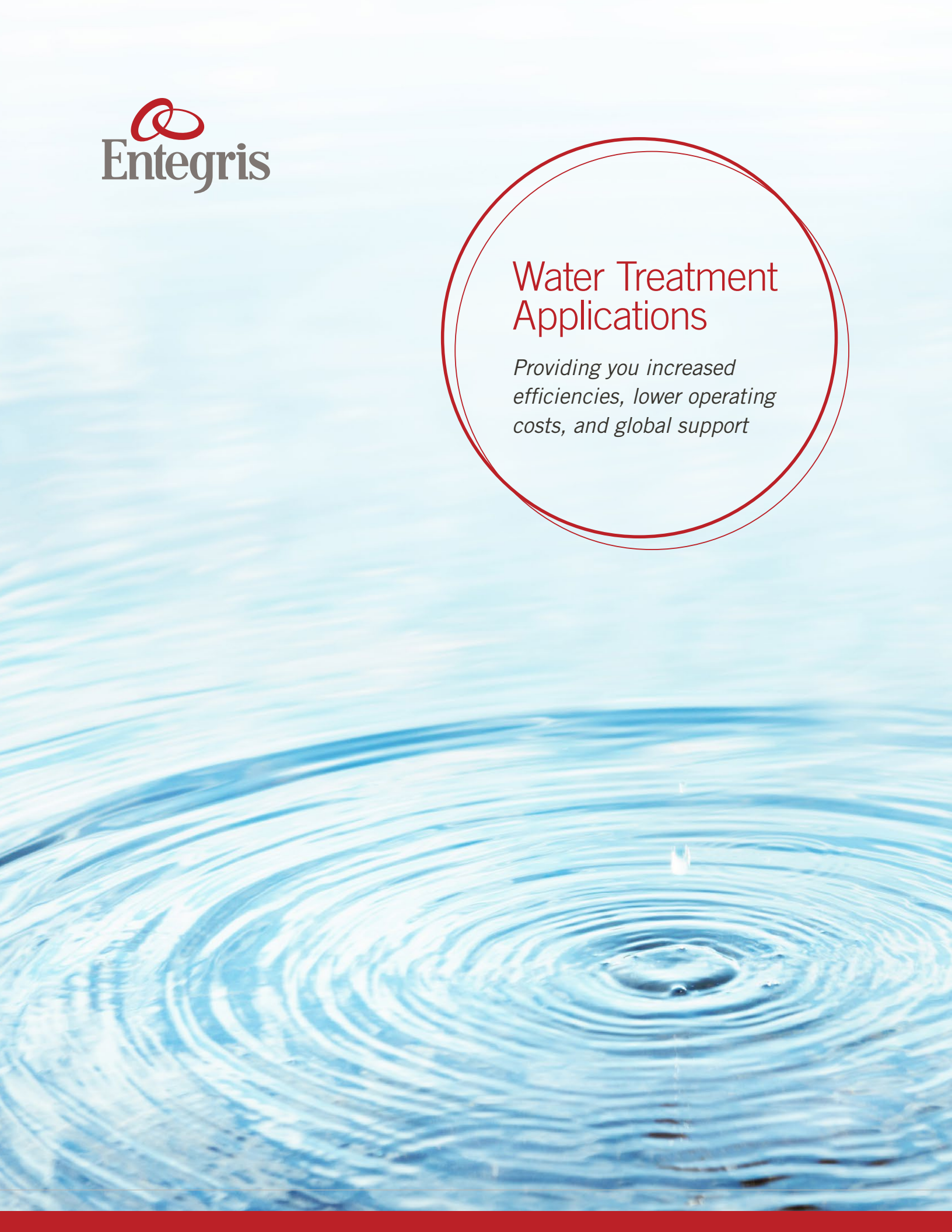
Entegris

Water Treatment Applications

Providing you increased efficiencies, lower operating