INTRODUCTION LETTER

TAPROGGE IS A WORLD-LEADING SPECIALIST AND AN EARLY PIONEER OF CLEANTECH SOLUTIONS.

For over 60 years, TAPROGGE has been a leading innovator of trailblazing solutions that improve energy efficiency in thermal water circuits in the energy industry. We also produce highly effective solutions for desalination and cooling processes, and other industrial applications. Our proprietary process engineering solutions help to deliver remarkably high primary global energy savings and to reduce the emission of harmful gases which impact the climate.

Maximizing energy and water efficiency – drives everything we do and makes our work so rewarding and effective. Our clear focus and ability to embrace innovation have enabled us to bring new and intelligent technological solutions to the market over recent years. These solutions have allowed us to successfully shape our future and to develop in areas above and beyond the market segments we originally served. We have expanded our areas of expertise through the technologies we have developed in our TAPROGGE, TERRAWATER and KLAREN brands. Components of these solutions complement and work in synergy with each other on many levels and will enable us to uphold our position well into the future as a leading provider of solutions which “maximize energy and water efficiency”.

We have delivered over 18,000 systems to customers all over the world who receive excellent customer service through our 10 subsidiaries and 60 international sales agents. We are continually expanding our business which encompasses the following areas:

Maximizing Energy and Water Efficiency in Power Stations and Industrial Applications

We optimize cooling water systems in power stations and industrial applications by using end-to-end solutions for water extraction, filtration and condenser tube cleaning.

Maximizing Energy and Water Efficiency in Seawater Desalination

TAPROGGE uses a wide range of innovative and environmentally friendly desalination concepts and tried-and-tested technology to deliver highly effective filtration and tube cleaning solutions.

INTRODUCTION LETTER

Fluid Concentration & Zero Liquid Discharge (ZLD)

The subject of reducing waste water volumes, right up to complete elimination of waste water, is one of the major tasks in the fight against water shortages and conservation of resources.

Water Recycling and Resource Recovery

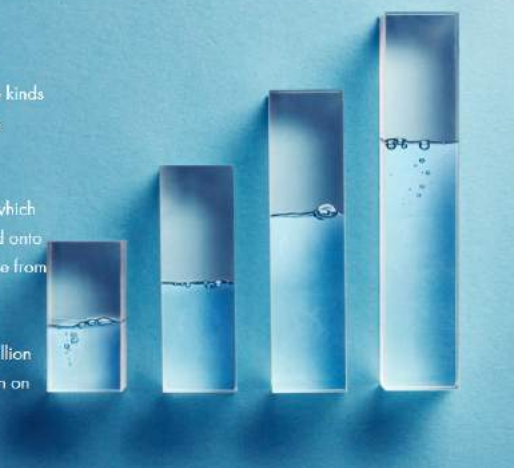
Efficient liquid-solid separation, waste reduction and the recycling of valuable resources protect the environment and provide added value for operators.

Efficiency and sustainability

All areas of the TAPROGGE business focus on making processes even more efficient. We are one of only a few companies in the world that produce these kinds of solutions which protect the environment, conserve resources whilst reducing production costs.

For example, using TAPROGGE systems can result in annual energy savings which equate to around 20 million tonnes of coal. If this amount of coal were loaded onto a goods train, it would be 3,600 kilometres long, which is roughly the distance from Helsinki to Athens.

Fouling problems cost power plant operators around the world USD 45.02 billion per year. We aim to significantly reduce these costs whilst reducing the burden on the environment to the high degree outlined above.

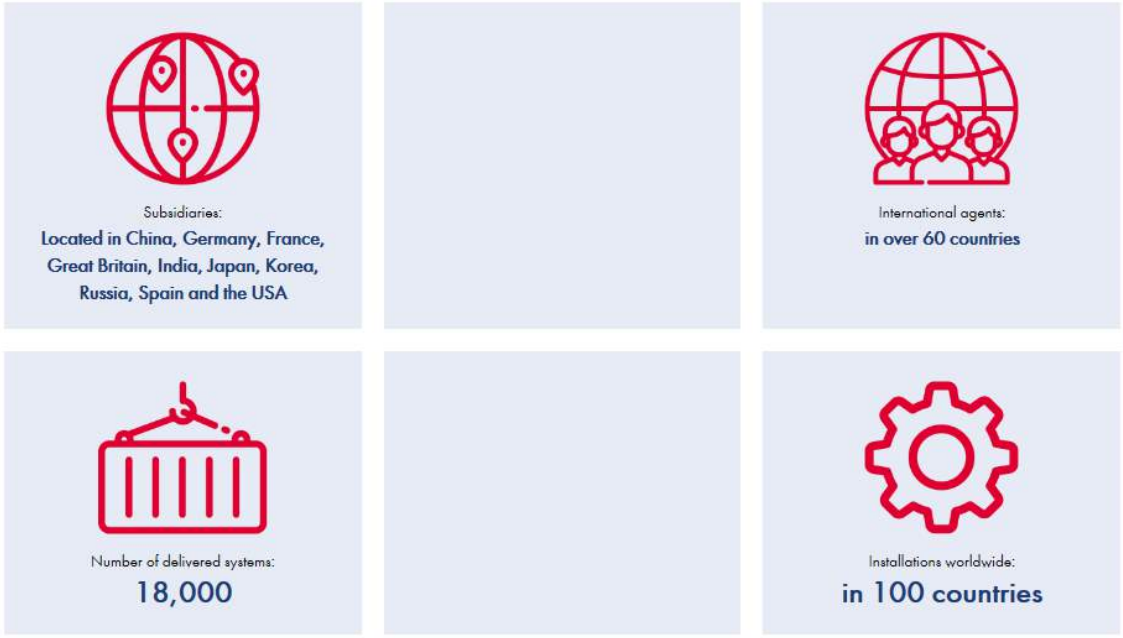


Year established:
1953

Number of employees:
approx. 350

Share capital:
10 million Euros

Annual turnover:
approx. 60 million Euros



Broad Developed Technology are as listed below with web-link for more information

1. **PASSIVE WATER INTAKE SYSTEM FOR WATER EXTRACTION IN POWER PLANT AND INDUSTRIAL UNITS: TAPIS** (https://youtube/Lbmf9ol63XM)

2. **AUTMATIC PRESSURE RELIEF BACKWASH FILTER FOR MECHANICAL FILTERATION IN POWER PLANTS, INDUSTRIAL UNITS AND FINE FILTERATION REQUIREMENT IN WATER TREATMENT PLANT:** PR-BW (https://youtube/Lbmf9ol63XM) *available in customized flow rate & filtration capacity'

3. **CONDENSER ONLINE TUBE CLEANING SYSTEM FOR AUTOMATIC TUBE CLEANING IN CHILLER/REFRIGERATION PLANT, CAPTIVE POWER PLANT, THERMAL POWER PLANT, NUCLEAR POWER PLANT AND MULTI-STAGE FLASH EVAPORATION THERMAL DESAINATION PLANT:** CTCS (https://youtube/Lbmf9ol63XM) * available for heat exchangers with water in tube sides

4. **KLAREN "SELF CLEANING HEAT EXCHANGER" FOR MULTI EFFECT EVAPORATOR WASTE WATER TREATMENT PLANT AND MECHANICAL VAPOUR RECOMPRESSION WASTE WATER TREATMENT PLANT , ASSISTINGNG IN ONLINE AUTOMATIC CLEANING OF VERTICAL EVAPORATOR:** (https://www.youtube.com/watch?v=fSRTiKFbOVE) * available for vertical heat exchangers across all applications with slurries/difficult liquids in tube sides

5. **TERRAWATER "Zero Liquid Discharge System" :** (https://www.youtube.com/watch?v=KSVxJefUUik)* available for all zero liquid discharge applications.

We have also established our 100% owned subsidiary organisation in INDIA to offer our solutions and services as per market trend/demand competitively with end to end support; so as to pass on the necessary commercial benefits along with our advanced technology to customers for a possible a win – win realisation.

As a parent organisation, TAPROGGE GmbH would continue to support with the design & engineering of the product manufactured at INDIAN facility in Vasai, Palghar, MAHARASHTRA.

Complete manufacturing and assembly would be carried out in our INDIAN Facility as per manufacturing and quality guidelines of our parent organisation.

We believe in providing value added services and build good will and are confident of assisting your esteemed organisation with our deliverables.

We look forward for an opportunity to build our associations in INDIA and beyond.

Thanking You and Obliged.

ASHISH D. MAHTO

COUNTRY HEAD – TAPROGGE INDITECH PVT LTD

MAXIMIZING ENERGY AND WATER EFFICIENCY

YOUR FRIEND AND PARTNER

MACRO FOULING AND MICRO FOULING

Macro Fouling Typology

Macro Organisms in the Intake

Biology of animal or vegetable origin entered through the intake

- swimming freely: fish, crab, jellyfish
- floating / forming deposits: dead animal parts, vegetation rests, such as leaves and grass
- forming deposits: mussels, larvae, sea pocks, hydroids, algae, etc.

