

**EISENMANN**



**ANAEROBIC DIGESTION TECHNOLOGY**  
BIOGAS SYSTEMS



**FOOD PROCESSORS, WASTE MANAGEMENT COMPANIES, MUNICIPALITIES AND FARMS ARE DISCOVERING THE ECONOMIC AND ECOLOGICAL BENEFITS OF EISENMANN BIOGAS PLANTS. A BROAD RANGE OF ORGANIC MATERIAL, FROM NUMEROUS APPLICATIONS, IS CONVERTED TO RENEWABLE ENERGY AND VALUABLE NUTRIENTS, TURNING WASTE INTO A RESOURCE.**

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# GENERAL INTRODUCTION TO BIOGAS

## Biogas – A Key Role in Renewable Energy

Biogas is generated through the controlled anaerobic digestion of organic materials. It is an ecologically friendly alternative to fossil fuels.

The methane rich gas can be used to fuel a combined heat and power (CHP) system or upgraded to pipeline quality natural gas.

## Biogas Uses

- Electricity
- Thermal energy
- Vehicle fuel
- Natural gas pipeline

## Biogas Composition

Methane	40 - 75%
Carbon dioxide	25 - 55%
Water vapor	0 - 10%
Trace gases	0 - 5%

## Anaerobic Digestion

Anaerobic digestion is the degradation of organic waste in a controlled, oxygen free environment. By properly managing the environment in which this process occurs through the feedstock recipe, temperature and residence time, the biogas yield is maximized. In addition to producing biogas, the process produces non-fossil fuel based soil amendments.

## Advantages

- Multiple products: natural gas, vehicle fuel, electricity, heat and soil amendments
- Reduction of greenhouse gas emissions
- Direct replacement for non-renewable fossil fuels
- Job creation and revenue generating opportunities
- Nutrient recovery and recycling
- Organic waste diversion from landfills



## US Market Potential

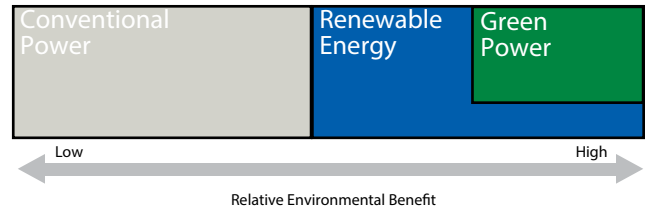
Food waste makes up 20% (34 million tons annually) of the overall waste sent to landfills. Currently, only 3% of this is recovered and composted. If half of this organic waste were anaerobically digested, enough electricity would be generated to power 2.5 million homes each year.\* The American Biogas Council projects up to 12,000 potential sites ready for development and predicts that renewable biogas could displace as much as 10-15% of fossil fuel based natural gas consumption by 2023.

## Market Drivers

- Growing public and political call for renewable energy
- Climate protection regulations
- Recycling and organic diversion initiatives
- More advanced technologies
- Subsidy and grant availability

\* Source: American Biogas Council, US Environmental Protection Agency

## US Energy Supply (not to scale)



Source: US Environmental Protection Agency

The US EPA defines green power as electricity produced from solar, wind, geothermal, biogas, eligible biomass, and low-impact small hydroelectric sources. These sources avoid the environmental impact of conventional power sources and produce no fossil-fuel based greenhouse gas emissions. Policy decisions, such as the state Renewable Portfolio Standards, and other standards will begin to require the use of renewable energy in electricity supplies. This, combined with growing consumer preferences, will result in a higher demand for green power from biogas.



## BIOGAS PLANTS

For energy rich organic waste streams, Eisenmann has developed a proprietary two-stage anaerobic digestion plant.

The first stage is a horizontal plug-flow digester that is continuous and automated. This primary digester is heated, insulated and fit with a horizontal agitator along its entire length. The continuously mixed plug-flow process is a highly effective method of generating biogas from organic matter. Plug-flow operation ensures that the biological processes take place under ideal conditions – maximizing gas yield and ensuring reliable, uninterrupted operation.

