

Water Management for the Photovoltaic Industry



Crystal clear answers to your needs

Time to market

The dynamics of the photovoltaic market demands the highest standards of all who are involved. Our engineers meet the requirements of this young and continuously changing market:

To enable fast-tracking of projects we have standardised and harmonised our systems. If the time available is particularly short, we can offer rental systems to bridge the gap.

24/7 production

Our target is to bring system availability as close as possible to 100 % at reasonable cost. Therefore, we integrate built-in redundancy wherever it is needed, without increasing costs where it is avoidable. Approved components from reliable suppliers are the basis of GMP for us.

For Hager + Elsasser an order does not end with the acceptance certificate. Our service network is available for you 24/7.

With growing production volumes, the handling of aqueous streams is becoming a real challenge. Hager + Elsasser offers solutions for areas with high raw water and waste water costs and limited water resources:

- The systems are optimised to reduce internal water consumption to a minimum.
- In combination with recycling and reclaim systems, we can reduce your water intake from the mains.
- Reliable automated systems minimise operating expenses.
- We are ready to operate and maintain your systems as long as you need us!

Evolving requirements

Our systems grow with your needs – thanks to modular design.

Nobody knows today what tomorrow's needs will be. However, Hager + Elsasser can draw from decades of experience successfully completing projects for the semiconductor industry.



Complete Water management

State of the art process water systems ...

...will reliably supply the required quantity of high quality process water.

You can benefit from:

- easy operation
- constant water quality independent of the actual recycling rate
- high water recovery rate
- easy system extension if the quantity or quality needs to be increased

Reliable waste water treatment ...

... results in high availability of the plant. State of the art design contributes to reducing sludge disposal costs and saving manpower.

Comprehensive process knowledge leads to highly developed professional solutions:

- treatment mainly from wet benches but also all other side streams such as air scrubbers, burn boxes etc.
- rinse water that cannot be recycled is collected separately and treated in the waste water treatment system
- process chemical concentrates are collected and treated separately.

Cost effective reclaim and recycling technologies ...

... let you benefit from considerable advantages. Clear understanding of production processes enables us to develop tailor-made water re-use concepts.

Once implemented, they will:

- cut costs of water supply and waste water treatment
- cope with water shortage
- minimise the environmental impact and contribute to green production



Unlimited spectrum

... allows for tailor-made solutions.

Skilled specialists choose from all available water and waste water treatment process technologies. Filtration, membrane technologies, ion exchange, classic flocculation systems, aerobic and anaerobic processes, up-to-date recycling technologies: all processes are available to provide the perfectly optimised solution for your project.

Reliable basis

... for reliable systems.

Decades of experience in water and waste water treatment for all kinds of electronic and semiconductor industries are combined with our analytical and research activities. Our in-house laboratory is one of the mainstays of our problem-solving approach. Pilot tests contribute to finding the optimal process combinations for highly specialised requirements.

Holistic concepts

... for future proof plant concepts.

Based on the above, an integrated overall concept is developed, considering all requirements from the ultra-pure water specification to the waste water discharge limits. Everything is possible, from the implementation of standard systems to the realization of a custom plant - or any variant thereof. The main focus of Hager + Elsasser is to always meet our customer's needs.



State of the art process water systems

As a leading company with decades of experience with high-purity water treatment, Hager + Elsasser has been involved in the production of solar cells both for silicon-based wafer manufacturing and solar cell production from an early stage. Building on this experience, we work with you to find solutions for unusual locations and unusual circumstances. Whether we find adverse raw water conditions, or your main goal is to optimise operating costs, our engineers will find the right solutions for your needs.

