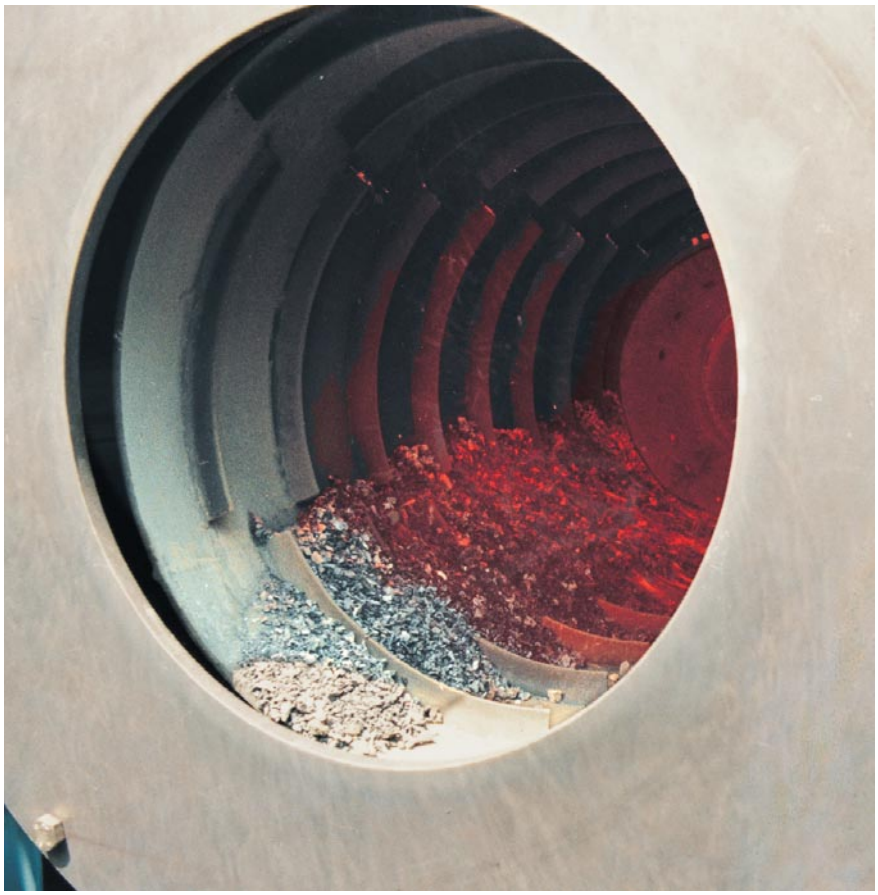
EISENMANN

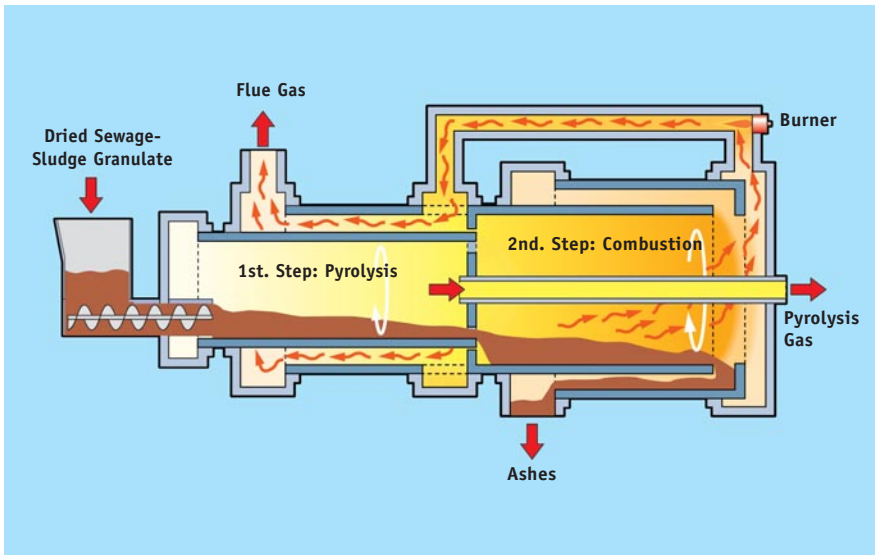
Thermal treatment of sewage sludge in the Pyrobustor®

Two exemplary applications

Decentralized sewage sludge disposal by incineration
The dual-chamber rotary kiln Pyrobustor®



Picture 1: View inside the Pyrobustor® combustion drum of Process Step II: Incineration of Combustible Sewage-Sludge Constituents.



