WATER TREATMENT PLANTS FOR A SUSTAINABLE INDUSTRY
Water treatment plant solutions
Customized design to meet client’s requirements
Technology advances made by Danieli
  - DANfilters: high filtering rate and deep filtration
    sand filters
  - ZLD: Zero Liquid Discharge
  - ZSP™: Zero Scale Pit
Energy/Water saving
Design criteria for metallurgical applications
Control and automation systems
Commissioning, training and water management
Case study installations
Water treatment plant solutions

Today, industrial operations have a greater concern about the environmental impact of their process, and saving water means saving money as well. Laws and regulations are pushing industrial companies to water recycle, reducing the discharge and makeup amount usually prepared using river or well water. Using the correct water quality will improve the final quality product too, with fewer impurities, while the equipment life will be extended and the cost of maintenance will be reduced. Another consideration is that each kind of industry needs different water quality for their production. Breweries need decarbonated water, while other drinks processors use demineralized water. Demineralized water for boilers must follow stated norms that depend on the working pressure of the steam boiler itself. This means a different technology must be applied to achieve the customers’ requirements. Condensate treatment is another interesting treatment, for power stations, and a very important one from the point of view of water savings. Care has to be shown to the cooling circuits water in order to avoid corrosion, but also to reduce water usage for makeup. Paper manufacturers need clean, uncolored water for their pulp preparation, to reduce waste in production. Each water quality can be prepared from different water sources, and with discharging that respect local norms and regulations. Following these considerations industrial companies need a reliable partner to develop together the best solution for their site. Thanks to its expertise in design and engineering, Danieli Plant Engineering, in combination with other divisions of Danieli Group, performs exceptionally well worldwide as supplier of water treatment systems for:

> Steel manufacturing;
> Oil and gas processing;
> Chemical and petrochemical plants;
> Power plants;
> Food and beverage industry;
> Pulp and paper mills;
> Chemical and fertilizer industries.

Danieli follows its customers from the very beginning of a project through to the final realization. Danieli is not a “hardware” supplier, but a technology partner, supporting its customers with:

> Concept and feasibility studies;
> Engineering and process design;
> Hazard and operability studies;
> Procurement of equipment and materials;
> Supply of proprietary equipment packages;
> Supply of complete plants and turnkey solutions;
> Plant commissioning and operator training;
> Technical service and support;
> Spare parts and service.
1. Kickoff meeting for a water treatment project at Danieli HQ.
2. Danieli Water Treatment design department developing 3D drawings for piping and equipment layout.
3. Example of pressure loss calculation for a plate heat exchanger with Aspen software.

Our Tools for designing Water Treatment Plants

With specific application requirements, Danieli Plant Engineering uses advanced software tools and instruments for maximum design quality to meet customer requirements. These tools, mainly are:

- Aspen software for process optimization;
- Heat and material balance calculation;
- Equipment selection;
- 3D piping design;
- Calculation of conditioning agents;
- Line pressure drop calculation;
- Structural analysis;
- Thermal analysis;
- Seismic analysis.

The Danieli Research Center, equipped with a chemical laboratory for water analysis, is where the development and optimization of components and equipment are carried out, also using scale models and prototypes.

Danieli cares about safety. All the Danieli plants are in compliance with the European Community CE mark and all the safety requirements are on rule as standard configuration offered by Danieli. More restrictive safety regulations can be easily implemented in conformity with the local laws and regulations or as per client’s requirements.
Danieli Water Treatment Dept. is effectively specialized in the treatment of water: primary and waste, civil and industrial, fresh or recycled. Thanks to its vast and multi-field technical experience gained during more than 50 years of activity and continuous and interdisciplinary research and development work, Danieli maintains extensive know-how, offering innovative process technology solutions to its customers.

Danieli’s designs are oriented to meet customers’ requirements, with customized plants and equipment to fulfill specific needs. Special care is focused on:

> Process Hazard Analysis to prevent any safety issues.
> Process/equipment to fulfill the most recent worldwide BAT (Best Available Technology) prescriptions.
> Equipment selection to avoid wasting power and water.