costs, and global support



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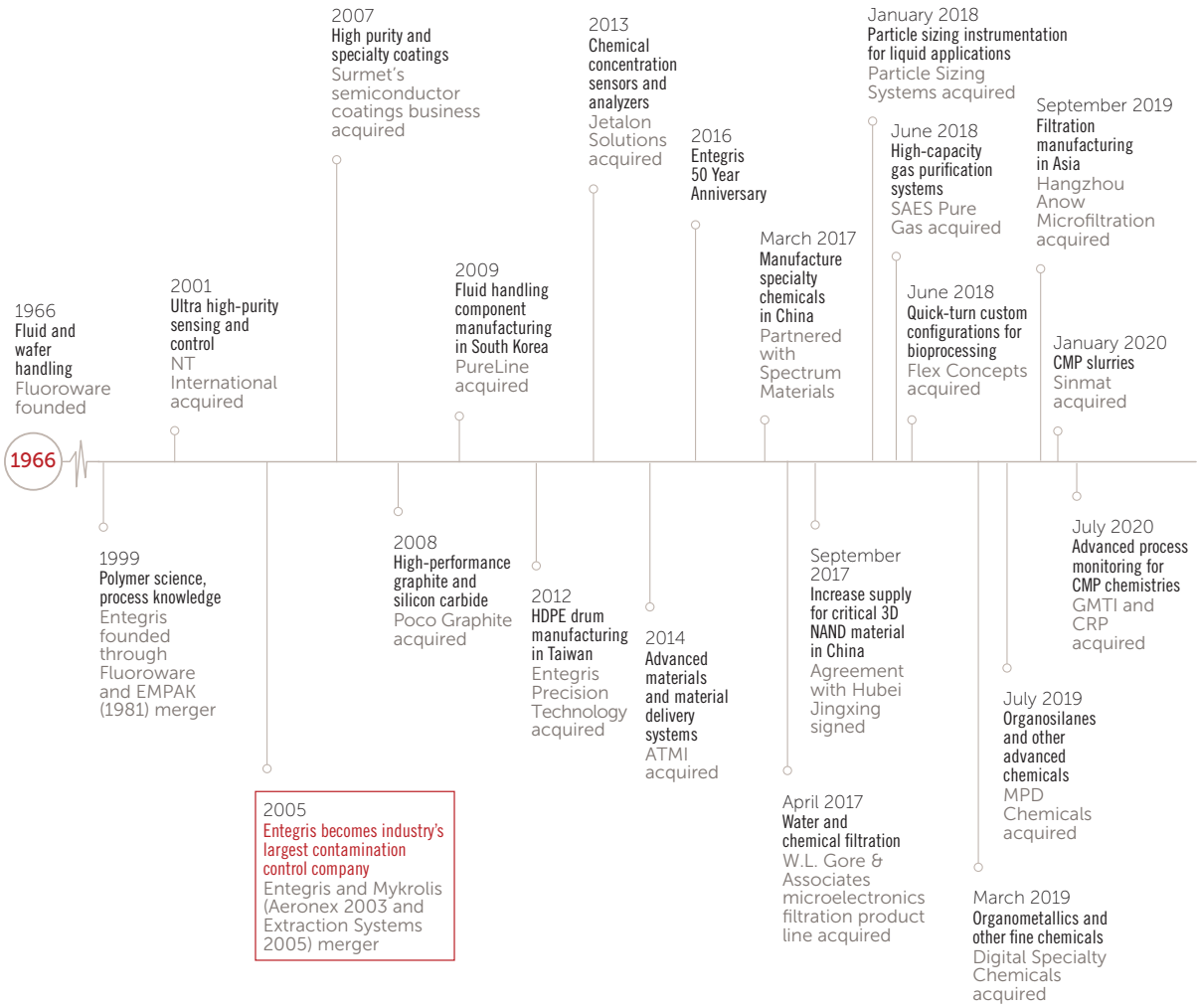
Why Entegris?