Macro Particles in the Intake

Large particles of inorganic origin entered through the intake

- stones
- gravel
- rubble etc.

Civilisation Refuse

Fouling of civilisation origin entered through the intake

- plastic bags and bottles
- paper refuse
- glass bottles
- other household and industrial garbage

Construction Debris

Detachment of construction parts of the water system

- detached cooling tower internals
- detached piping parts, e.g. concrete, gravel, rubber lining and corrosion parts
- remnants of maintenance and repair works

Micro Fouling Typology

Particulate Fouling/ Sedimentation

- Suspended solids in seawater sediment mostly on the lower halves of evaporator tubes.

Sand, mud, introduced corrosion products

Crystallization/ Precipitation

- Is caused mainly by the presence of undissolved inorganic salts in the cooling water which, with increasing ingress of heat, exceed the solubility limit and then precipitate by forming very hard deposits.

Hardness-causing salts (calcium- and magnesium-carbonates, calcium- and magnesiumsulfates, silicates), iron & manganese precipitation

Corrosion

- Comes into existence when the tube material itself reacts with the seawater and thereby creates undesired corrosion deposits.

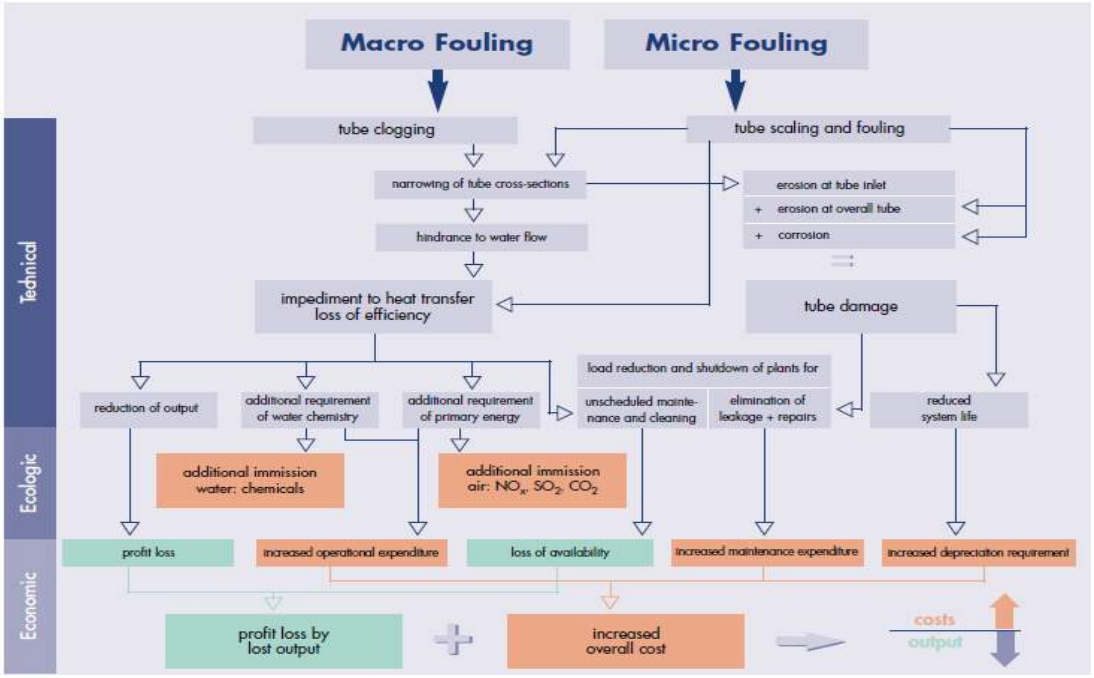
Corrosion products by chemical reaction with the tube material

Bio Fouling

- Is the development of organic layers. They are created by micro organisms and their metabolic products, but also by the settlement of macro organisms.

by macro organisms (sea pocks, mussels, larvae, algae), by micro organisms (e.g. slime-forming bacteria)

COMMERCIAL LOSSES ON ACCOUNT OF FOULING

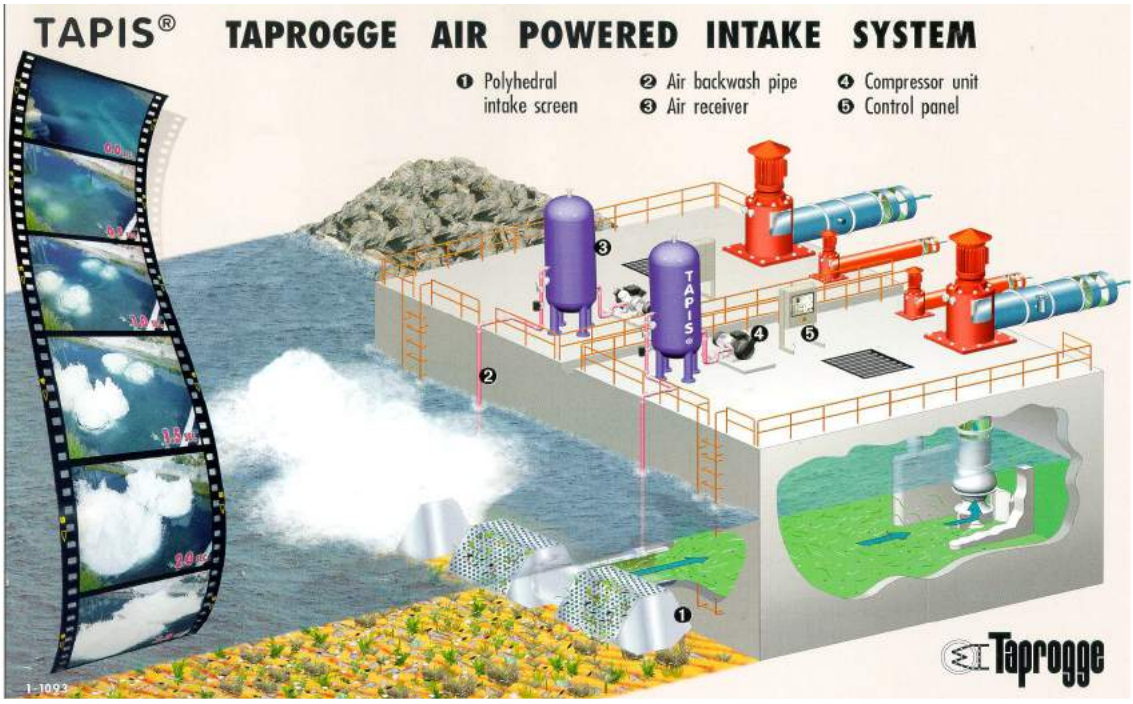


Industry-specific Effects of Fouling in Water Circuits

	Power stations (cooling)	Seawater desalination (evaporation)	Refrigeration machines (cooling)
Efficiency losses:	• Fouling increases the heat consumption of one turbine unit by 1 - 2 % and more. • An increase of the condenser backpressure of 10 mbar caused by fouling leads to a performance loss of the turbine of 1 - 2 %.	• Fouling reduces the drinking water output (GOR) of an MSF desalination plant by 17 % and more. • Increase of the consumption of anti-scaling chemistry from approx. 1.5 ppm to approx. 3 ppm	• Fouling increases the energy consumption of a refrigerator by 6 - 18 % and more. • Additional consumption of cooling water chemistry strongly depending on special application
Losses of availability:	• Load reductions and unit shutdowns for unscheduled outages for cleaning and repair works of heat exchangers	• Unscheduled outages for acidification and cleaning of evaporator tubes	• Loss due to tripping of refrigerator and scheduled and unscheduled manual cleaning procedures
Ecological extra burden:	• Additional immission of approx. 1 - 2 % of CO_2, NO_x from increased use of primary energy • Extra burden by additional consumption	• Doubling of ecologically effective discharge burden by additional application of anti-scaling chemistry	• Additional ecologically effective discharge burden by acidification of heat exchangers • Extra burden by additional consumption

PROTECTION AGAINST MACRO-FOULING

1. PRODUCT "SINGLE STAGE PASSIVE WATER INTAKE SYSTEM"



The TAPIS® single-stage water extraction system combines the features of conventional multi-stage pre-screening systems into one single stage without the need for waste disposal.

The specially designed housing and the integrated Cling-Free© filter elements form the TAPIS® polyhedron system.

The TAPIS® polyhedron system doesn't include any moving parts in the water which reduces maintenance costs and increases system availability.

TAPIS® is a fish-friendly solution. The Cling-Free© filter elements protect aquatic life by reducing flow velocity.

The TAPIS® system operates fully automatically. The internal polyhedral geometry facilitates extremely efficient backwashing. The modular structure of the TAPIS® system enables it to be modified to easily deal with throughput capacities and local topography.

