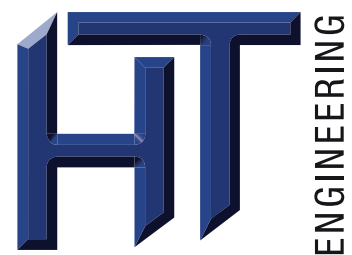
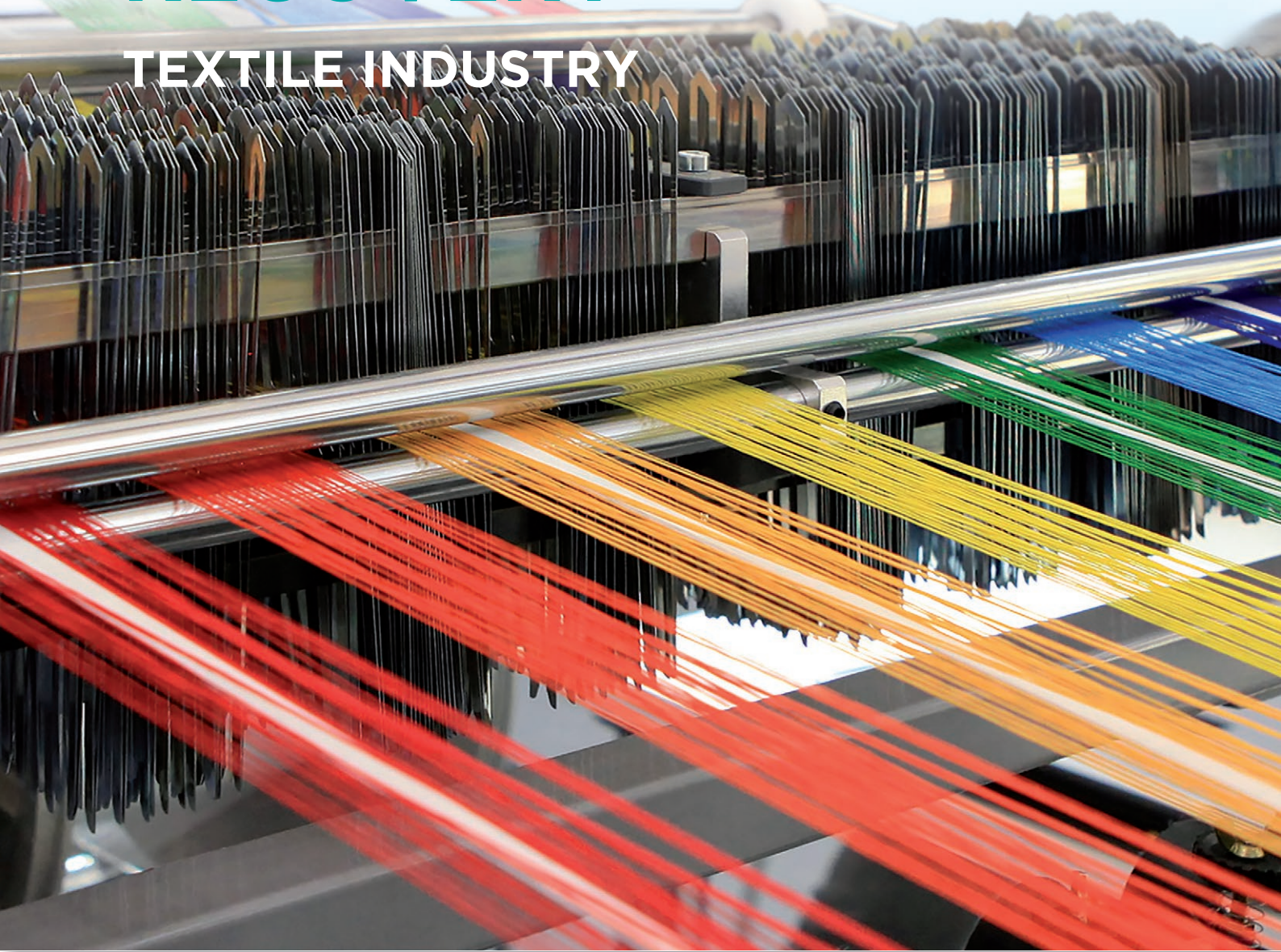