This guarantees the best optimization and effectiveness of the process in any condition, and reduces installation costs (CapEx) and management/maintenance costs (OpEx).

As standard, the water treatment plants are designed, built and ready for commissioning, within one year from the date of coming to force, thanks to plant engineering and development using the most sophisticated 3D CAD drawings and modelling systems, and pre-assembled supplies (such as packaged cooling towers, skid-mounted equipment, modular pipe works, etc.) minimizing on-site installation costs and the overall footprint of the plant.
Daniel Engineering is constantly awarded from its customers for the supply of water treatment plants because of its capability to always deliver the best technical and economical proposal; this result is backed by smart solutions (i.e., Zero Liquid Discharge, Zero Scale Pit, patented DANfilters, etc.) and by the largest reference list for plant installations worldwide.

Danieli water treatment plants grant the maximum optimization with a relevant reduction of the overall footprint. In fact, the use of the 3D design layout intelligently minimizes the housing space for complex units where a number of different sections and components have to be connected.

Danieli water treatment plant solutions and installations abide by prevailing local regulations. (ASME, GOST, BS, EN, BS, CPCB, GB-150).

1 Patented DANfilters, featuring high filtration rates and deep filtration, installed for a contact circuit of a steel mill in Eastern Europe.
2 Water treatment system for a steelmaking plant.
3 Package and field erected cooling towers.
4 Plant risk analysis.

A typical Job Safety Concept (JSC) made by Danieli for each unit of equipment installed in a water treatment plant. JSC is one of the risk-assessment tools used to identify and control workplace hazards. A JSC is a second-tier risk assessment with the aim of preventing injury to a person, or their colleagues and any other person passing or working adjacent.
DANfilters: high filtering rate and deep filtration sand filters

DANfilter (patented) is the result of the Danieli commitment to develop an improved sand filtering system. This proven technology, previously tested in a pilot plant to confirm its effectiveness, has already been installed in several plants, confirming optimal performances.

The Danieli special filter sets new limits in filtration rates and optimizes filtering efficiency: optimal water quality at low investment cost. Danieli knows how to properly design customized filters with filtration rates up to 60 m³/m²h, maintaining final water quality with less than 10 ppm of suspended solids.

It is possible to design filters with long filtration times and high-specific solid load. Therefore, Danieli know how to optimize all process requests, always minimizing investment and running costs, saving space in the layout design.

The peculiar characteristics of the DANfilters are the following:

- Monolayer type;
- High-rate filtering;
- Certified selection of sand granularity;
- Very deep filtering bed, with increased working time;
- Very accurate distribution of the backwashing air, avoiding formation of conglomerate balloons;
- Final co-current washing before putting into operation.

The invention (No. PCT/EP2007/061336 - No. WO 2008/049833) is essentially dedicated to uphold construction parameters, as well as the conditions for high-rate filtration and relevant backwashing design.

ZLD – Zero Liquid Discharge

In recent decades, the focus on the water cycle has been limited to ensuring quality suitable to its use in industrial processes, assuming unlimited availability of primary waters and at low cost. So, due to the above approach to the cycle of water, every year several hundred tons of chemical residues dissolved in the treated wastewaters are discharged in the rivers and in the sea. In reality, the availability of water resources is linked to the control of two key factors:

- Consumption must not reach values higher than the resource reconstitution;
- Deterioration may not exceed the capacity of self-healing of the resource.

As a consequence, not only ethical and environmental considerations, but also economic targets, require a critical review of current water uses, adopting where possible, the technologies that involve “zero liquid discharge”, or that minimize the discharge of wastewater.

Danieli achieves optimal management of the water cycle by implementing the reduction/zeroing of the primary water needs through the reuse of treated wastewater.