Technical data

Model series:	TAPIS®
Basic design:	Single-stage system for water extraction
Volume flow/polyhedron:	800 - 7,500 m³/h
Filter element:	Cling-Free®
Filtration rate: other rates available by customer request	5 - 20 mm (standard)
Material polyhedral housing:	Duplex
Material filter element:	Polyamide
Polyhedral housing design pressure:	0.15 bar
Controller:	PLC, protection class IP 65, operator panel
Options:	remote monitoring

Features and Benefits

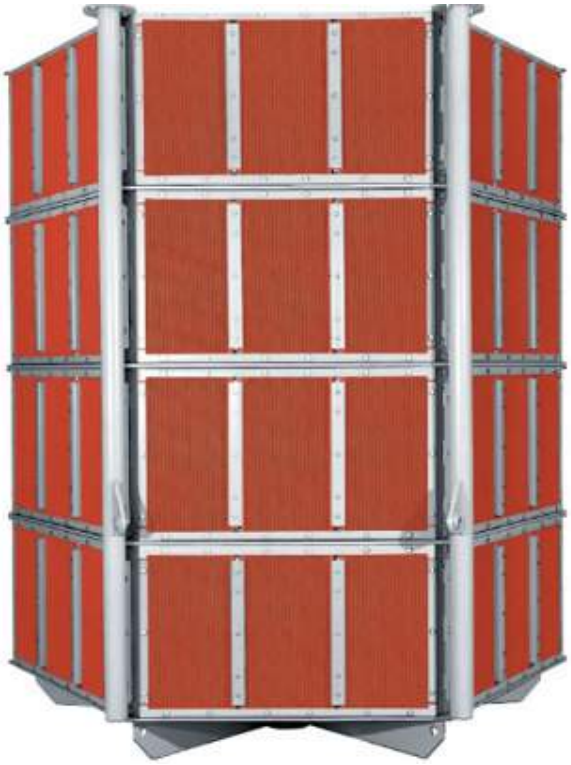
- TAPIS® polyhedra combine the features of conventional multi-stage systems into a single-stage system. This reduces the amount of investment that is usually needed for concrete channels which are traditionally used to carry the water that is going to be extracted via a multi-stage pre-screening system.

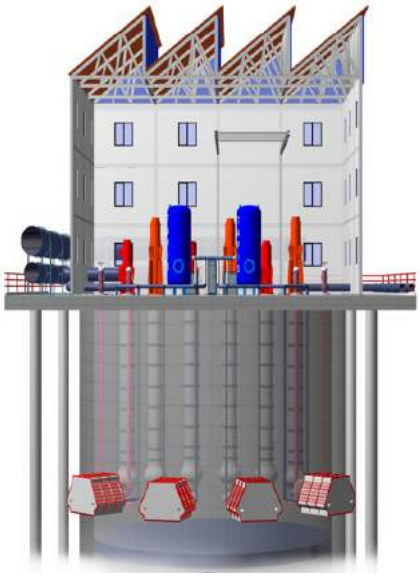
- TAPIS® polyhedra work without having to continually extract contaminants that have been removed. This prevents the running costs associated with environmentally friendly waste disposal from spiralling out of control.

- TAPIS® polyhedra make backwashing much more efficient than any other type of design. Using the sealed undersides of the polyhedra as designated rebounding plates for the injected pressurised air, which is introduced during backwashing, and optimising the spray nozzle geometry, created a completely new level of cleaning performance which is more uniform in terms of both time and spatial requirements. This reduces operating costs and increases system availability.

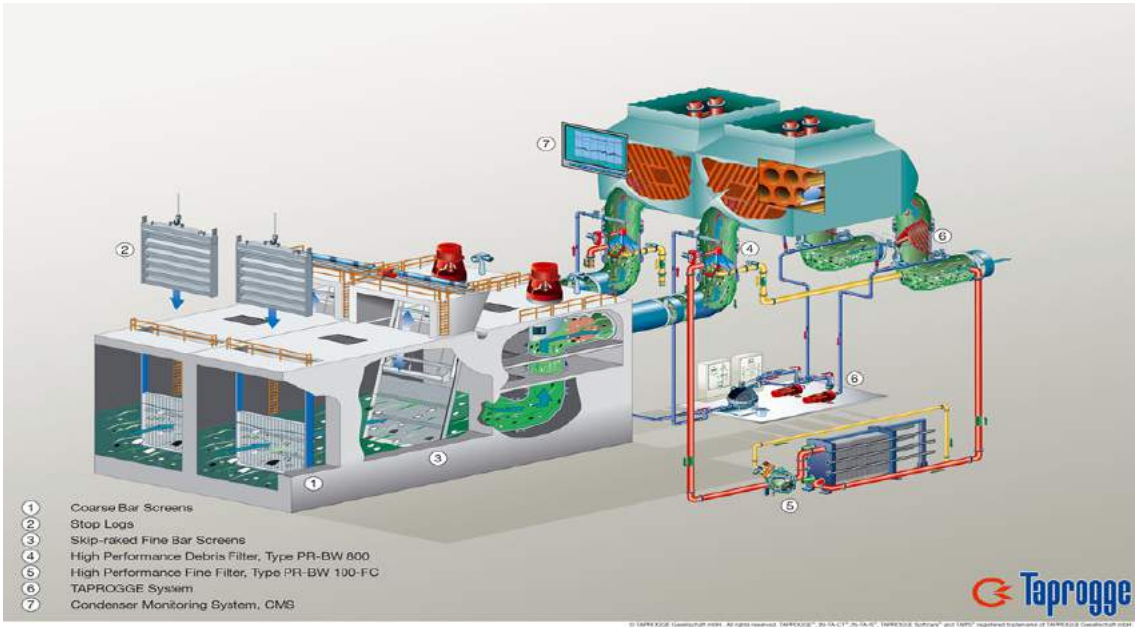
- TAPIS® polyhedra require a lower water level than cylindrical types which reduces construction costs.

- TAPIS® polyhedra do not include any moving parts, which is a big advantage in terms of maintenance costs, and sets this system apart from conventional travelling band screens and drum screens which have proven to be very expensive to maintain.





2. PRODUCT "MULTI STAGE MODIFIED WATER INTAKE SYSTEM"



For many industries, water extraction systems form the link between nature and technology. They represent the first link in the chain when water is converted from a natural to an industrial resource.

Conventional water extraction systems take up a great deal of space and require high levels of maintenance. For many years, they were the only type of cleaning process for industrial cooling water circuits. However, they have changed considerably over the years as knowledge has increased about the financial benefits of more efficient water treatment processes and because higher quality requirements must be reached for water that can be used in industry.

Conceptual changes have enabled investment and operating costs to be significantly reduced without placing any limits on functionality.

TAPROGGE has played a key role in this development, especially through the considerable technical advances we have achieved in downstream filter technology. Our IN-TA-CT® system now enables our customers to choose from a modular planning concept through to a complete solution to carry out their water treatment processes.

The solutions have evolved through viewing the purification process for equipment that requires protection in a holistic way.

Our key innovation involved placing a high-performance type PR-BW 800 filter directly in front of the heat exchanger that requires protection. This set-up supplemented the conventional rake systems, travelling band screens and drum screens and for the first time enabled macrofouling to be effectively

controlled across the entire pipe section, from the water extraction process through to the heat exchanger.

More than 700 of these filter systems have been installed in large cooling water circuits all around the world which has in a matter of a few years turned this technical concept into a standard system that is widely used around the world.

The fact that this high-performance filter is positioned in a considerably more effective place enables it to protect the downstream heat exchanger so that water extraction systems can focus solely on protecting the pump. Coarse bar and fine bar screens are able to perform this task sufficiently which involves significantly smaller amounts of investment.

TAPROGGE Pump Protection Concept

Using a two-stage cleaning chain comprising coarse bar and fine bar screens and stop logs connected upstream for isolating purposes, TAPROGGE designs and supplies a modified water extraction system which fulfils modern pump protection requirements.

This combined with the TAPROGGE type PR-BW 800 high-performance filter connected downstream provides a significantly more effective end-to-end solution than has ever been produced before. The solution protects pumps and heat exchangers and condensers connected downstream against troublesome macrofouling issues.

Operators can achieve considerable benefits:

- Savings on travelling band screens, drum screens and associated construction costs which reduces investment requirements.

- The performance and reliability of the cleaning processes are substantially enhanced by positioning equipment in a more suitable place and by enabling components throughout the entire system to perform more efficiently. This increases operational availability.

- A reliable one-stop solution. No interfaces required with the TAPROGGE system guarantee.

Features and Benefits

Fine Bar Screen System Control

- Specially developed three-rope technology enables the rake carriage to be opened and closed individually as the water travels up and downstream. If the passage of the gripper shell is impeded by debris particles that are buckling in the bar screen, repeated cleaning prevents any interruptions in the process.

- The partially perforated carriage shell prevents a “surge effect”, which temporarily occurs when water travels upwards through the water-air level,

which causes contaminants to be flushed out with water that is usually flowing away.

- Depending on the level of contamination and the cleaning frequency that has to occur as a result, instead of a more fixed cleaning machine, a movable machine can be positioned on tracks across the channel, which is especially useful if there are several channels. This can significantly reduce investment costs. For safety reasons the number of channels per movable cleaning machine should be limited to a maximum of three on a fine bar screen.