For more than 50 years, many high-tech industries have relied on Entegris to ensure the safety and purity of their technologies throughout the supply chain, from the raw chemicals to the final products. A portfolio of more than 19,000 products offers you a reliable, single-source provider with global manufacturing, customer services, and technical support. With a broad product offering, advanced manufacturing capabilities, world-wide infrastructure, and unmatched technical expertise, we provide proven performance and reliability to protect your overall process quality and efficiency.

We leverage our breadth of capabilities between semiconductor, life sciences, water treatment, energy, LED, consumer electronics, and aerospace markets.

HISTORY OF INNOVATION



EXPERIENCE YOU CAN COUNT ON

To ensure product performance throughout the production process, we have extensive capabilities in chemical, mechanical, and physical property analysis.

Contamination control is critical to your manufacturing processes and has a direct impact on production yields, product reliability, and operational efficiency. We focus on understanding your processes, sources of contamination, and on developing material-enabled solutions to ensure the cleanliness and integrity of those processes. We invest in identifying where impurities may be introduced and take corrective actions to prevent them, which is a critical first step in contamination reduction efforts.

To support your vital applications, Entegris utilizes more than 200 methods and applications, 300 analytical instruments, and 30 collaborating laboratories focusing on separation and materials science to provide you with the highest-purity, quality, and robust products.

Separation Science: Utilizing advanced knowledge in separation-science techniques to facilitate the separation, purification, and analysis of complex mixtures of organic and inorganic compounds offers solutions to precisely control micro and molecular contamination. Incorporating these techniques into your process improves your manufacturing flexibility and decreases your costs, providing you with the highest level of contamination control.

Materials Science: By studying the characteristics and uses of high-performance materials such as polymers, metals, graphite, silicon carbide, coatings, and carbon nanotube composites, we offer you high-quality products to improve performance, cost of ownership, and manufacturing yield. Sophisticated laboratory equipment and inspection techniques enable our scientists to thoroughly analyze materials for temperature capability, chemical compatibility, structural tolerance, and maximum strength.

PROVEN QUALITY AND PERFORMANCE

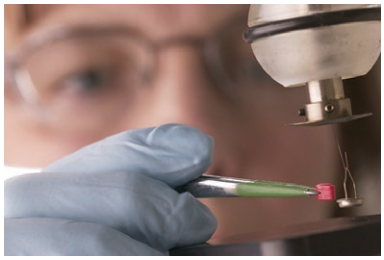
With over 2,300 active U.S. and foreign patents, we have the expertise to develop process knowledge and products that enable innovation and efficiencies. Combining advanced engineering and design expertise with tools such as Finite Element Analysis (FEA), Computational Fluid Dynamics (CFD), and MoldFlow® analysis and modeling enables us to optimize product design and speed technological advancements. In addition to innovative design, we also use R&D and quality lab analysis and testing capabilities to develop dependable solutions.

QUALITY TESTING

- Vibration and shock
- Safety and industry standardization
- Trace metals
- Electrostatic charge

PERFORMANCE TESTING

- Particle testing
- Flow rate optimization
- Ion chromatography
- Failure analysis



From the moment materials are delivered to Entegris to the time they are converted to products and installed in our customers' production lines, we ensure that they meet stringent specifications.

Ensuring product performance standards are met, proven techniques such as ISO 9001 certified manufacturing sites, documentation control, and quality testing are utilized. Each manufacturing capability has been developed, tested, and improved to create pure, durable, consistent, and reliable products.

- Membrane development
- Media development
- Ultrapure cleaning
- Molding
- Extrusion
- Tooling design/making
- Welding and flaring
- Overmolding
- Prototyping
- Machining

BROAD OFFERING

For more than 50 years, we have developed a broad portfolio of microcontamination control, advanced materials handling, and engineered materials to enable applications in many industries.

This experience offers you water treatment solutions in filtration and purification, housings, fluid handling, process monitoring, and liquid packaging to meet your needs and provide a single source of flexible product offerings.

