CERAMIC FILTRATION MANUAL

For Submerged Ultrafiltration (UF)

Version 1.0

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1. Introduction

Ceramic ultrafiltration (UF) is a cutting-edge filtration technology that utilizes ceramic membranes to separate and filter water. Ceramic membranes offer several advantages such as chemical and thermal stability, mechanical strength, less prone to fouling, superior performance, low power consumption, and long operational life span making the ceramic membrane process highly effective in a wide range of water applications.

This manual contains general guidelines for Cerafiltec technology, assembly, installation, commissioning, operation, and maintenance. However, depending on the application and its projection, project-specific installation requirements might be needed, thus, before installation, ensure that the location is ready as required by the project design and execution drawings.

It is vital that from the assembly personnel up to the user responsible for operation read this manual before installing and starting up the ceramic membrane filtration system. This manual must always be available at the location where the system is to be used.

It is necessary to observe not only the general safety information provided in this manual but also the pertinent safety laws as mandated by the country of location.

1.1 Safety Notices

The following safety notices are used throughout this manual to indicate potential hazards, prevent equipment damage, and ensure safe operation of the ceramic ultrafiltration system.

WARNING

Indicates a hazardous situation that could result in serious injury or death.

CAUTION

Indicates a situation that could result in equipment damage or minor injury.

NOTICE

Indicates important information to prevent product damage or improper operation.

2. Technology and Products

Ultrafiltration (UF) technologies provide a robust physical barrier against suspended solids, colloids, bacteria, and other microorganisms, producing consistently high-quality filtrate for municipal and industrial water treatment applications. In addition, UF membranes are commonly recognized as a disinfection technology, typically achieving a log removal value (LRV) greater than 5.

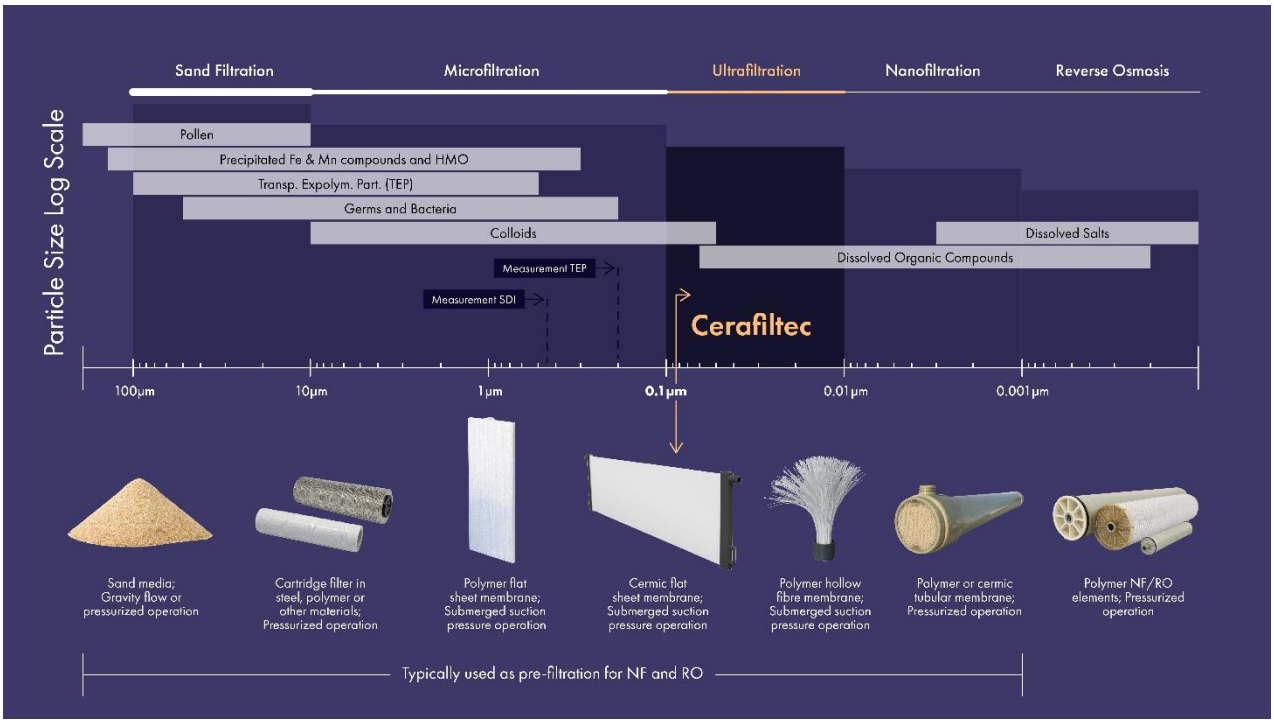


Figure 1: Filtration Spectrum with other filtration technologies

Cerafiltec's ceramic flat-sheet membrane solution goes beyond conventional ultrafiltration. The high resistance of ceramic materials, combined with enhanced cleaning capabilities, enables a high-performance filtration system designed for stable, low-maintenance, long-term operation.

When combined with advanced pre-treatment processes, such as active cake layer filtration for the selective removal of dissolved ions, Cerafiltec provides a superior filtration solution. It is particularly well suited as a pre-filtration step for desalination technologies, including nanofiltration and reverse osmosis. Cerafiltec filtration modules are highly resistant to seawater and are corrosion-free.

2.1 Cerafiltec Design Concept

A Cerafiltec module is a single, modular, and expandable filtration unit consisting of ceramic flat-sheet membrane plates installed in a glass-fiber-reinforced plastic housing. Each module can be equipped with up to 34 replaceable ceramic plates, providing a total membrane surface area of up to 6 m^2.

The module housing is designed to direct the feed water through internal channels while withstanding high mechanical loads. The housing and all associated accessories are completely metal-free, making the system suitable for highly demanding and corrosive applications while ensuring a long service life.

Figure 2 shows an exploded view of the Cerafiltec module, identifying its main components and illustrating the assembly of a complete filtration module.

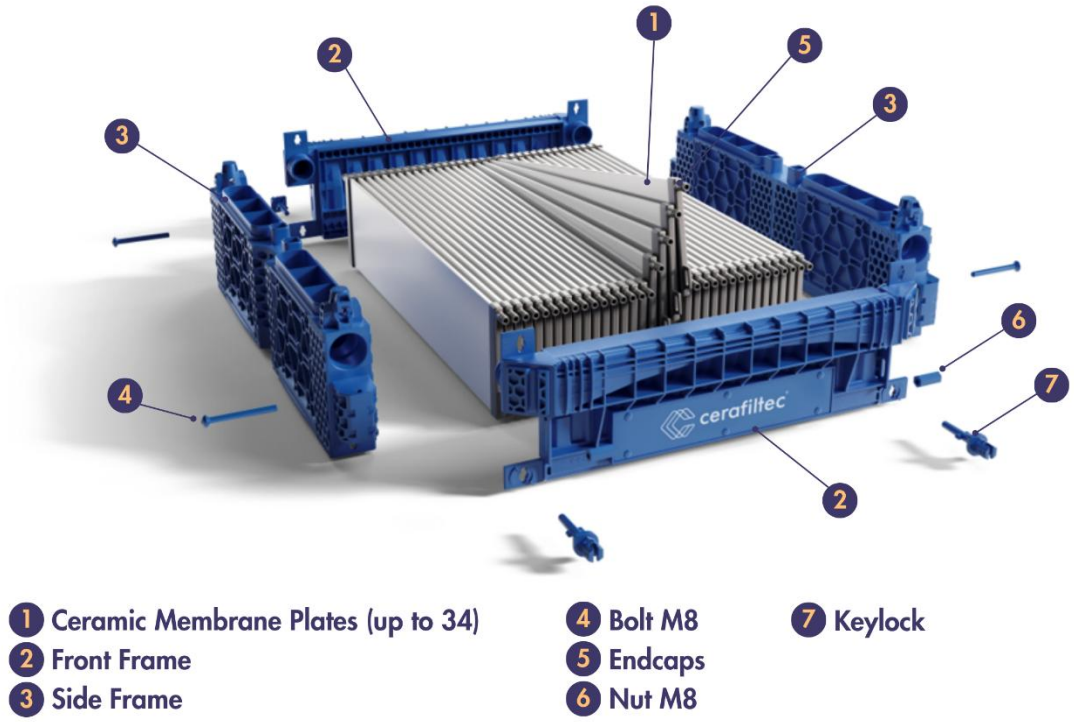
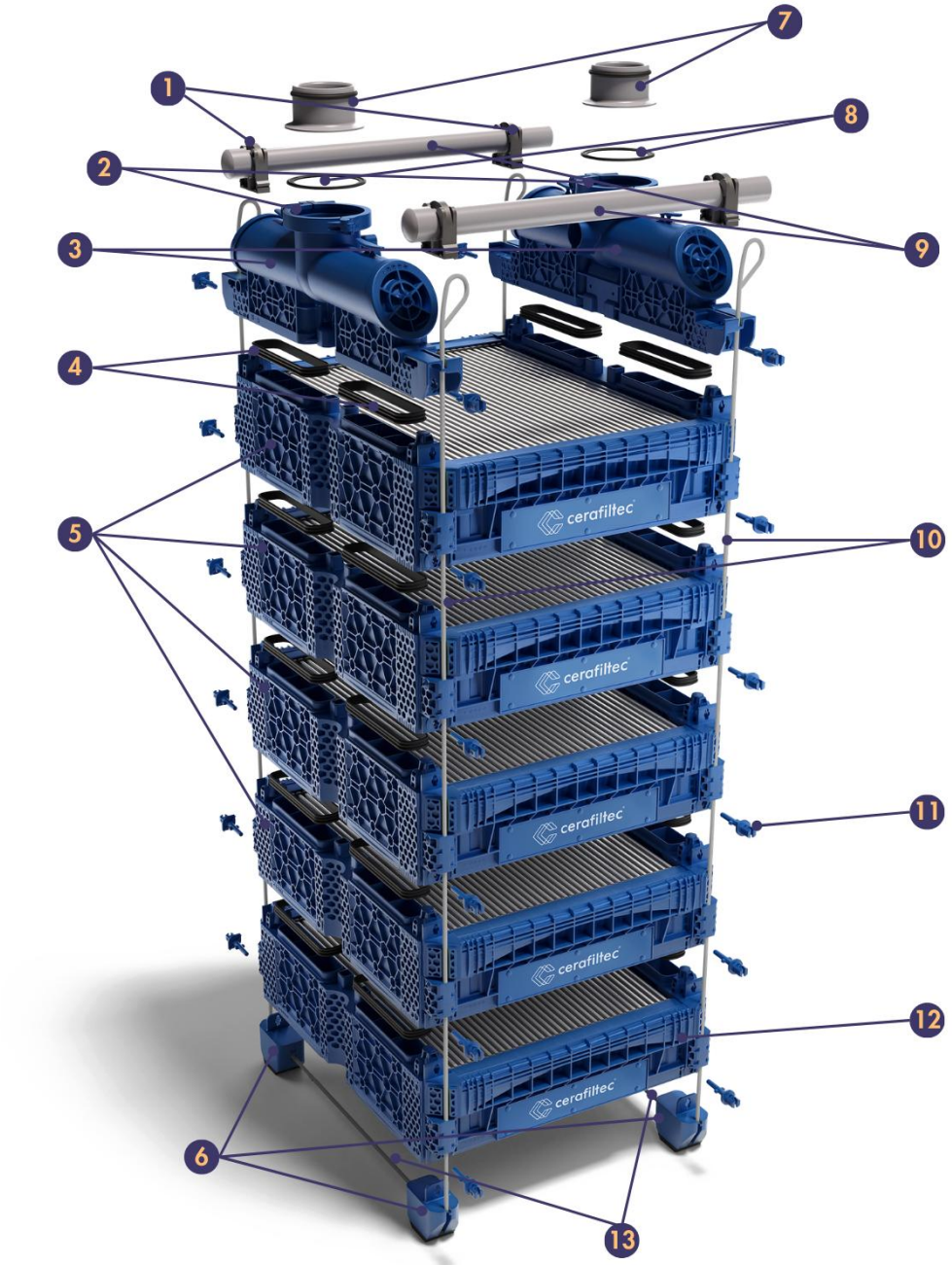


Figure 2: Exploded view of the Cerafiltec module showing the main components and assembly.

