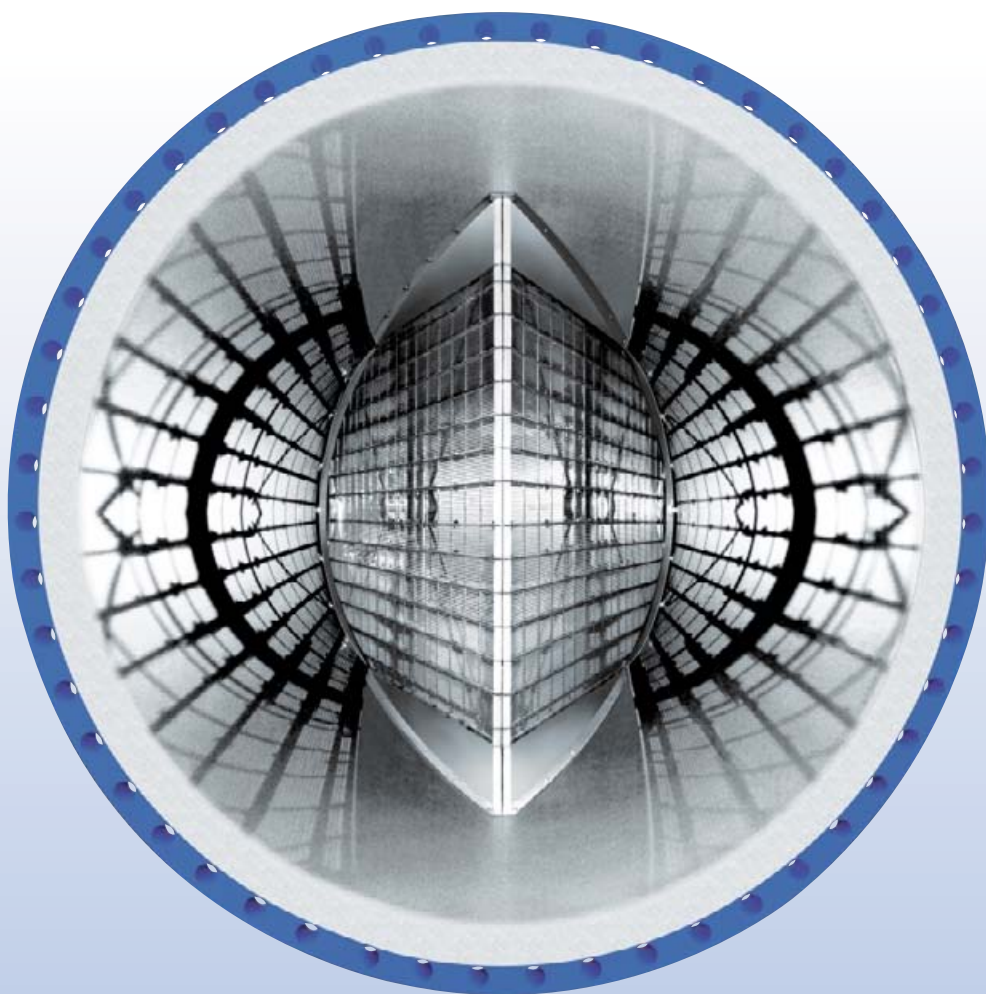


# IN-TA-CT<sup>®</sup>

Tube Cleaning for  
Seawater Desalination Plants



Tube Cleaning

4

## The TAPROGGE System.

*Since 1953 TAPROGGE has been the leading international supplier of special technologies for the optimization of cooling water circuits. One essential part in the success of our efforts is the TAPROGGE System. Named after its inventor, the system is today a synonym for the continuous cleaning of cooling tubes in heat exchangers the world over. In 1952 it was patented and, for the first time, successfully operated in a power station. Since then it has been perfected in several thousands of power station applications.*