The second stage occurs after the non-digestible solids are separated and the substrate is sent to the secondary digester. This stage is a heated, insulated, vertical stirred tank with a double-membrane roof for storing the biogas before use. Once the appropriate residence time has been reached, the fully digested substrate is then pumped from this tank to be used as soil amendment.



Eisenmann Biogas Plants are customized to provide the optimum solution for a variety of applications including food processing, waste management, agriculture and pre- and post-consumer food waste. Engineering and design work are done on an individual project basis to ensure customer requirements are satisfied while also adhering to the global Eisenmann quality standard. Local resources are utilized for material procurement and construction of each biogas plant.

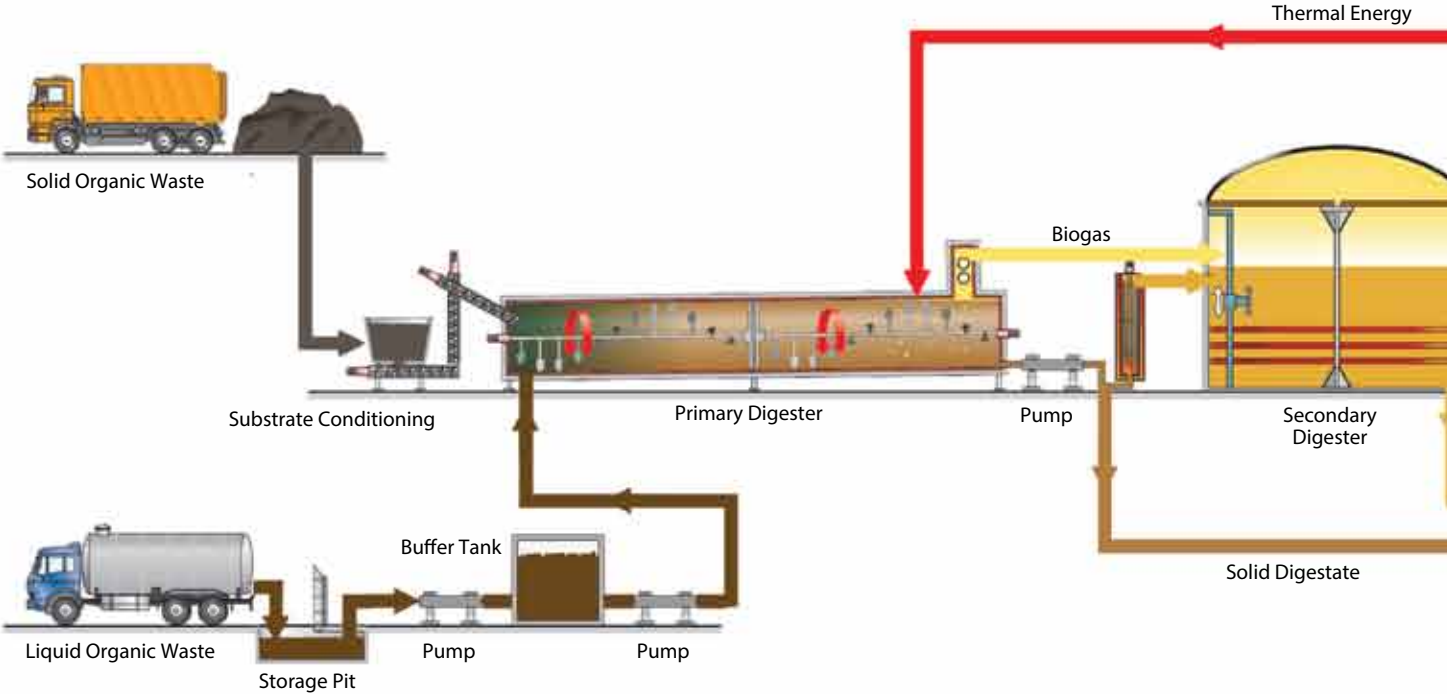
The proven Eisenmann continuously mixed plug-flow digester is available for a wide range of feedstocks. The robust design and plant configuration allows complete digestion and maximum gas yield. Systems are expandable with add-on modules allowing for a wide range of process capacity, from 3,000 to over 100,000 tons per year. These plants are ideal for high solids organic material.