Depending on the economic return and/or lack of availability of primary water, we can perform the recovery of 60–90% of wastewater, or carry out the total wastewater reuse with “Zero Liquid Discharge”. In the first case, the technologies used must allow the discharge of small quantities of treated effluent with characteristics in accord with the “emission limits of discharges into surface water or public sewer systems”, in the second case (“Zero Liquid Discharge”), the result waste is composed only of solids.

At a superficial analysis, to obtain a lower consumption of water, less pollution and a lower cost of management seems to be a dream. Instead, in many cases, we can prove that the rational and smart application of available innovative technologies can achieve these goals simultaneously.

In order that the industrial development and environmental protection may grow into a correct way at the same time, it is important first to optimize the industrial production processes. To do this, the objectives can be summarized as follows:

- Maximum efficiency of industrial production processes;
- High quality raw materials used to prevent the transferring of the pollutants from the production process to waste;
- Streamlining production processes to reduce duplication, complications and waste of energy;
- Raw materials at low salt content to reduce or eliminate the increasing of saline wastewater;
- Minimizing water demand in manufacturing processes;
- Minimizing of energy consumption.

Regarding the reduction of water demand, it is important to critically review the various water treatment processes in order to adopt technologies that integrate production processes with solutions that minimize the water requirement, or to reduce water discharge volumes to zero.

1. 3.8-m-dia. DANfilter battery treating 4,000 m³/h of direct cooling circuits for a 1.0-Mtpy mini-mill for long products in South East Asia.

2. Reverse osmosis skid for seawater desalination.

3. 5-m-dia. DANfilter battery with high filtering rate and deep filtration installed for a contact circuit of a 400-Ktpy seamless pipe mill in the Middle East.

4. Reverse osmosis desalination section to recover 60 m³/h of blowdown, at a ZLD project in Eastern Europe.
Main highlights of the ZLD plants

The first and more evident advantage of this kind of plant is its “environmentally friendly” aspect. It uses the most recent BAT—Best Available Technology in the steel industry, and drives the customer to achieve further advantages:

> **OpEx savings.** The recovered water is used to blend the makeup, thus increasing the quality of the cooling water and reaching a consistent saving in the relevant costs.
> **A consequence of above is the possibility to get very profitable rates in financing.**
Danieli has improved the common standard approach to contact cooling systems for conticasters and rolling mills, in order to reach the same good results in the water cleaning, but allowing significant CapEx saving in the overall application.

This new Danieli know-how is based on a proper partition of the overall rolling mill discharge. The first part collects the water discharged from the descaler and the first roughing stands, and contains most of the released scale (the larger and heaviest parts). The second part of flushing collects most of the overall water, containing little quantity of very fine scale, which is not a problem for pumps and relevant delivery pipes. Based on above situation, the Danieli solution is to use, in the collection of the first part, a special designed equipment (DAN-DREDGETM), which allows the quick sedimentation of the bigger, heavier and dangerous particles of scale, and their continuous extraction, drainage and discharging into a proper skip, or directly into a dedicated truck. The overflow water, now devoid of the dangerous scale, is then pumped to the water treatment plant for its final filtration.

### Comparison of principles of operation of the ZSP solution versus conventional scale pit system.

<table>
<thead>
<tr>
<th>ZSP solution</th>
<th>Conventional scale pit system</th>
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<tbody>
<tr>
<td>Waters coming from the direct cooling of rolling mill line are separated as different fluxes: fluxes containing big/heavy scale are sent to scraper conveyor packages while flux containing only small/light scale is collected in a separate pit and pumped directly to the longitudinal clarifier.</td>
<td>All waters coming from the direct cooling of rolling mill line are sent to the scale pit to allow the big/heavy scale separation.</td>
</tr>
<tr>
<td>The scraper conveyor packages and the pumping pit are located under/next to the rolling mill, consequently the concrete works are not so depth (-5 / -7 m).</td>
<td>The scale pit unit collecting all water from contact circuits is located outside the building, because of the depth required (-10 / -15 m).</td>
</tr>
<tr>
<td>The scale is removed continuously by the chain scrapers of the Dan-Dredge™.</td>
<td>The scale accumulated in the pit is removed periodically by an automatic bucketed.</td>
</tr>
<tr>
<td>Time required for the execution of civil works is limited (about one month).</td>
<td>Time required for the execution of civil works is considerable (about six months).</td>
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**ZSP™ - Zero Scale Pit**

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Energy / Water saving

Savings can be reached by adopting improvements in all the aspects involved: design of machinery, materials and components, control and automation. Even if the single modifications generally have a small impact, considering them as a whole, day by day they can reach a continuous improvement.