CONTAMINATION CONTROL

Filtration and purification

Housings

Fluid handling

Process monitoring

Liquid packaging

CERTIFICATIONS

Our Savana® MBV filters are tested and certified by the National Sanitary Foundation (NSF International) to ANSI/NSF standard 42 for components used in water applications. GRP housings are made per the ASME Section X Class II "Fiber-Reinforced Plastic Pressure Vessels" or EN13121/EN13923 standards. Steel housings are made per the ASME Section VIII "Boiler and Pressure Vessel" code or the European 97/23/EC Pressure Equipment Directive. Certification is available for both GRP and steel housings as an option. Materials of construction for our Savana lab disc disposable filters and Savana MBV filters conform to the U.S. Food and Drug Administration Code of Federal Regulations Title 21 Part 177.

Certifications vary by application and product configurations; please consult product specific datasheets.

CLOSE TO YOU

SALES AND APPLICATIONS SUPPORT

Entegris continually invests in expanding analytical and technology center capability globally. Our global direct sales team, sales channel partners, local applications engineers, and world-class customer service give you the support and expertise to solve your most difficult problems. This intimacy allows us to better understand your needs through direct feedback and roadmap sharing. By aligning our materials science, engineering, and R&D initiatives, we can develop indispensable contamination-control and high-performance solutions to solve your roadmap challenges.

TECHNICAL AND ENGINEERING SUPPORT

You will receive strong technical support and training from our local service groups, and engineers consisting of field applications engineers, technical service groups, and applications development groups.

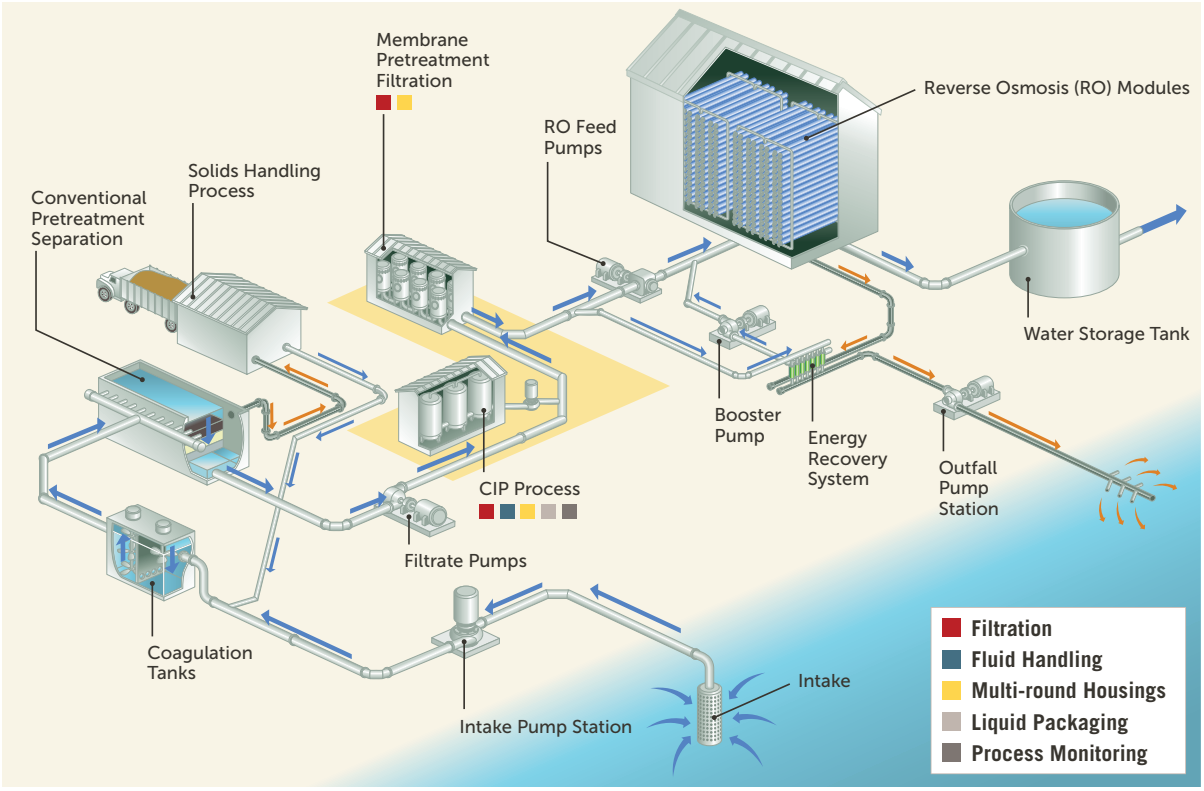
Our global field applications engineers work directly with you on product qualification and process improvements in your facilities. Also, in response to your needs for local technical service and fast turnaround, we maintain regional applications laboratories. These applications laboratories maintain process equipment that simulate your applications and provide product evaluation.