### **Features and Benefits of the Standard Eisenmann Biogas Plant**

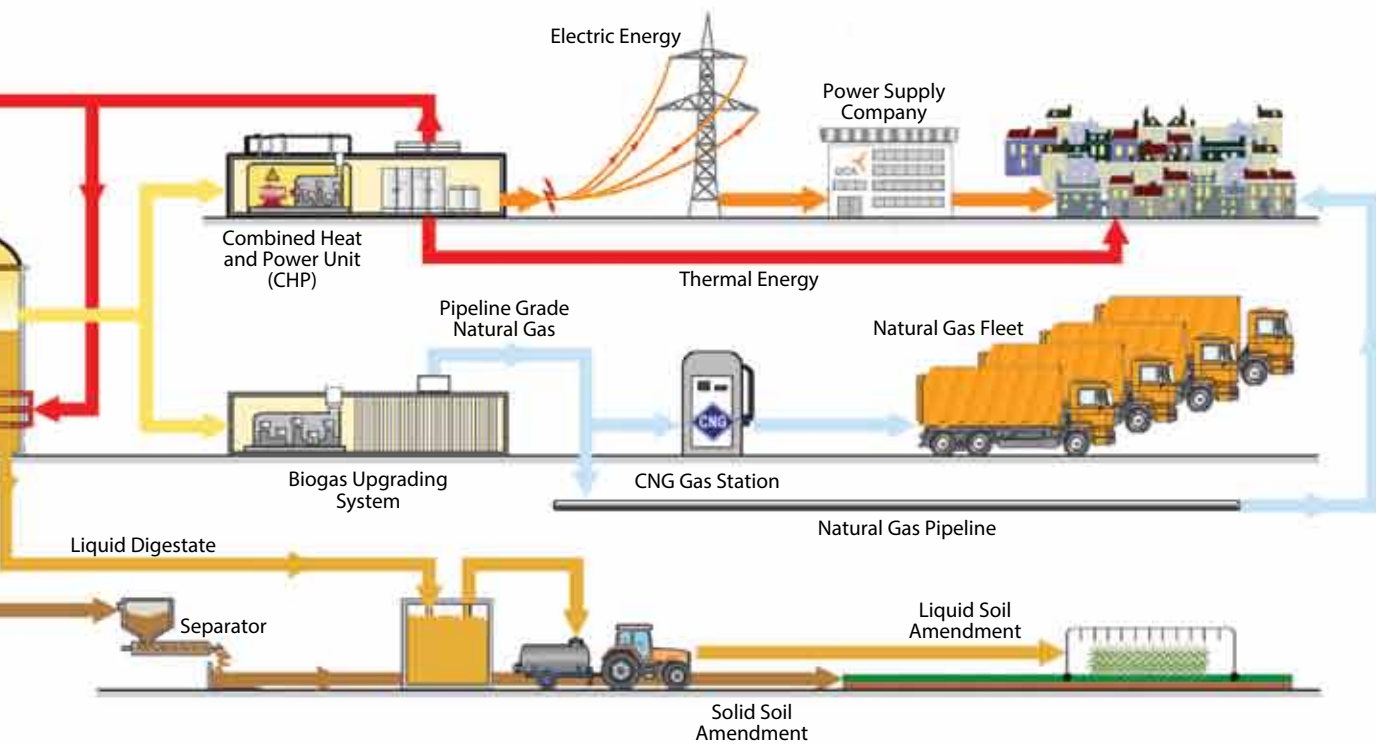
- Continuously mixed plug-flow process for feedstocks with high solids content
- High gas yield and high process stability
- Robust design capable of processing potential contaminants without risk of a system shut-down
- Enclosed system prevents emissions of offensive odors
- Short lead times and rapid on-site construction



# BASIC PROCESS FLOW OF EISENMANN BIOGAS PRODUCTION







# PLUG-FLOW DIGESTER FOR ORGANIC WASTE

## Eisenmann Continuously Mixed Plug-Flow Digester

The horizontal plug-flow digester is at the heart of the Eisenmann biogas system. This design delivers the best possible digestion and minimizes short-circuiting of feedstock, ensuring maximum biogas yield and reliable operation.

