

**EISENMANN**



**ENVIRONMENTAL TECHNOLOGY**



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EISENMANN DELIVERS CUSTOM-TAILORED, SUSTAINABLE SOLUTIONS  
FOR AN INTACT ENVIRONMENT.

## COMPLETE ENVIRONMENTAL SOLUTIONS FROM A SINGLE SOURCE

A healthy environment and state-of-the-art production are not a contradiction. Rather, they go hand in hand – thanks to sophisticated technologies that enable ecologically sound manufacturing.

Eisenmann customers stand to benefit in two ways: from our far-reaching experience with environmental technology, and from our comprehensive engineering skills in manufacturing and process technology.

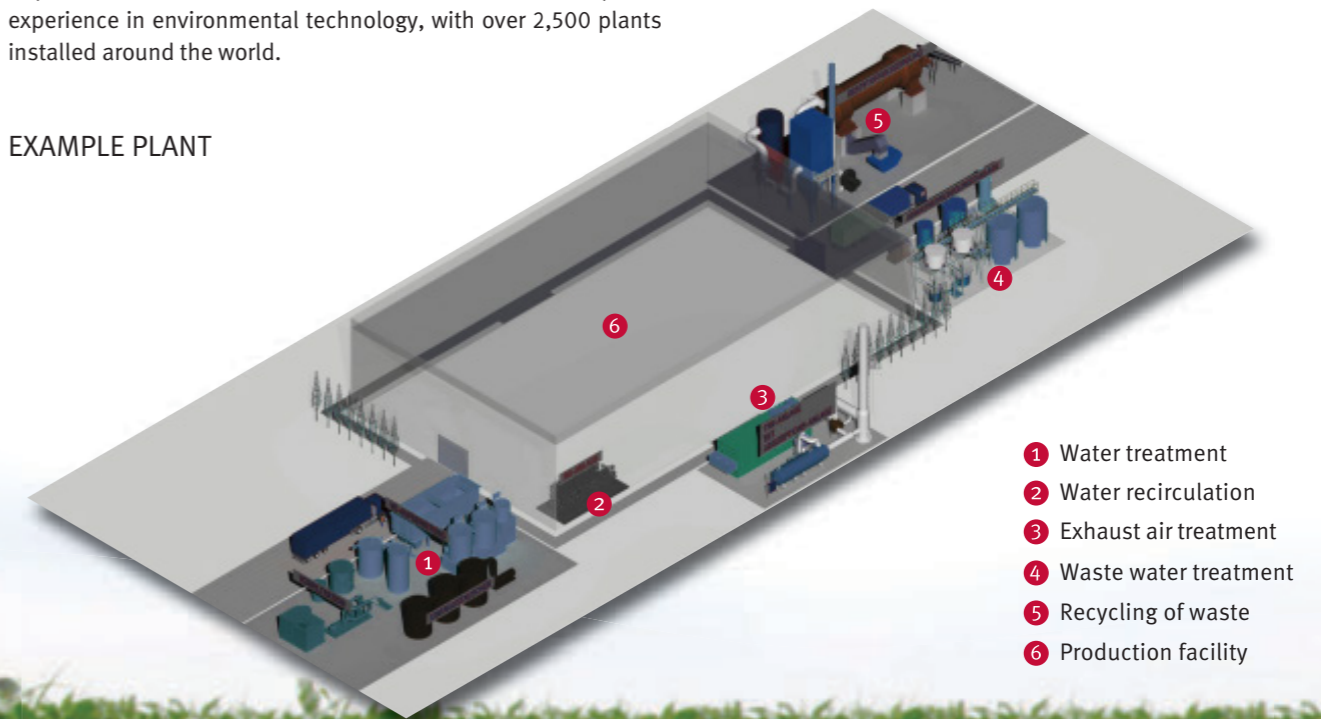
The Eisenmann Environmental Technology business unit provides a wide spectrum of tailor-made solutions and optimum process designs in the following areas:

- **Exhaust air treatment and heat recovery**
- **Water and waste water treatment, water recirculation**
- **Waste disposal and recycling of valuable materials**
- **Heat recovery from industrial and other waste**
- **Biogas and biogas upgrading plants**
- **Ammunition disposal**
- **Custom solutions for highly toxic waste**
- **End-to-end and integrated solutions**

### Customized solutions for industrial applications

When helping customers make their production processes cleaner and more environmentally friendly, our engineers first analyze the possible ways of preventing and reducing pollutants in the production facility. In close collaboration with our customers, our specialists develop customized solutions for water, air and waste treatment in line with the plant's specific requirements. Eisenmann can look back on over 45 years' experience in environmental technology, with over 2,500 plants installed around the world.

