



**TURBODEN
CHEMICAL ENGINEERING**

Cod. 22-COM.P-1-rev.0

OUR EXPERIENCE. YOUR POWER.

THE CHEMICAL ENGINEERING SERVICES

Turboden has expanded its offer to include chemical engineering services.

In addition to traditional skills, Turboden owns in-depth and varied skills in chemical engineering, mainly in:

- Chemistry
- Industrial chemistry
- Electrochemistry
- Material sciences
- Corrosion control

Expertise in chemical engineering is essential for maintaining a plant in performance at its best condition.

Already from the design phase, chemical engineering plays a key role in defining the characteristics of the plant.

Finally, the skills in chemical engineering make Turboden services distinctive from the others.

APPLICATION

Turboden chemical engineering team supports both its ORC customers and other companies with consultancy and/or a maintenance service in the fields of:

- Design & engineering
- Proposal engineering
- Quality control
- Commissioning
- After-sales services

OUR SERVICES

- Chemical & metallurgical laboratory service
- Chemical maintenance of cooling systems
- Chemical treatment of cooling water
- Corrosion prevention & control
- Geothermal heat exchangers maintenance
- Design & revamping of cooling systems
- Heat efficiency recovery
- Surveillance

CHEMICAL & METALLURGICAL LABORATORY SERVICE

Turboden owns an internal **Chemistry Lab** where skilled operators undertake a series of prevention and control activities, necessary to the proper operation of the plants.

Furthermore, Turboden collaborates with a **wide network of chemical and metallographic laboratories**, research institutes and universities in the field of liquid/solid gas characterization.

- Water analysis
- Solid deposits characterization
- Metallographic analysis
- Working fluid characterization
- Flue gas analysis
- Oil analysis

A properly addressed and relevant characterization always underlies the properly addressed and relevant operational action.



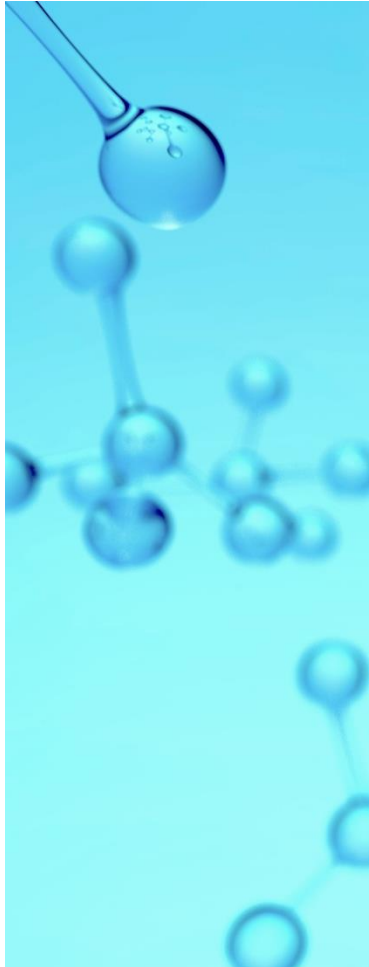
CHEMICAL MAINTENANCE OF COOLING SYSTEMS

Turboden can provide an accurate maintenance plan with **scheduled checks** that allow **to extend the life of the cooling systems**, which are normally subject to natural degradation due to electrochemical or microbiological corrosion phenomena.



- Chemical passivation of metal surfaces
- Fouling prevention
- Fouling removal
- Cathodic and anodic protection
- Galvanic protection
- Layup

CHEMICAL TREATMENT OF COOLING WATER



Water is the most used heat transfer fluid in cooling processes.

Appropriate chemical conditioning, conceived on the specificities of the available water resource and system's metallurgies, **is simply a mandatory activity**, in order to maintain both the right thermal exchange capacity and prevent the cooling system from premature deterioration.

This process always requires:

- accurate study of the water and the cooling system
- proper chemicals
- right equipment
- precise measurement and control tools



Turboden makes all of that available, by using **real time detection devices**, and allowing the control of systems by means of **remote controls**.

In detail:

- chemical characterization of water
- chemical characterization of geothermal water characteristics
- microbiological analysis
- metallographies
- gas chromatography
- solid/liquid elementary analysis
- spectrophotometry

CORROSION PREVENTION & CONTROL

Corrosion is a natural, unavoidable process, which constantly causes heavy costs in industry.

Corrosion can be kept under control by means of proper techniques, aiming at reaching the lifespan of an installation.

Turboden makes available a **wide set of services** including:

- anodic protection
- cathodic protection
- corrosion detection
- corrosion prevention



GEOHERMAL HEAT EXCHANGERS MAINTENANCE

Before being used as a carrier fluid, **geothermal water requires chemical inhibitors** to avoid saline precipitation in the exchangers and / or corrosion of the materials.

These phenomena normally have a negative impact on the availability of a geothermal plant, affecting profits and revenues.



Turboden makes the customer able to deal with such issues with the following activities:

- fouling mechanical removal – both scaling and corrosion products
- fouling chemical removal - both scaling and corrosion products
- corrosion prevention & control

DESIGN & REVAMPING OF COOLING SYSTEMS



The interface between primary thermal systems and its cooling / condensation equipment is crucial. Turboden supplies the necessary **revamping and retrofit of cooling systems**. This makes them work at their best and in full synergy with the whole plant.