Power supply and system distribution

A proper electrical distribution system design drives to improve energy savings. Reducing cable distances by properly locating electric cabinets and distribution switchboards can reduce energy dissipated during distribution process. Furthermore, locally compensating the power factor will improve the efficiency of the distribution network, because with such a technical solution only active power will be transferred. Power monitoring tools and power demand control systems also can be adopted, especially when power availability is limited, in order to select preferred loads and to establish switch-off criteria for unused equipment. High-efficiency transformers and motors are selected in order to reduce electric power losses. Other energy saving methods include using of variable speed motors, to be adopted when loads are discontinuous and depending on the process sequences.

Water treatment and system design

Water is a fundamental requirement in the steel industry: its scope is mainly the cooling of machinery and quenching the product, but it is also used in the process, for instance in beneficitation of raw material from mines, as a transfer media for delivering the iron ore, or as solvent in the chemical processes of cold treatment of strips. The cooling systems can be designed following different philosophies. As a matter of fact, the cooling process is commonly performed in evaporative cooling towers, because this is the easier, the most efficient and the less expensive way. This process also has the smaller power requirement. In order to save energy, special automation programs provide the modulation, of the fans rotation, with start-stop or in continuous mode with an inverter, following the heat dissipation requirement of the system. Great care is taken with the cooling tower type and in its selection. The cooling water temperature is designed for the maximum temperature acceptable to the system, in order to avoid wasting power that is not strictly necessary to the process. The long, wide experience of the Danieli Water Treatment Plants Department guarantees in the most effective process for any condition and lower costs for installation (CapEx) and management-maintenance (OpEx). In all the above uses, considerable quantities of water are lost, by evaporation (direct or for cooling purposes), by losses (drift or condensation), leakage, evaporation in the blowdown and makeup water quantities are lower, thus resulting in water savings. This principle must be implemented together with requirements listed to the above point; otherwise it can be ineffective and dangerous. Danieli helps customers to define the best conditioning program in accordance with the local chemical supplier, which will support the customer in the future production stages.

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Increasing of circulating water quality control

As a corollary to the previous discussion, the mentioned philosophy acts as a guide to improve water quality control. The circulating water quality continuously changes in its concentration by the succeeding evaporation, makeup and blowdown events. An effective water quality control allows reaching and maintaining the upper designed limit of concentration factor, ensuring meanwhile the integrity of machinery and piping. But, not only automation is involved in this scope: chemical analysis control carries the same importance and is duly executed with frequency according to Danieli prescriptions.

Implementation of circulating water conditioning

Another approach for increasing the concentration factor of the circuits is to improve the efficiency of the chemical conditioning. If the scaling and the aggressiveness effect of the circulating water is more efficient, it is possible to accept a higher value in the concentration factor. Consequently, the blowdown and makeup water quantities are lower, thus resulting in water savings. This principle must be implemented together with requirements listed to the above point; otherwise it can be ineffective and dangerous. Danieli helps customers to define the best conditioning program in accordance with the local chemical supplier, which will support the customer in the future production stages.

Targets

> Efficient wastewater treatment
> Customized chemical conditioning systems
> Tailor-made automation programs
> Special water treatment plant cooling system design
> High-efficiency equipment
> Power monitoring tools
> Water quality improvement and control
> Reuse of blow-down and flushing water
> Zero Liquid Discharge

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Reuse of blow down

The blowdown must be discharged, but this does not mean that it is a pollutant discharge. On the contrary, it is simple circulating water, of the same quality involved in the process. Therefore, this water can be reused for other secondary purposes, such as slag quenching, fumes cooling, pavement cleaning / rinsing, or irrigation.

