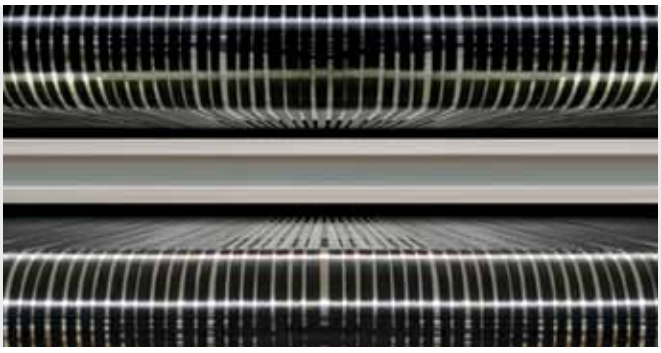
EISENMANN

CARBON FIBER


CARBON FIBER – MATERIAL OF THE FUTURE.

Content



Oxidized PAN-Fiber.

Carbon fiber lines - General contractor solutions

One source
Integrated solutions for carbon fiber production lines with proven equipment quality from the most integrated carbon fiber equipment supplier

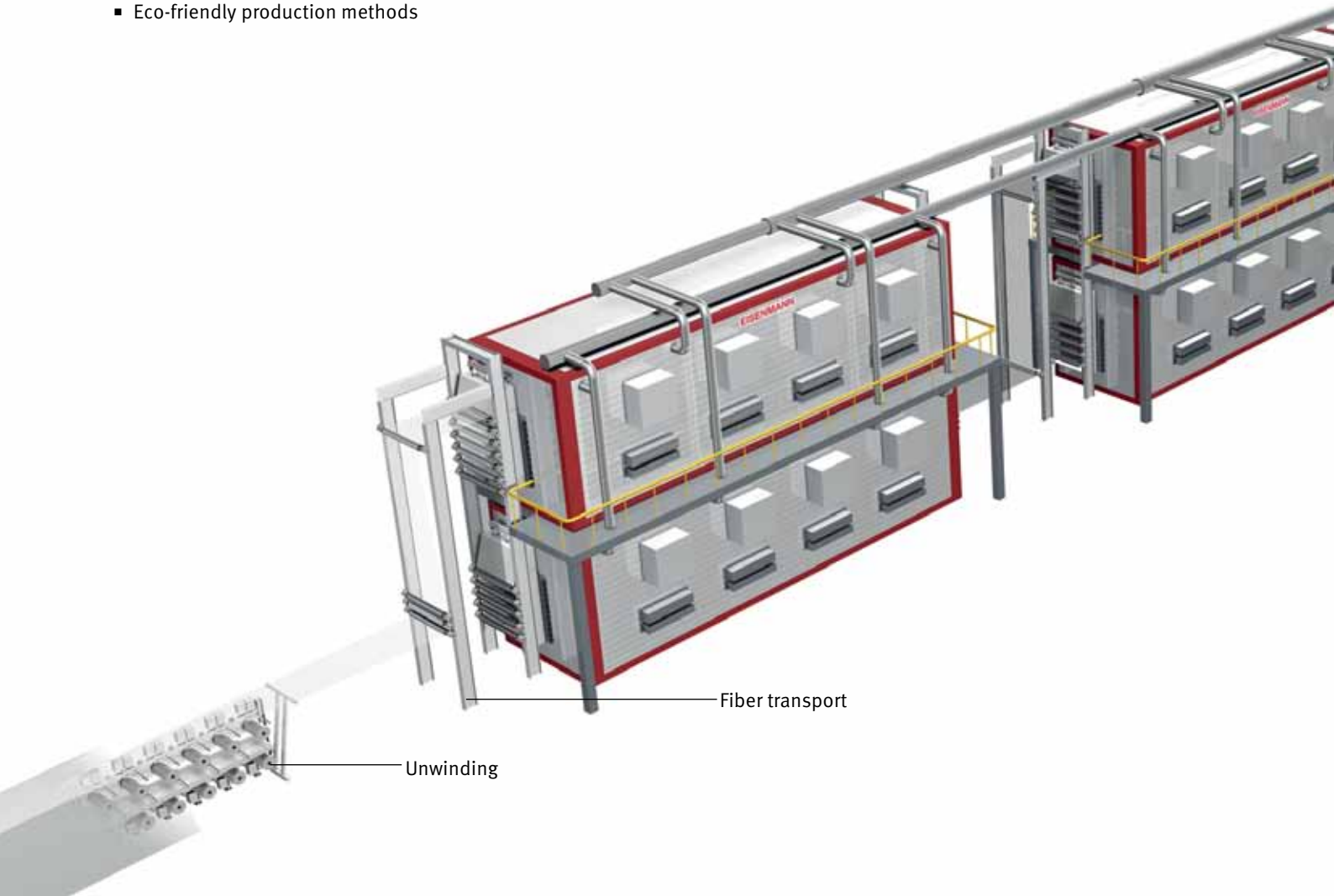
Your benefit
- Lower project costs through synergy effects in project planning, project management, installation and commissioning
- High reliability and productivity through perfectly synchronized equipment and interfaces
- Reduced planning efforts on customers side
- User friendly by an all embracing process control
- Faster into the market