The Cerafiltec design does not require surrounding support frames or hose connections between individual modules. Up to 16 modules can be stacked vertically to form a module tower.

Figure 3 illustrates the assembly of individual modules into a module tower together with the main tower components.



1 Pipe Clips
2 Clamp
3 Header Collectors
4 Profile Gaskets
5 Standard Modules
6 Corner Feet
7 Clamp Adapter
8 Flat Gaskets
9 Sprinkler Pipes
10 Lifting Ropes
11 Keylock
12 Base Module
13 Rope Protection Pipes

Figure 3: Exploded view of a Cerafiltec module tower showing the main tower components.

A module tower can also be configured as part of a multi-tower arrangement. Multiple single towers can be easily connected via a common header pipe at the top of the towers. This fully modular configuration allows for flexible tower design without the limitations of a surrounding steel frame.

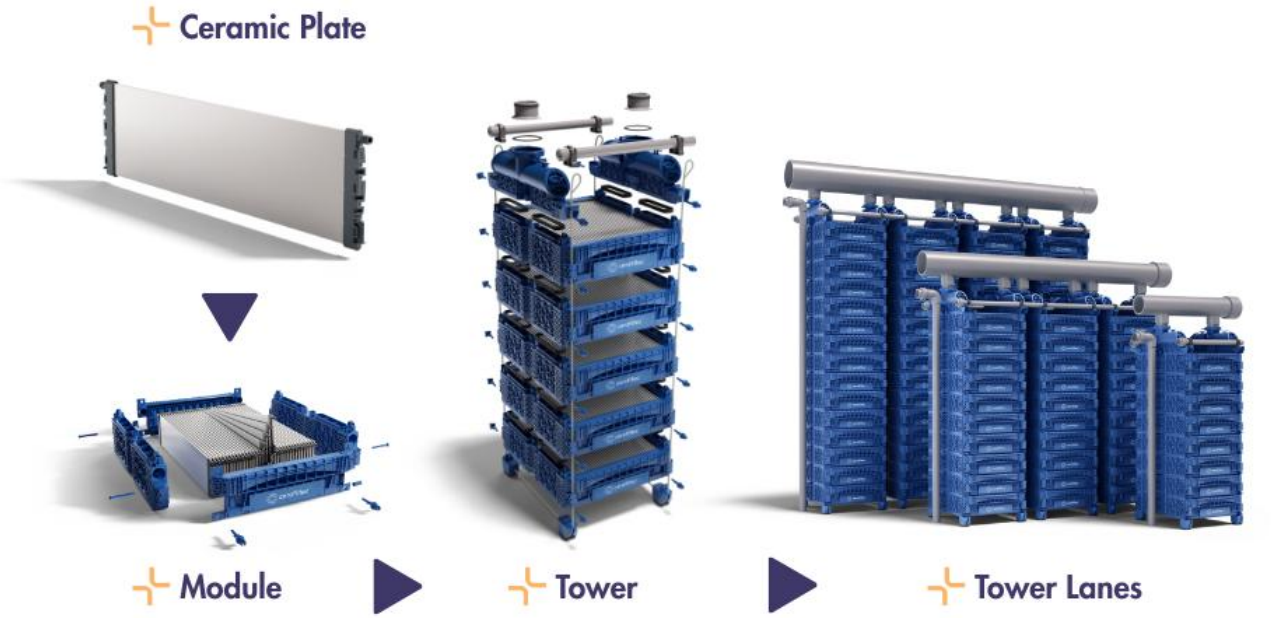


Figure 4: From a single membrane to a stack of modules (tower)

Benefits:

- Reduced filter area requirements due to high-flux operation, resulting in significant CAPEX savings
- Suitable for challenging applications without the risk of corrosion
- Capable of operation at elevated temperatures
- Fully modular design without a surrounding frame, allowing the number of modules per tower to be adjusted at any time to optimize project costs or increase future plant capacity
- Highly compact system layout, as towers can be installed close to each other without the need for interconnecting hoses

2.2 Module Specification

- Filtration module with ceramic flat sheet membranes suitable for submerged applications
- Multi-ceramic plate configuration with exchangeable single ceramic plates
- Internal filtered water piping
- Module housing fully made of glass fiber reinforced resin – free of any steel parts
- Out-to-in filtration and in-to-out backwash

Table 1: Module Specifications

	 Module 6.0 S BLUE 61	 Module 6.0 S BLUE 419	 Module 6.0 S BLACK
Certification	NSF Certified to NSF/ANSI 61	NSF Certified to NSF/ANSI 419	
Application	Drinking Water with NSF 61	Drinking Water with NSF 419 + 61	Wastewater Industrial & Municipal
Dimension L x W x H	710 x 576 x 160 mm/28.0 x 22.7 x 6.3 in		
Dry weight	36 kg/ 81.6 lbs		
Material *Ceramic Plate*	Alumina		
Material *Module housing*	SABIC NORYL™ resin 30% glass fiber reinforced blend of PPE/PS		
No. of plates *per module*	34		
Avg. spacing *between plates*	6.7 mm / 0.26 in		
Filter area *per module*	6.0 m^2 / 64.6 ft^2		
Permeate pressure *Max. suction*	-0.7 bar / -10.2 psi		
Backwash pressure *Max. delivery*	1.2 bar / 17.4 psi		
Max. operating temperature	60 °C / 140 °F (D. HOT)		40 °C / 104 °F

2.3 Accessories and Tools

Cerafiltec supplies accessories as Integral, Essential, and Ancillary Accessories.

Integral Accessories are required for a complete tower assembly and form an integral part of the standard system configuration.

Essential Accessories are required for proper installation and maintenance during operation.

Ancillary Accessories can be supplied by Cerafiltec for specific applications and are generally considered client scope. Cerafiltec provides the corresponding specifications and drawings where applicable.

Detailed information, including technical specifications and drawings, will be provided during project execution.

Table 2: Integral accessories

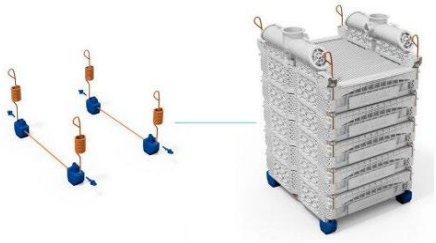
Header Set	Base Set
 – Connection from the top module of a tower to the header piping – Contains 2 header collectors, 4 clamp halves 4", 2 clamp adapters, 2 flat gaskets, 2 bolts & nuts, and 4 keylocks – Simply to be connected via key lock system – Simply to be connected via a key lock system – Plastic pipe adapter available in different sizes, metric as well as ASTM standard – Plastic pipe adapter to be glued to standard hose or pipe sizes	 – To be installed at the bottom of a tower, below the base module. – Contains 4 corner feet, 2 rope protection pipes, ropes, and 4 keylocks – To be installed below the bottom/base module of each tower – Simply to be connected via a key lock system – Rope to be threaded through each module and to be connected to the lifting device for installation of the tower inside the tank – Once the tower is installed, the rope ends to be fixed on the header collector

Table 3: Essential Accessories:

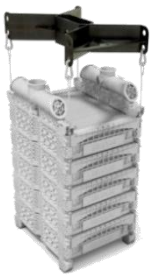
Lifting Device	Mounting Tools	Spare Part
 	 1 x Socket Nut 17 mm 1 x Screwdriver TX27 1 x Screwdriver flat 2 x Hand clamp long 2 x Hand clamp short 2 x Membrane Positioning Tool	 → Open Catalog

Table 4: Ancillary accessories

sUF	
Sprinkler Set (Essential)	Aeration Set (Essential)
	
	

3. Transportation, Storage, and Handling

The following transportation, storage, and handling instructions describe how to handle the Cerafiltec ceramic membrane modules correctly. It is important to read these instructions attentively to handle the product in a safe way.

3.1 Transportation

Cerafiltec modules are typically packed on Euro pallets and protected by wooden frames with a wooden lid or alternatively wrapped in protective foil. The packaging method may vary depending on customer requirements, destination, and selected freight method.

The maximum pallet height and the number of modules per pallet depend on the applicable freight method and transport requirements. For safety reasons, the maximum recommended stack height is 10 modules per tower. This means that up to 2 × 10 modules can be transported on one pallet.

Typical pallet dimensions and weight are approximately: 120 cm x 80 cm x 215 cm with a weight of ~ 900kg max.

Figure 5: Packaging of Modules

CAUTION: Use only suitable means of transport and safety devices and secure Cerafiltec's ceramic modules against shifting and tilting!

NOTICE: Shipment is only permitted in dry conditions at temperatures between a minimum of 5°C (41°F) and a maximum of 40°C (104°F).

CAUTION: To move the euro pallet, a suitable forklift is necessary!

The offloading of the equipment and package must be done with an adequate forklift. Refer to the technical specifications for the exact weight of the units and always operate lifting equipment according to the manufacturer's recommendations. Do not walk, stand, or place any loads on top of the packaged equipment.

WARNING: Don't use a crane with rope-system as damage to the membranes may occur!

Figure 6: Use adequate forklift for unloading

Figure 7: Wrong unloading of pallet box

If deviations or damage are identified during inspection of the packaging units, the affected modules and/or equipment must be clearly labelled, separated, and stored appropriately. The affected packaging units, modules, or equipment must not be installed under any circumstances until Cerafiltec's Quality Assurance department has been consulted and has determined whether the components may be used, must be returned, or must be scrapped.

WARNING: Pay attention to the weights when unloading and lifting the module towers!

The weights of the individual pallets can be found on the enclosed delivery notes.

3.2 Storage

CAUTION: If temporary storage of ceramic modules is necessary, it must take place on a suitable, level surface!

NOTICE: Storage is only permitted in dry conditions at temperatures between minimum 5°C (41°F) and maximum 40°C (104°F)!

CAUTION: Direct solar radiation must be avoided at any time to prevent damage caused by the tension of the material!

CAUTION: While in storage, possible damages to Cerafiltec´s ceramic modules through environmental influences or extraneous cause must be avoided!

WARNING: Keep away from heat or flame!

CAUTION: Take extreme care to prevent membrane surface from damage, since membrane is exposed to surroundings. If possible, maintain membrane modules in the wooden crates/foil they arrive in, until time of installation!

The membranes must be stored dry. If stored wet, there is a risk of biological growth on and inside the membrane modules that will require expensive cleaning.

3.3 Handling

The components may be heavy. Always ensure that sufficient personnel are available for safe handling.

After opening the transport boxes, visually inspect the modules for damage. Any visible external damage, for example damage caused during shipment, must be documented and reported immediately to Cerafiltec in writing. The report should include relevant information such as module numbers, a description of the complaint, photographs, and any other supporting documentation.

CAUTION: Cover the top module of assembled towers with a Styrodur® or plastic plate to prevent damage! Keep the cover all the time until the installation is complete. Remove it when the system is ready for start-up and commissioning.

Modules are normally delivered as pre-assembled towers in wooden boxes on Euro pallets. Due to shipment height limitations, some towers may be delivered only partially assembled, and additional modules may need to be added on site to complete the final tower configuration. If a tower must be assembled on site, ensure that all required parts are available in the correct quantity and are in good condition before starting the work.

Cerafiltec recommends that modules are handled by at least two people. They must wear suitable personal protective equipment, including safety shoes and safety gloves. The total weight of a dry module is approximately 36 kg. Modules must be handled only by the front sides. Never lift, carry, or support modules by the membranes or from below the membrane area. Any damage resulting from improper handling will void the product warranty.

Modules may also be lifted by crane when the header set is attached, provided that suitable lifting equipment is used and all applicable lifting and safety requirements are observed.

Figure 8: Handling of modules

Membrane discoloration may occur during transport and storage because the membrane material is hydrophilic and may absorb or attract moisture from the surrounding environment.

Such discoloration does not indicate a quality defect and does not affect membrane performance. It can be removed during start-up by performing a membrane cleaning with a sodium hypochlorite solution containing 200 ppm free chlorine.

3.3.1 Lifting of a Module Tower

When lifting a module tower by crane, all applicable local regulations, standards, and safety instructions for lifting heavy loads must be strictly observed.