Picture 2: The dual-chamber rotary kiln "Pyrobustor®". Functional principle.

The amount of sewage sludge in Europe increases steadily. The resulting problems are primarily characterized by the lack of landfill space and insufficient possibilities of its local or regional use. Its application as fertilizer practiced for a long time in agriculture is becoming increasingly questionable. Its incineration in centralized large-scale plants proves to be cumbersome, expensive, and not very friendly to the environment, not least because of the often long-distance transport routes.

Pyrobustor®, the solution to the problem

An advantageous problem solution, especially for operators of medium-sized and small sewage treatment plants, or regionally operating combines, is provided by the brick-lining-free dual-chamber rotary kiln "Pyrobustor®" developed by EISENMANN. Installed on site, in the immediate vicinity of the wastewater treatment plant, it converts pre-dried sewage sludge in utilizable heat and inert ashes that can be deposited in landfills. The generated heat is used for both the internal process and the external substitution of primary energy. This decentralized mode of disposal suited for throughputs exceeding approx. 400 kg sewage sludge per hour and sludge with a residual moisture of approx. 10 percent saves energy, relieves the environment, and provides operators with a reliable waste disposal method in the long term.

Structural configuration and function

In the Pyrobustor® (Picture 2), the two process steps, pyrolysis and combustion, run in sequence. It consists of a pivoted combustion chamber and a pyrolysis chamber within, which is connected to the former in a torque-proof manner. Both chambers are drum-shaped. Spiral transport and mixing conveyors are positioned inside the drums, which continually convey the material to be treated towards combustion and ash removal (Picture 1). On the feeding side, both drums are sealed off from the firmly standing wall components, so that two separate outlets ensue, one for pyrolysis gas, the other for flue gas.

The material to be treated reaches the pyrolysis chamber over a plug screw. The pyrolysis gas produced during low-temperature carbonization under a condition of oxygen deficiency is directly transported into an afterburner chamber, whereas the coke enters the combustion chamber through a material lock. The flue-gas stream produced in the course of combustion is heated up further (before subsequent purification and power utilization) and led through an annular gap past the pyrolysis chamber, to which it conveys a fraction of its thermal energy. This covers the heat requirement of the process that takes place at this site. The accumulating ashes are transported towards the ash-removal system, whereby a fraction of its heat energy is returned to the combustion chamber.

The arising pyrolysis gas with its high calorific value is combusted in the already mentioned afterburner chamber for at least two seconds at approx. 850°C, together with the flue gas previously purified across a cyclone. The hot flue gas is used for heat extraction. Depending on the individual operating conditions, the thermal energy gained serves, for example, to generate steam, prepare hot water, or to heat up thermal oil which heats the upstream sewage sludge dryer (cf. following exemplary applications). At any rate, utilization of the heat derived from the sewage sludge results in considerable primary energy savings, associated with an according reduction of CO_2 emissions.