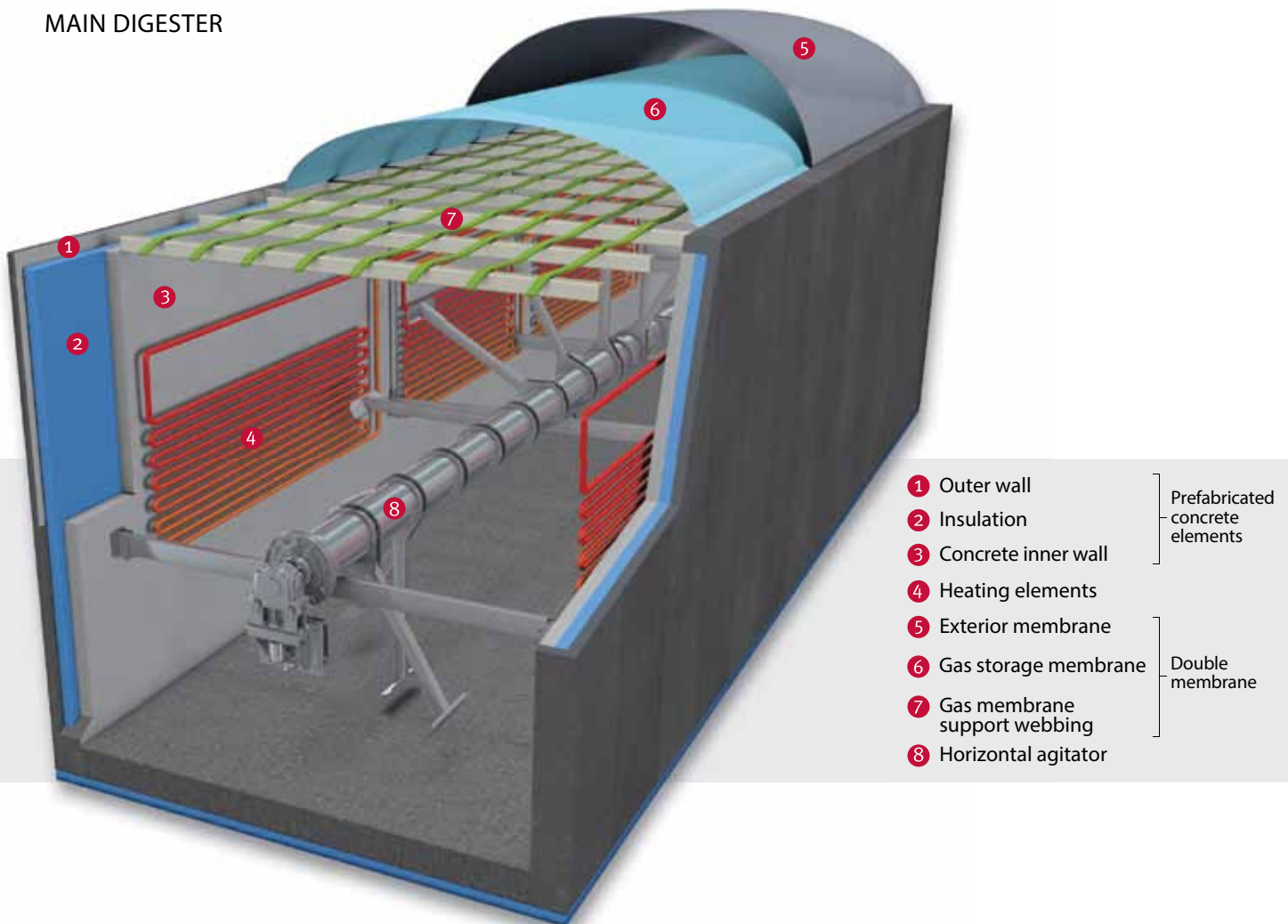
The Eisenmann system design is ideal for high organic loads and continuous high solids digestion.