Reuse of flushing water after a dedicated treatment

A further implementation of the previous point is represented by the recent Danieli establishment of a “Transferable Wastewater Treatment Plant”. This containerized unit, a Danieli property, is temporarily installed at all sites where no waste treatment is available, and makes it possible to efficiently clean the resulting dirty wastewater from flushing and cleaning and passivation operations. Cleaned water is conveniently reused in other operation or for first filling of the circuits. This represents a profound commitment by Danieli to water savings and respect for the environment.

Recovery of blow-down

Another Danieli contribution is the “zero discharge system”. All blowdowns and wastewater discharged are chemically treated and then passed through Reverse Osmosis treatments, until the non-recovered water is reduced to a value compatible with the slag quenching of site. The final small fraction of water, with its high TDS content, is then used and evaporated for that purpose. If we consider the external environment of the steelmaking facility, the effect is “zero discharge”, because all the withdrawn water is completely used “inside” the system. No water is discharged outside.

Use of closed circuits with zero evaporation

In some few cases, for the indirect cooling circuits it is possible to use the “closed type” together with an “air-cooler” system. No water is evaporated, and water consumption is limited only to the mechanical losses. A limitation to this solution is in the temperature of the cooled water, which can practically reach not less than 10 °C above the ambient air temperature. Therefore, this solution is applicable in cold climates or for applications where hot water is acceptable for cooling purposes.

Danieli CHR®: Clean Heat Recovery

In the fume treatment plant gas and fumes are cooled with water in a closed loop. In the electric arc furnace approximately 20-30 % of the total input energy is lost through the primary fumes. To recover such energy Danieli developed the CHR® plant to produce electric energy, with consequent fuel savings and reduction of greenhouse gas emissions. In a closed loop water acts as a vehicle of energy, so the hot water coming out from heat exchanger (hot fumes heat water up to 200 °C) is sent to an accumulator, then to the ORC closed loop. The ORC-Organic Rankine Cycle technology is a cycle that converts heat into energy using an organic fluid with a boiling point occurring at lower temperature than the water-steam phase change. In field plants, energy recovered can reach values of 15-20 kWh/t of produced steel. Recovering part of the waste heat offers the opportunity to access to public financing, which varies from country to country.
Design criteria for metallurgical applications

Steelmaking is one of the industrial processes which has the greatest consumption rate between water usage and tons of material produced. The goal to develop a sustainable and environmentally friendly steel industry is leading to the reduction of water demand in the cooling and treatments processes. Continuous research aimed at increasing production quality and capacity has led to the development of sophisticated machinery which works under extreme conditions. The call for environmental sustainability of the total steel production system has inspired us to highlight two development targets related to water use:

> A need for best quality cooling water at all times, to promote longer recirculation and avoid scaling and/or corrosion of the machinery;
> Respect for the environment linked to water discharge, with low levels of polluting agents accumulated in the continuous recirculation.

Aware of these fundamental principles, Danieli Plant Engineering aims to achieve a dual target, namely:

> To reduce the amount of makeup water and
> To reduce wastewater volumes significantly, to meet the ever-increasing demands of lower environmental impact.

Danieli Plant Engineering Systems adopted this philosophy of water management, right from the outset of its activity. It represents the central nucleus around which the water treatment planning and project research develops.

The use of closed cooling circuits, in-line cleaning of the water contaminated during the production cycle and the purification of the effluent water, represent considerable progress in safeguarding the external environment, and therefore have contributed significantly to the creation of production plants that have little impact on the environment.

Danieli Plant Engineering Systems gained wide experience in the auxiliary utilities of the steelmaking plants and other processes. Therefore, it is able to manage all the various and complex problems concerning the process and effluent water treatment and cooling systems.

Technical Data

The water treatment plant is the main auxiliary plant for the steelmaking industry. For this reason technical data such as thermal load, cooling water flow-rate and inlet pressure must to be taken into consideration.