The following Items should be on site:

- Original Cerafiltec lifting device (highly recommended)
- Shackles, grommets, and coil loops suitable as per the tower weight.
- A crane which can handle the given weight at the necessary cantilever.

Ensure that all four rope ends are positioned at the same height. If the rope ends are not level, open one knot and adjust it to the correct position until all four ends are at equal height. Insert a grommet into each knot.

The lifting device must be suspended centrally from the crane hook using a suitable lifting belt.

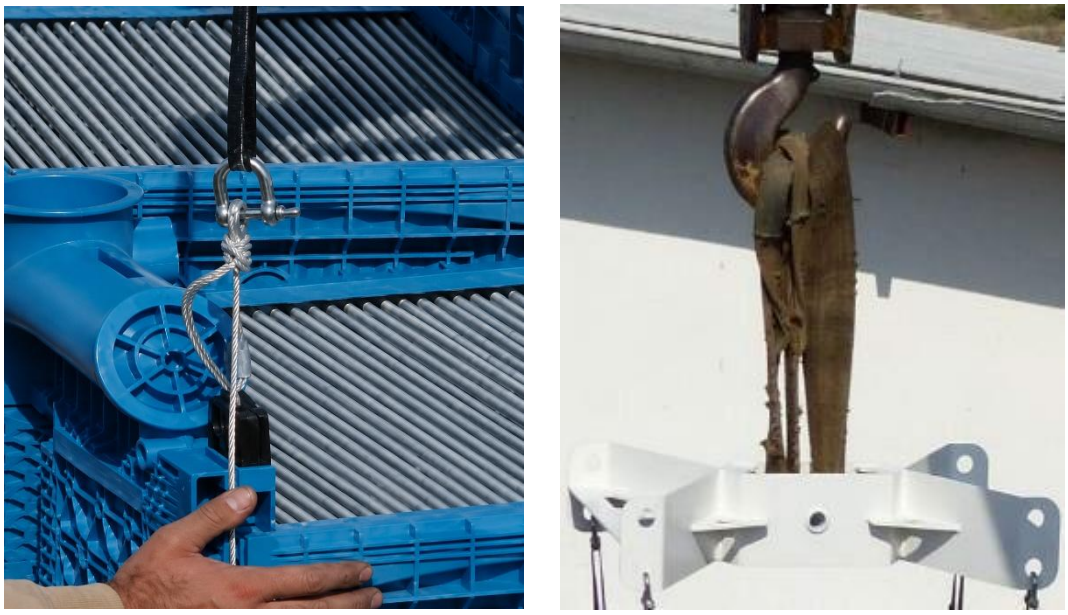


Figure 9: Fixing lifting arrangement

Connect four coil loops to the lower holes of the lifting device using four suitable shackles, preferably triangular shackles. The length of the coil loops depends on the specific site requirements. The coil loops must be connected to the rope using suitable shackles or carabiners.

When connecting the lifting device to the filtration tower, ensure that it is positioned correctly. Since the module has a rectangular cross-section, the lifting device must be aligned in the correct orientation.

Tip: The shorter side of the lifting device must be on the same side as the front frame (Cerafiltec logo).

The coil loops must hang exactly vertically. If the coil loops are not vertical, open the shackles and rotate the lifting device by 90° before reconnecting it.

Figure 10: Lifting a tower with the Lifting Tool

CAUTION: Cerafiltec's ceramic modules must be protected against shocks and strong vibrations at any time!

CAUTION: Direct solar radiation must be avoided at any time to prevent damage caused by tension of the material!

4. Safety Instructions

This section is intended to ensure the protection of personnel and the system during plant operation.

4.1 Chemical Safety

Various chemicals are used for cleaning the filtration unit. Acids are used to remove deposits of inorganic salts, while sodium hypochlorite is used to remove fouling caused by bacterial growth on the membrane surface.

Chemical storage tanks must be refilled when the tank level is low or empty. When handling chemicals, the following safety instructions must be strictly observed:

- Wear appropriate personal protective equipment, such as protective gloves, safety glasses, and suitable protective clothing, and always follow the instructions provided in the applicable Material Safety Data Sheet (MSDS).
- Ensure that each chemical is filled into the correct storage tank. Always compare the chemical with the safety labels on the storage tanks before filling.
- Never mix incompatible chemicals. In particular, acids and sodium hypochlorite must not be mixed, as mixing them can spontaneously generate chlorine gas.
- Failure to follow these instructions may result in severe injury or death.

4.2 Cautions and Warnings

Hazard Symbol	Description	Safety Instructions
	WARNING OF TILTING DANGER! Always ensure the stability of the Filtration Unit against tilting. Depending on the height of the Filtration Unit an anti-tilting device may be necessary!	
	WATCH FOR FALLING OBJECTS! Watch always for falling objects. We recommend wearing a safety helmet and safety shoes during assembly, replacement, maintenance or repair! Please follow the safety instructions in this document.	
	WATCH FOR SHARP EDGES! Watch always for sharp edges. We recommend wearing gloves during assembly, replacement, maintenance or repair! Please follow the safety instructions in this document.	

Hazard Symbol	Description	Safety Instructions
	WARNING OF HEAVY COMPONENTS! Some components may be heavy. Always ensure that an adequate workforce is available. We recommend for the handling of the Filtration Modules, at least 2 workers	
	CORROSIVE MATERIAL In the event of cleaning (ACEC), avoid any contact with irritant and/or corrosive chemicals. We recommend wearing protective goggles and gloves during the whole cleaning process! Please follow the safety instructions in this document and the material safety data sheet (MSDS) of the chemicals!	
	RISK OF BREAKAGE! Some components are fragile (in particular the ceramic membranes). Always handle all components with care. We recommend wearing gloves in case of any damage! Please follow the safety instructions in this document.	
	EXCESS PRESSURE In the event of backwashing and CEB process, the permeate channels and the filtration modules are subject to pressures not to exceed 1.2 bars. Keep clear of these components during these processes. We recommend wearing protective goggles at all times.	
	BIOHAZARD In the event of using Cerafiltec modules for the treatment of e.g., waste water or other water with possible biological contaminations, ensure that all local regulations are observed. We recommend wearing protective goggles and gloves at all time!	
	GENERAL WARNING Please note that not all local regulations, hazard warning notices and safety instructions are covered by this document using Cerafiltec modules. Please acquaint yourself with the local regulations in order to avoid any health risk! We recommend wearing protective clothing at any time!	

5. Assembly, Installation, and Commissioning

The instructions for assembly and installation are intended to ensure the correct setup and reliable operation of the ultrafiltration (UF) system.

5.1 Assembly

This section provides the instructions required to prepare, assemble, and disassemble the ceramic filtration tower safely and correctly.

5.1.1 Preparation

A filtration tower mainly consists of stacked ceramic modules. Although the ceramic material is highly robust and capable of withstanding harsh operating conditions inside the filtration tank over long periods, ceramic components can break if subjected to strong mechanical impact. Damaged ceramic components must be repaired or replaced before installation or operation.

In addition, dust and oily aerosols should be avoided, particularly for systems intended for drinking water applications, as contamination may negatively affect system cleanliness and performance.

Upon delivery to the installation site, only the top of the wooden transport box should initially be opened in order to:

- inspect the modules and towers for visible damage, and
- verify the completeness of the delivery against the delivery note and packing list.

After inspection, the transport box should be properly closed again and kept closed until tower assembly begins. Storage temperature must not exceed 40 °C. For further details, refer to the applicable storage and handling instructions.

Modules are normally delivered as pre-assembled towers packed in wooden boxes on Euro pallets. Due to transport height restrictions, some towers may be delivered only partially assembled, and additional modules may need to be added on site to complete the final tower configuration.

If on-site tower assembly is required, ensure that all necessary parts are available in the correct quantities and in good condition before starting assembly. Component quantities should be verified using the packing list.

If unacceptable deviations, damage, or missing parts are identified during inspection, the affected items must be clearly labelled and separated. Such components must not be installed under any circumstances until Cerafiltec's Quality Assurance department has reviewed the issue and determined whether the modules or accessories may be used, returned, or scrapped.

The filtration tower can be assembled using only a limited number of tools; however, assembly must always be carried out by at least two persons.

Figure 11: Sliding agent to be put with brush (e.g., Molykote compound 111)

The following items should be available on site before assembly begins:

- Suitable lubricant for all profile gaskets at the permeate connections. As standard, the gaskets are made of EPDM. Therefore, the lubricant must not contain mineral oils or any other ingredients that may degrade EPDM. Depending on the application, the lubricant must also comply with applicable local regulations and approvals, for example drinking water approval where required.
- A clean brush for applying the lubricant.
- A flat and stable working surface of at least 1 × 1 m or 3 × 3 ft.
- One or two ring spanners, size 17 mm or similar. A spark plug spanner, for example, is also suitable and works well for this purpose. This tool is used for the key lock. Do not use a screwdriver, as this may damage the key lock.

5.1.2 Tower Configuration

The tower configuration may consist of 1 to 16 modules, resulting in an overall tower height between 435 mm and 2,675 mm, depending on the selected configuration.

Before assembly, verify the tower size specified for the project.

Each filtration tower always starts with a base module, which is the lowest module of the tower.

Table 5: Mounting Filtration Tower Basic Information

Tower Size *No. of Modules*	Height *mm*	Weight *kg*	Rope length *mm*
1	435	46	2 x 2520
2	595	82	2 x 2840
3	755	118	2 x 3160
4	915	154	2 x 3480
5	1075	190	2 x 3800
6	1235	226	2 x 4120
7	1395	262	2 x 4440
8	1555	298	2 x 4760
9	1715	334	2 x 5080
10	1875	370	2 x 5400
11	2035	406	2 x 5720
12	2195	442	2 x 6040
13	2355	478	2 x 6360
14	2515	514	2 x 6680
15	2675	550	2 x 7000
16	2835	586	2 x 7320

5.1.3 Assembly of Module Tower

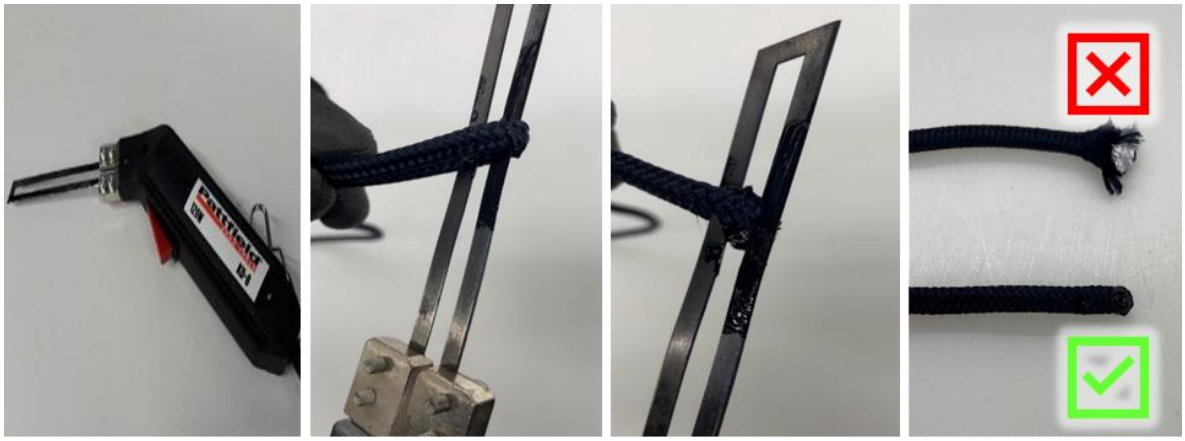
It takes at least two people to assemble a filtration tower. Refer to the following steps:

1. Put one base module on the floor. Put it on the front frame and lift one side. Put 2 corner feet in and secure it with 2 key locks. Lift the module in the same way on the other side and assemble the other both feet with the key locks.