# ZLD TECHNOLOGY FOR WASTEWATER RECOVERY

TEXTILE INDUSTRY



**HYDROTECH**  
a gradiant company



# STATE-OF-THE-ART TURNKEY SOLUTIONS FOR WASTEWATER RECOVERY

Textile industries generate wastewater containing high levels of pollutants, with significant disposal costs. The Zero Liquid Discharge (ZLD) technology, which is included in more than 35 plants designed and built by Hydrotech Engineering, is an effective solution to fully recover wastewater destined for industrial use. Processing by-products are transformed so that they can be reused, or the amount to be disposed of is minimised, thus eliminating the liquid effluent completely.

This advanced technology promotes circular water economy and a substantial reduction in operating costs by recycling wastewater. As a result, water can be reused directly in industrial processes, with a significantly lower environmental impact.



Hydrotech Engineering's advanced wastewater treatment solutions can handle water with **COD up to 6000 mg/l** and **TSS up to 400 mg/l**, ensuring high performance in all conditions

# HT-TECH TECHNOLOGY FOR TEXTILE WASTEWATER TREATMENT

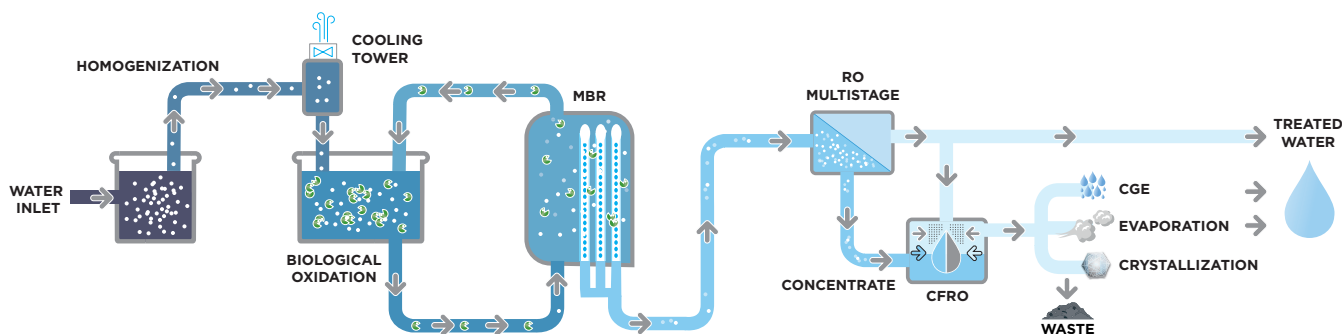
Hydrotech Engineering has developed **HT-TECH**, a state-of-the-art system for the treatment of wastewater from the textile industry to achieve **ZLD (Zero Liquid Discharge)**. This solution brings together biological processes, membrane filtration and innovative technologies to ensure effective purification and maximum wastewater recovery.

The system offers two main solids separation options after biological treatment:

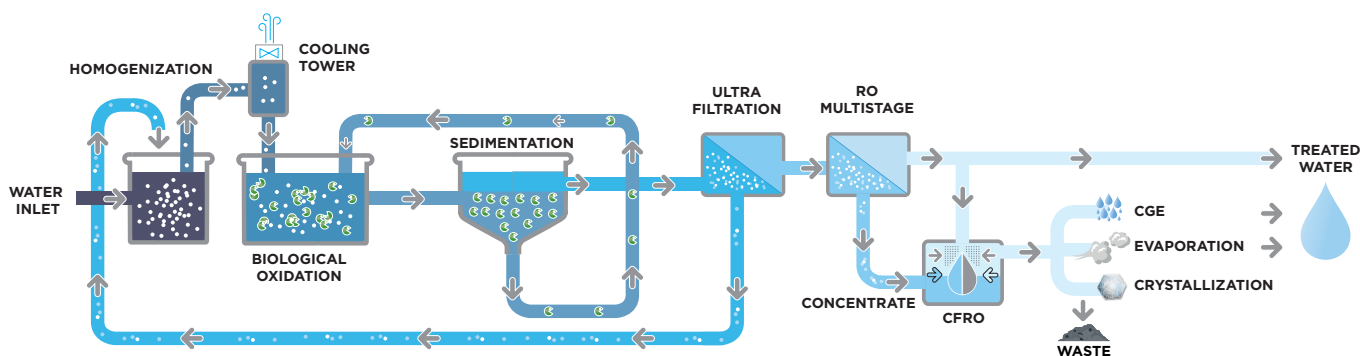
1. **Membrane Bioreactor (MBR)**
2. **Ultrafiltration (UF)**, available both **as pressurised** and **submerged Side Stream** configuration, installed after a traditional clarifier.

To make the water reusable and maximise recovery, the process incorporates **multistage reverse osmosis (RO)** technology, which ensures high recovery rates with minimal energy consumption. Subsequent to reverse osmosis, **CFRO** technology (patented by GRADIANT, our mother company), makes it possible to achieve salt concentrations beyond the reach of conventional membranes. This technology drastically reduces the amount of effluent to be evaporated, cutting energy consumption and making the ZLD system competitive in every respect: low initial investment, low operating costs and minimal environmental impact.

## MBR TECHNOLOGY - REVERSE OSMOSIS



## SIDE STREAM UF TECHNOLOGY



# ADVANTAGES OF THE ZERO LIQUID DISCHARGE TECHNOLOGY

ZLD wastewater treatment technology offers numerous advantages, ensuring efficiency, sustainability and optimised management of operating costs:



## **Full wastewater recovery.**

The system recovers the full amount of treated wastewater, minimising waste and improving resource efficiency.



## **Highly efficient biological oxidation.**

Thanks to advanced biological oxidation technology, treatment yields are optimised, reducing time and costs without compromising the quality of the treated water.



## **Reduced operating costs with innovative membranes.**

The adoption of advanced membranes significantly reduces operating costs, improving component life and minimising maintenance requirements.



## **Streamlined and low-cost maintenance.**

The plant design is designed for quick and easy servicing, reducing downtime and costs associated with routine and extraordinary maintenance.



## **Maximum energy efficiency with multistage RO technology.**

Multistage RO and CFRO systems provide significant energy savings, consuming around 1.50 kWh/m<sup>3</sup> during the entire treatment cycle and improving overall efficiency.



## **Treatment of highly polluting waters.**

Our systems can treat water with high levels of dissolved solids (up to 6000 ppm), allowing the treatment of complex effluents without compromising process efficiency.



# HOMOGENISATION, COOLING SYSTEM AND BIOLOGICAL PROCESS

## HOMOGENISATION

To ensure a constant supply to the plant, homogenisation is essential. A network of air diffusers located at the bottom of the tank mixes and oxygenates the entire wastewater amount. This prevents the development of anoxic areas within the storage and homogenisation unit, which could cause unpleasant odours.

Wastewater from production can have a temperature of around 50-65°C.

To improve purification rates through activated sludge oxidation, cooling towers are provided to lower the temperature to around 34-35°C, which is ideal for the biological process.

After cooling, before entering the biological tank, the water passes through a fine screen to remove any suspended solids that could cause rapid fouling of the membranes.

## BIOLOGICAL PROCESS

Biological processes involve treatments where pollutants, such as biodegradable organic substances, nitrogen and phosphorous compounds, are removed from water mainly through biodegradation by means of biomass (consisting of bacterial populations). These processes comprise a sequence of anaerobic and aerobic reactions taking place in biological reactors.

In the oxidation tank, autotrophic bacteria degrade organic substances and oxidise organic and ammonia nitrogen. Denitrification occurs in the anoxic tank, where heterotrophic bacteria reduce nitric nitrogen to gaseous nitrogen (N<sub>2</sub>) in the absence of oxygen, contributing to effective water purification.