System Components

Stoplogs

Stoplogs are used for initial blocking of inlet channels

Coarse screen

The coarse screen forms the first stage of mechanical water treatment

Fine screen

The fine screen forms the last stage of the mechanical water treatment chain

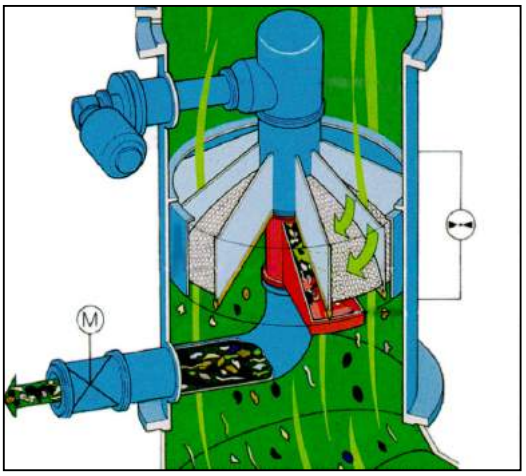
3. PRODUCT "DEBRIS FILTER"

TAPROGGE PR-BW 800 High-Performance Cooling Water Debris Filter

Optimised to deliver the highest levels of performance, safety and convenience

The PR-BW 800 is a high-performance backwash filter designed to filter cooling water in power stations and large industrial water systems.

It is suitable for volumetric flows of up to 100,000 m³/h and it also safely removes the highest concentrations of macrofouling from cooling water with its exceptional debris discharge capacities. It also effectively protects turbine condensers, heat exchangers and other consumers that are connected downstream from troublesome macrofouling issues.



Technical data

Volume flow:	approx. 2,000 - 100,000 m³/h
Nominal connection widths:	DN 800 – DN 3,400
Filtration grade:	5 mm (standard) – 13 mm; other sizes available on request
Filter element:	Perforated filter or a stainless steel grid; plastic Cling-Free® elements; hybrid elements
Housing material:	Steel, rubberlined
Temperature:	max. 80°C
Quantity of dischargeable fouling:	2.6 ltr./m³ cooling water (depending on the type of fouling)
Controller:	Programmable logic controller
Options:	Bypass valves; FilterOptimizer; Remote monitoring
Special versions:	upon request

Features and Benefits

- This TAPROGGE filter concept was developed in response to requests from operators for process engineering specifications to be individually customised and enhanced. Safe, convenient and delivers maximum performance.

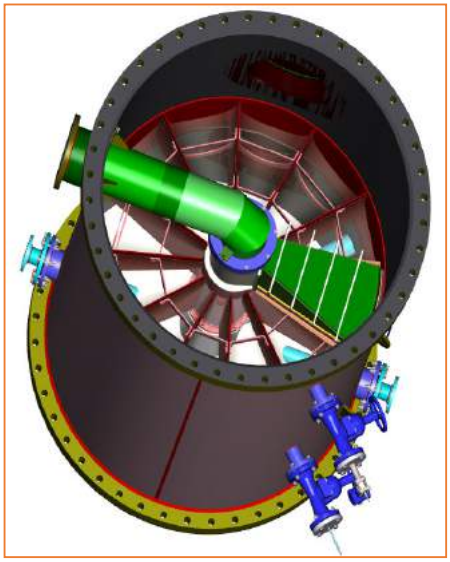
- The unusually high debris discharge capacities (up to 2.6 ltr.of fouling per m^3 of cooling water) ensures that even the highest concentrations of fouling that suddenly arise can be reliably removed from the cooling water. In many places, installing a PR-BW 800 filter removes the need to continue operating or planning the use of a travelling band screen or drum screen upstream.

- A highly efficient residue-free filter backwashing process is guaranteed by aligning the system according to the concentration and type of fouling. This unique level of flexibility is made possible by combining the pressure-relieved multi-chamber system, the variable rotor speed and the choice of filter surfaces which are adjusted to suit the various types of fouling. It is easy to exchange each filter segment without dismantling the filter. Deep chambers also prevent the backwash rotor from becoming jammed by large particles of debris.

- The rotor automatically changes direction if there are obstructions in one of the filter chambers which ensures the system can operate smoothly.

- A low volume of backwash water, lower pressure losses and less drive power keep operating costs low. Various customised installation options are available which provides maximum flexibility when planning the system. It is possible to install the system on existing pipework with the complete housing casing in the steel ring between the existing flanges or on a mounting ring.

- The filter is set up ready for the FilterOptimizer to be installed; this is an intelligent tool which optimises the backwash point. An integrated bypass solution is available for special safety and operational availability requirements.

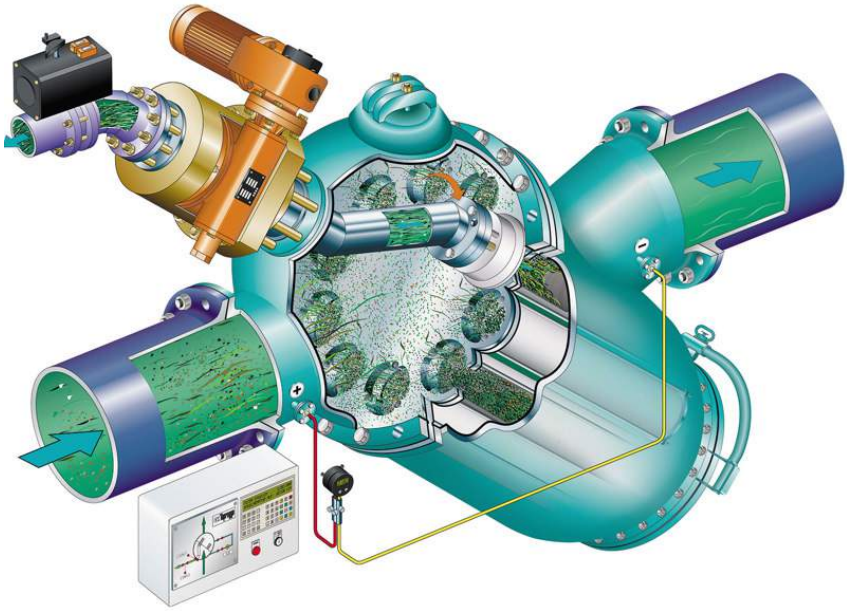


4. PRODUCT "SELF CLEANING FINE FILTER"

TAPROGGE Cooling Water Debris Filter PR-BW 100-FC

Continuous fine filtration of cooling water and other liquids

The PR-BW 100-FC is a filter series designed to fine filter liquids. The filter is based on the successful and superbly designed PR-BW 100 and the particularly efficient "active filter elements". This means the filter is able to handle volumetric flows of up to approx. 12,000 m³/h. The "active filter elements" are available in a range of 50 to 1,000 microns and are particularly effective against mussel larvae which now have the potential to cause serious problems.



Technical data

Volume flow:	< 200 - approx. 12,000 m³/h
Nominal connection widths:	DN 100 - DN 1,200
Filtration grade:	50 - 1,000 microns
Filter element:	"active" plastic filter elements, stainless steel wedge wire
Housing material:	rubberlined steel, stainless steel
Temperature:	max. 80 °C
Controller:	Programmable logic controller
Special versions:	upon request

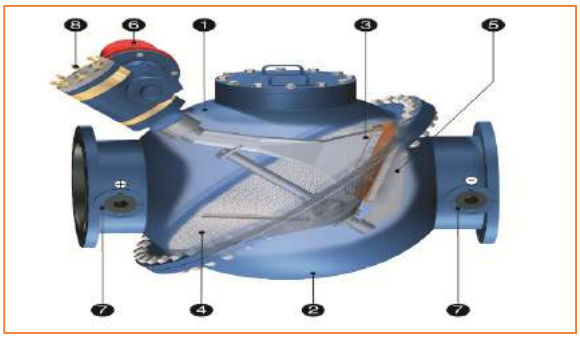
Features and Benefits

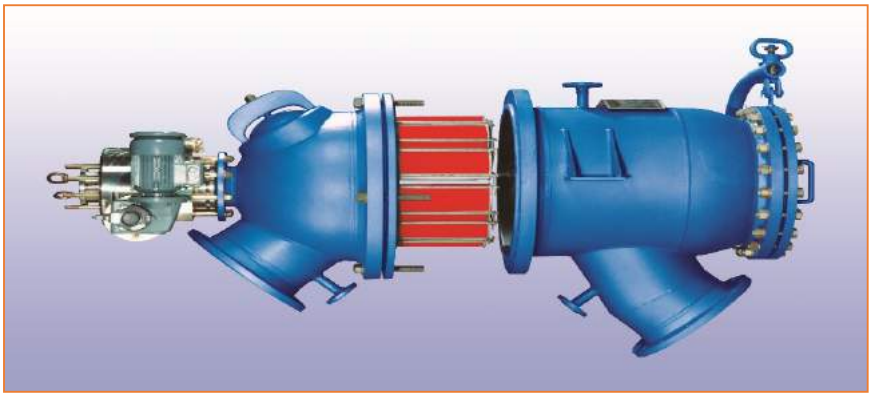
- The patented filter cartridges are the key components of the PR-BW 100-FC. Unlike well-known filter materials that were previously used, the TAPROGGE filter cartridges are composed of “active filter elements” with adjustable elastic filter gaps. Even though the filter gaps are set to a specific width when the filtration process is running, the filter gaps in the “active filter elements” open autonomously when the flow reverses during the backwash process. This means that even trapped particles are released and intensively cleaned.