The above parameters are required from the technical departments in order to design the water treatment plants for:

> Primary plants: ore treatment facilities, pelletizing plants, coke-oven units, and by-product facilities;
> Melting shops: blast furnaces, Direct Reduction plants, BF’s and EAF’s;
> Secondary treatment: ladle metallurgy furnaces, VO and VOD units;
> Continuous casting machines: for billets, blooms, thick and thin slabs;
> Rolling mills: long product mills (bars, wire rod and sections), hot strip mills and cold strip mills;
> Finishing lines: pickling, galvanizing, tinning, painting lines.

1. Water treatment plant located in Middle East for a 1.4 Mtpy DR-based mini mill with indirect cooling circuit for 22,000 m³/h and direct cooling circuit for 5,000 m³/h.
2. 50-m-dia settling units serving an iron ore pelletizing plant in the Middle East.
3. Water cooling towers and water emergency tank for a 2.4-Mtpy hot strip mill in North Africa.
4. Water treatment system for the galvanizing line of a 100,000-tpy cold mill complex for stainless steels, located in Northern Europe.
5. 800-m³/h lamellar clarifiers to treat water from reheating furnace in a cold mill complex for stainless steel in the Middle East.

1 2 3 4 5
Site conditions

The environmental conditions are fundamental data for a correct dimensioning of the Water Treatment Plant as well as for the definition and application of the cooling systems, which thus will guarantee the maximum operating capacity for the plant, even under the most extreme working conditions.

The most important elements to be considered in designing a water treatment plant are as follows:

- Available water quality on site;
- Dry bulb temperature;
- Wet bulb temperature;
- Wind speed and direction;
- Seismicity;
- Geotechnical survey;
- Local environmental regulations.

Danieli Engineering’s water treatment plant technology uses:

- Closed circuits (pressurized or not);
- Open no-contact circuits;
- Contact circuits;
- Induced draft, cross-flow, forced and closed cooling towers;
- Plate exchangers;
- Air coolers;
- Chiller systems.

Treatment of dirty water in contact circuits is carried out according to various schemes, often multiphase, consisting of separation by gravity, centrifugal force, and coagulation. Specialized sand filtration is done with our special high-rate DANFilters.

1. Longitudinal clarifier of a direct cooling water treatment system for a 1.1-Mtpy bar and rod mill in the Middle East.
2. Circular clarifier of a water treatment plant for a 4.7-Mtpy mining, beneficiation and pelletizing plant located in the Middle East.
3. Overview of a water treatment plant for a 1.0-Mtpy minimill (meltshop + rolling mill) for long products in South East Asia.
Control and automation systems

As standard practice, the automation system of a water treatment plant consists of:

- PLC system (Programmable Logic Controller) for basic automation;
- HMI system (Human Machine Interface) for supervision activities or synoptic mimic diagram;
- Communication network;
- Set of pushbuttons, instruments and local components.

In particular, for all the plant areas under control, including pumping stations, cooling systems, filtering batteries, purification plant, etc., the PLC is responsible for:

- Execution of automation sequences in automatic, manual and local manual mode;
- Acquisition of data from the field.

The HMI system, which consists of a networked PC or an operator terminal directly connected to the PLC, is dedicated to the other functions, including diagnostics, device testing, setting of operational parameters, manual controls, real-time and historical trends, and displaying of plant mimic diagram panels for dynamic monitoring of processes. Thanks to the color graphics and real-time updating, the supervisor has immediate and continuous information on plant status.

With its high performance standards, the Ethernet provides the internal PC-PLC connections and it is the means for integrating with the other technical areas of the plant with the higher automation level. The objective of maximum efficiency is pursued by integrating the areas not directly involved in the production process.

Due to the fact that the PLC does not work during black-out periods, for safety reasons all emergency systems and devices are “hard-wired”. In order to ensure the real-time assistance and to perform the required feedback actions due to alarms from the monitored plants, Danieli can supply the Tele Assistance Control System by remote connection. From Danieli offices the qualified operators can act directly to solve the plant troubles. As integration of the Tele Assistance the SCADA is the most sophisticated tool for the real-time data acquisition and supervisory control system.