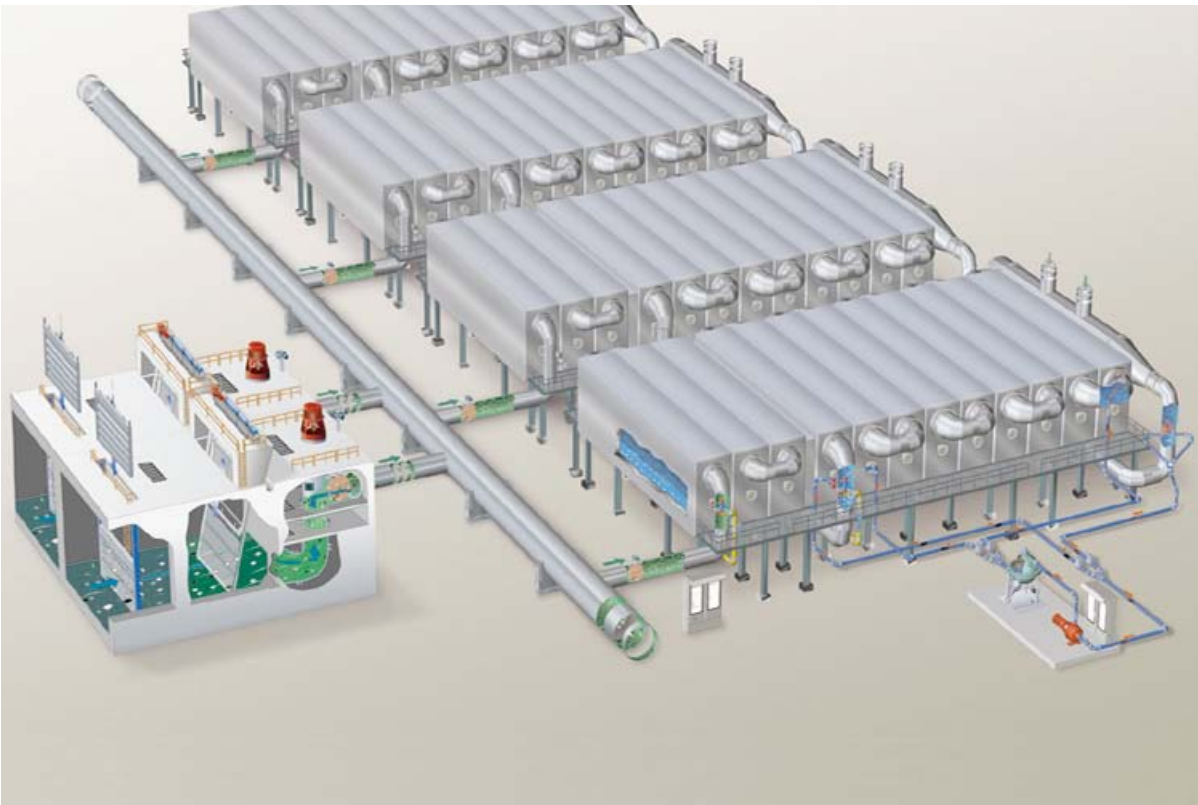
*In the early 70s we enhanced and developed further the application technology for the use of the TAPROGGE System in seawater desalination. Since then it has become a technical reference value and world standard in this field as well. Hundreds of TAPROGGE Systems are successfully being applied by all major operators of MSF desalination plants in the arid zones of the world where they are realizing thermal capacity gains day by day which significantly increases the output of produced drinking water. In doing so, they are at the same time relieving the environment by reducing the consumption of energy and chemicals.*

Over the years the system has of course changed, its design being continuously perfected, resulting in the system being extended as a requirement of the numerous individual applications.

It is TAPROGGE's well-founded know-how of application technology that is the guarantee for our customers. Today more than ever, by taking best advantage of the performance gains, which yield maximum economic benefit, the initial cost of the system is recovered many times over the life of the plant.

By their integration into our overall IN-TA-CT® scheme, the TAPROGGE Systems can easily be combined with further IN-TA-CT® modules. This is of particular importance in the case of TAPROGGE Debris Filters which are installed upstream to avoid blockage of tube sheets of evaporators and to guarantee an undisturbed ball circulation if there is a risk of macro fouling.

With IN-TA-S® the application and operation of the TAPROGGE Systems are successfully taken care of throughout their lifetime.