- Using “active filter elements” increases the operational reliability of the cleaning process. These “active elements” require much lower backwash velocities than conventional filter elements which often become permanently blocked; this ensures that filtration can continue unimpeded.

- The PR-BW 100-FC is constructed in a considerably more compact way than conventional backwash filters which is primarily due to the performance capabilities of the “active filter elements”. This provides significant advantages in terms of space requirements, pipework layouts and accessibility. By rotating one half of the housing, the filter can be adjusted in a completely flexible way to suit the current pipe arrangement which reduces installation costs considerably.

- Parameters relating to costs, e.g. backwash rate, pressure loss and fouling absorption capacity can be adapted to suit each application. This enables the impact of process engineering concepts on investment and operating costs to be individually optimised at an early stage.



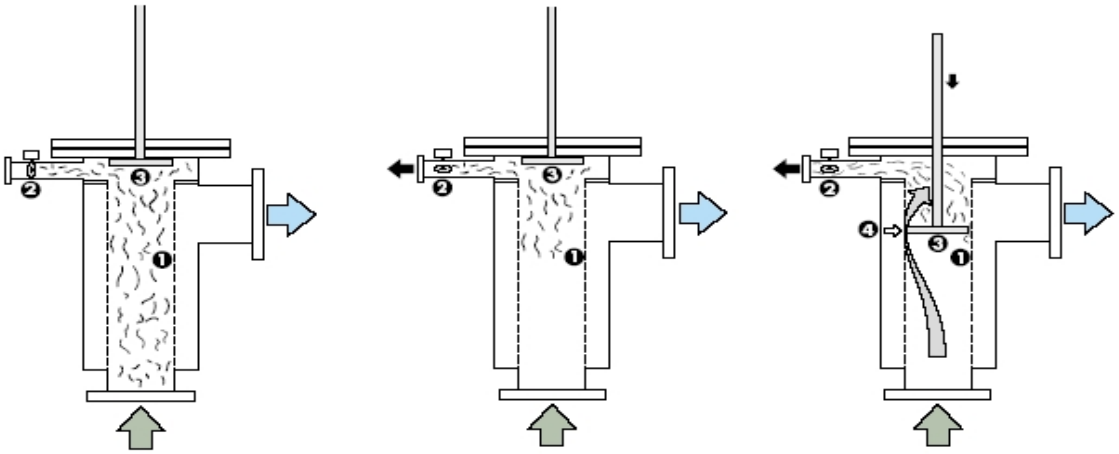


5. PRODUCT "DYNAMIC FILTER"

TAPROGGE Dynamic filter

An innovative automatic backwash filter for use in fine filtration systems

TAPROGGE's Dynamic filter product range can handle fine filtration requirements over a filter fineness range of 50 microns to 5 mm at volumetric flow rates of up to 4,000 m³/h. TAPROGGE has combined two well-known operating principles – "dynamic backwash" and "active filter elements" – to create a cost-effective and reliable filtration solution. The filter is cleaned automatically without interrupting the flow rate to reliably ensure that operator's facilities can remain permanently available for use.



Technical data

Volume flow:	up to approx. 4,000 m³/h
Nominal connection widths:	DN 80 - DN 600
Filtration grade:	50 microns – 5 mm
Filter element:	"active" plastic filter elements, stainless steel wedge wire, stainless steel perforated plate
Housing material:	rubberlined steel, stainless steel, PVC
Temperature:	max. 80 °C
Controller:	Programmable logic controller
Operation:	Pneumatic
Special versions:	upon request

Features and Benefits

- Using “active filter elements” increases operational reliability. These “active elements” require much lower backwash velocities than conventional filter elements which often become permanently blocked; this ensures that filtration can continue unimpeded.
  In addition, adherence to the “dynamic backwash” principle significantly reduces the amount of flushing water that is required. This reduces operating costs and ensures that the system can be reliably kept clean even when system pressure is low. This product range complies with the European Pressure Equipment Directive 2014/68/EU.

- The filters operate automatically and without interruption which ensures that operator’s facilities can remain permanently available for use. This avoids any unplanned stoppages for expensive manual cleaning procedures. The components can be directly installed in the tube system vertically or horizontally and delivery is completed in the Plug & Work standard. This means all components are despatched from the TAPROGGE factory completely preassembled and wired up. Additional fine adjustments to the installation are not required on site which keeps installation costs down to a minimum. The hardwearing construction of the filter also minimises maintenance costs.

PROTECTION AGAINST MICRO-FOULING

6. PRODUCT "AUTOMATIC TUBE CLEANING SYSTEM FOR CHILLER/REFRIGERANT APPLICATION"

Type CCS Strainer Section

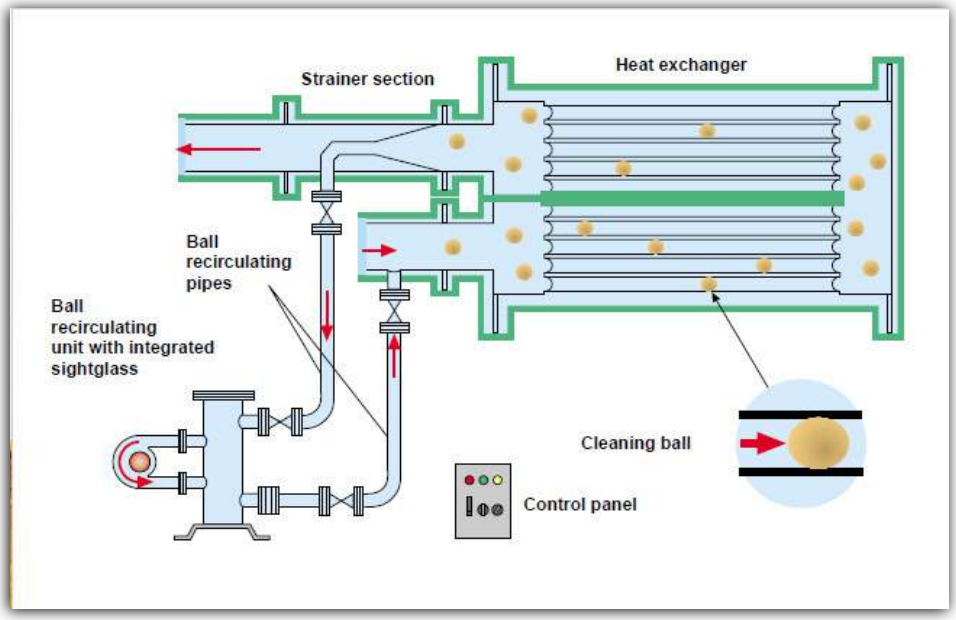
An energy saving program for air conditioning systems

The optimised Type CCS system for water-cooled condensers in air conditioning units is based on TAPROGGE's tried-and-tested cleaning principle. Microfouling hinders the thermal efficiency of water-cooled condensers even in what are considered to be closed cooling water circuits. This applies to both cooling applications and heat pump applications. In terms of functionality and cost, the rigid Type F1 and Type T1 strainer sections have been perfected for these applications (with typical cooling water flows of approx. 125 – 1,750 m³/h).

This is where TAPROGGE cleaning balls are separated before the heat exchanger via the ball injection device and fed into the cooling water flow. The cleaning balls are then injected again before the heat exchanger through the recirculating unit consisting of the ball collector and the recirculating pump, which is directly mounted onto the collector, and the connecting pipework. The corresponding controller regulates the system and reliably provides information on the respective operating conditions.

Technical data

Model series:	CCS
Volume flow:	125 – 1,750 m³/h
Nominal connection widths:	DN 150 – DN 500
Strainer version: (Type F1)	Strainer inserted upright, no welding
Housing material:	Steel, rubberlined
Temperature:	max. 80 °C
Controller:	electronic control unit ensures the system operates fully automatically and enables the cleaning intervals to be selected
Options:	upon request, e.g. pressure and temperature measuring points
Special versions:	upon request



Features and Benefits

- TAPROGGE CCS systems consistently maintain heat transfer levels on condensers and ensure that the compressors are not subjected to as much mechanical stress, as proven by the fact that the system uses between 10 to 20% less energy.

- In terms of actual requirements, space requirements and functionality, this optimised system operates in accordance with TAPROGGE's renowned cleaning principle using TAPROGGE's tried-and-tested sponge rubber balls which have earned an outstanding reputation in power station applications.

- Our modular product options make it easy for you to find the right solution to suit your application's requirements which is achieved with the assistance of our experienced engineers.

