



- 1 Reverse osmosis system in El Guna Egypt.
- 2 PV pumping system for irrigation – a Fraunhofer ISE project in Egypt.
- 3 Salt works in Chile.

WATER TREATMENT AND SEPARATION

Water makes our planet unique. At the same time, it is the natural resource most consumed by human beings. Already a scarce commodity in many regions of the world, the reckless use and disposal of water will continue to increase the amount unfit for consumption, hence accelerating its scarcity even more.

At Fraunhofer ISE, we work towards finding energy efficient and sustainable solutions to treat non-potable water and recycle reject water, thereby helping to close the gap between water consumption and water replenishment.

We provide research, consulting and development on topics ranging from water management to material, component and system design. Our primary focus is on water energy nexus projects as well as mineral and fluid recovery using membrane technologies.

We transfer our know-how and skills to a wide range of applications, from acid recovery in the steel plating industry to humidifiers and dehumidifiers for air conditioning in domestic and industrial applications. Our project partners include NGOs, governmental organizations, associations, membrane suppliers as well as companies developing new components for desalination and water treatment. They benefit from our long time expertise and our excellent technical infrastructure.

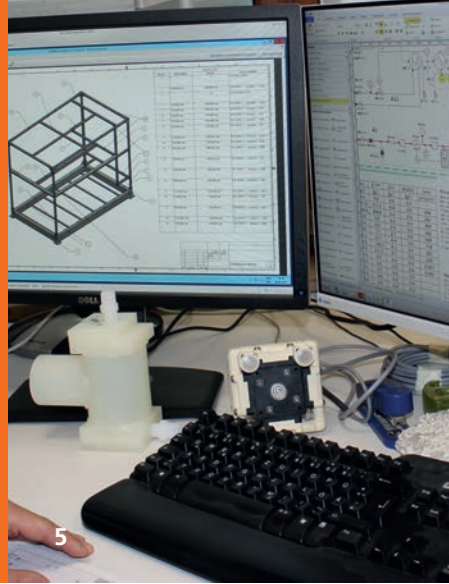
Fraunhofer ISE is equipped with state-of-the-art membrane testing facilities for ultrafiltration and reverse osmosis as well as highly sophisticated test facilities and simulation tools for membrane distillation and related processes. Our more than 20 pilot and demonstration systems in eight countries, both on-grid and off-grid, have given us comprehensive practical experience in the design, construction, operation and monitoring of plants on the international level.

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Water Energy Nexus

Fraunhofer ISE develops and applies renewable energy driven, grid-connected and off-grid treatment technologies for drinking water production and irrigation:

- PV driven pumping systems
- PV driven reverse osmosis desalination
- PV driven ultrafiltration for purification and disinfection
- solar-, geothermal and waste heat driven membrane distillation (MD) for desalination
- concentrated solar power and multi-effect distillation for desalination

Minerals and Fluid Recovery

We develop and construct components, processes and demonstration systems for the recovery of liquid and solid substances from industrial waste water and brines:

- MD for acid recovery in steel plating industry and related processes
- MD for super-concentration of brines before crystallization
- electrodialysis metathesis (EDM) for selective separation of mono and multivalent ions

Membrane Technology

We investigate MD, reverse osmosis (RO), ultrafiltration (UF), electrodialysis (ED) membranes and develop entire processes, systems and components:

- hydrophobic membranes for membrane distillation and related membrane contactors
- electrodialysis membranes and stacks
- scaling and fouling on membranes
- MD module, process and system technology
- liquid-liquid and liquid-gas contactors

Skills and Competence

- simulation-based process, component and system development and design
- experimental investigations, analysis and development of membrane modules, processes and systems
- construction of components, lab scale systems and entire demonstration plants
- simulation-based design studies for CSP desalination plants
- techno-economic studies on renewable energy driven desalination

4 Membrane test facility for the separation of highly aggressive chemical solutions.

5 Engineering, simulations and process design at Fraunhofer ISE.

6 Membrane distillation demonstration plant for sea water desalination in Gran Canaria.

Facilities and Resources

- comprehensive physical simulation tools for detailed MD module design
- simulation tools for the layout of renewable energy driven desalination systems
- test facilities for the characterization of MD and ED membranes
- module performance test facilities for MD and RO modules
- MD test cell for process characterization of highly corrosive, aggressive or hazardous media ($0 > \text{pH} > 12$)
- test infrastructure for thermal desalination systems up to 250 kW_{th}
- construction facilities for spiral wound and flat plate membrane modules (winding, welding, potting)