Sustainability
- Improved energy efficiency in each production component
- Production line integrated energy recovering solutions
- Eco-friendly production methods

Ecological responsibility
- Energy efficient exhaust gas purification systems with guaranteed achievement of the permissible limits

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

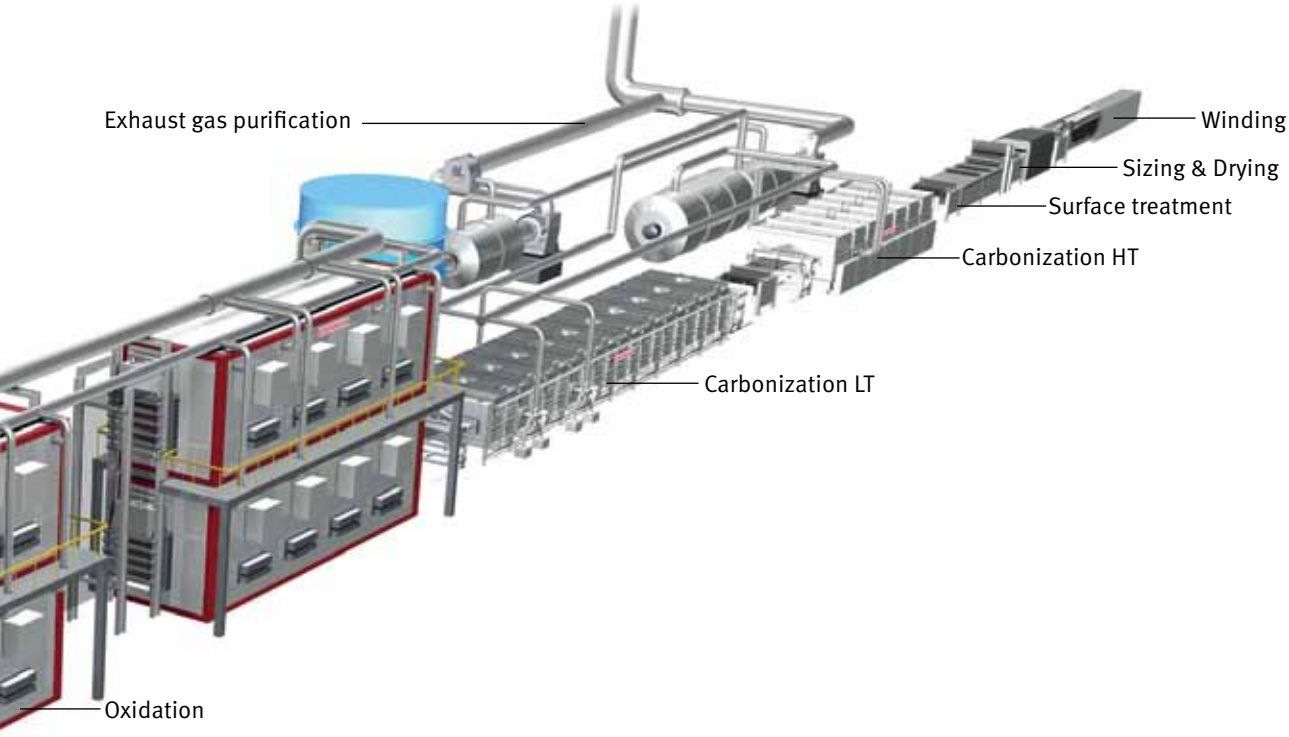


Reliability

- State of the art equipment with proven German quality
- Closely connected partners for fiber transport, 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



Planning	Engineering	Sourcing	Installation	Operation
■ Concept ■ Feasibility study	■ Basic engineering ■ Detail engineering	■ Manufacturing ■ Purchase	■ Delivery ■ Assembly ■ Commissioning ■ Training	■ Start-up support ■ Process improvement ■ Maintenance/ Services ■ Spare-Parts

Supported steps to complete carbon fiber lines.

In cooperation with our partners, Eisenmann is able to provide the complete production equipment as a general contractor. The partner for the fiber transportation, surface treatment and sizing systems is Trützschler. Unwinding and winding are sourced from well known suppliers with the best references in the market.

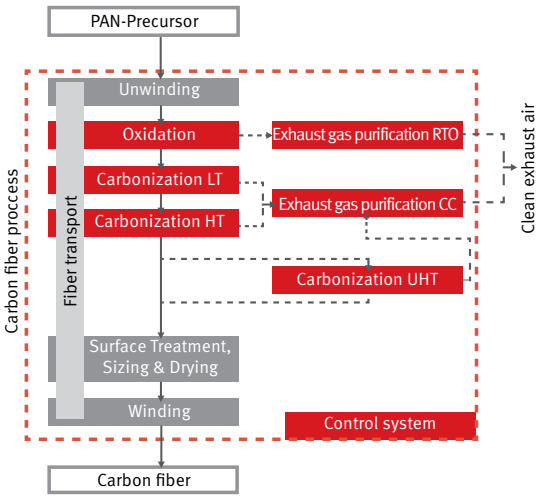
Our technology partners - Trützschler Nonwovens and EPC Group

Trützschler Nonwovens is known as a competent manufacturer for machinery and systems for the nonwovens and man-made fiber industry. By the merger of the companies Fleissner and Erko, Trützschler Nonwovens has become one of the leading suppliers of lines for the production of nonwovens made of natural and man-made fibers worldwide, with the latter often being produced on machines or complete lines of Trützschler Nonwovens. More than 300 fiber lines with capacities of up to 250 tons/day, sold in the last 50 years, prove the competence of Trützschler Nonwovens.

Trützschler Nonwovens products for carbon fiber:

- Complete fiber-transportation
- Fiber-monitoring system
- Bathes for surface treatment
- Sizing bathes
- Contact, blowing or infrared driers

Trützschler also provides complete precursor lines which has been optimized for high-quality PAN precursor tows.



Complete PAN based carbon fiber process.

The EPC Group is specialized in the development of innovative, efficient and high-quality processes and plants.
For carbon fiber, EPC supplies the utilities and carbon fiber factory design including:

- Infrastructure
- Utilities
- Civil Engineering
- High purity nitrogen generation

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.