7. PRODUCT "CONDENSER AUTOMATIC TUBE CLEANING SYSTEM FOR CAPTIVE POWER PLANT APPLICATION"

Type E 1 Strainer Section

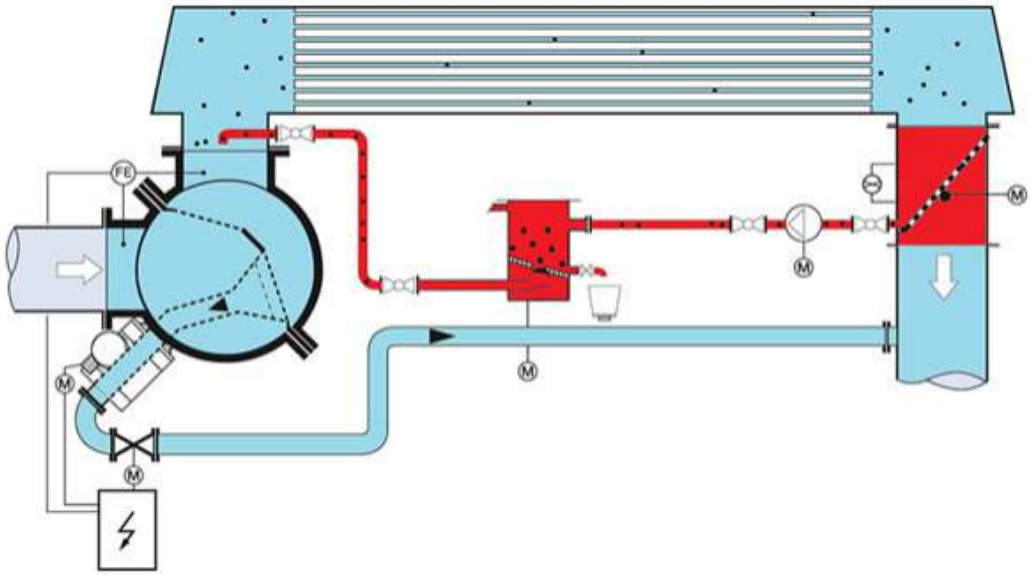
Continuous mechanical cleaning – programmed for efficiency

The TAPROGGE tube cleaning system with the Type E 1 strainer section; for automated, continuous, mechanical cleaning of cooling tubes in heat exchangers and condensers with a cooling water flow of approx. 100 – 6,000 m³/h. A hydrodynamically optimised and back washable elliptical strainer is used to separate

TAPROGGE cleaning balls which are introduced into the cooling water flow upstream the heat exchanger via a ball injection device. The cleaning balls are then fed through the recirculating unit again, which consists of a recirculating pump and a ball collector, and the connecting pipes before the heat exchanger. A programmable logic controller regulates the system and reliably provides information about the processes that are required whilst the system is in operation.

Technical data

Model series:	E 1
Volume flow:	100 – 6,000 m³/h
Nominal connection widths:	DN 150 – DN 1,000
Strainer version:	Edgewise bars, bracing construction, upright, no welding
Housing material:	Steel, rubberlined
Temperature:	max. 80 °C
Controller:	Programmable logic controller
Options:	Ball Recirculation and Ball Effectiveness Monitors
Special version:	available on request, e.g. explosion-proof versions
On-site turnkey installation:	upon request

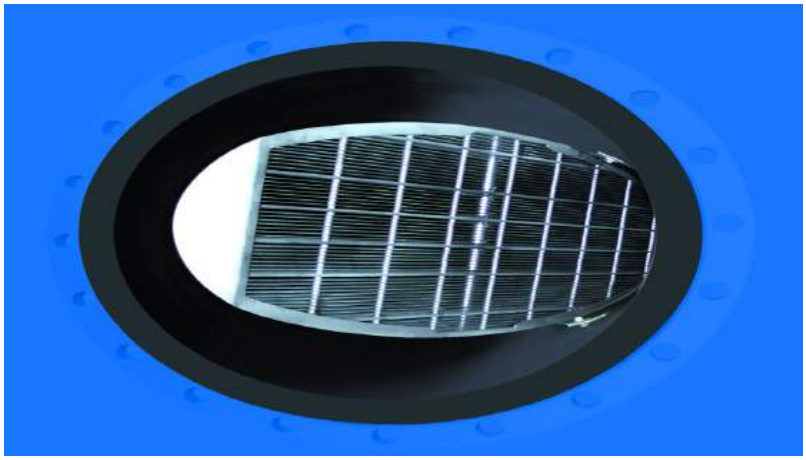


Features and Benefits

- TAPROGGE cleaning systems continuously maintain heat transfer on each heat exchanger and reliably resolve any microfouling issues you are specifically experiencing.

- Reliability and durability were and continue to be the top priorities with this highly efficient modular system, from the ball injection device, the strainer section with back washable strainer to the recirculating unit which consists of a recirculating ball pump, a ball collector and a control cabinet.

- These modules enable our project engineers to be highly flexible. This combined with expertise they have gained through installing thousands of different systems ensures you will have the optimum system to suit your needs. We are certain that we can solve your specific problems by configuring customised designs based on process engineering principles, including modules such as the strainer and the ball recirculating pump, along with the right choice of materials.



8. PRODUCT "CONDENSER AUTOMATIC TUBE CLEANING SYSTEM FOR THERMAL, GAS BASED AND NUCLEAR POWER PLANT APPLICATION"

Type D 2 Strainer Section

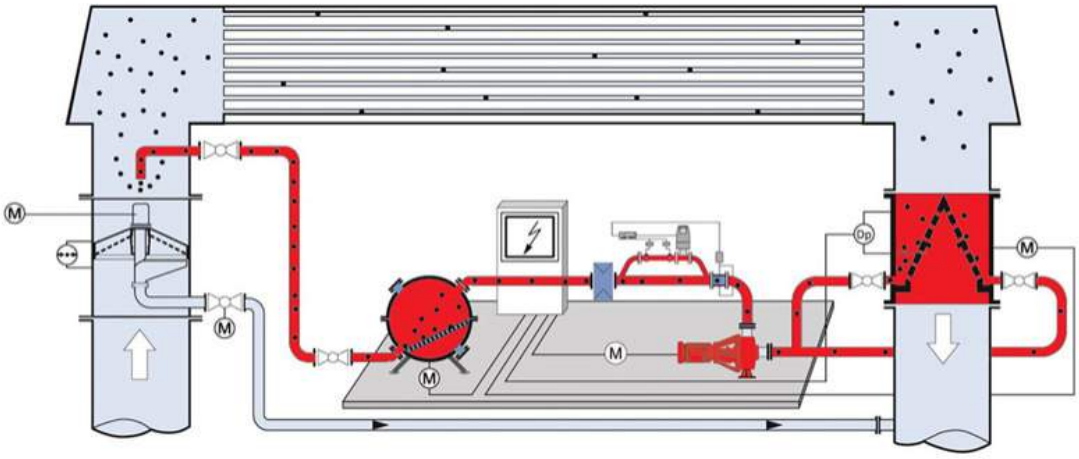
State-of-the-art technology that maximises efficiency in power stations all over the world

The TAPROGGE cleaning system with the Type D 2 strainer section; for automated, continuous, mechanical cleaning of cooling tubes in heat exchangers and condensers with a cooling water flow of approx. 4,000 – 90,000 m³/h. Two hydrodynamically optimised and back washable semi-elliptical strainers designed in a "roof-like shape" are used to separate TAPROGGE cleaning balls which are introduced into the cooling water flow upstream the heat exchanger via a ball injection device.

The cleaning balls are then fed through the recirculating unit again, which consists of a recirculating pump and a ball collector, and the connecting pipes before the heat exchanger. A programmable logic controller regulates the system and reliably provides information about the processes that are required whilst the system is in operation.

Technical data

Model series:	D 2
Volume flow:	4,000 – 90,000 m³/h
Nominal connection widths:	DN 800 – DN 3,600
Strainer version:	Strainer inserted upright, no welding
Housing material:	Steel, rubberlined
Temperature:	max. 80 °C
Controller:	Programmable logic controller
Options:	Ball Recirculating and Ball Effectiveness Monitors
Special version:	available on request, e.g. explosion-proof versions
On-site turnkey installation:	upon request



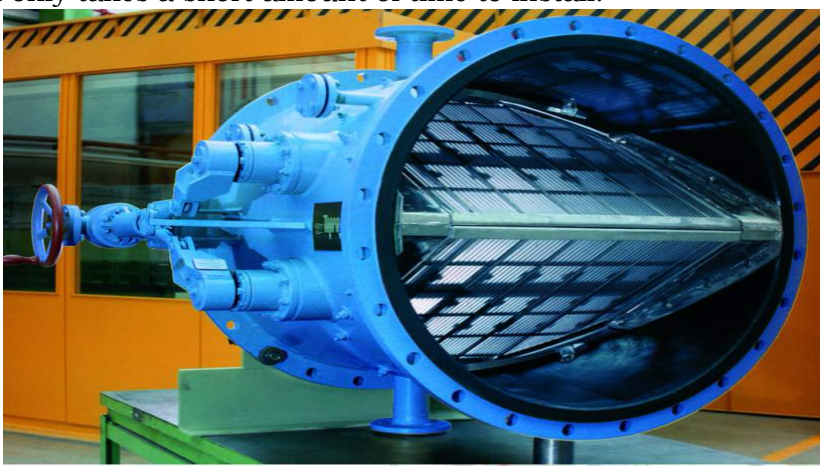
Features and Benefits

- TAPROGGE cleaning systems continuously maintain heat transfer on each heat exchanger and reliably resolve any microfouling issues you are specifically experiencing.