LOGISTICS EXPERTISE

To support your logistics requirements, we manage the infrastructure and service provider partnerships, offering broad capabilities to ensure your supply chain door to door. Providing import processing, insurance, and transportation, we bring expertise in air, ocean, LTL, intermodal, small package, and hazardous shipments. You will receive in-house, regional logistic support in the U.S., Germany, Israel, South Korea, Japan, Taiwan, Malaysia, Singapore, and China. And our top-ranked freight partners provide import processing services and transportation to all the remaining locations around the globe.

North America | Europe and Israel | Asia

Entegris in Water Treatment Applications



In many parts of the world, access to fresh water is limited. In other areas, global requirements to decrease water consumption require improvements to water management, especially in industrial processes such as ultrapure water required for semiconductor applications or produced water applications in mining/oil/gas. Water treatment spans a large number of industries and applications. Each application presents unique challenges to meet operating requirements in the most economical manner. Challenging applications, industry standards, and the pressure to be efficient and environmentally friendly require highly-engineered solutions for water treatment or recovery.

For decades, we have served the most demanding water treatment applications with broad capabilities in chemical handling, filtration, and purification. Offering filtration capabilities that span from microfiltration to nanofiltration and covering a large breadth of materials and membranes, our filtration capabilities address water challenges from 50,000 total dissolved solids (TDS) to removal of nanoparticles for the most demanding applications. Global laboratories, logistics, and infrastructure enable the highest levels of technical support across the globe to optimize your water treatment operations.

Desalination

Seawater, brackish, and other high salt content water offer an alternative source to meet the world's increasing fresh water needs.

As Sea Water Reverse Osmosis (SWRO) or Brackish Water Reverse Osmosis (BWRO) applications continue to grow, they bring a cost-effective alternative to distillation and condensation. Reverse osmosis (RO) operates ideally if the TDS are kept at low concentrations, as premature membrane fouling affects the RO function. Pretreatment becomes necessary to protect the desalination plant's RO core process, whether it is through coagulation, flocculation, or any other clarification method. If your current pretreatment components that require chemical cleaning are not fully chemically resistant, they may demonstrate lower-than-projected filter life – increasing your overall costs.

We offer corrosion-resistant multi-round filter housings and reliable filters to decrease downtime, increase filter life, and increase operational efficiencies from the laboratory to the largest municipal applications. These high-loading and low pressure drop filters improve the RO's efficiency and reduce the plant's overall energy consumption. For clean-in-place (CIP) filtration and chemical delivery, our solutions maximize system uptime and reduce operating costs. We are the preferred supplier of large GRP housings used in pre-RO and CIP filtration in several large SWRO projects (180,000 to 600,000 m^3/d) in the Middle East.

Process Water

Water is a vital constituent of the process or product being produced.

Particles, organic compounds, impurities, and other contaminants prohibit the use of tap water in laboratory applications, scientific research, sensitive process steps, and industrial processes. It is vital to control certain constituents. Suspended or dissolved contaminants can cause corrosion, scaling of boilers, pipes, and components, and also affect heat transfer in cooling water systems. Optimizing the performance of your process and equipment can dramatically minimize costs and maximize your return on investment.