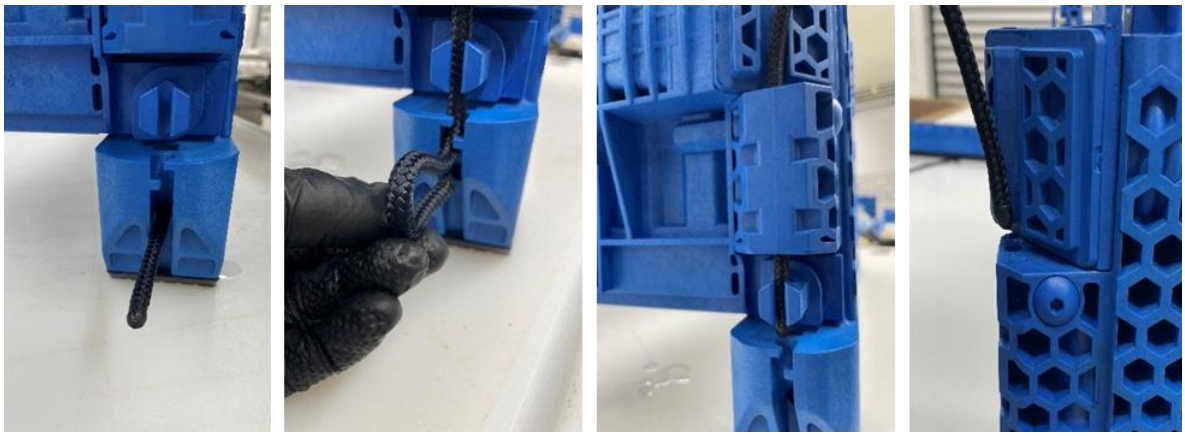


CAUTION: Ensure that the first module is a base module! All succeeding modules above it are standard modules.

2. For one tower, two ropes are necessary. The ropes must be the same and the right length. Both ends must be cut with a special hot rope cutter, not with a knife or scissors. The diameter of the rope ends should not be wider than the rope itself, otherwise, it will cause problems during threading.



3. Thread one rope left and right into the holes on the lower side of the corner feet until it comes out on the top of the first module. If it is stuck, try to twist the rope with your fingers with a slight pressure. Do the same with the second rope on the other side. Finally, all 4 ends of the two ropes are on the top of the first module.



4. Make sure the gasket is placed in the correct orientation. New gaskets have a little flap on the bottom – see picture on the left. Previous gaskets may not have this flap. In this case, the thicker side must face down – see picture on the right.

CAUTION: If gaskets are installed incorrectly (upside down), the module will pass pressure decay testing under pressure, but leaking under suction is possible. Please verify that the largest rib of the gasket is on the bottom side

5. When all 4 gaskets are in the right position, coat only the outer side of the gasket with slide agent. Use a clean brush for this activity.

6. Put the second module on the top of the first, press it, and use the one-handed clamp from the Cerafiltec Mounting Accessories.

   Don't force the welded edges of the plastic frame!

7. Press the one-handed clamp, put the key lock into the holes, and close it with the ring spanner.

CAUTION: The key lock's "line" should be positioned horizontally when inserting it into the hole, and ensure that it is fully inserted before turning clockwise until the "line" is in a vertical position. Never try to close the key with force!

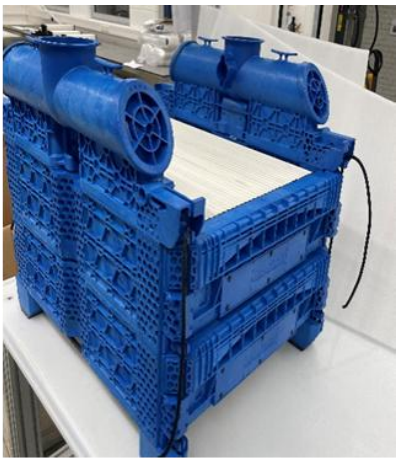
8. Thread the rope through each corner until the top module is finished.

9. Repeat the instructions 4 to 8 until the correct size of the tower is reached.

10. The completion of a tower is the header collector.

Installation is the same as for a module (step 4 to 8).





11. Prepare the lifting knots at every end of the ropes.






12. Install the pipe clips for the sprinkler system. Turn the pipe clip in the right direction and push it into the cutout until you can hear a “click”. When both clips are installed and open, do the same on the other side of the tower.



13. Put the sprinkler pipes and turn until the top holes are horizontal.

To install the pipes, they must be cut to the right length, which is defined by the distance between the towers. Ideally, the connection will be done by a metric screw fitting. The fitting will be connected to the pipe by gluing it with a special glue for PVC-U pipes. The final tightening of the threads of the PVC fitting must be done after the installation of the towers in the filtration tank.

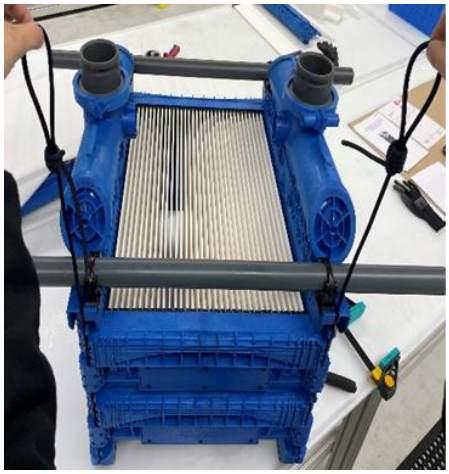
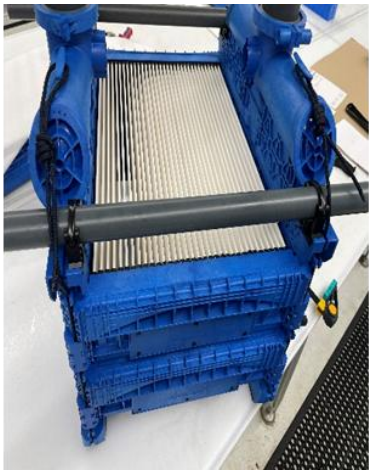


Note: Certain applications may not require a sprinkler system. In such cases, pipe supports are used instead of sprinkler pipes.

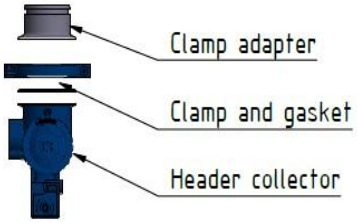
14. Assemble applications adapter to the header collector.



15. Assembly of the tower is now complete. Insert the shackles to lift the tower. Ensure that the shackles are suitable for the weight of the tower.


Cerafiltec will provide up to clamp adapter only. Client to prepare o-rings, flexible PVC pipe, and collector pipe to complete the tower assembly



Step-by-step installation video guide:
https://www.cerafiltec. com/how-to-assemble/

5.1.4 Disassembly of a Module Tower

Lift the tower and place it on a flat and stable floor.

Remove the header by opening the four keys and pulling on the header parts. Place the header parts on a clean surface.

To disassemble a tower, first open all four rope knots. Then open all four keys of the top module using a ring spanner. The top module must be lifted by two persons. Repeat this procedure for each subsequent module until the tower is fully disassembled.

Handle all modules with care. Place the modules only on a flat and stable surface. Do not place tools or other objects on top of the modules. If the modules are to be stored for an extended period, they must be covered or placed in a suitable box to protect them from contamination and damage.

5.2 Installation

Tank dimensions and the required filtration equipment are defined in the Cerafiltec project design. The tank design and all relevant standard drawings required for installation will be provided during project execution.

Due to the modular tower design, Cerafiltec equipment can be installed efficiently and with a high degree of flexibility.

5.2.1 Preparation of the Filtration Tank

The filtration tank should generally be designed as compactly as possible in order to reduce water loss during discharge and cleaning operations.

If cross-flow is required during filtration, for example by continuous aeration during the filtration process, sufficient space must be provided around each individual tower. As a minimum, the free area around each tower should correspond to the tower cross-section when viewed from above. This space is required to ensure proper downstream flow conditions.

A reliable sludge removal during backwash and complete tank drain for chemical waste is essential for the system. For this purpose, a drain channel or ditch is required underneath each tower or tower lane. Depending on the application, a drain channel with a slope up to 2% is required or be installed with no slope is required. The required channel width must correspond to the total inner width of the membrane tower, typically 520 mm.

A smooth trowel finish is required, particularly on the tank bottom, to prevent the accumulation of sludge and deposits and to ensure complete and effective tank drainage. The bottom surface should also be water-levelled to allow proper installation of the base frames, tower position holders or support frames.

The tank surface must be chemically resistant to protect it from exposure to cleaning chemicals. Typically, tank coatings such as epoxy or polyurethane linings are applied to provide additional chemical resistance.

Concrete corrosion must be avoided under all circumstances. Debris from damaged or broken concrete can severely damage the membranes.

Before installation begins, the filtration train must be fully prepared. This means that all civil construction work has been completed and that piping, valves, instrumentation, and all related works within the scope of the project partner have been installed.

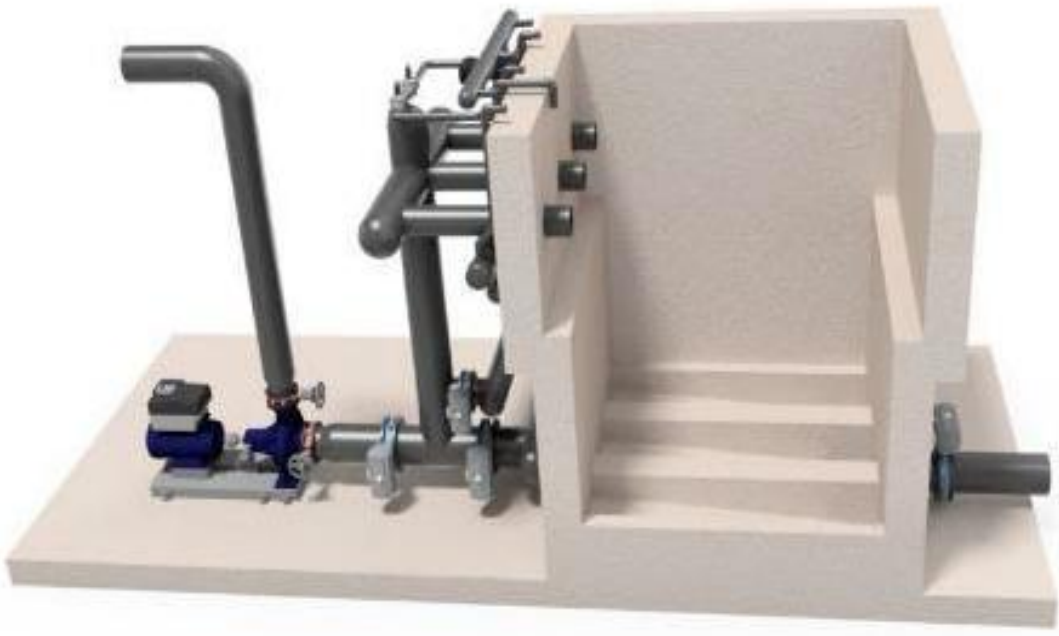
5.2.2Installation Steps in the Filtration Tank

NOTICE: Cerafiltec will provide its specific scope of material supply. All other components and accessories not explicitly mentioned will be end-user/installer scope. End-user/installer shall fully understand the required materials and have them ready before installation of the tower modules inside the tank. Cerafiltec will not be responsible for providing any missed components under the end-user scope.

Important Note: Adhere precisely to the general arrangement (GA) drawing to ensure all components are in the right position and properly aligned during installation.