- Reliability and durability were and continue to be the top priorities with this highly efficient system which includes the ball injection device, the strainer section with back washable strainer and the recirculating unit which consists of a recirculating ball pump, a ball collector and a control cabinet.

- These modules enable our project engineers to be highly flexible. This combined with expertise they have gained through installing thousands of different systems ensures you will have the optimum system to suit your needs. We are certain that we can solve your specific problems by configuring customised designs based on process engineering principles, including modules such as the strainer and the ball recirculating pump, along with the right choice of materials.

- The arrangement of the strainer into a “roof-like shape” ensures that the system only takes a short amount of time to install.



9. PRODUCT "CONDENSER AUTOMATIC TUBE CLEANING SYSTEM FOR MULTI-STAGE FLASH EVAPORATION THERMAL DESALINATION PLANT"

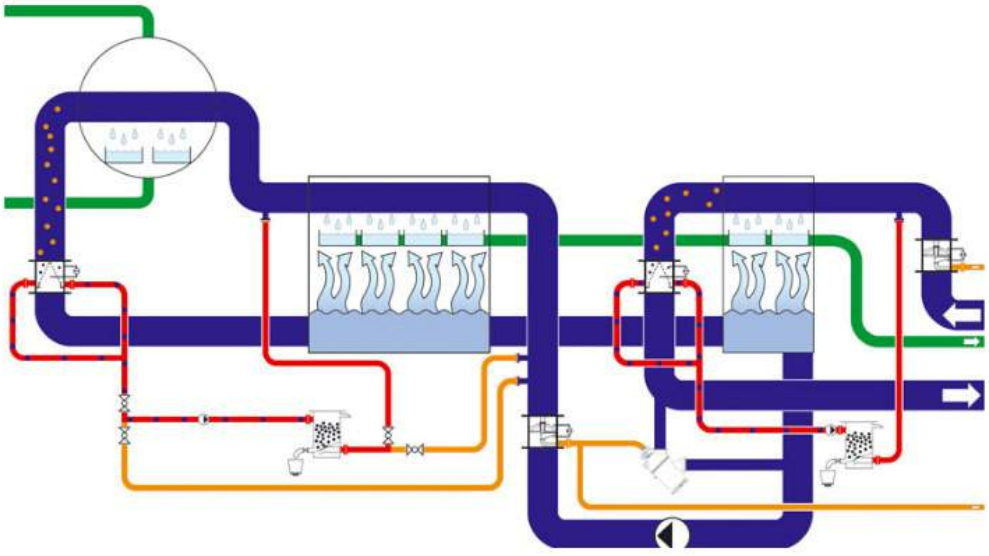
Scaling Prevention in MSF Plants

MSF tube cleaning

Multi-Stage Flash Distillation (MSF) involves a thermal desalination process. Seawater and brackish water are generally used as raw water (source product).

Microfouling, especially the precipitation of salts (scaling), can significantly affect the transfer of heat in the MSF plant. In addition, frequent unplanned downtimes, which consequently occur in MSF plants in order to carry out manual cleaning procedures, become unavoidable and are likely to cause damage to the MSF plant.

TAPROGGE Tube Cleaning Systems reliably solve problems caused by microfouling. They permanently maintain the heat transfer process in MSF plants, reduce the need to use anti-scaling chemicals, prevent unplanned downtimes that would be required for manual cleaning processes and prevent damage to the MSF plant. TAPROGGE Tube Cleaning Systems provide continuous online tube cleaning and can be used independently from each other both in the heat rejection section and in the heat recovery section with brine heaters. The use of tube cleaning systems in MSF applications has been considered state-of-the-art technology (world standard) for a number of decades.



Features and Benefits

- TAPROGGE cleaning systems continuously maintain heat transfer on each heat exchanger and reliably resolve any microfouling issues you are specifically experiencing.

- Reliability and durability were and continue to be the top priorities with this highly efficient system which includes the ball injection device, the strainer section with back washable strainer and the recirculating unit which consists of a recirculating ball pump, a ball collector and a control cabinet.

- These modules enable our project engineers to be highly flexible. This combined with expertise they have gained through installing thousands of different systems ensures you will have the optimum system to suit your needs. We are certain that we can solve your specific problems by configuring customised designs based on process engineering principles, including modules such as the strainer and the ball recirculating pump, along with the right choice of materials.

- The arrangement of the strainer into a “roof-like shape” ensures that the system only takes a short amount of time to install.

10. PRODUCT "SPONGE CLEANING BALLS"

TAPROGGE Cleaning Balls

Our cleaning balls reliably do the job

TAPROGGE cleaning balls are essential tools for maximising heat exchanger efficiency. The main factors that influence cleaning performance are:

- current problems caused by fouling
- hydraulic boundary conditions
- design parameters in the cleaning systems that have been installed

TAPROGGE

- . . . has gained 60 years of experience and expertise developing, manufacturing, designing and operating cleaning balls.
- . . . has gained considerable amounts of experience cleaning thousands of heat exchangers all around the world.
- . . . as a manufacturer of cleaning balls and cleaning systems, also guarantees that perfect synergies can be achieved between the systems and the cleaning balls.
- . . . manufactures cleaning balls exclusively in Germany.

TAPROGGE – end-to-end heat exchanger cleaning by experienced experts.

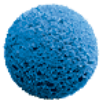
TAPROGGE cleaning balls for every type of cooling water with temperatures up to 80 °C

TAPROGGE cleaning balls for every type of cooling water and brine with temperatures between 80° C and 120 °C

Some important types images as shown below.


R200


P150

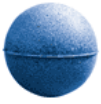

S160


T160


S220


T200


PL150

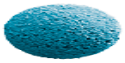

L160


T300


P130

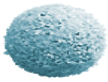

R200


S110


S200


PL130


T200


G160

Ball range

Choosing the optimum type of cleaning ball out of a selection of 48 standard and special types, each available in 3 hardness grades in diameters of 14-44 millimetres, is essential to ensure cleaning is as successful as possible.

Identifying the best possible cleaning ball is a balance between:

- optimum cleaning efficiency
- maximum service life
- trouble-free ball circulation

TAPROGGE has specially developed engineering software to handle this complex selection process. Our expert service team would be happy to help you select the best possible cleaning ball for your TAPROGGE system!

11. PRODUCT "KLAREN SELF CLEANING HEAT EXCHANGER FOR ON-LINE AUTOMATIC CLEANNING OF EVAPORATOR TUBES IN MULTI EFFECT EVAPORATOR / MECHNICAL VAPOUR RECOMPRESSION FOR WASTE WATER TREATMENT PLANT"

KLAREN Heat Exchanger Cleaning System

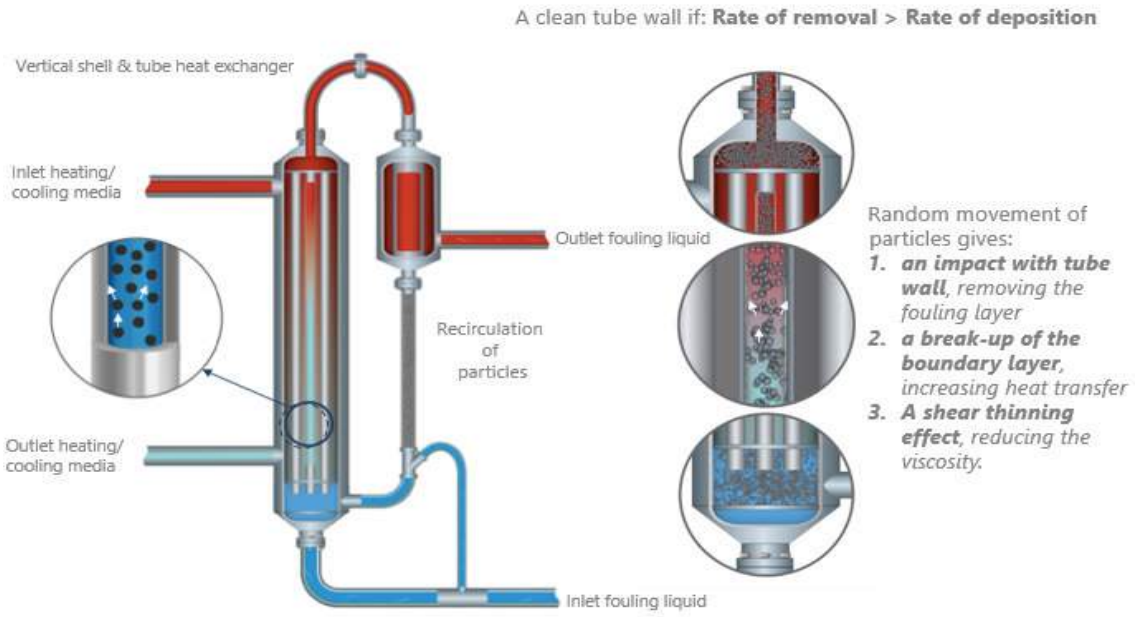
Introduction

Solid particles circulate through a fluidised bed into the tubes of the vertical shell-and-tube heat exchanger, which can operate with a clean surface, whereas the tubes in conventional heat exchangers become heavily contaminated within weeks, days or even hours.