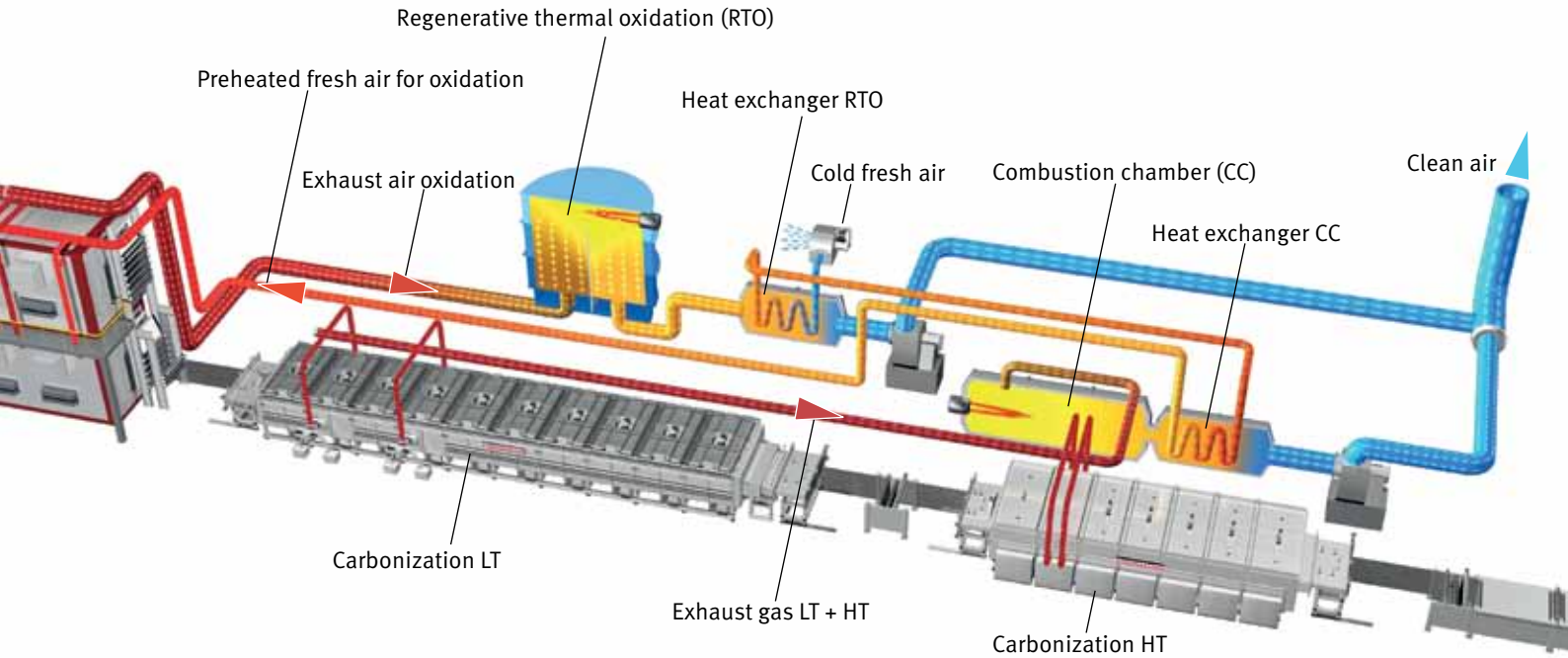
Eisenmann offers an optimized overall energy concept for the complete carbon fiber production line.
This concept includes reduced energy consumption in every component as well as integrated and customized energy recovery solutions resulting in reduced operating costs and a smaller carbon footprint.

Heat recovery

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

Usage

- 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 a integrated heat recovery system for preheated fresh air for oxidation.

Oxidation oven

Fiber quality
- Superior oxidation quality across the entire fiber band by excellent temperature and airflow uniformity over the whole process room
- Optimized fiber quality by matching the best ventilation system for your precursor material