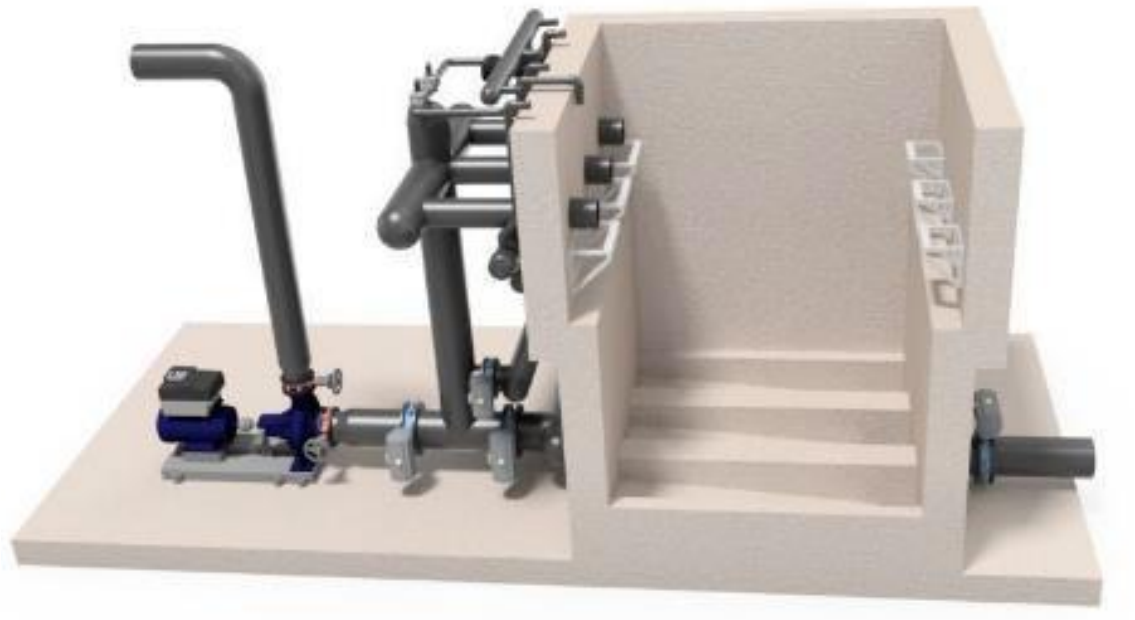
The next steps are an example of a typical standard Suf (3 tower-lane) installation.

1. Installation of filtration Tank.

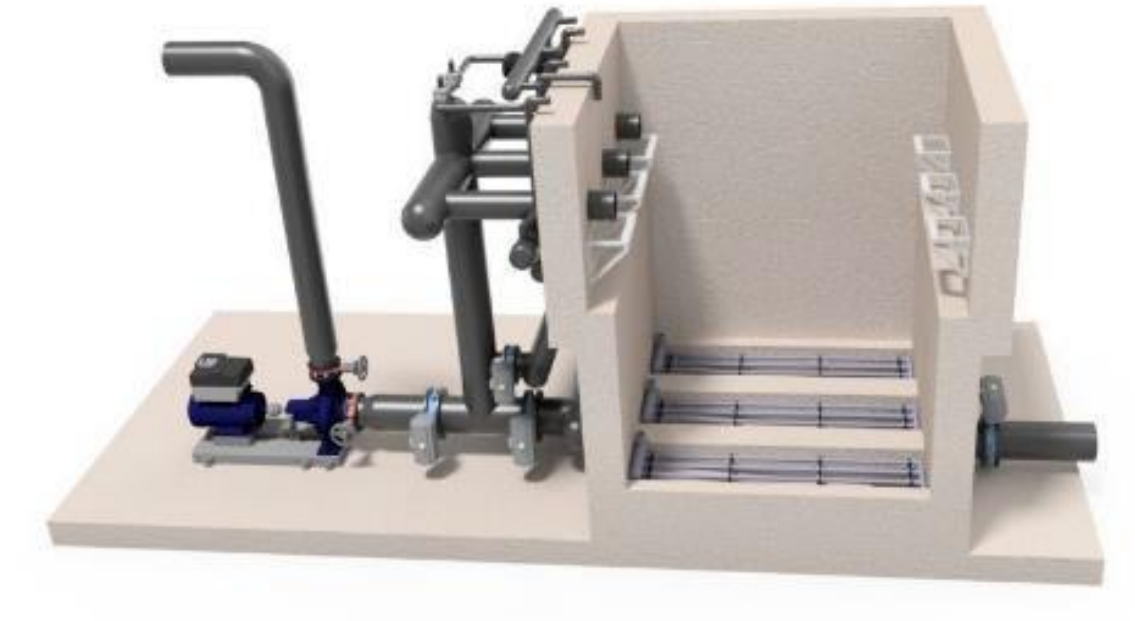


Ensure that the puddle pipes are fixed in the center of the channel and that the center of the puddle will be aligned with the center of the towers.

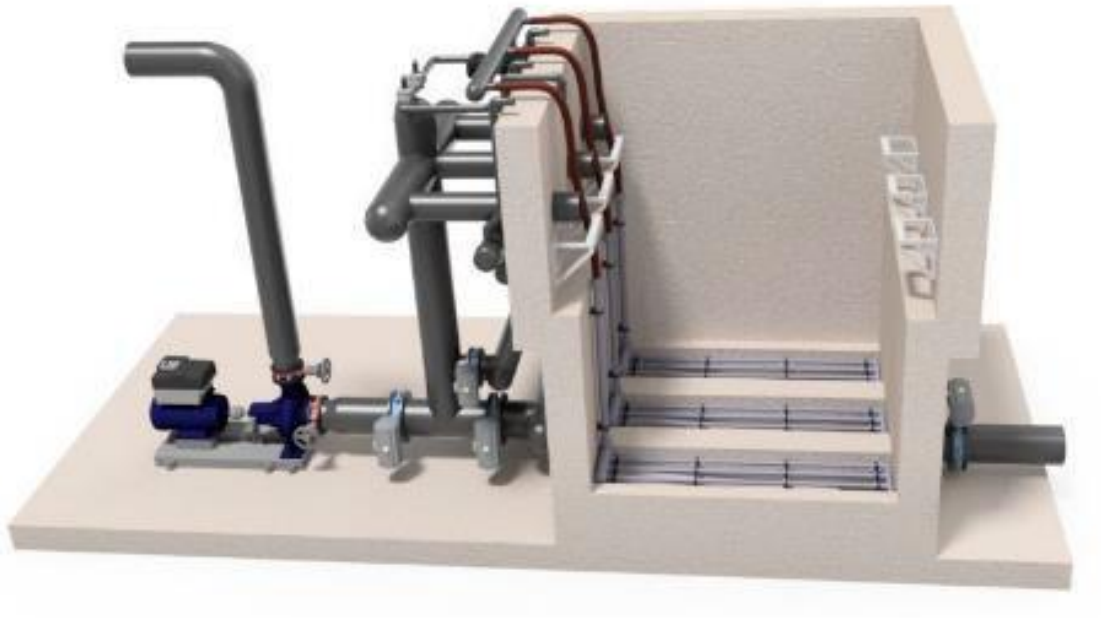
2. Installation of filtered water header **pipe holders** on the left and right sides of concrete walls.



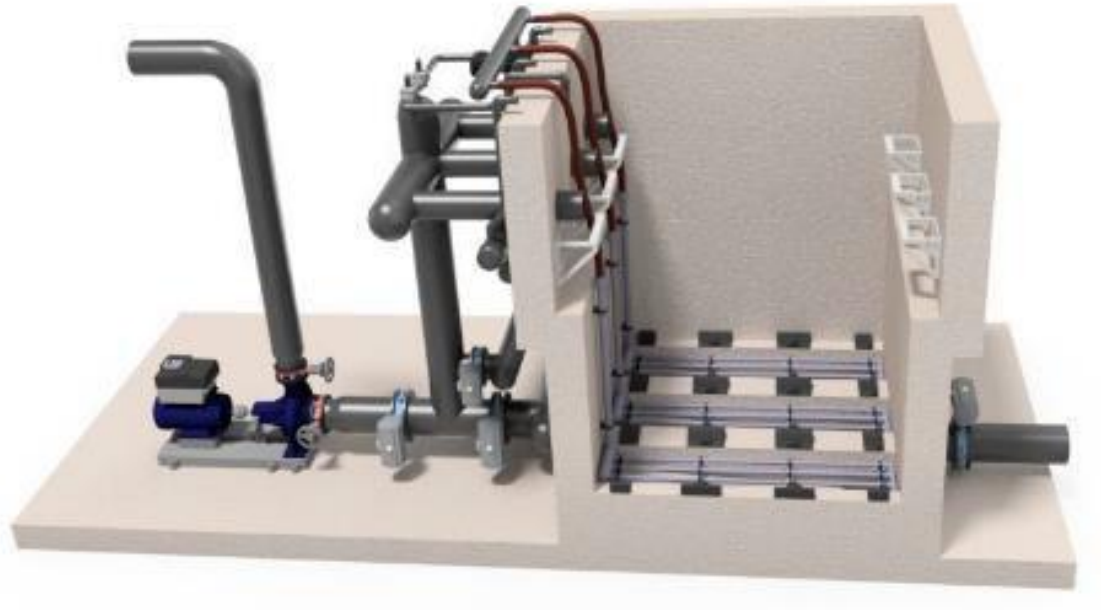
3. Installation of air scouring sets to be fixed by screws on the concrete bottom to the base frames if frames are used.



4. Connection of installed **air-scouring sets** to common blower pipe.

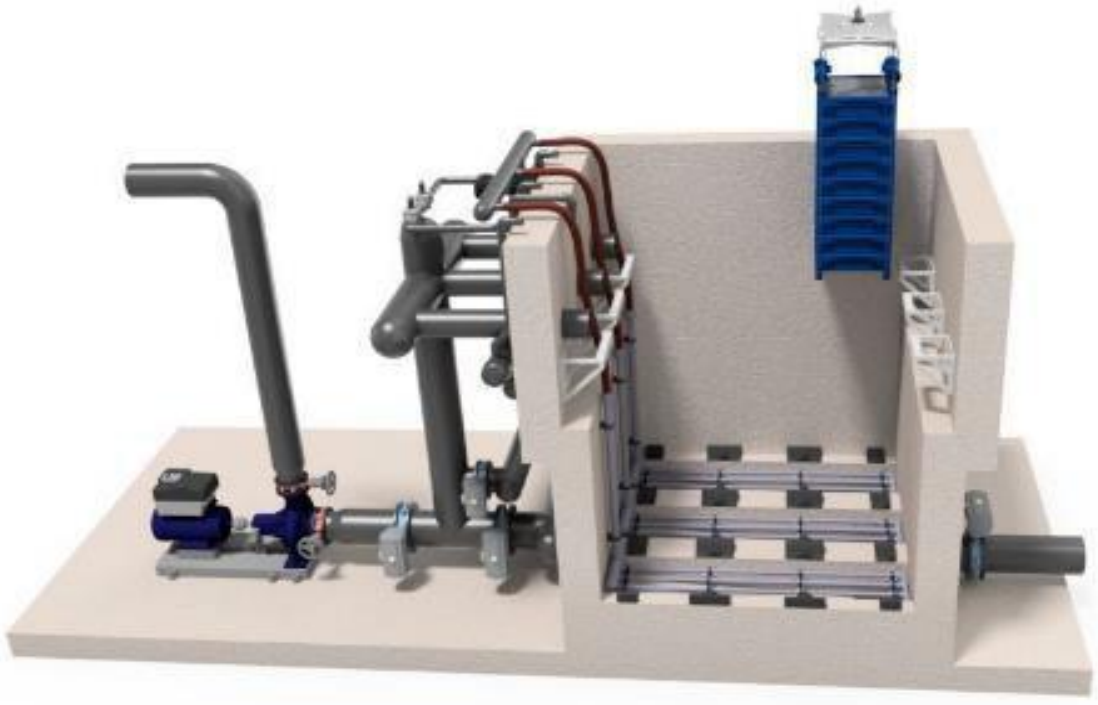


5. Installation of tower holders on the bottom of the tank.



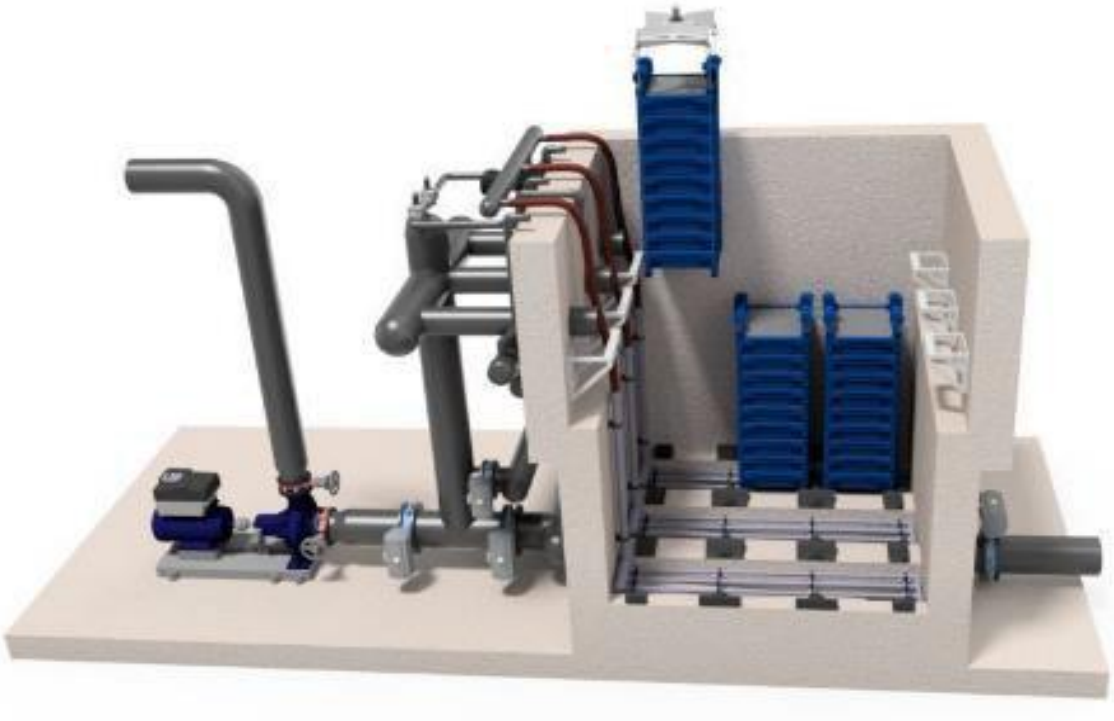
Note: If a base frame is used instead of position holders, the air scouring set shall be attached to the base frame. Always refer to Cerafiltec's standard engineering drawings for the correct configuration based on the application.