Eisenmann's proven experience and complete process knowledge provides the best solutions for our customers.

## Advantages at a Glance

- Continuous high solids digestion
- Feedstock flexibility
- Compact modular design
- User friendly automated system
- High organic load with ideal residence time
- Maximized gas yield
- Minimized feedstock dilution and recirculation rates

## MAIN DIGESTER



The system design is based on years of green engineering excellence and optimized to ensure these attributes work together to maximize gas yield.

### **Horizontal Agitator**

The horizontal agitator ensures proper mixing of the feedstock and facilitates gas release from the homogenized material.

### **Design Features**

- External bearings, no internal or submerged bearings
- Frequency controlled drives with robust gear boxes
- Mixer speed and torque monitoring
- Continuous lubrication via automatic grease pumps

### **Heating**

Heating elements with separate heating circuits ensure precise, even temperatures and reliable sanitization.

### **Control System**

The industrial grade control system provides fully automated operation, continuous monitoring and data logging for exceptional system reliability. Remote monitoring can be included.

### **Safety Systems**

Comprehensive, highly effective safety systems in accordance with applicable local legislation and standards.

### **Pressure-Tight Doors**

Strategically placed pressure-tight doors offers easy access for maintenance and inspection.

### **Double-Membrane Gas Storage**

The roof of the digester can include a removable double-membrane biogas storage with a gas-level indicator to provide consistent biogas flow to downstream equipment. This optional gas storage ensures complete safety when producing and handling biogas.

### **Separation**

Needs vary for different applications. Screw-press separators are available in various configurations depending on feedstock and customer requirements.





**Municipal Biogas Plant**

## CASE STUDY: MUNICIPAL BIOGAS PLANT

Eisenmann designed and constructed a state-of-the-art biogas plant for Kelsag Biopower AG, in Liesberg, Switzerland. A biogas plant was incorporated into an existing composting facility, allowing the co-generation of heat and power, the production of digestate to be used as fertilizer and the reduction of the odor.

The plant is designed to process 12,000 metric tons of regional organic waste annually. The solid digestate is subsequently composted and the liquid digestate is used as a non-fossil fuel based fertilizer. A CHP system is utilized to convert the biogas into electricity that is fed into the national grid.

Technical data	
<b>Year constructed:</b>	2010
<b>Feedstock:</b>	yard waste, residential food waste, waste from the food industry
<b>Feedstock throughput:</b>	12,000 t/year
<b>Main digester capacity:</b>	215,000 gallons 800 m <sup>3</sup>
<b>Nominal biogas flow rate:</b>	88 CFM / 150 Nm <sup>3</sup> /h
<b>Installed electrical capacity:</b>	330 kW



# EISENMANN INDUSTRIAL SERVICE

Eisenmann offers a broad service and support portfolio. Eisenmann believes in creating a true partnership, driven by customer needs.

## Services:

- Inspection
- Maintenance
- Repairs
- Remote diagnosis
- Stand-by support
- Maintenance contracts
- Full-service solutions

By providing professional maintenance, short repair times and quick turn-around on spare parts, Eisenmann Industrial Services is dedicated to exceeding customer expectations and ensuring plant success.



# BIOGAS PLANT CONSULTING

The goal of Eisenmann's consulting services is to maximize your biogas plant's performance. Tests are conducted on the feedstock, and corresponding recommendations are provided. This is followed by a controlled start-up phase in conjunction with monitoring and analysis.