We provide filtration and purification capabilities from removal of high solid streams to very tight low-loading applications
for ultrapure industries such as pharmaceuticals and semiconductors. Process water treatment involves the proper selection of the high-purity filtration and fluid handling systems to meet both the water purity requirements and the operational needs. Utilizing our laboratories to analyze feed water, we determine the optimum filtration solutions for your applications. For example, a filtration system may need adjustments to accommodate for filtrate changes, such as in cases where incoming surface water quality fluctuates due to seasonal variations or the water degrades with time from in-ground water source changes. Our chemical delivery, filtration, purification, and housing solutions help solve your most stringent water quality challenges, improve overall cost savings, and increase energy efficiencies.

Municipal Water

Scarcity and tougher water quality regulations make municipal water treatment a constant challenge.

Water treatment applications are complicated by variation in feed water quality. As an integral part of the process, microfiltration assists in producing safe drinking water by improving the water quality through removal of protozoa, algae, and other contaminants.

Choosing the correct components to function with other process variables and optimize water purity is important. To meet your challenging process and operational efficiency demands, we offer filtration solutions tested and certified by the National Sanitary Foundation for municipal and industrial applications. This ensures that they meet the highest industry standards for water purity and safety.

Additionally, the water treatment systems require CIP capabilities, and it is critical that the components utilized are chemically compatible to maximize the lifetime of the system. We provide the best cost of ownership solutions by minimizing operating cost through reduced energy requirements and improved component lifetimes. From high flow, depth, pleated, or melt-blown fibers to membranes of various materials and thicknesses, we offer a variety of filter lengths, diameters, flow rates, and connections to meet your housing and system requirements.

Ultrapure Water

As technology advancements increase, so do ultrapure water (UPW) cleanliness requirements in industries such as semiconductor and pharmaceutical.

Feed water contamination may include bacteria, particles, and organic and inorganic sources. These contaminants can cause defects in some applications or affect process capabilities or final product specifications. Metallic and anionic contaminants can cause failure in electronic products, corrode equipment, and interfere with bioprocesses. Making the right component, filtration, and purification choice is critical to your manufacturing. You require high contamination removal efficiency, consistency from batch to batch, and products that will not contribute to contamination levels.

As a leading supplier to the most demanding industries, we use the highest-purity materials to provide contamination control. Focusing on your process, we develop filtration, purification, and chemical delivery products to provide performance, efficiency and reliability in your UPW applications. Providing high flow, prefiltration and final filtration designed for applications requiring non-dewetting, hydrophilic properties, metal ion removal, asymmetric shape and deformable particle holding, Entegris offers a flexible product offering and broad capabilities. With more than 50 years of experience in filtration and purification, we offer high retention, low pressure drop, compact designs and contamination control to the ppm and ppb levels. Our Trinzik® UPW filters are particularly suited for UPW applications, providing unmatched flow rates and reliable performance in UPW systems for more than five years.

Wastewater Recovery

Water is often used or produced during industrial processes.

Before this water can be either discharged or recycled, it often requires treatment. The type of treatment required varies with local regulations and/or its designated applications, but all treatments require microfiltration to reduce total dissolved solids as part of the water treatment system. Wastewater treatment involves the proper selection of the microfiltration and fluid handling systems to meet water purity requirements, overall costs and operational needs.

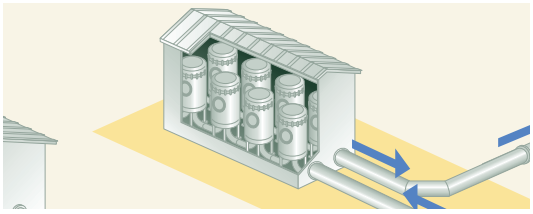
We provide filtration capabilities from removal of high solid streams to very tight low-loading applications in ultrapure industries such as pharmaceuticals and semiconductors. Utilizing our laboratories, we offer effluent analysis to determine the optimum filtration solutions in your applications. In addition to initial process optimization, a filtration system may need adjustments to accommodate for filtrate changes, such as in produced water applications where the organic/solid content varies with the age of the operation. Offering you innovative chemical delivery, filtration, and housing solutions, we can help solve your most stringent water quality challenges, improve overall cost savings, and increase energy efficiencies.