### EXAMPLE PLANT



# EXHAUST AIR TREATMENT

In line with the “reduce, reuse, recycle” principle, we begin by examining the entire production process to gain a holistic picture of the current situation. We believe that the best way to protect the environment is to avoid emissions. To decide which measures and processes are best suited to a particular application in terms of effectiveness and cost, a number of factors must be considered. These include the temperature and volume of exhaust air to be treated, the type and concentration of pollutants, and opportunities for utilizing recovered energy.

## Thermal treatment

The fastest and safest way to remove combustible organic contaminants is through oxidation. During this process, the polluted air is heated to a sufficiently high temperature to oxidize the organic compounds to mostly water and carbon dioxide.

## Thermal oxidation (TO)

TO is ideal for applications where the waste heat can be recovered and directly utilized in other production processes. Thermal oxidation technology is regarded as robust, reliable, and universally deployable.

## Regenerative thermal oxidation (RTO)

RTO is rapidly gaining in popularity due to its low supplemental energy requirements, and because in many cases, there are no suitable heat consumers on the same site. The Eisenmann concept features a special rotating air distribution system instead of a valve or damper system.



Exhaust air purification with thermal oxidation (TO).



Regenerative thermal oxidation (RTO) with rotating distributor to minimize pressure fluctuations.

## Adsorption

In contrast to the thermal methods described earlier, adsorption processes do not require high temperatures, and do not convert the contaminants.

## Adsorption wheel

Adsorption systems are used to concentrate large volumes of exhaust air with few contaminants. Because smaller air volumes with a higher concentration can be treated more economically, concentrating the contaminants in a low-volume desorption stream is a logical first step in the treatment of exhaust air with a low pollutant load. This makes subsequent processes – such as combustion or solvent recovery – more cost effective.

## Combustion chambers

Eisenmann combustion chambers are ideal for exhaust air with high concentrations of halogens and explosive air/solvent mixtures. Various configurations are available for a range of applications. For example, the Eisenmann Turaktor can be installed as a vertical or horizontal combustion chamber for the removal of pollutants.

The combustion chambers are typically combined with a downstream boiler. Next, the exhaust air is purified, usually by means of a combined quench/scrubber system. Some systems also include a downstream DeNOx unit.



Exhaust air purification with an adsorption wheel and TO in the chemical industry.



Combustion chamber for halogen-laden exhaust air.

## WATER AND WASTE WATER TREATMENT



*This continuous treatment plant for precipitating fluoride from waste water was pre-assembled at Eisenmann.*

Eisenmann develops and designs tailor-made systems for process water supply and waste water treatment. Various processes can be combined for the development and installation of water management systems, and for the implementation of zero liquid discharge (ZLD) concepts. Our customer base includes players from the chemicals and automotive industries and all other sectors where water plays a major role in production processes.

### **Inorganic contaminants in waste water**

For many decades now, Eisenmann has been leveraging conventional chemical-physical processes, including precipitation, and subsequent flocculation, sedimentation and gravel filtration for removing heavy metals, fluorides and phosphates from industrial waste water and flue gas purification plants.

No matter what toxic inorganic substances the industrial waste water contains – cyanide, chromates, arsenates or nitrites – Eisenmann offers the corresponding purification process.