Most significant products:

- Engineering for logic development and graphics pages
- Control systems architecture for PLC and DCS
- Digital / analogic control logics for process control
- Engineering and manufacturing of control panels and electrical switchboards
- Inverter panels, MCC panels, PCC panels, Local control boxes, etc.
- Integrate automation together with technological line
Commissioning, training and water management

Targets

> Provide skilled personnel to follow erection/commissioning activities of Danieli water treatment plant projects in a professional way

> Ensure a smooth transition of all projects from the build phase through to the operating/maintenance and service phases

> Satisfactorily hand over water treatment plant projects to our customers

Danieli can supply a full set of services on site, through its Erection & Commissioning Department and Danieli Service Department:

> Erection and commissioning of plants;
> Advisory services;
> Training to operators;
> After-sales service.

The full spectrum of services, such as erection, commissioning and startup assistance for new plants, supervising to refurbishment and upgrades of existing plants, retrofitting and revamping projects, can be provided all over the world.

The aim of the department, through its internal resources, is to:

> Provide skilled personnel to follow erection/commissioning activities of Danieli water treatment plant projects in a professional way;
> Ensure a smooth transition of all projects from the build phase through to the operating/maintenance and service phase;
> Satisfactorily hand over water treatment plant projects to our customers.

Danieli Erection & Commissioning Department developed and established a quality management system based on ISO 9001 standard, therefore our supervisors are following an internal QA/QC process to ensure that the complete installation is inspected, pre-commissioned (or set to work), adjusted, tested and regulated to respect both environmental conditions and design specifications. Usually the following steps are considered:

> Construction: during the erection phase Danieli supervisors guarantee the accurate following of installation phases through the application of a mechanical completion system;
> Pre-commissioning: this involves carrying out a sequence of checks to ensure the system is complete, correctly installed in accordance with design requirements and then preparing the system for commissioning. DIMAC has developed its own cold test check-lists that normally are shared with the customer;
> Commissioning: starting up and testing all equipment individually, and then the whole plant. Then, the key factor is the process of adjusting fluid flow within the specified tolerances of the project;
> Testing: evaluating the plant performances, which can be temperatures, pressures, flows, water analysis.

These guarantee that, at the hand over, our customers receive a plant with all the services fully operational. The test results will be documented, witnessed and issued complete with a full set of operating and maintenance manuals for the maintenance staff. This allows for any subsequent defects or modifications to be identified and appropriate remedial action carried out.

After commissioning/hand over of a new plant, Danieli Service can provide a range of one-time and ongoing support to ensure that it remains well-maintained and operates at optimal levels. Whether our customers need training to do the work on their own, or want to rely on Danieli’s experts to take care of it, Danieli Service can ensure that the plant continues to offer long-term, reliable, and safe water treatment services.

Danieli Service can offer the following support services:

> Operator training;
> On-call assistance and troubleshooting;
> Routine inspections;
> Full operation and maintenance services;
> Remote monitoring.

Danieli’s goal is to achieve the customer’s satisfaction, ensuring a safe work place on site. Danieli personnel operating during erection and commissioning phases apply the company standards for the prevention and protection of the health and safety for the workers involved. Danieli applies procedures and instructions that are periodically certified by external corporations in compliance with the OHSAS 18001/07 British standard. Danieli personnel operating during erection and commissioning phases apply the company standards for the prevention and protection of the health and safety for the workers involved. Danieli applies procedures and instructions that are periodically certified by external corporations in compliance with the OHSAS 18001/07 British standard. Danieli staff are trained periodically, taking into consideration the risk assessment carried out in compliance with the Safety European Regulations and their specific tasks.

Water Management

Danieli Engineering Systems also facilitates supply of speciality services, as construction and management in global service (BOOT - build-own-operate-transfer) where Danieli receives a concession from a customer to finance, design, construct and operate a WTP, as stated in the concession contract.