Entegris in Water Treatment Processes

We offer high-performing filtration and purification, housings, fluid handling, process monitoring, and liquid packaging solutions specifically designed to optimize your water treatment operations and provide reliability, ease of use, and reduced costs. Key processes include:

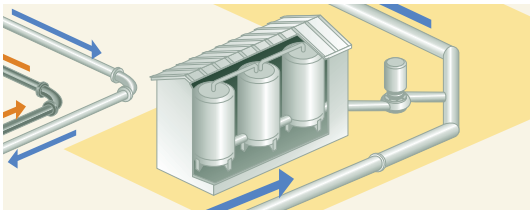
- ***Membrane Pretreatment Systems***
- ***Clean-in-Place (CIP)***
- ***Chemical Delivery***

MEMBRANE PRETREATMENT SYSTEMS



As you strive to protect the RO process from dissolved and colloidal foulants (iron, manganese, silica, and others) and natural organic matter, your pretreatment system components need to be cost-effective and reliable. Depending on your source water quality, the fouling potential could be quite variable and challenging. If your current pretreatment components need frequent chemical cleaning, demonstrate lower-than-projected membrane filter life and water quality targets, the pretreatment efficiency is lower, while the overall costs increase. We offer corrosion-resistant multi-round filter housings and reliable filters to decrease downtime, increase filter life, and increase operational efficiencies. These high-loading and low pressure drop filters improve the RO's efficiency and reduce the plant's overall energy consumption.

CLEAN-IN-PLACE (CIP)



Even with coagulation, precipitation or microfiltration steps, organic and inorganic compounds, colloids, slime, and particle fouling still happen. Because of this issue, you utilize harsh alkaline or acidic chemistries to remove organic fouling and low-pH chemicals (for example, citric acid, hypochlorous acid, sulfuric acid, hydrochloric acid) to remove inorganic foulants. To continue to keep your process running efficiently, you need rugged, chemically inert and reliable filters with broad capabilities that also provide for easy disposal. Filters with a high loading capacity and low pressure drop would improve the RO's efficiency and reduce overall energy consumption. Entegris offers GRP housings, a full range of highly retentive membranes, and more than 50 years of technical and manufacturing experience in the filtration of high-temperature, aggressive chemicals. In addition, we have fluid handling components to deliver clean chemicals, liquid packaging for safe chemical storage, and process monitoring instruments that provide accurate chemical dosing. These contamination control solutions help improve your operational efficiency and ensure the integrity of your RO process.

FILTER CARTRIDGES

RO feed water quality varies and appropriate filtration technology must be applied to achieve water quality requirements most efficiently and cost-effectively. With more than 50 years of experience in filtration we provide a wide range of filtration technologies and products designed to meet your form factor, water quality, chemical resistance, and process specifications. Our high-flow cartridges reduce the total number of filters and are easy to exchange. Depth melt-blown filter cartridges offer longer lifetime and cost-effective filtration of high particle loading water streams.

MULTI-ROUND GRP FILTER HOUSINGS

An effective pre-treatment system is needed to remove large particles, dirt, and colloids that may foul the RO units. Minimizing such fouling helps maintain stable RO performance, prevent RO membrane failure, and reduce cleaning downtime.

Our GRP housings and filter cartridges deliver reliable and effective filtration to protect downstream RO units. The GRP composite materials used in the housing does not corrode in saline applications and is easier to maintain than steel vessels. Our CNC controlled polar filament winding technology provides accurate, repeatable fiber placement and increases mechanical strength.

Designed for ease of operation, filter cartridges can be removed individually or as a whole basket. Spare baskets can be filled with new filter cartridges beforehand for quick filter changes.