### **Organic contaminants in waste water**

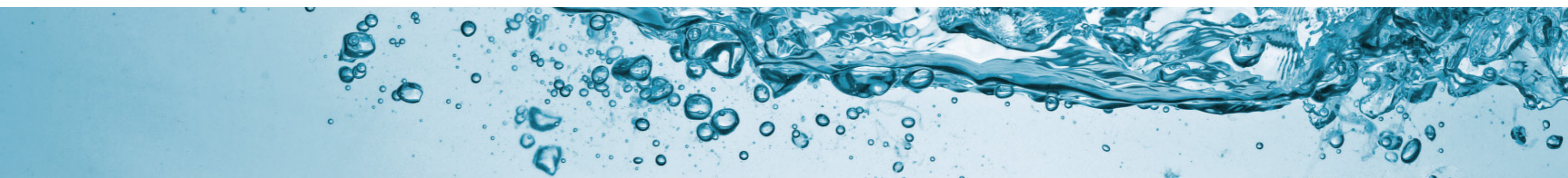
Eisenmann's patented Fentox process is used for oxidizing toxic or non-degradable pollutants in the chemical industry. Biodegradable waste water can either be anaerobically digested, with biogas as a by-product, or purified in industrial water treatment facilities. As the sewage sludge can be converted to biogas in a high-load digestion system, a high proportion of the energy necessary for the operation of the water treatment facility can be recovered. In addition, Eisenmann offers all standard processes for separating oil and water, and removing oil or grease.

### **Water management systems and ZLD concepts**

Environmental laws and regulations are tightening in many parts of the world, and water is becoming increasingly scarce. As a result, our customers are growing aware of the need to optimize their consumption of this resource, and to minimize pollutants released into the environment. Eisenmann offers solutions tailored to these imperatives. We are intimately familiar with our customers' production processes – which enables us to choose the most appropriate recycling methods. For sites where waste water cannot be discharged, Eisenmann closely collaborates with customers to implement zero liquid discharge concepts (ZLD).



*Ultrafiltration with tubular modules for emulsion splitting at a waste-management facility.*



## THERMAL WASTE DISPOSAL AND RECYCLING OF VALUABLE MATERIALS

Eisenmann Environmental Technology's portfolio includes facilities for the thermal treatment of a wide range of residues in solid, liquid, viscous and gaseous form, such as industrial waste and sewage sludge from municipal and industrial waste water treatment plants. The technologies offered by Eisenmann can also be used for the inerting of non-recyclable materials for disposal in landfills, and for the incineration of hazardous waste such as toxic materials with combustible components, or substances containing persistent organic pollutants (POPs).

A wide variety of thermal waste disposal methods are available, depending on the customer's requirements. These include drying, incineration, pyrolysis, torrefaction, gasification, and multi-stage processes.

### **Turaktor®**

The Turaktor® high-turbulence combustion chamber was developed by Eisenmann for the thermal treatment of liquids, suspensions and contaminated gases. Furthermore, the Turaktor® has been successfully employed for catalyst regeneration and precious metal recovery.



*Fluidized bed incinerator for processing oil shale at a cement plant.*

### **Fluidized bed incineration (FBI)**

A wide array of applications, energy-efficient operation and considerable flexibility in terms of input materials and throughput rates – these are just some of the benefits of FBI. This process can be used for incineration of solids such as biomass, viscous waste, dewatered sewage sludge, and oil sludge.

### **Rotary kiln**

Rotary kilns are employed for the thermal treatment of solid and viscous materials and can be all-steel or brick-lined. Depending on the calorific value of the input material, rotary kilns are designed for either co-current or counter-current operation.

### **Chambustor chamber kiln**

The chamber kiln can be deployed for recovering precious metals from solid and viscous materials. It can also be used for environmentally-friendly disposal of highly toxic or contaminated materials. Batch processing with the Chambustor is a highly cost-effective solution for the disposal of waste produced intermittently or in small quantities.

### **Pyrobustor®**

The Pyrobustor®, a dual-chamber rotary kiln with no refractory lining, was specially developed by Eisenmann for decentralized sewage sludge incineration. It is particularly suitable for small to mid-sized waste water treatment plants installed on-site. The Pyrobustor® converts pre-dried sewage sludge into heat and inert ash that is suitable for landfill disposal.



*Rotary kiln for the treatment of hazardous waste.*

## BIOGAS PLANTS



Digestate storage tank and horizontal plug-flow digester made of pre-fabricated concrete elements.

### Biogas plants – a key renewable energy source

Biogas is produced via anaerobic digestion of organic materials. These can be renewable raw materials such as maize silage, or biowaste. Renewable raw materials are fermented to produce renewable energy. When biowaste is used, there is an added benefit of environmentally-friendly waste treatment.