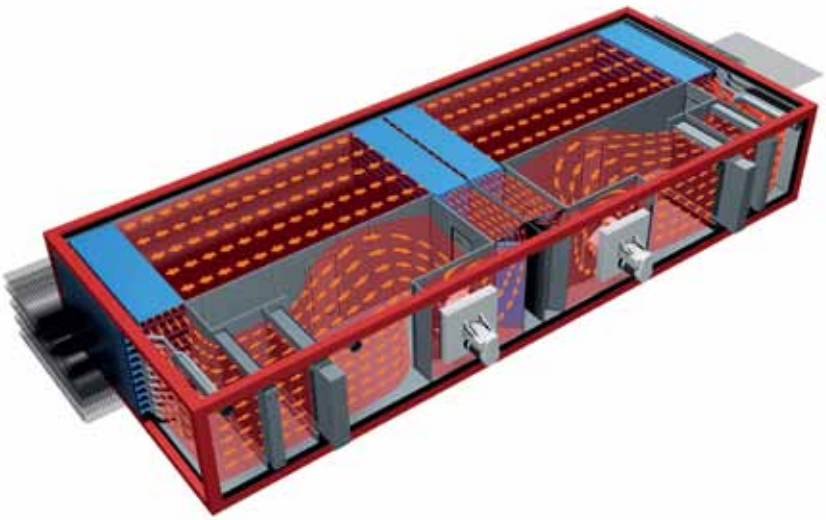
Productivity
- Shortest oxidation times through best and safest control of exothermal reaction
- Reduced maintenance time by easy access and maintenance-free seal welded interior
- No down time for cleaning of filters through changing during operation

Efficiency
- Energy cost savings through minimized transmission losses and preheated fresh air for end seals
- Lowest manufacturing costs per kg of carbon fiber

Environmental protection
- Operator safety through 100% prevention of process gas emissions by the patented multi stage air sealing system and seal welded housing

Scope of delivery
- All scales
- Vertical-Down ventilation systems
- Center-to-End ventilation systems
- Horizontal-Cross-Flow ventilation systems
- Patented air inlet boxes for Center-to-End
- Patented end seal system
- Control system and software

Vertical-Down-Flow.



Center-to-End.

Technical know-how

- Comprehensive technical expertise of more than 60 years experience in thermal processing technology
- Superior oxidation oven technology proven in numerous projects
- Preferred supplier for the oxidation process at established carbon fiber manufactures for high-end applications like aerospace

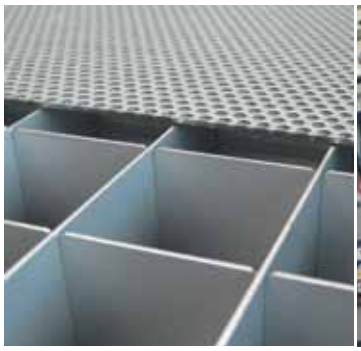
Customer support

- Assistance starting with feasibility studies for the best oxidation parameters and technology supported by customer trials at our R&D oven
- Customer focused world-wide sales support
- Short delivery times and efficient project execution
- Extensive range of services

R&D

In addition to customer trials, the R&D oven enables Eisenmann to achieve continuous improvements in its process equipment. Newly developed designs are tested and verified with respect to operator convenience and warranted process parameters such as airflow and temperature conformity.
All new developments focus on the optimization of the process, as well as further reduction of investment and operating costs.

Oxidation oven vertical down.



Carbonization furnaces

Fiber quality
- Superior carbonization quality across the entire fiber band by excellent temperature uniformity inside the whole muffle

Productivity
- Reduced down time through excellent durability of muffles and heaters
- Minimized condensation of tar at the inlet area of the muffle

Scope of delivery
- Low-temperature (LT) carbonization furnace up to 1,050°C with air-circulation
- High-temperature (HT) carbonization furnace up to 1,800°C
- Ultra-high-temperature (UHT) carbonization furnace up to 3,000°C
- Patented muffle bearing for LT
- Insulated inlet sealing boxes with adjustable distortion free orifices
- Multifunction outlet sealing boxes for sealing and cooling
- Gas distribution, measuring and control stations
- Gas preheating systems
- Cooling water distribution stations
- Control systems and software

Energy efficiency
- Low transmission losses
- Minimized consumption of protection gases

Reliability

- More than 100 years 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 manufactures for high-end applications like aerospace