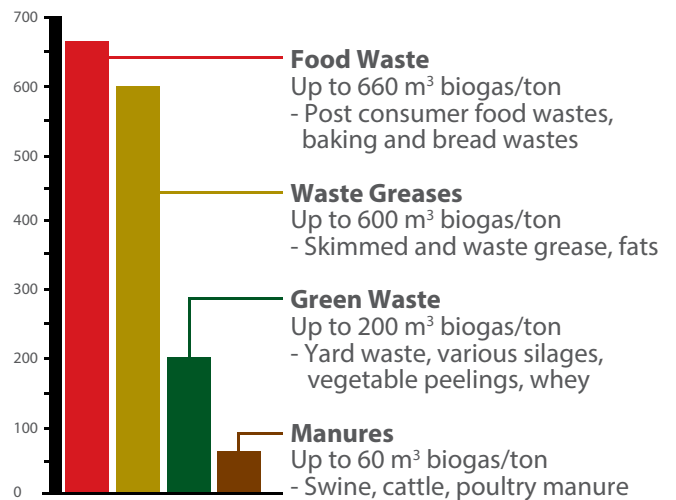
Close collaboration with Eisenmann Industrial Services ensures maximum system uptime, consistent high performance and expert advice on alternative feedstock and plant modification or expansion.

## Consulting Services:

- Feedstock recommendations to achieve client objectives
- Tailor-made start-up plan
- Analysis of all biologically relevant operating parameters
- Recommendations on best-practice plant operation
- Optimization of plant operation by means of plant monitoring and analysis

Not all feedstocks yield the same biogas output and the feedstock recipe greatly impacts plant performance. Eisenmann knows this and is dedicated to ensuring maximum biogas yield. The biogas team consults with clients to find the ideal recipe for sustainable results and optimal plant performance.

## Potential Biogas Yield from a Range of Feedstocks



# THIS IS EISENMANN

Eisenmann is a leading industrial solutions provider of environmental technology, surface finishing, material flow automation, firing lines for ceramics and special installations for coating, recycling, thermal treatment and energy recovery. Eisenmann designs and builds custom plants including waste to energy solutions, air pollution control systems and paint finishing lines.

More than 3,600 employees work in 12 locations worldwide to develop new ideas and concepts in the areas of production, painting, assembly and distribution. Among them are experts and specialists with experience in a wide range of industry sectors. This experience and talent gives Eisenmann the advantage for creating cost effective, customized solutions with state-of-the-art technology.

All Eisenmann technologies and solutions have been researched and tested in advanced technology centers to meet a global standard of quality. In the US, projects are locally engineered and procured to customer specifications. This method saves considerable time and cost for assembly on site and ensures minimal interruption to your production process during installation.

Eisenmann strives to constantly improve the solutions and services offered to customers. Through innovation and dedicated customer service, Eisenmann is recognized as a trusted technology partner.



*US headquarters, based outside of Chicago, IL.*



*Eisenmann technology center in Holzgerlingen, Germany.*





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## **Environmental Technology**

Eisenmann Environmental Technology offers a complete portfolio of state-of-the-art, highly efficient environmental engineering systems. Worldwide, systems are designed and built to meet or exceed customer specifications for:

- Biogas
- Waste water
- Exhaust air
- Hazardous waste incineration
- Ammunition disposal
- Wood gasification

Eisenmann draws on 60 years of successful experience in industrial plant engineering to deliver high quality projects in compliance with all applicable safety standards. Professional project managers and experienced service experts ensure smooth, swift installation and reliable operation.