6. Positioning of first module tower. (For tower lifting arrangement, refer to Sec. 3.3.1)

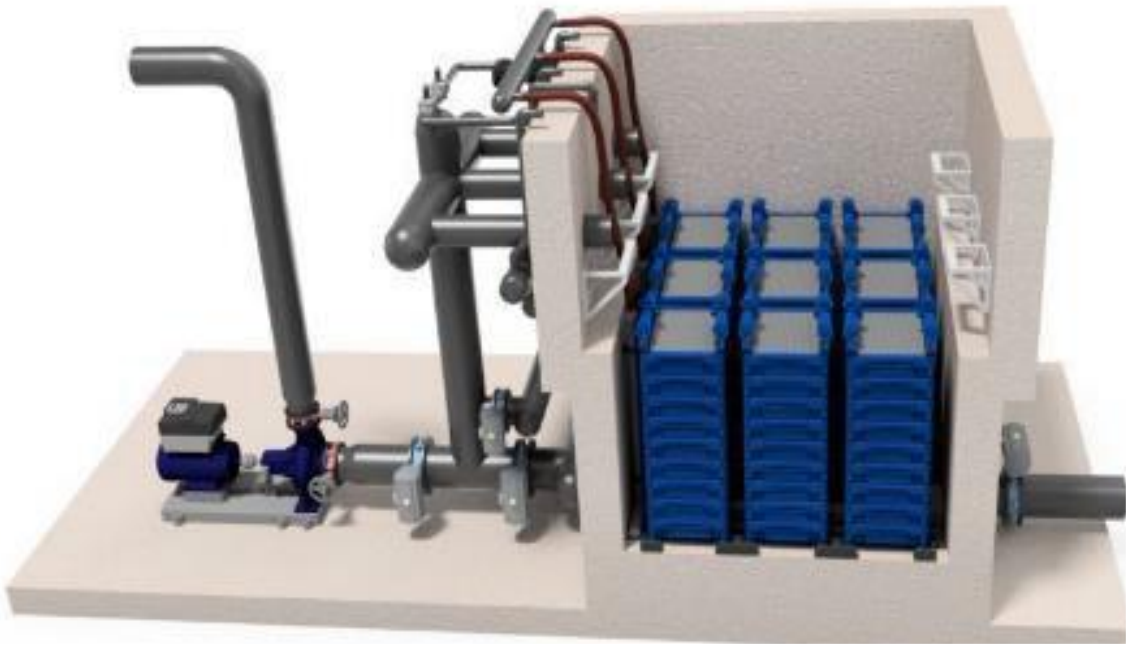


Consider the site conditions and safety protocols when lifting and positioning the tower inside the tank. Ensure that no part of the tower hits any solid surface that may damage the tower or modules.

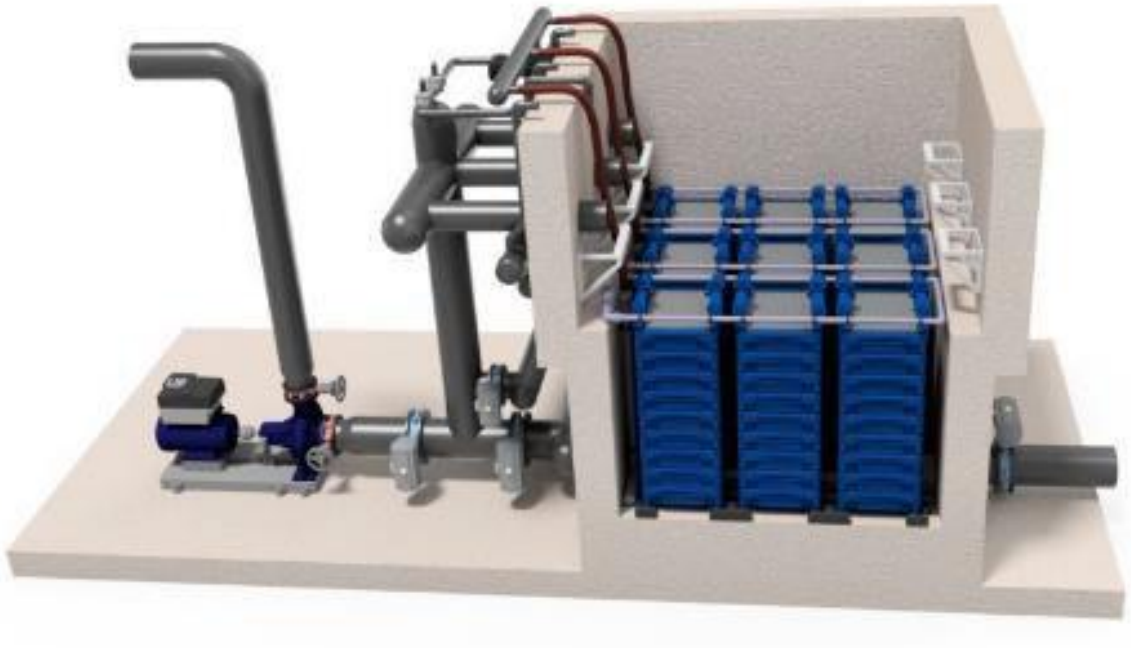
7. Completion of first tower lane.



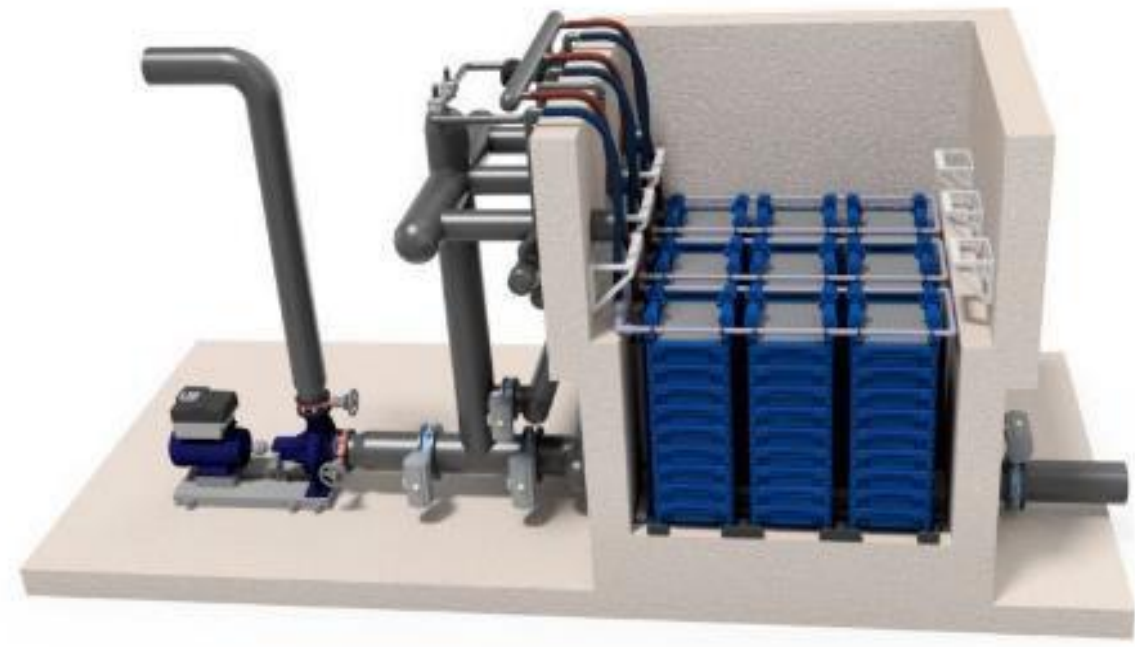
8. Repetition of tower positioning for all remaining tower lines.



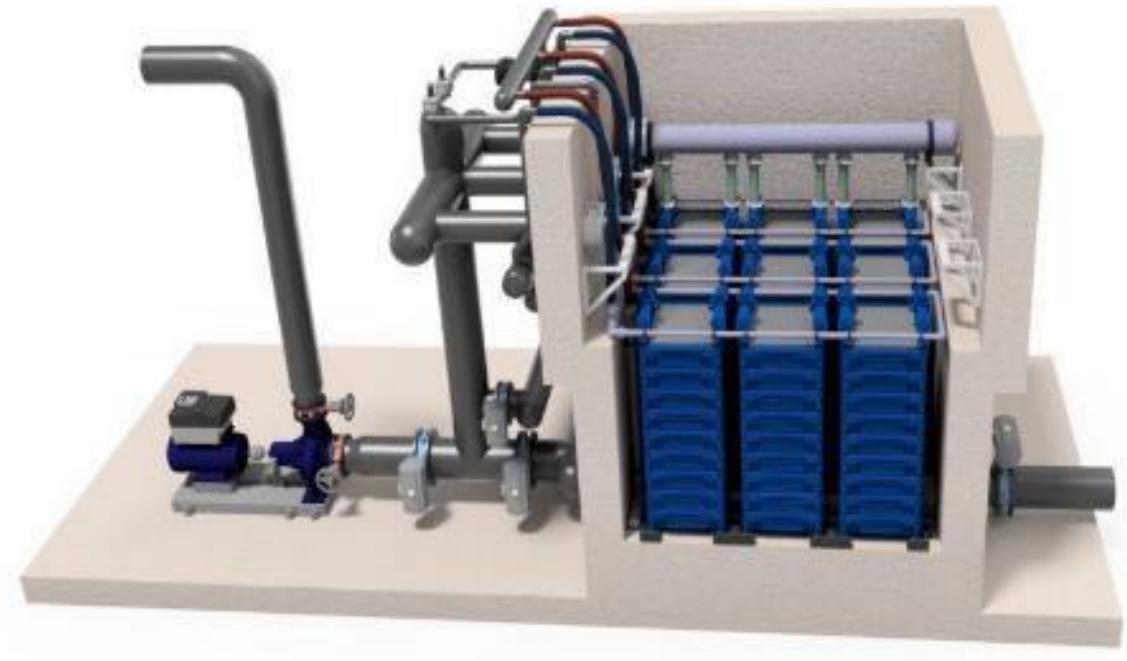
9. Installation of **sprinkler pipe/ pipe support sets** on top of all tower lianes. .