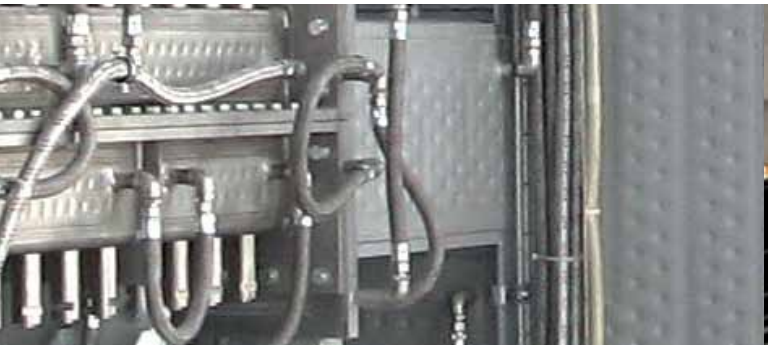
Cooling water distribution station.

Customer support

- Customer focused world-wide sales support
- Short delivery times and efficient project execution
- Extensive range of services

Further customer benefits

- Loading of electrical network system in a symmetric way
- No expensive compensation equipment needed – Ruhstrat offers exclusively manufactured variable transformers, which avoid the charging of the supply network system with harmonic waves



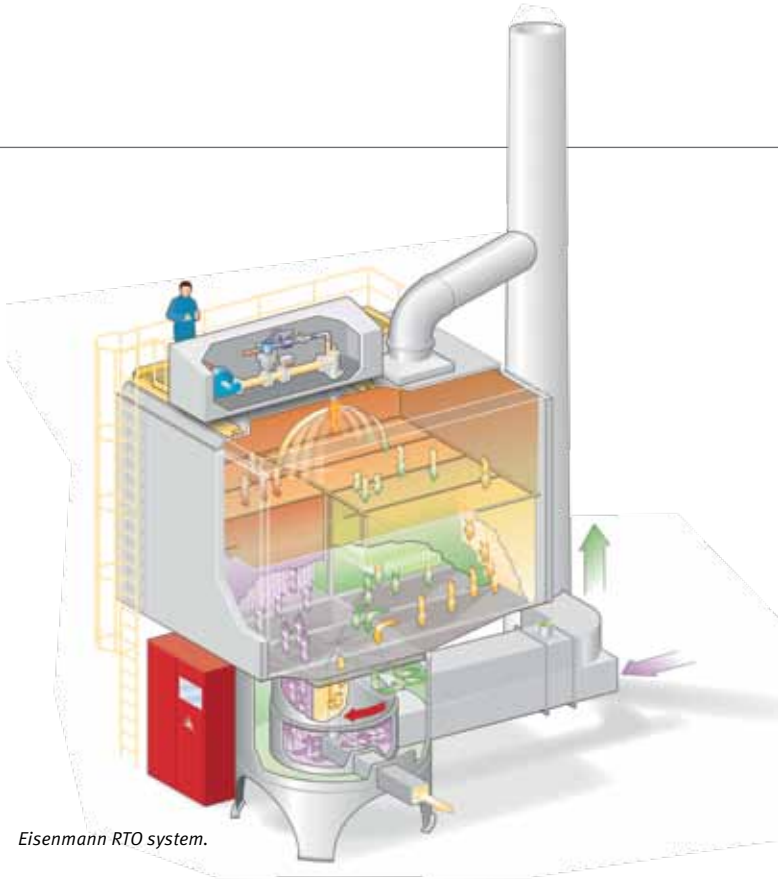
Exhaust air purification

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).

Benefits of Eisenmann RTO:

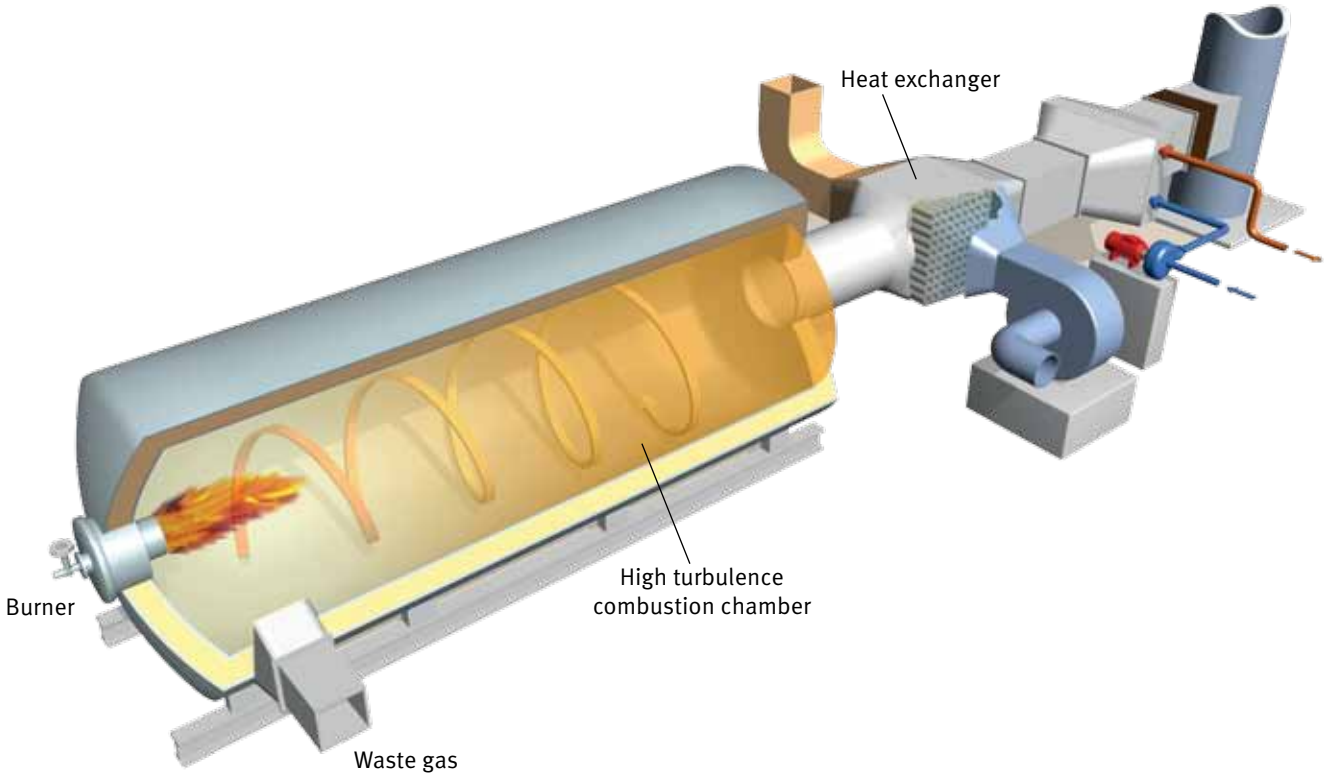
- Very high internal heat recovery
- Space-saving single reactor design
- Continuous air distribution instead of damper mechanism
- No complicated and maintenance intensive flaps, no pressure variations caused by switching operation
- No need for compressed air
- Low operation and maintenance costs



Eisenmann RTO system.

Reliability
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.

Benefits of Eisenmann CC:
- Highly turbulent exhaust air flow
- Complete burn out of pollutants
- Low NOx by multi-stage combustion
- Further secondary measures for NOx reductions are available



This is Eisenmann

As a leading international supplier of systems for surface finishing technology, environmental engineering, material flow automation and high-temperature technology, we offer our customers a leading edge based on sophisticated plants, individual solutions and global service.

Our name is synonymous with comprehensive systems competence, top quality and reliability. Our products set standards and revolutionary technological advances.

Approximately 3,600 employees, half of whom are engineers or technicians, develop new ideas world-wide for your manufacturing, paint shop, assembly or distribution departments. They include experts and specialists with well-founded know-how in various fields and trades. This is highlighted in made-to-measure concepts, the most modern technology and a high degree of economy.

Eisenmann is developing and combining individual processes to form an overall process solution from a single source, tailored to encompass all the customer's specific requirements. Our systems are extensively optimized with regard to production costs, quality and sustainability.

Eisenmann Technology Center in Holzgerlingen.

Your notes

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