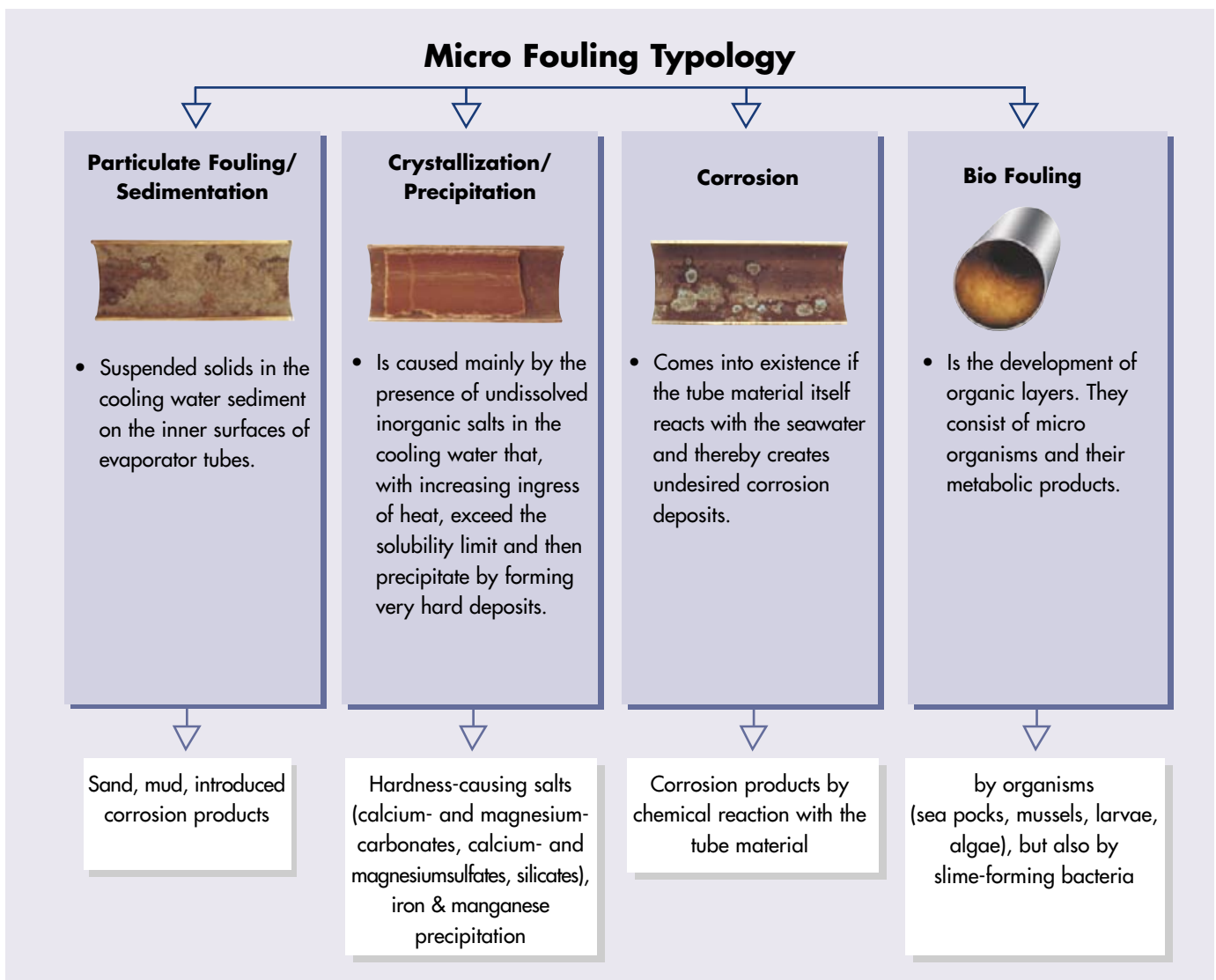


TAPROGGE in seawater desalination plants

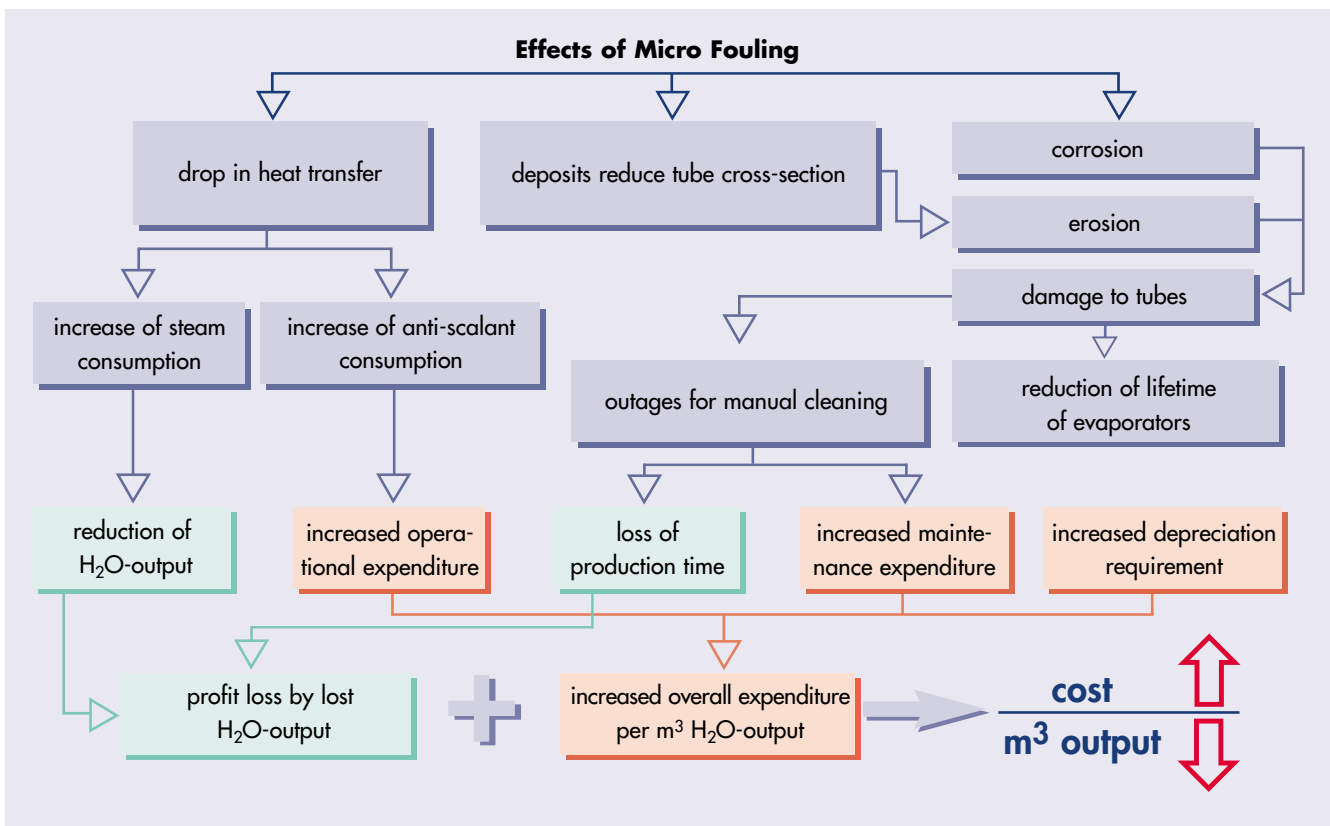
## A Challenge: the Micro Fouling Problem.

The seawater used in MSF desalination plants for the extraction of drinking water contains dissolved and undissolved substances which, depending on location and type of the main water inlet, can significantly vary in both quantity and composition. The undesired deposition of these substances on the inner surfaces of evaporator tubes is designated as micro fouling.

Due to the high temperatures in evaporator tubes of MSF plants, the most important micro fouling mechanism is crystallization, especially the precipitation of calcium carbonates. Particulate fouling, bio fouling (above all with titanium-tubed evaporators) and corrosion fouling (especially with copper and copper/nickel materials) also occur.



Micro fouling, especially the precipitation of calcium carbonate, considerably impairs the heat transfer in evaporator tubes. As a result, the efficiency of the evaporator plant decreases, and the increased dosage of anti-scalant chemicals, that is necessary as a counteraction, causes further cost. In addition, frequent unscheduled outages of the evaporator plant for manual cleaning purposes are inevitable, and damages to the evaporator cannot be excluded.



Performance losses due to the above are not acceptable in the international water business, especially when taking today's competitive conditions into account.

TAPROGGE Systems reliably solve micro fouling problems. They permanently maintain the heat transfer of the evaporator plant and reduce the injection of anti-scalant chemicals. Due to their short payback time of 1 - 2 years they have been state of the art for seawater desalination for many years.