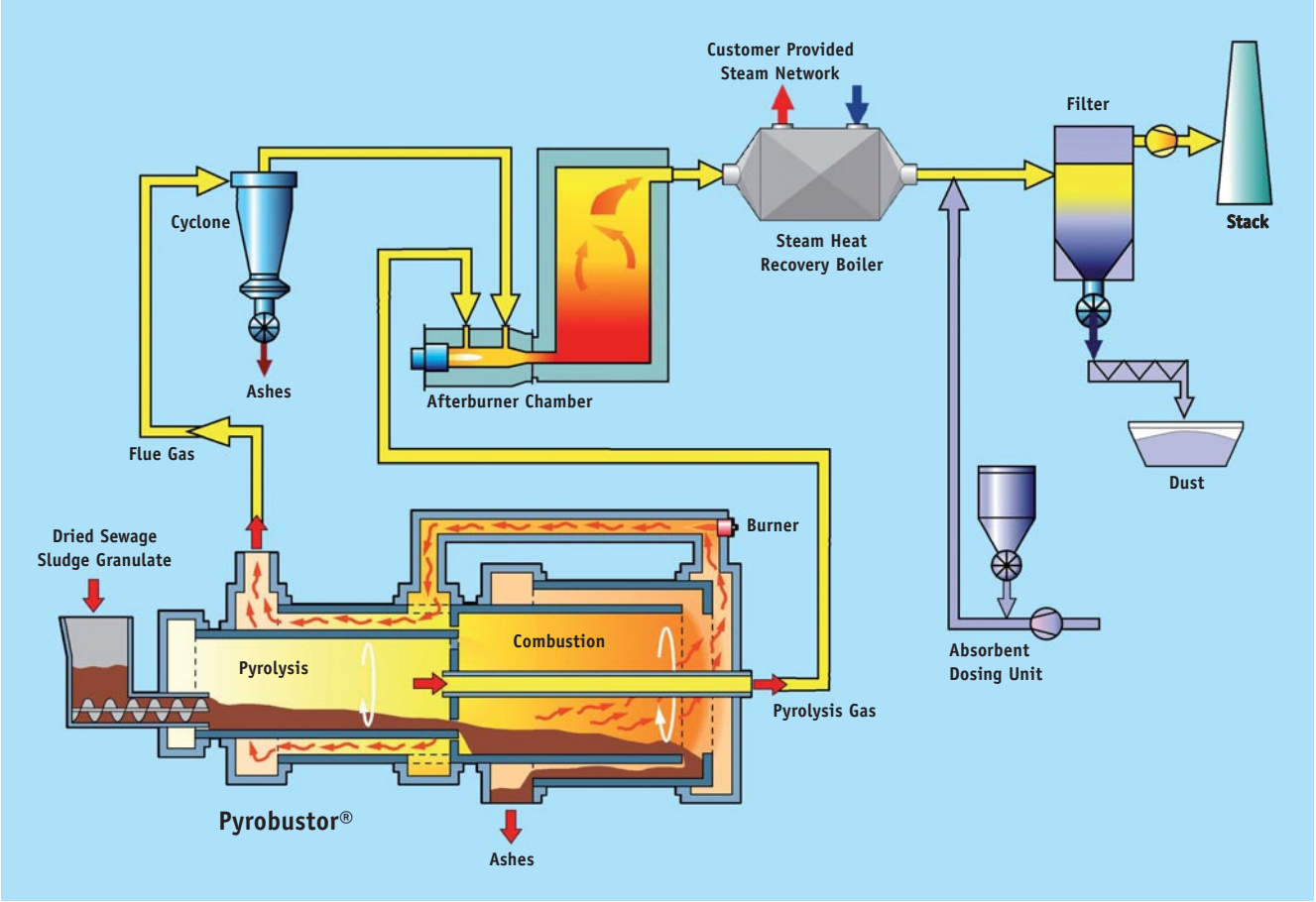
Depending on the pollutant content of the initial material, the cooled-down flue gas passes a filter system dosed with absorbents to separate acidic flue-gas components and capture potentially existing heavy metals and/or a scrubber stage, before it is discharged into the flue outlet.

At termination of the process, only about one-third of the dry-granulate volume remains in the form of ashes which, on account of the low loss by combustion, amounting to approx. two percent, can be deposited in a landfill assigned to Category 1 according to the German Waste Disposal Ordinance, a landfill for inert wastes according to the EU Directive, or be reused in further applications.

Exemplary application 1: Biomass-fueled power plant combined with sewage sludge utilization

Near A7 motorway exit Dinkelsbühl/Neustädtlein, the "Crailsheimer Model" is now in a state of realization, the only one of its kind throughout Europe as far as we know. Under the lead management of the public services in Crailsheim, the regional sewage sludge utilization company develops a highly efficient combination of plants for 27 communities in Baden-Württemberg and Bavaria on the basis of time-tested technologies: A combined heat and power plant fueled by biomass processes the wood wastes from the nearby forests to produce heat and electricity with a neutral CO2 balance. And to utilize the regional occurrence of sewage sludge, it uses a EISENMANN Pyrobustor®.

Picture 3: The hitherto unique combination of a biomass-fueled power plant and Pyrobustor® for the thermal utilization of sewage sludge, known as the "Crailsheimer Model".



Picture 4: Functional diagram of the Pyrobuster® facility installed by the regional sewage sludge utilization company for thermal sewage sludge utilization, including heat recovery to generate steam for the biomass-fueled combined heat and electricity power plant

From the organic constituents of sewage sludge he Pyrobustor® produces an energy-rich gas which can be utilized in accordance with one's individual operating conditions (see also Picture 4). The remaining mineral residues, in which the heavy metals the sewage sludge contains are bound in an insoluble state, can be deposited in a Category 1 landfill or, if possible, also be reused, for example, as an aggregate construction material for paving roads.