One result of the continual development of this market is a compact and modular standard plant concept for generation of process water meeting the highest demands:

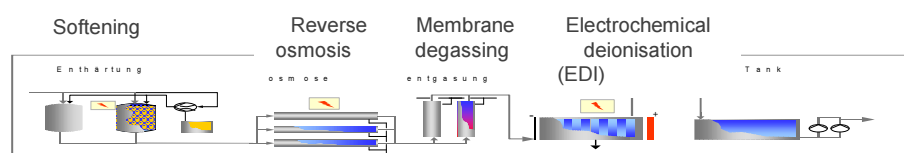
ROCEDIS Semiconductor with a conductivity $< 0,1 \mu\text{S/cm}$!

This system consists of:

- Softening with special salt saving technology
- Reverse osmosis with highest water conservation factor
- Membrane Degassing (optional) for chemical free carbon dioxide removal
- State-of-the-art Electrodeionisation (EDI)

The generated process water typically meets the following specification:

- Resistivity $> 16 \text{ M}\Omega \text{ cm}$
- Silica $< 10 \mu\text{g/l}$
- consistently high water quality
- high availability for 24/7 operation
- full automation
- chemical free operation
- very compact design
- easy maintenance
- optimised operation costs
- easy system extension if the water consumption or the future requirements for water quality increase
- optimal solution for numerous fields of application



Waste water treatment with the best available technology

We have successfully combined a variety of processes optimised for the waste water resulting from photovoltaic wafer production. These include, the removal of fluoride for the silicon type and heavy metals for the CIS technology. Special processes for HF, HNO₃ etc. are available.

For small and medium capacities, Hager + Elsasser can offer standardised systems and concepts which are combined, optimised and integrated to suit project-specific requirements

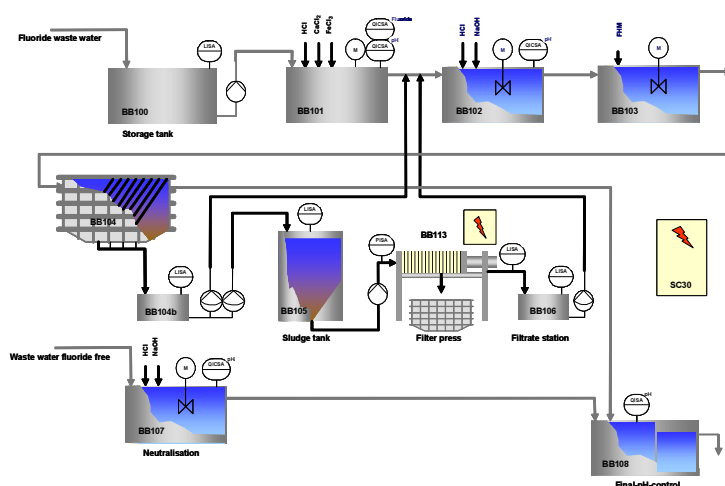
However, we have successfully completed numerous custom plants, wherever this turned out to be the more economical solution. In any case, the process combination is chosen on the basis of your individual needs, taking into account concentration of contaminants, in addition to considerations such as the need for continuous treatment and operational safety. We are continually adapting to increasingly stringent safety and ecological standards concerning waste disposal.

Depending on your requirements, recycling systems can be designed as part of an integrated solution or as stand-alone systems. Fully integrated systems have the advantage of lower investment costs and significantly smaller footprints.

If an existing water treatment system is to be extended by means of a recycling system, a stand-alone solution is always possible and can be installed later on.

Whatever solution suits you, the benefits of a 'one-stop shop' for all your needs are the same:

- smaller footprints can be achieved
- integrated concepts reduce the cost of spare parts management
- integrated electrical systems
- one contact person for service and maintenance of your water and waste water systems



Customer Service – made to measure

It takes expert advice and assistance to keep your water system operating smoothly, reliably and cost effectively. We reinforce your standard in-house checks with regular monitoring, performed by highly experienced service technicians.

Regular servicing can assist in increasing the availability of your plant and avoid costly down time. Regular servicing also helps to optimise the consumption of consumables and also exploit the potential to make minor, cumulative improvements in plant operation and efficiency during its life.

Anytime anywhere

Our service team is available to you at any time for all your inspection, repair and maintenance needs. In the event of a fault, we are at your disposal as an expert partner at many service locations. You can reach a contact person day and night via our hotline.