The target is the **enhancement of cooling systems towards the best efficiency** by means of:

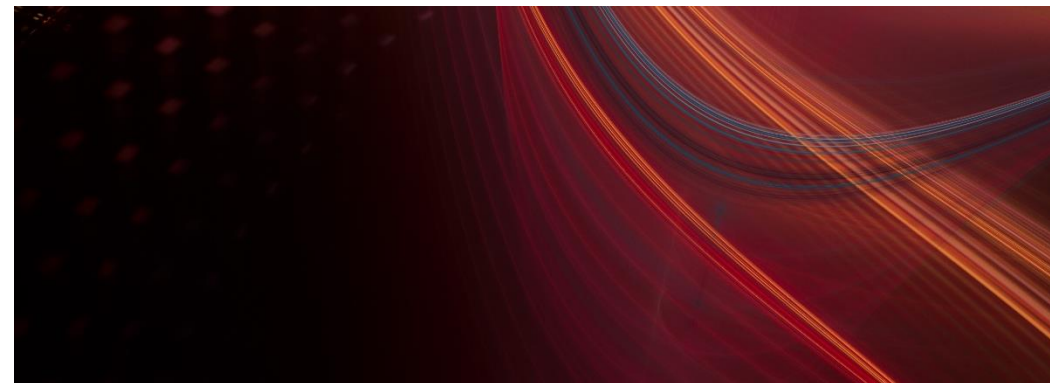
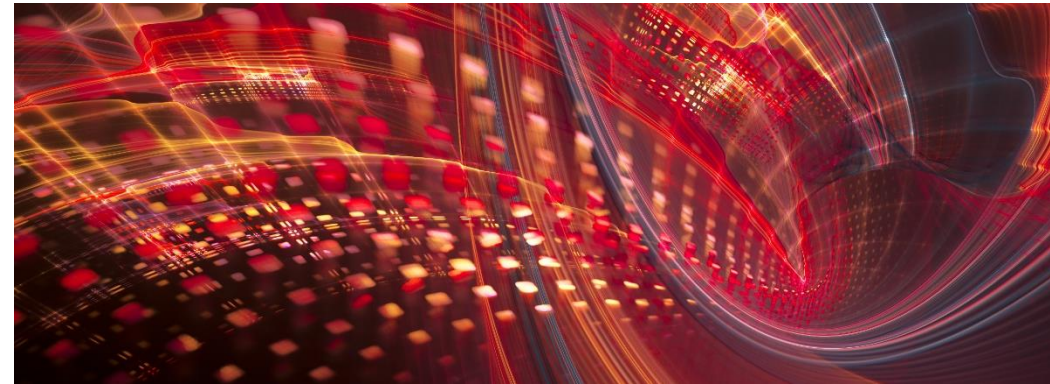
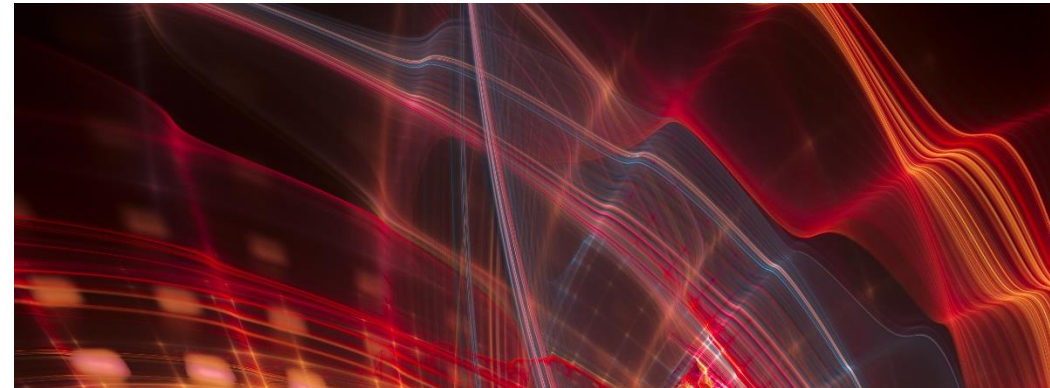
- process modification & improvement
- mechanical & electrical design
- automation
- adiabatic heat exchangers
- protection against corrosion

HEAT EFFICIENCY RECOVERY

Heat exchangers gradually reduce their own heat exchange capacity, due to normal phenomena associated with the operation process (fouling, corrosion, spoilage). As the exchange capacity decreases, **electricity production also decreases**, ultimately causing a loss of profit.

Turboden provides:

- chemical cleaning
- hydro blasting
- CO₂ blasting
- steam blowing
- air blowing



SURVEILLANCE

Thanks to the **remote-control system**, it is possible to **monitor the evolution of working fluids and heat carriers in real time**. This leads to preventing failures, improving the profitability of the process, and increasing earnings.



That is why we offer **reliable solutions** for:

- analysis plans
- continuous remote analysis
- supply of real time detection kit