# TWO APPROACHES TO WATER FILTRATION: MBR/SIDE STREAM UF

## MBR (MEMBRANE BIOREACTOR)

MBR technology effectively combines the **activated sludge system** (anoxic and aerobic reactor) **with a submerged ultrafiltration system, providing highly efficient treatment of the effluent.**

This approach uses membranes to clarify the biomass, solving one of the main challenges of traditional biological processes: the need to settle suspended and colloidal organic matter to separate it from the liquid phase.

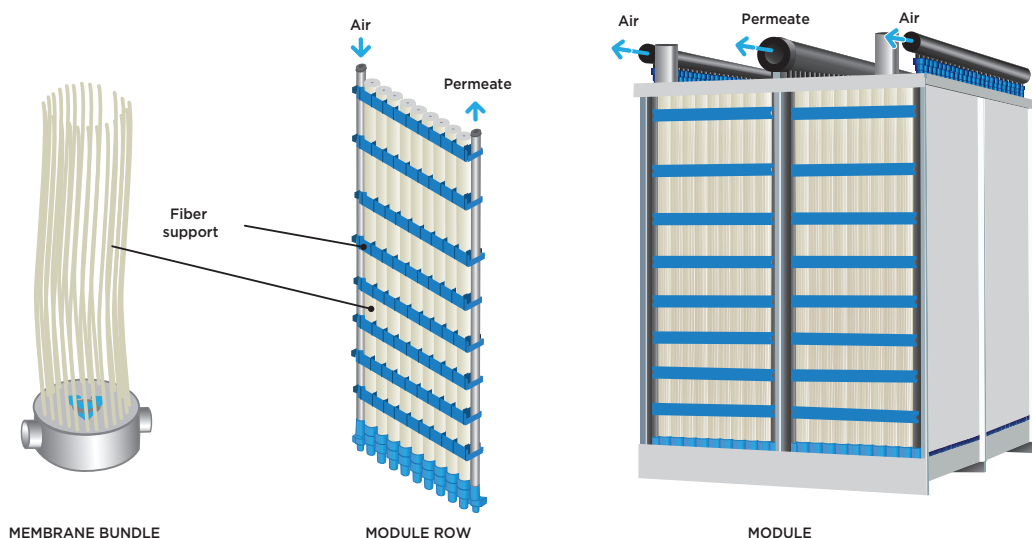
One of the distinguishing features of biological processes with MBR technology is their ability to completely retain settleable suspended organics. This significantly increases the process' overall efficiency, promoting greater assimilation of substances by microorganisms.

MBR is an effective solution for treating heavily polluted industrial wastewater. It uses semi-permeable membranes submerged in tanks; through a vacuum system, the liquid is drawn through the membranes, which retain suspended solids, including bacteria that contribute to water purification. Aeration and backwashing cycles remove residue from the membrane surface. This process can handle sludge concentrations twice as high as traditional methods, increasing treatment efficiency while reducing the size of the bioreactor.

### CHARACTERISTICS OF SUBMERGED ULTRAFILTRATION

Type	Hollow fibre
Nominal pore size	0,03 µm
Membrane material	PVDF
Membrane diameter	2.6 mm
Max TMP (Transmembrane Pressure)	9.0 psi / 0.6 bar
Operating temperature range	5 - 40 °C
Operating pH range	2.0 - 10.5
Removed Components	Viruses, giardia, cryptosporidium, bacteria, colloids, algae and suspended solids
High mechanical resistance	✓

### STRUCTURE OF THE ULTRAFILTRATION MODULES SUBMERGED IN THE REACTOR



# SIDE STREAM UF (ULTRAFILTRATION)

Side stream UF, unlike MBR, **uses membranes for solid-liquid separation after sludge sedimentation.**

This system ensures the removal of sludge particles and suspended solids that were not retained during the sedimentation process. The removal of these impurities is essential to optimise the performance of reverse osmosis, as any remaining particles can compromise the effectiveness of this technology by causing blockages or reducing the membrane's permeation capacity.