10. Connection of installed sprinkler sets to common sprinkler pipe. No common connection required if its pipe support.

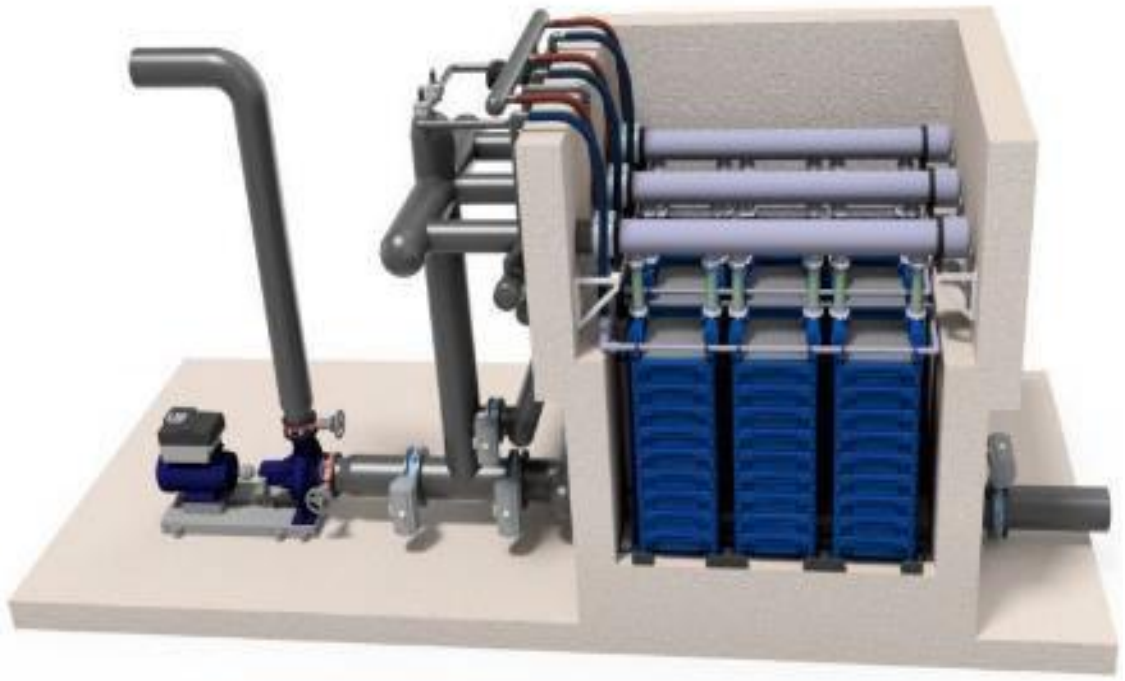


11. Installation of filtered water header pipe couplings and header pipe, connection to each tower, fixing on wall holders, and coupling.



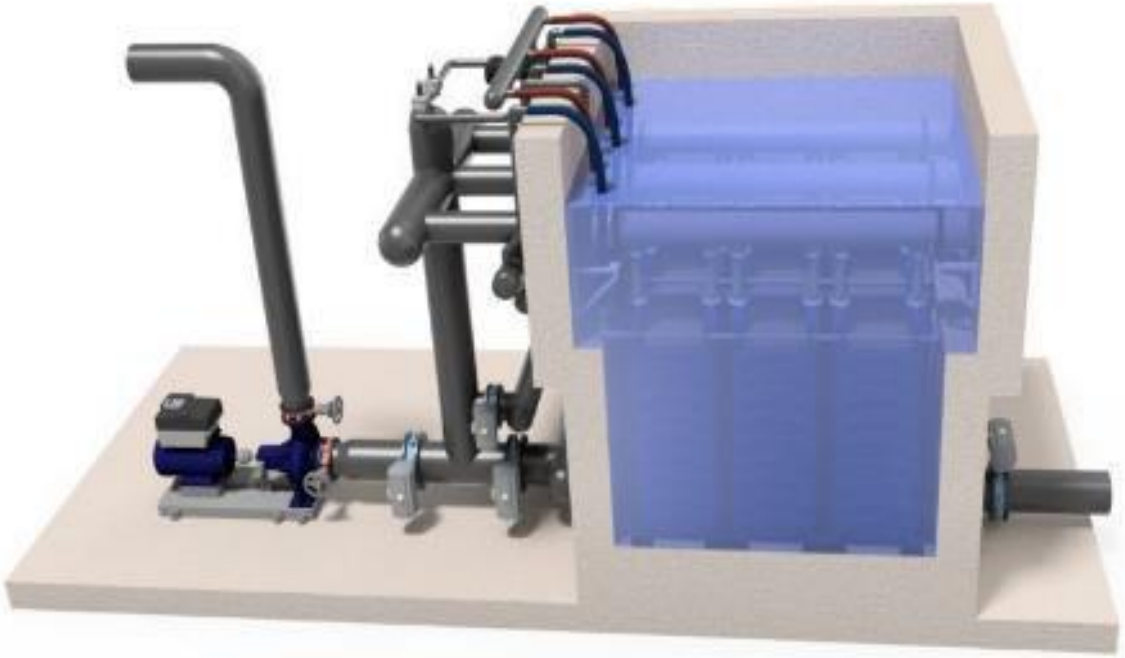
Cerafiltec recommends using flexible PVC pipe as a connection pipe between the tower and the line header. However, in the case of using hard PVC pipe, make offsets by heating the connection pipe to prevent misalignment of the clamps at the towers.

12. Repetition of filtered water header pipe installation for all remaining tower lines.

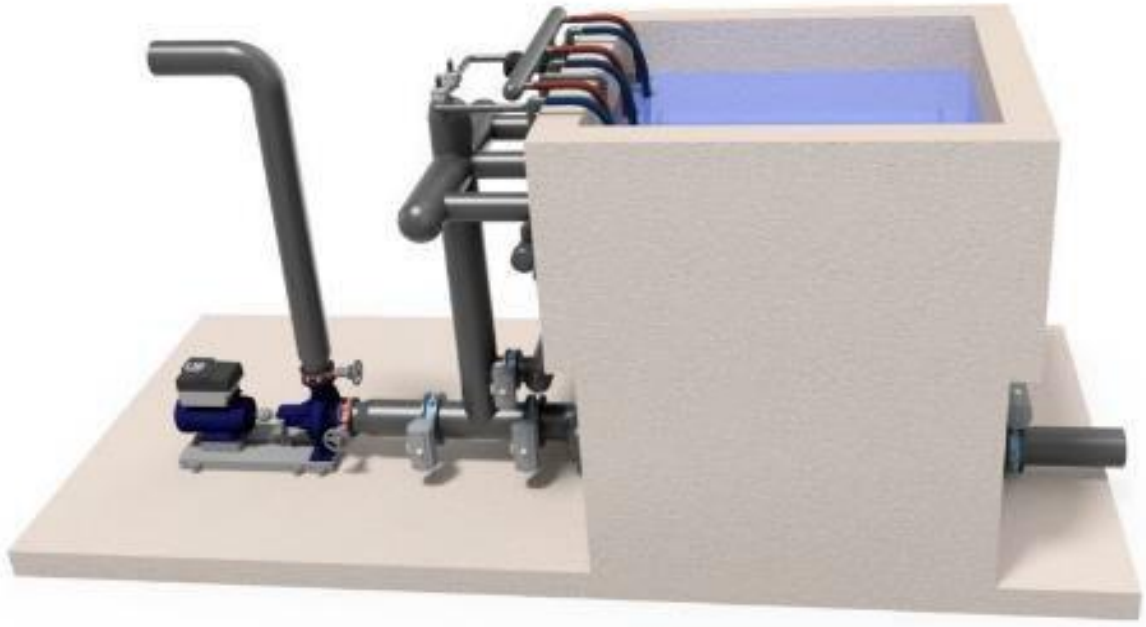


13. Ensure that all related electro-mechanical components are tested and working before the testing of the towers.

14. Conduct leak test and process start-up. Refer to sections 5.2.3 Leakage Testing and 5.3 Commissioning (Start-up Filtration).



15. Ready for operation. The train can be put into operation as per projection.



5.2.3 Leakage Testing

Before starting the filtration process, all filtration towers must be checked for leakages as shown in Figure 13.

The leakage test is performed to detect possible damage to a filtration tower that may have resulted from manufacturing defects, transport damage, or improper handling.

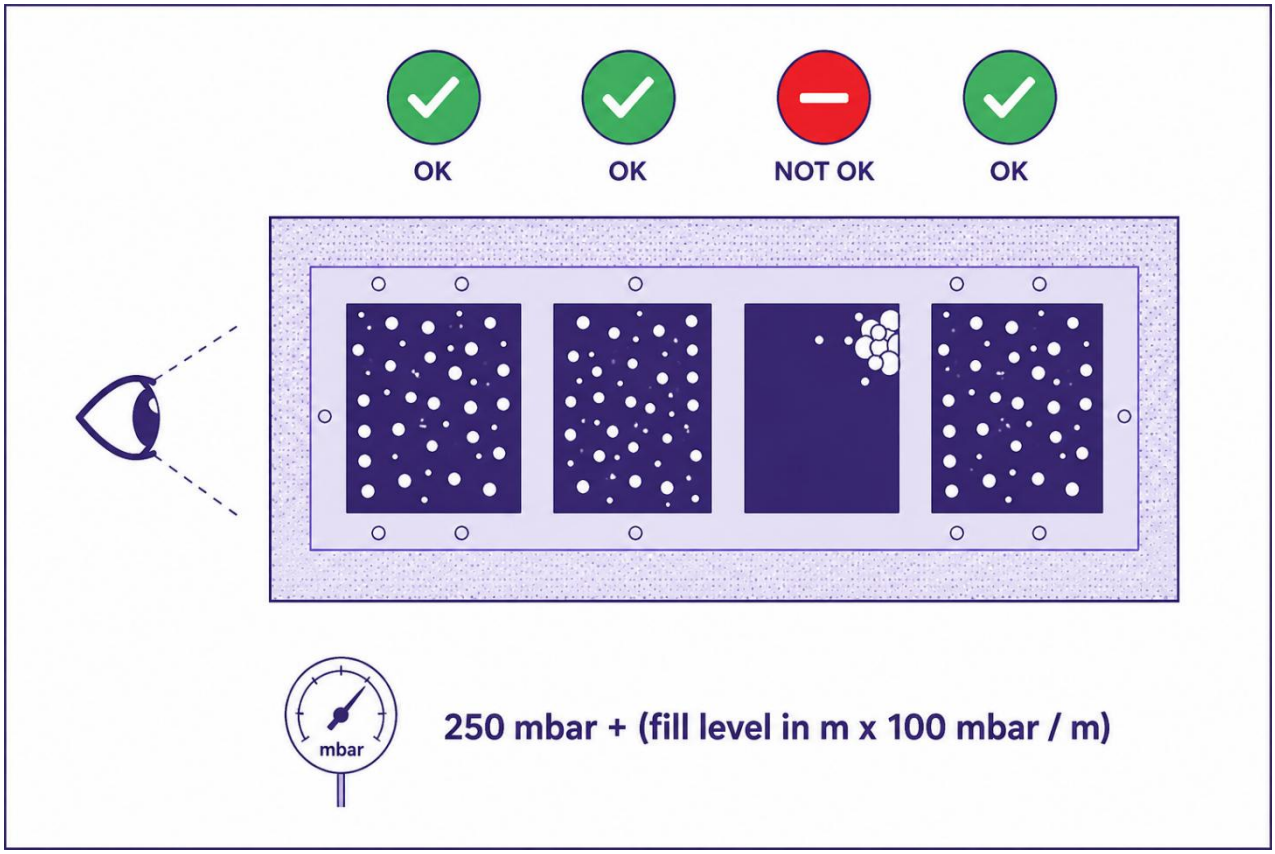


Figure 12: Observation of Leakages

Leakages can be detected by performing a bubble-point test. For this test, the filtered water header pipe is connected to an air supply line using a suitable adapter or connector. The complete tower, including the header pipe, must be fully submerged in clear water, either in the filtration tank or in a separate test tank.

During tank filling, larger leakages may already become visible. If the filtration tank is used for the test, all hand valves and automatic valves connected to the filtration line, including filtration, degassing, and circulation valves, must be closed before the tank is slowly filled with clear water, such as tap water.

If larger leakages are present, the air inside the filtration tower will escape and coarse bubbles will appear in the water.

If no leakages are detected during filling, overpressure must then be applied to the filtered water pipe. The required test pressure depends on the actual submersion depth and the resulting hydrostatic head above the filtration tower.

Cerafiltec recommends a submersion depth of approximately 3.0 m, corresponding to a total overpressure of 550 mbar.