Our highly qualified staff have many years of experience with all water treatment issues. Their premier expertise is maintained through continual training and education.

Service Packages

Our Service packages all come at fixed prices, and can be tailored to your specific needs and timeframes. We are committed to quality and a timely delivery. Fixed prices ensure cost transparency.

Our maintenance package comprises the following:

- Inspection of your water treatment plant for its working condition, plus information about any potential for optimisation and instructions about its implementation.
- Inspection of the plant's process, mechanical and electrical systems.
- Examination of treatment efficiency by means of water analysis, often on site, and fine adjustment of the plant to adapt to changing operating conditions.
- Training of your staff in the operation of the plant.
- Advice and technical support on all issues of water treatment technology.
- Detailed status report with proposals for any operational changes or plant modifications.



Service and maintenance can be tailored to your needs in many ways, and several special options are available to complete the package:

A consignment stock lets you benefit from:

- Guaranteed on-time delivery
- Spare parts availability without initial investment
- Goods in stock with no storage cost.
- Expiry dates are monitored by Hager + Elsasser
- Warranty period starts upon withdrawal of goods

Operation models

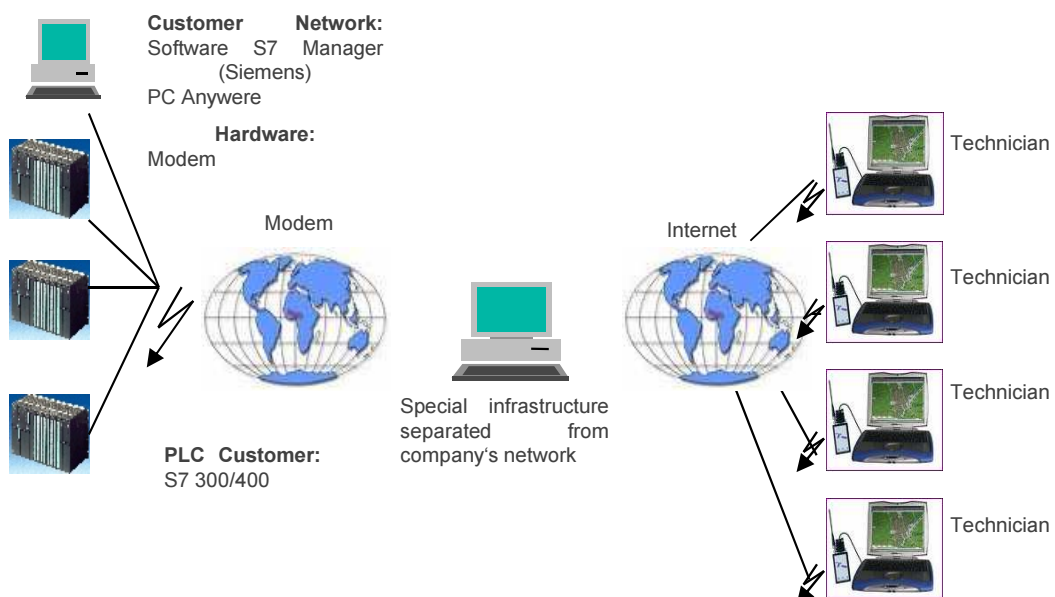
If you do not have the staff to operate your plants we can help you with an operator model, which will be specially adapted to your needs. We will jointly work out a consistent concept, and water supply to your production facility will no longer be a problem. Building on experience, technology and service capability we are able offer you a holistic service package, even including financing.

Remote maintenance RECON

The remote maintenance concept can be an interesting alternative to the hands-on service-packages.

RECON service means:

- Online supervision
- Operational support
- Trouble shooting
- Analysis of operating data



H+E ranks among the world's leading suppliers in the fields of: water & wastewater treatment, and energy efficiency. Based on its global presence, the **H+E GROUP** has completed projects in over 50 countries.



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