Ultrafiltration helps to extend the life of reverse osmosis membranes, reducing the need for maintenance and replacement. In addition, this preparatory step makes operation of the system more efficient as a whole, ensuring a more sustainable and high-performing wastewater treatment process.



## ULTRAFILTRATION SIDE STREAM FEATURES

Type	Hollow fibre
Nominal pore size	0,03 $\mu\text{m}$
Membrane material	PVDF
Membrane diameter	8 mm
Max pressure	5 bar
Max temperature	40° C
Removed Components	TSS
High mechanical resistance	✓

# ADVANTAGES OF MBR AND SIDE STREAM UF TECHNOLOGIES

	MBR	SIDE STREAM UF
<p><b>Highly efficient biological treatment:</b> high MLSS concentration and long SRTs promote the growth of specialised biomass that assimilates organic matter otherwise difficult to biodegrade.</p>	✓	✓
<p><b>Quality effluent for reuse:</b> ultrafiltration membranes act as a physical barrier against suspended and colloidal particles, ensuring a high quality permeate, free of solids and turbidity. The final treatment with reverse osmosis recovers 100% of the effluent, making it suitable for reuse.</p>	✓	✓
<p><b>Compact system:</b> MBR technology can be used to treat wastewater with a MLSS concentration of 8/10 g/l, reducing the size of the biological treatment tanks compared to conventional sedimentation systems. This results in a smaller plant footprint and building cost savings, and it also eliminates the need for a sedimentation tank.</p>	✓	
<p><b>Easy to integrate into existing systems:</b> this adaptability allows companies to implement the technology without complex or costly modifications to existing facilities.</p>		✓
<p><b>Plug and play system:</b> construction and pre-assembly on a skid, ready for use. This construction method speeds up the production process, making the units ready for use as soon as they are delivered to the site.</p>		✓
<p><b>Quick maintenance:</b> skid-mounted configuration also simplifies maintenance, as units are easily accessible and can be replaced or repaired quickly.</p>		✓



# MULTI-STAGE REVERSE OSMOSIS

Reverse osmosis (RO) is the optimal technology to ensure **maximum water recovery**. It's a barrier that can remove microbiological components and dissolved inorganic and organic substances when combined with ultrafiltration pre-treatment. It's a type of membrane that operates according to the osmotic principle, i.e. the water is separated by applying pressure on the membrane in the opposite direction to the natural direction of the osmotic flow.



MEMBRANE OF REVERSE OSMOSIS (RO)

The RO membrane is installed with a wound spiral configuration that follows the principles of tangential flow filtration. More precisely, by applying pressure, the water is forced to pass through the membrane: the filtered water (permeate) collects in the inner part of the filter, while all the dissolved components remain concentrated in the outer part.

To maximise water recovery, the concentrate is subjected to a multi-stage treatment as part of the reverse osmosis process. The clean water obtained is ready for reintegration into the industrial process.

## CHARACTERISTICS OF REVERSE OSMOSIS

Degree of filtration	1 - 10 nm
Pressure	10 - 70 bar
% Recovery	93 - 94%
Water quality	Maximum
Treats groundwater, surface water and brackish water	✓
Removed components	Endotoxins/pyrogens, insecticides/pesticides, herbicides, antibiotics, nitrates, soluble salts, metal ions, heavy metals, arsenic, boron and fluorine

## ADVANTAGES OF MULTISTAGE REVERSE OSMOSIS

- **High water quality and complete removal of impurities completa delle impurità.** Ensures high quality purified water through effective removal of organic and inorganic elements.

- **Energy efficiency and high recovery rates.** Ensures high recovery rates with low energy consumption, optimising resources.

- **Compact and functional design.** Small footprint and membrane structure for more effective cleaning.

- **Easy installation and operation.** Plug-and-play system for fast installation and immediate start-up.