A good guide to the value of losses from micro fouling in modern MSF desalination plants is:

- micro fouling reduces the drinking water output of an MSF plant by approx. 18 %
- micro fouling causes an increase of the consumption of anti-scalant chemicals by a factor of 2 and more

## From the Idea to the Solution - the TAPROGGE Process in MSF Plants.

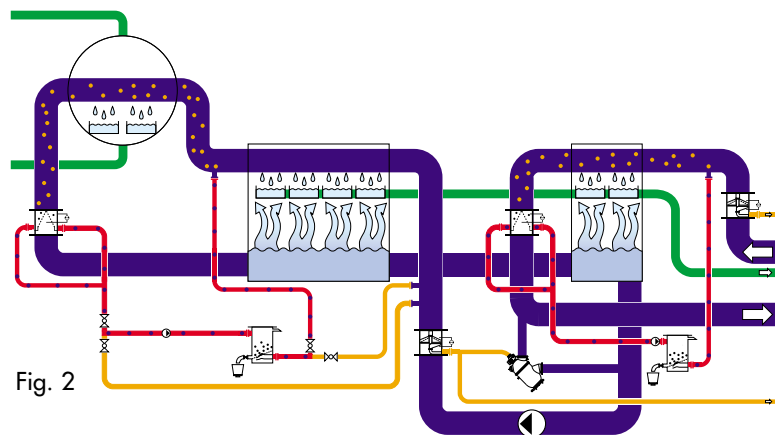
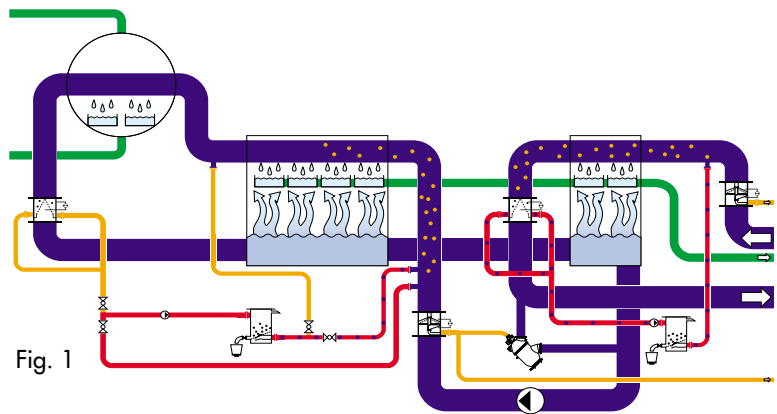
### A. Function

The process that was named after its inventor, Josef Taprogge, results in the permanent cleanliness of the inner surfaces of evaporator tubes by continuously recirculating flexible sponge rubber balls whose diameter is slightly above the diameter of the tubes to be cleaned. The type of cleaning ball is adapted to the temperature level of the evaporator plant.

### B. Layout

Two independent TAPROGGE Systems serve Brine Heater and Heat Recovery Section, and the Heat Rejection Section. The TAPROGGE System for Brine Heater and Heat Recovery Section is arranged in such a way that all stages of the Heat Recovery Section and of the Brine Heater can be cleaned in alternating mode (fig. 1), but also the Brine Heater separately (fig. 2).

As an optimal protection from macro fouling and chipping of calcium carbonate scales, as well as to guarantee trouble-free ball recirculation, the installation of TAPROGGE debris filters is recommended. A further TAPROGGE filter takes care of the fine filtration of the make-up water circuit.



## C. Cleaning Operation

Whereas the cleaning system of the Heat Recovery Section works in continuous recirculation mode, the operation of the TAPROGGE System for Brine Heater and Heat Recovery Section is effected in batch mode.

According to the batch mode, a pre-defined number of cleaning balls are fed via the ball injection into the circuit at the cold end of the Heat Recovery Section by means of the ball recirculating pump (fig. 1). The cleaning balls are distributed in the water flow of the brine and moved through the evaporator tubes of Heat Recovery Section and Brine Heater where they do their cleaning job.

Upon completion of this passage, the cleaning balls flowing with the heated brine are first transported into the strainer section installed at the Brine Heater outlet from where they are subsequently re-fed to the ball collector and collected. This is effected by the ball recirculating pump after the ball recirculation pipe has been released (fig. 3). After the catching procedure, pump operation is switched off and the ball recirculation unit is separated from the hot brine flow. Afterwards the balls are ready for being injected into another batch cycle.