Almost all Eisenmann biogas plants feature a plug-flow digester with an externally supported horizontal agitator shaft. Thanks to these agitators, Eisenmann plants are particularly well-suited for substrates with a high solids content, such as biowaste from biowaste collection programs.

The biogas can be used in cogeneration plants for the production of heat and electricity. As an alternative, it can be treated in a biogas upgrading plant, and the resulting biomethane fed into the natural gas pipeline system.



Horizontal digester made of steel.

## BIOGAS UPGRADING



Biogas upgrading using membrane technology.

### Biogas upgrading

Eisenmann employs membrane technology to upgrade raw biogas from 50-65% methane by volume to biomethane of natural-gas quality (approx. 97% methane by volume). This biomethane can be fed into the pipeline system, used as vehicle fuel or employed to generate heat. The upgrading process creates a storable and flexible source of energy from a renewable feedstock.

### Membrane technology

After being preconditioned, the raw biogas stream is compressed and then concentrated by means of a multi-stage membrane system. By employing highly selective hollow-fiber membranes it is possible to achieve a methane concentration of more than 97% by volume. After upgrading, the biomethane is dry and meets the dew-point criteria of the public gas grid.

### The benefits

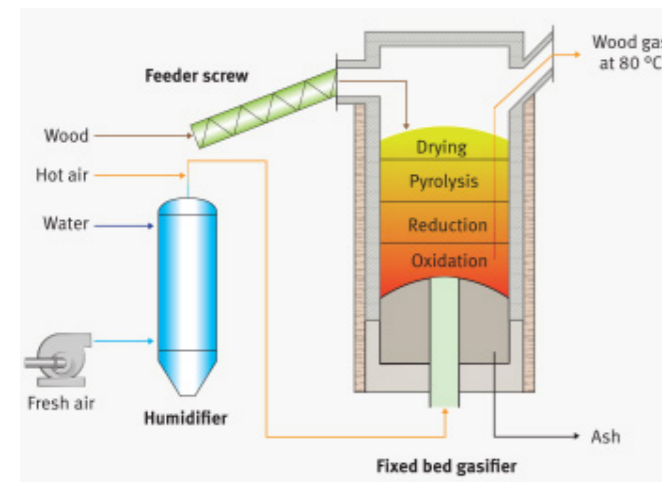
The exceptionally selective and efficient membranes deliver the following advantages:

- Lower operating costs
- Low capital expenditure
- Modular design
- Rapid system start-up
- Easier system control
- Low methane leakage



## WOOD GASIFICATION

Eisenmann offers biomass power plants based on wood gasification technology, with an output of up to 5 MW<sub>el</sub>. In projects of this type, it assumes end-to-end responsibility and coordinates all other providers. The German energy industry is undergoing structural change, driven by the transition away from nuclear power towards renewables. To meet base load requirements using renewable energies, utilities are increasingly deploying decentralized biomass power plants. With an output between 2-5 MW<sub>el</sub>, these plants are set to play an important role in Germany's future energy mix.



Gasification with counter current method.

### The benefits of the counter current technology

- The method has been proven over several years' reliable operation, at more than 8,000 hours annually.
- It has received positive feedback from the German Biomass Research Center (DBFZ) and the German Federal Ministry for the Environment.
- Landscaping materials are used as fuel, ensuring maximum subsidies for renewable energy (such as EEG in Germany). The landscaping materials – which have a water content between 30-50% – are deployed as soon as they are chopped up.
- Solids such as bark, conifer needles, and chippings can constitute up to 25% of the materials.
- Very low ash content: maximum 1.5% of the dry landscaping materials used for gasification.
- High electrical efficiency at 25%. When an ORC module is added, this figure can rise to 30%.

## INTEGRATED CUSTOMER-SPECIFIC SOLUTIONS



Treatment of waste water produced during flue gas purification: oxidation, precipitation, and sedimentation in a high-performance sludge settling tank.

Our extensive range of solutions for waste water, exhaust air and waste enables us to develop sophisticated plants that combine a variety of processes, and assume overall responsibility for their implementation. This ensures seamlessly dovetailed processes and minimized operating costs. The modular waste disposal plant described below is a prime example:

- 1. Module 1: High-turbulence combustion chamber (Turaktor®)** for incinerating liquid waste.
- 2. Module 2: Exhaust air purification** for purifying flue gases produced by the Turaktor®.
- 3. Module 3: Waste water plant** for treating water after the flue gas purification line.