These solid particles of glass, ceramic or metal (metallic wire) from 1.5 to 5 mm in diameter produce a gentle scouring action on the insides of the heat exchanger tubes.

The cleaning effect that is produced by this process removes contaminant deposits from the insides of the tubes before they have had chance to accumulate and keeps the heat exchanger surfaces clean. This maintains a constant heat transfer coefficient.

In addition to the cleaning effect, the particles improve heat transfer a decrease flow velocity and reduce pressure loss in comparison with conventional heat exchangers. Zero-fouling is guaranteed as long as the rate of fouling removal by the scouring action of the particles exceeds the rate of fouling precipitation.



Improved Energy Performance

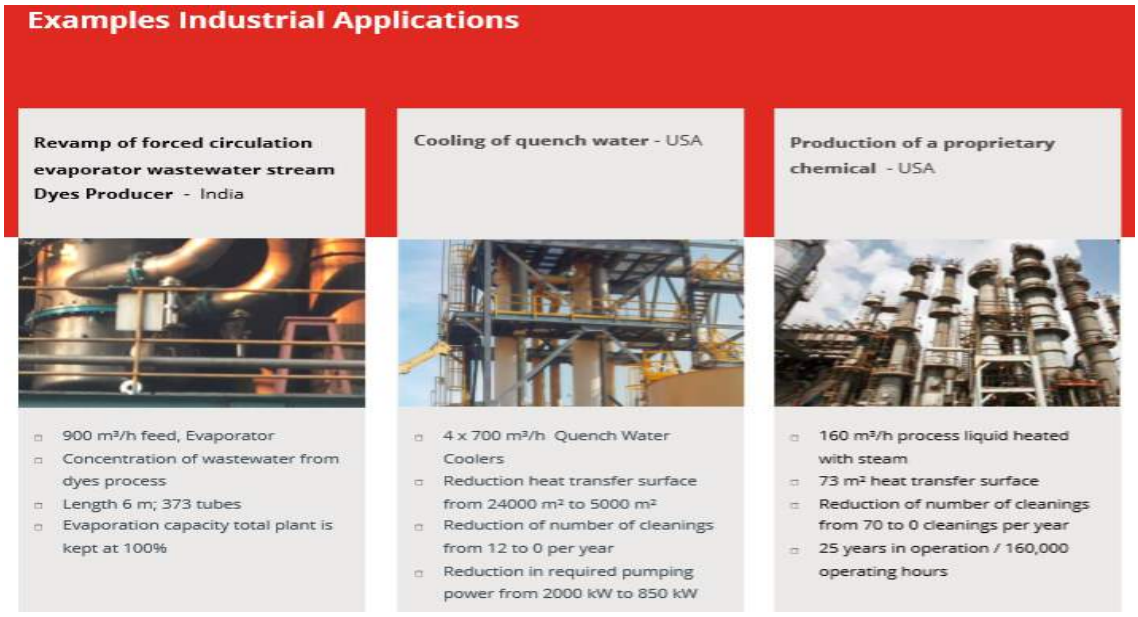
The pipes are kept clean in self-cleaning heat exchangers, ensuring that heat transfer remains constant which improves energy efficiency.

- When using a shell-and-tube heat exchanger to cool quench water, a 50% reduction in the heat transfer coefficient can be achieved within 20 days. The heat transfer coefficient remains constant in self-cleaning heat exchangers.

- Due to the lower flow velocities and the shorter tube lengths, the amount of pump capacity required is reduced in most applications. In the application outlined above, this amounts to a reduction of more than 50%.

- The use of self-cleaning fluidised bed technology on an evaporator, which concentrates wastewater, enables higher concentrations of solids to be produced in the circulatory flow without causing contamination problems when compared with falling film evaporators. This enables higher volumes of water to be recycled and dramatically reduces decomposition. If a spray dryer is added to achieve zero liquid discharge, the overall energy use of the self-cleaning unit combined with the spray dryer only amounts to 60% of the energy used by the falling film unit. The main reason for this is that KLAREN technology is able to further concentrate the waste water which results in lower flow rate because less energy is needed for spray drying.

- A shell-and-tube heat exchanger uses water to recover heat from an exothermic reaction. The heat is used at another stage in the process. Contamination on the chemical component side of the heat exchanger causes a reduction in the heat transfer coefficient which consequently decreases heat recovery capacity. If a fouling layer develops, higher amounts of additional steam need to be used to heat the process at a different point. In a self-cleaning heat exchanger, heat recovery from the exothermic reaction remains constant and steam does not need to be used.



ZERO LIQUID DISCHARGE PLANT

12. PRODUCT "DESALINATION / WATER RECOVERY / ZERO LIQUID DISCHARGE SYSTEM USING PLANT WASTE HEAT"

Desalination Plants Powered by Waste Heat

Drinking water abstraction through seawater and brackish water desalination.

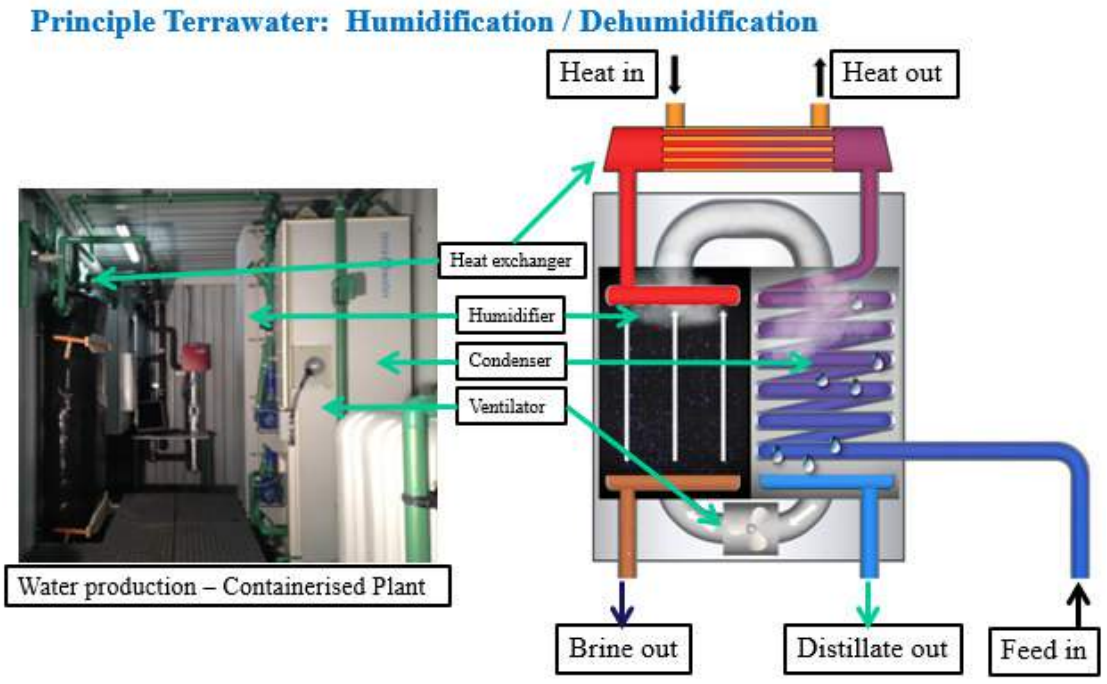
TerraBasic is our standard desalination solution which is based on the natural principle of evaporation. It can be used with waters with lower scaling tendencies (e.g. seawater, brackish water) and is ideal when connected to waste heat.

It can be used as a mobile system or a fixed system (industrial). The output rate is 10%. TerraBasic does not require any tube cleaning which makes it suitable for waters with a salinity level (TDS) of a maximum of 70,000 ppm or a hardness level of a maximum of 2,000 mg/l.

It is also suitable for waters with low levels of biological matter.

TerraBasic operates with closed air circulation which increases thermal efficiency.

TerraBasic uses waste heat from other processes and completely does away with the need for chemicals.



Features and Benefits

- Simple to use which means specialists are not required; local residents can operate the system
- The system is able to withstand harsh environmental conditions (heat, frost, hail, dirt, heavy rain etc.)
- Operating materials, such as chemicals etc., are not required
- Very low operating and maintenance costs
- Discontinuous operation is possible

Visit our website on www.taprogge.de for more technical details.

For any enquiry and our query please reach us on +91 9022819673 / info@taprogge.in.