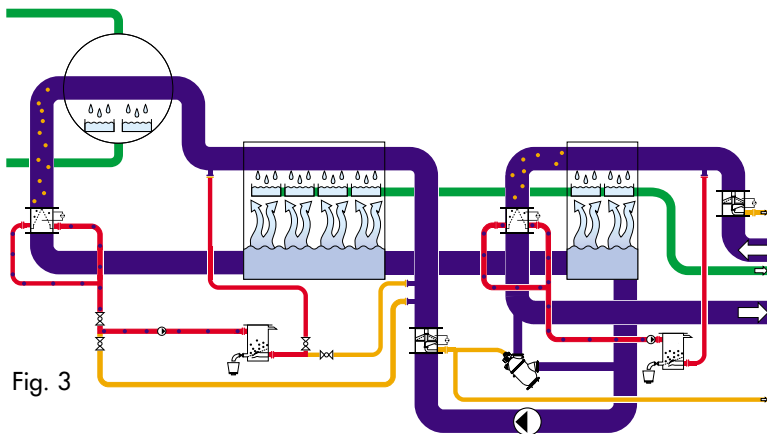


Fig. 3

This process is repeated continuously.

Given the fact that the water flow can contain impurities (macro fouling) that can settle on the screens, the strainer section is provided with a backwash mechanism. The backwash process is initiated either according to the degree of fouling (differential pressure across the screens), or according to pre-set time intervals.

All operational processes are monitored and controlled by a programmable controller. To safeguard the long-term cleaning success, the worn cleaning balls are regularly replaced by fresh ball charges.

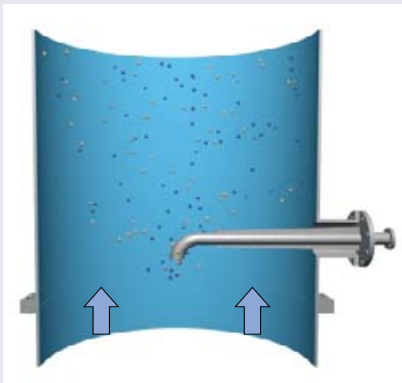
## A modular Construction Kit.

From our application experience gained through several hundreds of installations in different MSF plants the world over, the TAPROGGE System has been perfected over the years and now constitutes a sophisticated modular construction kit that is able to meet the full extent of the operators' requirement profiles.

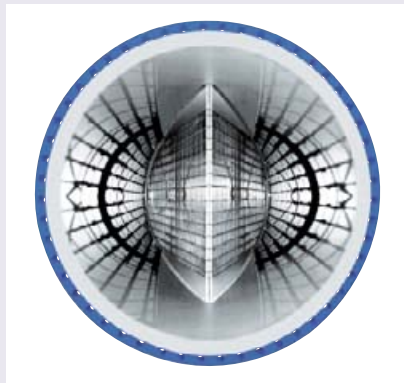
The packaging of the modules to suit the relevant operational environment is the daily task of our project and planning engineers. They make use of a basic kit that may optionally be complemented by further components.

### The basic Construction Kit. In the basic Version, the

#### Ball injection



#### Strainer section



Type: D2  
Nominal diameter: DN 800 and bigger  
Screens: 2 semi-elliptical screens in "roof shape"

#### Features:

- Place of installation can flexibly be adapted to space conditions
- Multiple ball injection with larger flows

#### Features:

- patented vortex vane, thereby:
  - lowest pressure losses by avoidance of outdated suction points located in the flow centre
  - induction of a secondary flow in parallel to the screen surface by which a self-cleaning effect of the screens is reached; the screens remain free from macro fouling in the main areas
- screens without welding as bracing construction to avoid crevice corrosion
- screen design with edgewise bars to avoid matting caused by fibrous debris

## TAPROGGE System comprises 3 Components:

### Recirculating Unit



Type: C13  
Application: for medium-size evaporators / ball charges



Type: C55  
Application: for large evaporators / ball charges

### Features:

- TAPROGGE Recirculating Units include:
  - ball recirculating pump
  - ball collector
  - control panel
- TAPROGGE Recirculating Units are:
 

Functional units in Plug & Work standard, i.e. mounted and cabled ready for work. The operator is thus saved costly installation work on site.
- Option: Remote Monitoring
 

By the optional installation of a data logging function and relevant evaluation software, the TAPROGGE System can be remotely monitored. By Remote Monitoring the operator has the immediate benefit of TAPROGGE's application know-how without incurring travel expenditure.