The plant erected in the currently still growing industrial area of Waldeck near Dinkelsbühl solves the sludge problem for about 200,000 people living in the region of Hohenlohe-Franken. About 18,000 to 22,000 tons of mechanically dewatered sewage sludge are accrued annually from all communities involved. The sludge contains approx. 25 percent dry matter which is transformed into a granulate with a dry matter content of approx. 88 percent before it is incinerated in the Pyrobustor®.

The energy required for the drying process is deducted from a fraction of the waste energy from the electricity generated by the 9 MW biomass-fueled heat and electricity plant, which can produce up to 72 million kWh/a of EEC-subsidized electricity, a capacity nearly equivalent to the annual requirement of 18,000 households.

In this case, the Pyrobustor® (Picture 5) which has already proved its worth in thermal sewage sludge treatment is designed for a throughput rate of 650 kg/h = 5,070 tons of dry granulate/year, with a calorific value of approx. 12,200 kJ/kg. The excessive heat from afterburning (Picture 6) serves to generate steam which is fed into the central steam network of the biomass-fueled combined heat and power plant. The energy cycle is thus closed. The aggregate plant practically does not need any primary energy in the form of fossil fuel.

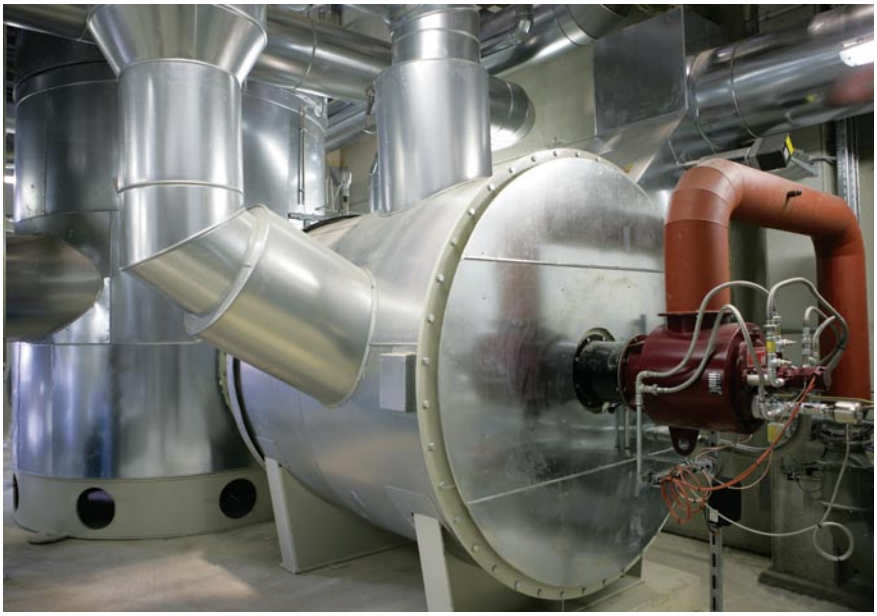
Hence, it also contributes a considerable share to climate protection which is demanded by all of us. Besides, the reciprocal exploitation of the energy fluxes achieves a much higher degree of efficiency than can be accomplished with conventional power plants, which, among other effects, permits a less expensive supply of heat and cooling to companies located in the neighborhood.

The generation of electricity and heat has been going on since late 2007. Pre-drying and thermal treatment ("mineralization") of sewage sludge entered a stage of full operation in the first half of 2008. Beforehand, the regional sewage sludge utilization company, builder

Picture 5: The continuously working Pyrobuster® designed for a throughput of 650 kg dried sewage sludge granulate with approx. 88% DM per hour.

and operator of the overall plant, invited the population, who had been well informed in advance to the realization stage and was therefore positively disposed, to an "Open Construction Site Day" on September 8, 2007, an event which was met with a great response.

Besides, the interest in this novel joint facility reaches beyond the borders of the region. The significance of the pilot project was underscored in February 2008 by the visit of a high-rank governmental delegation under the leadership of the Federal Minister of the Environment, Sigmar Gabriel. It was expressly acknowledged that both the avoidance of sewage sludge tourism and the prevention of incalculable costs by means of an autonomous local treatment in the scope of the "Crailsheimer Model" had been realized in a most excellent manner.