## **The Biogas Experts**

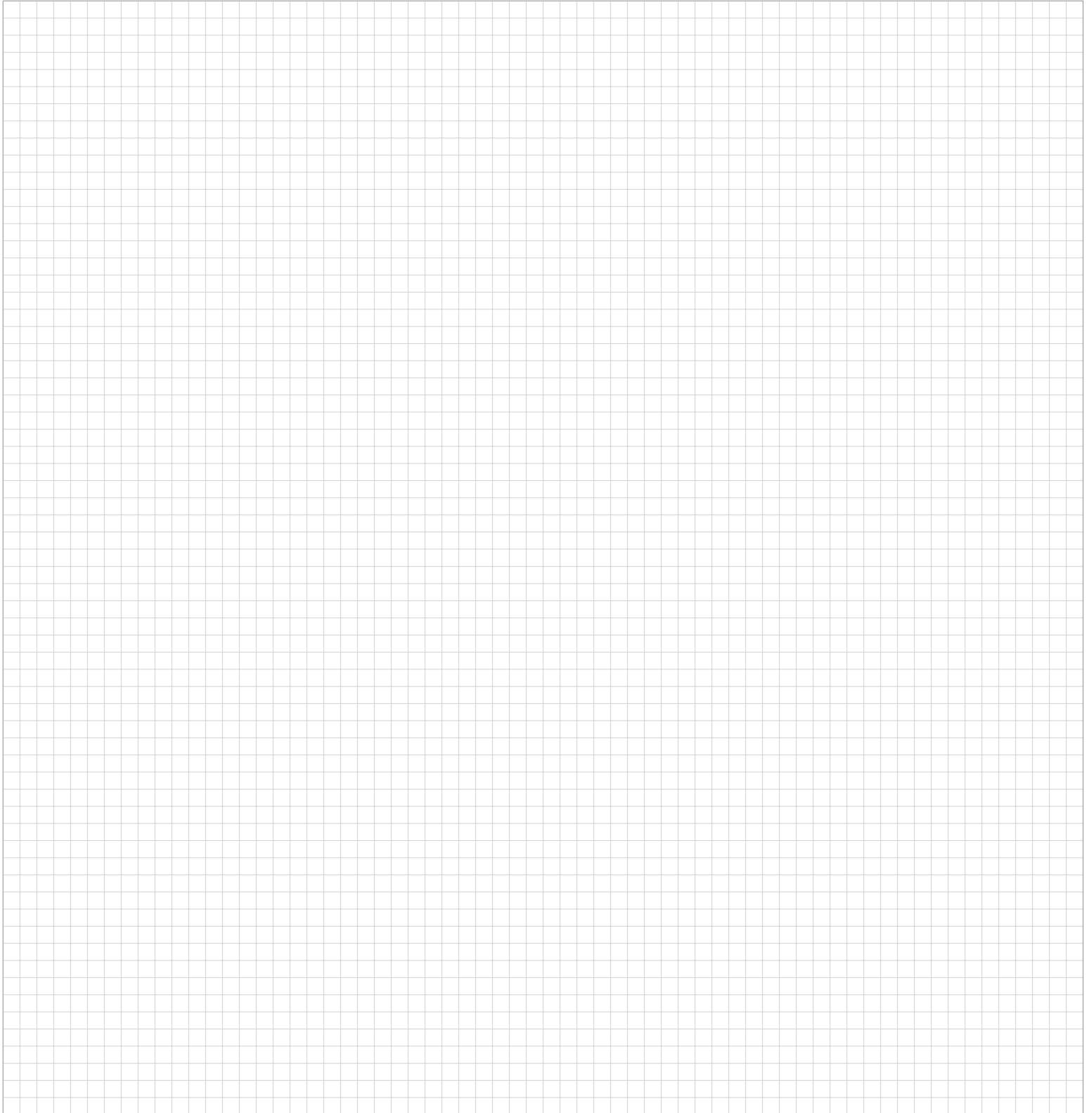
The first high solids Eisenmann biogas plant was completed in 2003. It featured a horizontal plug-flow digester and steel stirred tank post digester. Eisenmann has since developed a modular anaerobic digestion system providing maximum flexibility for a variety of applications. Eisenmann has more than 90 biogas plants in operation.

## **Eisenmann Expertise**

- High-Solids organic waste solution
- Turnkey manufacturing and installation
- Proven end-to-end process knowledge
- Trusted and experienced industry leader

# NOTES

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