The customers have only to pay the quantity of used inlet water (or discharged outlet water) without any issue about project, investment, operating and maintenance expenses.
Case study installations

**Emirates Steel, UAE**
1.4-Mtpy DRI-based minimill #1 for bars and wire rod
1.4-Mtpy DRI-based minimill #2 for heavy sections

- **Plant location**: Abu Dhabi, UAE
- **Plant type**: Sea water reverse osmosis plant for makeup water production
- **Makeup water**: 1,400 m³/h (minimill #1) and 1,600 m³/h (minimill #2)

**Unicoll-Universal Metal Coating Co., KSA**
250,000-tpy Cold strip mill complex

- **Plant location**: Jubail, Kingdom of Saudi Arabia
- **Plant type**: Water and Wastewater Treatment Plants
- **Indirect cooling**: 1,540 m³/h
- **Direct cooling**: 20 m³/h
- **Makeup water**: 50 m³/h
- **WWTP**: Pickling, cold rolling mill, annealing, galvanizing, and painting lines

**Emirates Steel, UAE**
1.9-Mtpy Direct Reduction Plant

- **Plant location**: Abu Dhabi, UAE
- **Plant type**: Water Treatment Plant
- **Indirect cooling**: 11,400 m³/h
- **Direct cooling**: 1,275 m³/h
- **Makeup water**: 450 m³/h

**Dneprosteel, Ukraine**
1.32-Mtpy steelmaking plant

- **Location**: Dnepropetrovsk, Ukraine
- **Plant type**: ZLD-Zero Liquid Discharge Water Treatment Plant
- **Indirect cooling**: 11,681 m³/h
- **Direct cooling**: 1,330 m³/h
- **Makeup water**: 165 m³/h

**Saudi Iron & Steel Co. - Hadeed, KSA**
1.0-Mtpy steel meltshop and wire rod mill

- **Plant location**: Jubail, Kingdom of Saudi Arabia
- **Plant type**: Water Treatment Plant cooled in sea water system
- **Indirect cooling**: 7,900 m³/h
- **Direct cooling**: 2,820 m³/h
- **Makeup water**: 485 m³/h

**SAIL - IISCO Steel Plant, India**
0.75-Mtpy bar mill + 0.5-Mtpy wire rod mill

- **Location**: Burnpur, West Bengal, India
- **Plant type**: ZLD-Zero Liquid Discharge Water Treatment Plant
- **Indirect cooling**: 1,060 m³/h
- **Direct cooling**: 100 m³/h
- **Makeup water**: 20 m³/h

**JESCO-Jubail Energy Services Corp.**
400,000-tpy seamless pipe plant

- **Plant location**: Jubail, Kingdom of Saudi Arabia
- **Plant type**: Water Treatment Plant
- **Indirect cooling**: 3,115 m³/h
- **Direct cooling**: 2,700 m³/h
- **Makeup water**: 50 m³/h

**NMDC - Nagarnar, India**
2.9-Mtpy Thin Slab Caster and Hot Strip Mill complex

- **Plant location**: Nagarnar, Chhattisgarh, India
- **Plant type**: ZLD-Zero Liquid Discharge Water Treatment Plant
- **Raw water**: 3,426 m³/h (TSC), 3,064 m³/h (HSM)
- **Indirect cooling**: 10,185 m³/h, 6,500 m³/h (strip cooling)
- **Direct cooling**: 135 m³/h

**Unicoil-Universal Metal Coating Co., KSA**
250,000-tpy Cold strip mill complex

- **Plant location**: Jubail, Kingdom of Saudi Arabia
- **Plant type**: Water and Wastewater Treatment Plants
- **Indirect cooling**: 1,540 m³/h
- **Direct cooling**: 20 m³/h
- **Makeup water**: 50 m³/h
- **WWTP**: Pickling, cold rolling mill, annealing, galvanizing, and painting lines
WATER TREATMENT PLANTS FOR A SUSTAINABLE INDUSTRY