Picture 6: Excessive heat from the afterburner chamber is used to generate steam.

Picture 7: The public wastewater treatment plant of Central Puster Valley is hidden inside a mountain. Only administration, sewage sludge drying and the Pyrobustor® plant for thermal sewage sludge utilization are located above the ground.

Exemplary application 2: Thermal sewage sludge treatment in the southern tyrolean puster valley

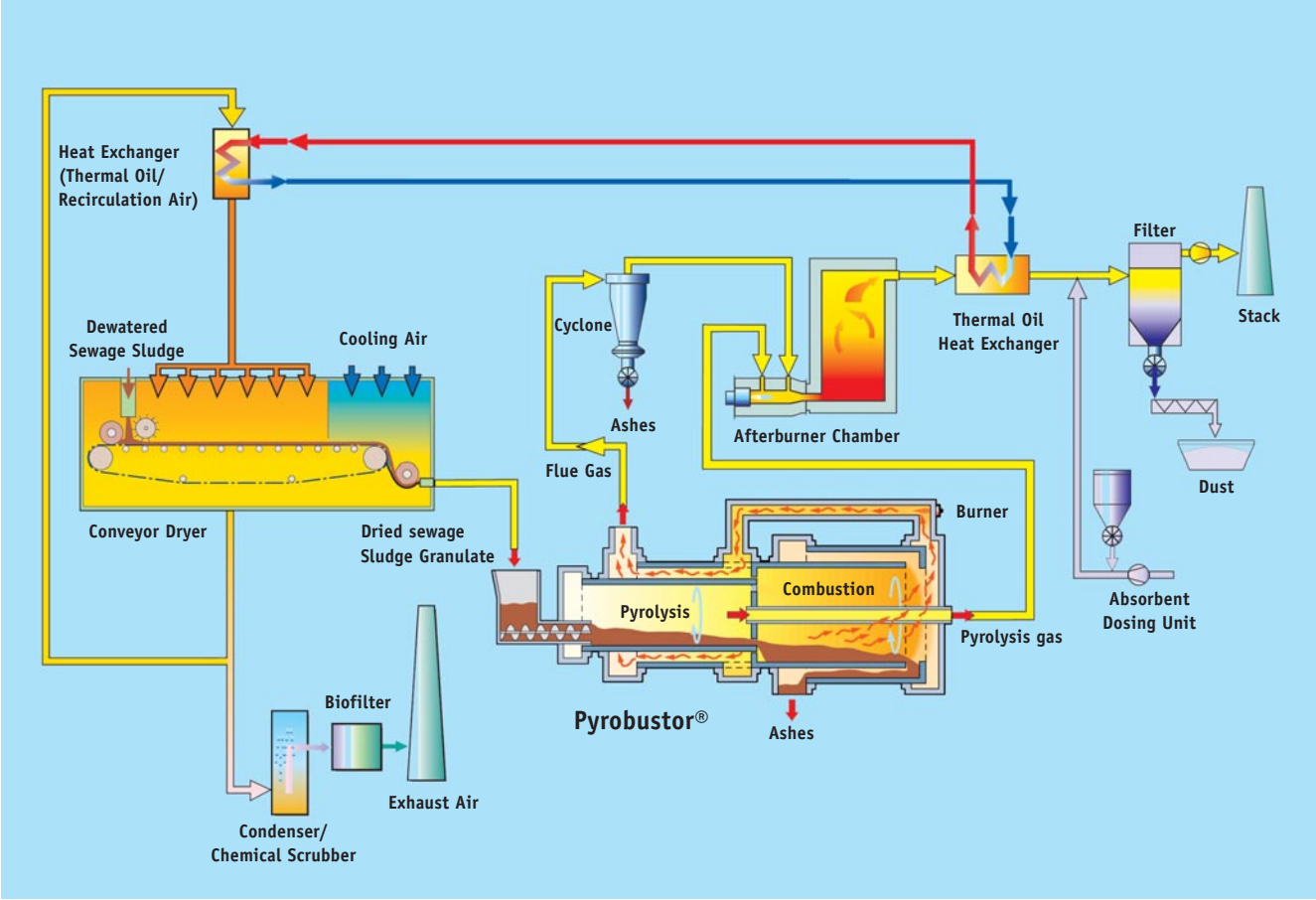
Tobl Mountain near St. Lorenzen in South Tyrol harbors in its interior the public water treatment plant of the Central Puster Valley — the only sewage treatment plant in Central Europe which is housed in a cavern. Underground, withdrawn from the view of tourists coming here all year round, the waste waters of the by now 14 communities are centrally treated. From the outside, only the "surroundings" can be seen being well adjusted to the landscape (Picture 7).