In these three steps, hazardous, highly toxic materials are converted into waste safe enough for landfill disposal. The treated water can be discharged to the drains, and the treated air can be released into the atmosphere.



## AMMUNITION DISPOSAL



*In the Turaktor® – a high-turbulence combustion chamber – gaseous and liquid by-products of detoxification/neutralization processes are incinerated at 1,200°C.*



*Fully automatic stationary plant with a moving bed reactor for the disposal of 30,000 metric tons of unexploded ordnance.*

Eisenmann has been developing and building ammunition destruction plants tailored to customers' requirements since 1990. In terms of the number of completed projects and technologies developed, Eisenmann is the world's number-one specialist for designing, constructing and operating thermal ammunition treatment facilities.

### **Conventional ammunition**

Eisenmann developed the patent-pending moving bed reactor for the safe, environmentally-friendly and cost-effective destruction of conventional ammunition. To maximize sustainability and comply with emissions regulations, the reactor can be equipped with a flue gas purification unit, specially designed in accordance with the composition of the input stream.

### **Chemical ammunition**

For the safe disposal of large amounts of centrally stored chemical ammunition, Eisenmann has developed fully automatic plants that can be installed on-site. The individual components have been tested and proved in practice. These include high-tech solutions for process monitoring and for safe handling prior to the disposal process. During the detoxification/neutralization of chemical warfare agents, reaction products are produced that must then be disposed of safely. The Eisenmann Turaktor®, a high-turbulence, brick-lined combustion chamber,

is a sound solution for the environmentally-friendly disposal of the liquid and gaseous residues generated by the hydrolysis process.

### **Thermal disposal of rocket propellant and landmines**

Eisenmann developed a special-purpose rotary kiln engineered for the safe, effective and eco-friendly disposal of rocket propellant. As part of a disarmament project, Eisenmann designed and installed a disposal complex comprising a rotary kiln for intercontinental missile propellant, a detonation chamber for antipersonnel mines, and a shared flue gas purification unit for the two systems.

### **Operator models**

In addition to designing, building and maintaining ammunition destruction plants, Eisenmann offers customized operator models. Qualified specialists are available for ensuring safe, reliable operations of disposal systems for both conventional and chemical ammunition.



*Semi-mobile system for the destruction of chemical ammunition.*



*The rotary kiln with a refractory lining ensures safe, long-term operation at temperatures up to 1,200°C. It is used for the disposal of rocket propellant.*

## MAINTENANCE AND SERVICES



Proper maintenance is key to the longevity and efficient operation of production plants. What's more, opportunities for improvement or upgrades must be regularly examined to keep the technology up to date in every way.

Eisenmann offers custom-tailored services:

### Standard after-sales service

- Supply of spare parts
- Maintenance management
- Employee training and instruction

### Plant optimization

- Retrofits and upgrades
- Plant modifications
- Process optimization
- Consulting

### Custom solution

- Service modules
- Emergency on-call service
- Remote services
- Ramp-up support
- Support during production

### Full service and operator models

## THIS IS EISENMANN

Eisenmann is a leading global provider of industrial solutions and services for surface finishing, material flow automation, thermal process technology and environmental engineering. A family-run business founded in 1952 in southern Germany, Eisenmann develops and builds made-to-measure manufacturing, assembly and distribution facilities that are highly flexible, energy- and resource-efficient – and have been deployed by enterprises worldwide for over 60 years. The company has around 3,800 employees in Europe, the Americas and BRIC countries.

Specialist engineers and technical staff comprise around half of the workforce. Thanks to their in-depth understanding of process engineering, they are able to develop plant configurations precisely tailored to each application. Prior to shipping, the systems are fully assembled and thoroughly tested at our dedicated Technology Center, ensuring problem-free installation and rapid commissioning at the customer site.



Technology Center in Holzgerlingen, Germany.

Ground-breaking technology, high customer satisfaction and outstanding cost-effectiveness underscore the stand-out quality delivered by Eisenmann.



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