## TAPROGGE Systems are Systems with added Value.

### By TAPROGGE Systems you obtain:

- efficiency and availability by permanently constant heat transfer of your evaporator plants
- reduction of your fuel cost (steam rate), increase of your drinking water output
- relief of environmental burden by substantially reduced anti-scaling chemistry
- longer lifetime of your evaporators by reduction of corrosion and erosion
- reduced corrosion in the evaporator units
- avoidance of unscheduled shutdowns due to tube leakage

### TAPROGGE - the cost effective investment

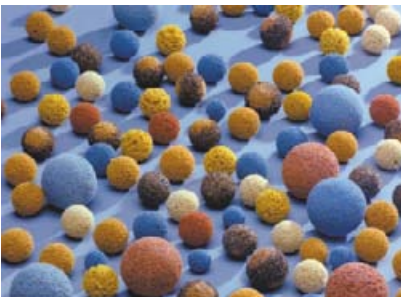
- |   |                 |
|---|-----------------|
| • MSF plant operation without TAPROGGE System                 | GOR approx. 6.5 |
| • MSF plant operation with TAPROGGE System                    | GOR > 7.6       |
| • Additional output of drinking water resulting from TAPROGGE | > 17 %          |

For a plant of today's capacity of 45,000 m<sup>3</sup>/day and a conservative annual charge of 8,000 operating hours, the GOR (Gained Output Ratio) increase results in an additional output of produced drinking water of 2.1 million m<sup>3</sup> per year. This is an undeniable extra benefit resulting in a payback time of 1 - 2 years. In addition, further savings are achieved by reduced anti-scaling chemistry (drop of dosing rate from around 3 ppm to 1 - 1.5 ppm).

- Decisive factors of success:
  - availability of an adequate range of cleaning balls
  - competent support in the field of application technology to realize an optimum cleaning mode

### And TAPROGGE provides even more:

- Support in application technology at the planning stage. Prior to investment, tube examinations can provide valuable knowledge in view of the feasibility and the extent of the future cleaning success. This assists the operator to make his investment decision wisely.
- Access to the most comprehensive ball assortment the world over. With the system the operator is provided merely a mechanism for the transport of the cleaning balls in the cooling water circuit. This alone does not yield a benefit. Benefit is created only by the application-technological know-how of the relations among water chemistry, tube material and cleaning balls. The availability and optimal choice of ball type and cleaning mode are the key to effective tube cleaning. That's why TAPROGGE supports its customers by an unparalleled range of cleaning balls for high temperatures.
- Expert know-how by IN-TA-S®. More than 50 TAPROGGE Service experts at 10 international service bases provide the operators with maximum availability. More than 10,000 TAPROGGE Systems in over 100 countries of the world are proof of the know-how and experience of our international service team. In fact it can be proven that by IN-TA-S® the yearly benefits exceed the investment value of the TAPROGGE System by far.



## **TAPROGGE Care & Comfort Package**

### **Quality right from the Start**

- Performance by TAPROGGE as per DIN EN ISO 9001
- Safety of design by fulfilling the requirements of the European Pressure Equipment Directive 97/23/EC
- Application of a management system for safety, health and environmental protection (SCC)
- Standard documentation; documentation upon customer's request, respectively
- The use of extremely corrosion-resistant materials with long lifetimes safeguards the preservation of the value of investment.

### **Compatibility by IN-TA-CT® Modules**

- The PR-BW 800 filter is a modular element of IN-TA-CT®, our integral principle for the optimization of cooling water circuits.
- By combination with a TAPROGGE prescreening system and a TAPROGGE debris filter of our PR-BW series upstream, an effective overall solution presents itself for the protection from micro and macro fouling, in particular from scaling, from the intake to the evaporator units. A complete solution - without interfaces - and inclusive of the TAPROGGE System Guarantee.

### **Competence and Experience out of one Hand**

- Application consultancy, project management, fabrication, installation and commissioning of the PR-BW Systems are available from TAPROGGE out of one hand.
- With more than 12,000 successful applications, TAPROGGE can make use of its application-technological experience in its special field that stands unparalleled the world over. This plus of competence is indispensable for difficult media and unknown cleaning behaviour.
- In addition to that, the cooling water test circuits of TAPROGGE's Technological Centre allow a particularly reliable and cost-effective simulation of site conditions.

### **Comprehensive Operator Support by IN-TA-S®**

- By the installation and commissioning of the TAPROGGE System, operators have immediate access to IN-TA-S®.
- By IN-TA-S®, TAPROGGE takes care of the operator in all questions of operation and maintenance. Scope, duration and frequency of the care can be determined by the operator.
- Particularly quick support is available to the users of our Remote Monitoring Service.



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