AS early as 1998, the operating corporation ARA Tobl GmbH (ARA Pustertal AG today) decided to procure a sewage sludge drying plant, in order to reduce the volume and weight of the accrue sludge. The drying plant annually converts approx. 17,000 tons of wet sludge containing 20-22 percent DM into approx. 4,200 tons/a sewage sludge pellets containing a residual moisture of approx. 10 percent.

However, this minimization did not yet satisfy the operators, since all that could be done was to transport the pellets as fertilizer to the valley of the Po River, which is, after all, more than 300 km away. For this reason, the company initiated a competition for ideas, from which the EISENMANN proposal of thermal utilization in the Pyrobustor® emerged as the winner.

The installed Pyrobustor® plant for the continuous incineration of dried sewage sludge pellets with a calorific value of 12,000 kJ/kg is designed for a throughput capacity of 550 kg/h in 7,500 operating hours per year (Picture 9).

The heat recovery ensuing from thermal treatment was tailored to the operating conditions: the hot flue gases from the afterburner heat up the thermal oil which, in turn, heats up the sewage sludge dryer (see also schematic representation Picture 8). This way, up to 70 percent of the primary energy formerly needed for the drying process could be saved and approx. 1,500 tons less CO2 were annually discharged into the atmosphere.



Picture 8: Functional diagram of the Pyrobuster® facility of ARA Puster Valley. Here, the excessive heat from the afterburner chamber is used to heat up thermal oil for the upstream sewage sludge dryer.

Picture 9 (right): The Pyrobustor® operating at full load from early 2006 onward

The accumulating ashes, basically easy to deposit in landfills, is taken over by a recycling company for further processing.

ARA Pustertal AG – ISO certified as early as 1999 – hence exploits all possibilities to ward off environmental burdens (not only) from its beautiful locality. In addition, local sewage sludge treatment accounts for a safe and reliable disposal and saves money on account of the optimal utilization of the energy contained in the sewage sludge. This solution to the problem which is to be considered as both ecologically and economically sound is worth being copied in many other places as well.

What you also ought to know

For almost 30 years EISENMANN has been building thermal plants for energy recovery and material recycling, in other words, the safe disposal of solid, paste-like and liquid wastes and residual material of the most various kinds.

The plant concept is invariably adapted to the requirements of the individual case at hand. Apart from the dual-chamber rotary kiln "Pyrobustor®" presented here, there are single-chamber rotating cylinders in brick-lined or all-steel construction, fluidized-bed power plants, as well as chamber kilns, roller passage kilns, and trolley hearth kilns to choose from, or even exclusive special constructions.

High turbulence reactor "Turaktor®"

The high turbulence reactor "Turaktor®" (Picture) is applied particularly for the thermal treatment of liquids, suspensions, hazardous gases and dusts. It has also proven its practical worth in the regeneration of catalysts and the recovery of precious metals.

EISENMANN has been building plants to purify exhaust air for over 40 years now. Selectable are thermal afterburning or vertical thermal afterburning as well as regenerative afterburning, both with upstream absorption wheel, if required, for the minimization and concentration of exhaust air to be decontaminated.

Considering the current immense increase of energy prices, EISENMANN has attached great importance to optimal heat utilization and CO2 reduction by means of saving primary energy.

As far as the topic "renewable energy sources" is concerned, we make a contribution with highly efficient biogas plants that are very successful on the market.

In addition, EISENMANN'S Environmental Technology program comprises plants for water preparation, water treatment, and water circulation for almost all areas of manufacturing and service provisions.

On request, repair, service and long-term maintenance will be accepted.

EISENMANN

EISENMANN Anlagenbau GmbH & Co.KG
Environmental Technology
P.O. Box 1280 · 71002 Böblingen · Germany
Phone +49 7031 78-0
Fax +49 7031 78-1000
www.eisenmann.com