# CFRO (COUNTERFLOW REVERSE OSMOSIS) TECHNOLOGY

CFRO (Counterflow Reverse Osmosis) is an innovative Reverse Osmosis technology developed and patented by **Gradiant**, a global leader in advanced water treatment solutions. This system is designed to treat water with Total Dissolved Solids (TDS) concentrations of up to 200,000 mg/L. It uses a unique technology that applies a concentrated brine to the permeated part of the membrane, reducing osmotic pressure and allowing high salinity water to be treated

with lower pressures than traditional systems.

The CFRO consists of a series of standard reverse osmosis membranes, which are used in an innovative design where the flow of permeate water and concentrated brine follow opposite directions. This countercurrent flow maximises the efficiency of water separation and recovery. By reducing operating pressure (up to 83 bar), the system achieves high recovery rates and

reduces energy consumption, thus improving the sustainability of wastewater treatment.

The CFRO system is designed to treat high concentration brine without compromising membrane efficiency, making it ideal for desalination applications, the management of high salinity wastewater such as industrial wastewater, and brine concentration processes.

## ADVANTAGES OF CFRO

- High water recovery efficiency

- Lower operating pressures

- Reduced energy consumption

- Environmental sustainability

- Longer membrane life

## CGE (CARRIER GAS EXTRACTION) OR EVAPORATOR AND CRYSTALLISATION

At the end of the wastewater treatment process, two advanced solutions are available: **Carrier Gas Extraction (CGE)** technology or **Multi-Effect Evaporator (MEE)**. CGE, developed by Gradiant, mimics the natural rain cycle by using a carrier gas to evaporate and condense water, transforming it into high-quality fresh water even from concentrated brines. Alternatively, MEE uses a series of decreasing pressure evaporations to maximise heat efficiency, ensuring reliable treatment of high salinity water. As a final option, salt residues can be further concentrated and crystallised, resulting in stable solids and minimising liquid waste. These solutions ensure a sustainable, versatile and optimised process for various industrial needs.

# EXCELLENCE IN INDUSTRIAL WATER TREATMENT PROCESSES

## TURNKEY PLANTS

- Creation of state-of-the-art tailor-made systems
- Quality assurance, cost reduction and project time reduction
- Complete management: design, development, in-house construction and after-sales service

## AUTOMATION

- In-house software for universal plant management
- Plants designed to automate maintenance activities, reduce operating costs, maximize production and reduce downtime

## REMOTE CONTROL

- Continuous monitoring of parameters and timely remote intervention by a specialized in-house team
- Preventive maintenance and optimization of plant performance

## PILOT PROJECTS

- Risk reduction and prior assessment of the feasibility of the project through the construction of pilot plants
- Supply of the best technologies with the highest performance on the market

## PRE-ASSEMBLY

- Construction and pre-assembly of the plant and all ancillary sections in Italy
- Reduction of plant footprint, costs and optimization of logistics
- Pre-assembly carried out by a specialized team

## INTERNATIONAL VENDORS

- Collaboration with the best international suppliers to ensure reliable and high-quality solutions
- Immediate service for spare parts that are quickly available

## ZERO LIQUID DISCHARGE

- We specialize in the implementation of advanced solutions for wastewater treatment
- Recycling of wastewater with a reduction in environmental impact and water consumption



# REFERENCES

Hydrotech Engineering has established important collaborations with leading global companies in the textile sector, building over 35 ZLD turnkey plants in different parts of the world, including Asia, Africa and Europe. These successes have solidified our partnerships with renowned players in the industry who have repeatedly confirmed the high standard of our services during various collaborations, reinforcing their trust in Hydrotech Engineering.

Discover the plants built by Hydrotech Engineering here:



For over 23 years, Hydrotech Engineering has been building state-of-the-art turnkey plants for the treatment of process water and wastewater using semipermeable membrane and biological process technologies. With more than 200 proven installations in over 25 countries, Hydrotech Engineering has supported over 100 companies in reducing water consumption and recovering as much as possible for more sustainable water use.

Our team coordinates projects, from design to after-sales service, all over the world between the headquarters in Italy and India.



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