Our GRP filter housings are designed to ASME-X or EN-13121/ EN-13923 standards and can be customized to required flow, pressure, and orientation.

Small size (400 to 700 mm ID) GRP vertical housing with fast opening

Fabricated as one part, no seams or joints

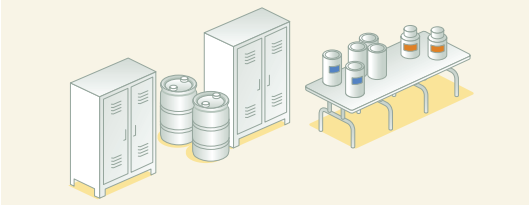
Large GRP horizontal housing with high-flow cartridges

Large GRP vertical housing design with cartridge basket

FLUID HANDLING

Without contamination-controlled fluid management systems, chemicals, though pure when delivered, are vulnerable to recon-tamination by particles, metals, and impurities. Not all components are the same in terms of cleanliness and chemical compatibility. Our fluid handling systems deliver a higher level of purity to meet your processing requirements.

CHEMICAL DELIVERY



Controlled manufacturing processes and facilities depend on many key parameters. The facilities department is the engine room and nucleus of the plant; a well-designed, well-maintained facilities area ensures operational excellence and operational costs that meet expectations. With water treatment, the facilities group has the responsibility to provide and distribute a number of key services in order for the plant to run effectively and efficiently. If one of these key components fails, it is inevitable that the end product will be impacted or some area of the production line will be closed down. The worst-case scenario is shutting down the entire production line until a solution is found. In a cost-competitive market, over-engineering or duplication of components is not possible due to the high investment costs and low return on investment (ROI). Making the right selection at the design stage of the facility is imperative. To solve your process and cost of ownership issues, we offer a full range of contamination control solutions for chemical compatibility and high performance.

FLUID HANDLING

Chemicals, though pure when delivered, may be contaminated by process components while transported to and through the process. Choosing the correct components to function with other process variables and optimize chemical compatibility is important. We have a proven understanding of fluoropolymer processing and regularly evaluate our fluid handling components to ensure they are the cleanest, best-performing components available to meet your stringent purity requirements.

LIQUID PACKAGING

High-purity PFA containers deliver safety and purity as you handle corrosive and hazardous chemicals from storage and transport to point-of-use and packaging processes. Providing easy connections and quick changeouts, our innovative key-coded dispense heads allow for safe, clean, and easy fill and dispense processes. Our solutions offer safety, purity, and reliable performance while at the same time improving your operational costs and maintaining the integrity of your chemicals.

PROCESS MONITORING

Ensuring accurate chemical delivery, our process monitoring solutions enhance both the productivity and safety of your chemical delivery applications. By directly measuring chemical concentration through an optical refractive index technology, our monitors ensure your chemical blends and validate system flushing after a clean-in-place operation. We offer a full line of high-purity, chemically-compatible control and measurement solutions for your most demanding applications.

Managing Your System Just Got Easier

Discover increased efficiency, lower operating costs, a global infrastructure, technology portfolio, and unmatched operational excellence. We use proven advanced materials science to help you solve your most difficult challenges to maximize uptime while reducing operating costs. Decades of experience enable us to provide water treatment solutions optimized for your application.

- Filtration and purification
- Housings
- Fluid handling
- Process monitoring
- Liquid packaging

For More Information

Visit www.entegris.com for the latest technical papers, application notes, or the Customer Service Center nearest you.

LIMITED WARRANTY

Entegris' products are subject to the Entegris, Inc. General Limited Warranty. To view and print this information, visit entegris.com and select the Legal & Trademark Notices link in the footer. Entegris does not warranty any failure in the case of customers using unapproved foreign components.

FOR MORE INFORMATION

Please call your Regional Customer Service Center today to learn what Entegris can do for you. Visit entegris.com and select the Contact Us link to find the customer service center nearest you.

TERMS AND CONDITIONS OF SALE

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