The actual overpressure is calculated as follows:

Overpressure = 250 mbar + fill level [m] × 100 mbar/m

or, in imperial units:

Overpressure = 4 psi + fill level [m] × 1.45 psi/m

Before applying the full overpressure to the filtration tower, the pressure must be increased gradually as described below:

- Apply 50–100 mbar to detect leakages at the filtered water header and connected piping.
  Holding time: 5 minutes
- Increase the pressure to 100–150 mbar to detect leakages at the upper filtration modules and piping.
  Holding time: 5 minutes
- Increase the pressure to 200–250 mbar to detect leakages at the middle filtration modules and piping.
  Holding time: 5 minutes

- Increase the pressure to 550 mbar, or to the calculated pressure based on the actual submersion depth, to detect leakages at the lower filtration modules and piping.
  Holding time: 10 minutes

Intact filtration towers show an evenly distributed formation of fine bubbles only above the ceramic membranes.

If a filtration tower shows unevenly distributed coarse bubbles, one or more membranes, seals, or frame components may be damaged. In such cases, the leakage must be carefully verified and the fault corrected before the system is put into operation.

The exact leakage location can be identified as shown in Figure 13. For example, when checking the header for leakages, the tank should be filled with water only up to the level of the header.

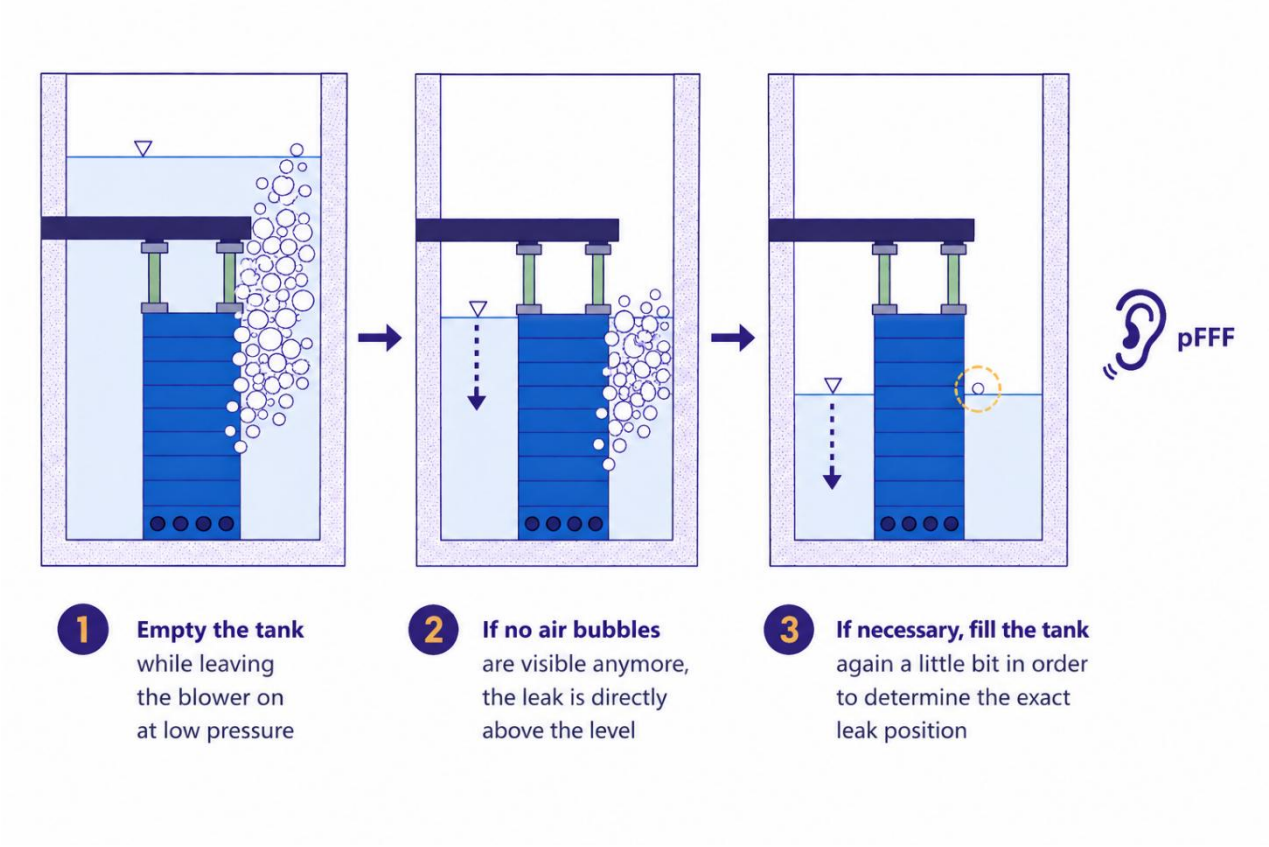


Figure 13: Finding exact location of the leakage.

We recommend checking for leakages periodically, e.g. after every chemical cleaning (CIP).

To detect any leakages in the pipeline going to the filtration towers, conduct a water leakage test by using the backwash pump.

5.3 Commissioning and Start-up Filtration

Before commissioning and starting up the system, the functionality of all main components must be checked. This includes pumps, blowers, valves, sensors, instruments, and all related equipment. Ensure that feed flow is available, the pre-treatment system is operating correctly, and all valves are in the correct position in accordance with the Functional Description.

The actual raw water or feed water parameters must be checked and compared with the design parameters. In case of deviations, Cerafiltec can provide support in adjusting the system operation to suit the actual site conditions.

However, if the feed water quality or operating conditions deviate from the original design basis, Cerafiltec shall no longer be liable for the originally specified performance in terms of permeate quality and quantity.

Only filtration towers that have been correctly assembled and installed without defects may be started up. A successful leakage test of the filtration towers is mandatory before start-up.

All pipes and tanks must be rinsed and free from deposits, such as production residues, sludge, or other contaminants. If tank filling was performed in combination with the leakage test, the degassing valve must be opened until all air has been evacuated.

Once the preparation procedure has been completed, the following start-up sequence may be initiated:

- After filling the filtration tank, start filtration at a reduced flow rate of 25% of the design flow. After trouble-free operation, the flow may be increased by 25% every hour until the design flow is reached.
  Recommended operation time: 3 hours
- Start the aeration system and check the functionality of the blower and air piping. An even distribution of air bubbles must be ensured.
  Recommended operation time: 5 minutes
- Start the sprinkler system and verify correct functionality.
  Recommended operation time: 5 minutes
- Start a backwash sequence, including aeration and sprinkler operation, after completion of one normal filtration step, as specified in the operation description. Backwash pressure, backwash flow, and the time required for emptying and refilling the filtration tank must be recorded.

During start-up, the following parameters must be checked periodically, at least once every hour:

- Transmembrane pressure during filtration and backwash
- Flux
- Permeability
- Permeate quality, including SDI, turbidity, metals, and organic matter

After three hours of operation, these parameters should be in accordance with the design water parameters defined in the project documentation.

During the first three days of operation, permeate quality and all relevant operating parameters, including pressure and flow, should be checked and recorded every two hours.

In case of recommissioning, it is mandatory to conduct chemical cleaning of the membranes and leak test prior to recommissioning/filtration process can begin.

6. Operation

This section provides a general overview of the basic operating process for Cerafiltec ceramic ultrafiltration systems.

For project-specific operating parameters, such as filtration time, flux, cleaning sequences, and other process specifications, refer to the applicable project design documentation and projection. These documents define the required operating conditions to ensure proper system performance.

6.1 Basic Filtration Process

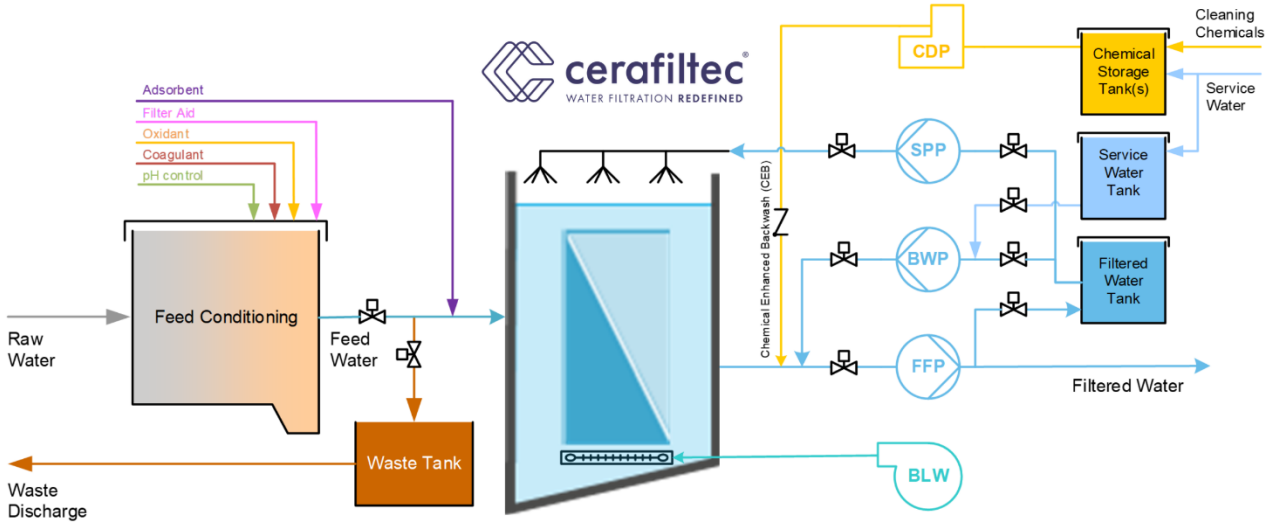


Figure 14: Basic Process Flow Diagram

The operation of the system includes the following basic process steps:

a) Filtration

Filtration is the separation process used to remove suspended matter from the feed water. During filtration, feed water is drawn or pumped from the outside of the membrane to the inside. Contaminants are retained on the membrane surface, while filtered water passes through the membrane as filtrate.

b) Backwash

Backwash is the process in which part of the filtrate water is pumped in the reverse direction, from the inside of the membrane to the outside. This removes accumulated particles and layer formation from the membrane surface.

The backwash flow is typically set to 2.0 to 2.5 times the filtration flow.

c) Sprinkler

During sprinkler operation, filtrate is sprayed from nozzles located at the top of the tower onto the modules. This helps mobilize accumulated particles between the membrane plates and supports the backwash process.

d) Air Scouring

Air scouring is the process of introducing air into the water to improve the removal of solids from the membrane surface. The rising air bubbles create turbulence around the membrane plates and help detach accumulated particles.

e) Chemical Cleaning

Chemical cleaning is performed using standard cleaning procedures. Concentrated chemicals may be dosed into the backwash feed line for chemically enhanced backwash, or CEB. Alternatively, chemical cleaning may be performed via the sprinkler system or as a manual or semi-automatic clean-in-place, or CIP, procedure.

f) Degassing

During suction operation in water, outgassing is a normal phenomenon. To remove gases from the filtration line, an air trap should be installed upstream of the filtration pumps. Gas collected in this trap must be removed by an automatic air release system. The degassing point is located at the highest point of the filtration line. Depending on the application and Cerafiltec's recommendation, degassing may be designed as either passive or active degassing.

g) Membrane Integrity Test (MIT)

The membrane integrity test, or MIT, is used to verify membrane integrity and detect possible leakages. The test may include pressure decay measurement and visual inspection. For the test, oil-free air is applied to the filtrate side of the membrane system, followed by a pressure hold test and visual inspection for air bubbles in the membrane tank.

6.2 Process Principles

The membrane system operates through alternating filtration and backwash cycles. The following sections describe the operating principles of both processes.

6.2.1 Filtration and Backwash

7 Out-to-in filtration	8 In-to-out backwash
The filtration principle works from OUT-TO-IN. Single ceramic plate with filter active layer on the	After some time, a backwash process is required to clean or remove the accumulated

outside of the membrane. Suspended solids are rejected on the membrane surface forming a cake layer while the clean water passes through the membrane body and is collected at both end caps.

solids trapped outside the ceramic plate. This is done by reversing the flow direction, which works from IN-TO-OUT of the ceramic plate.

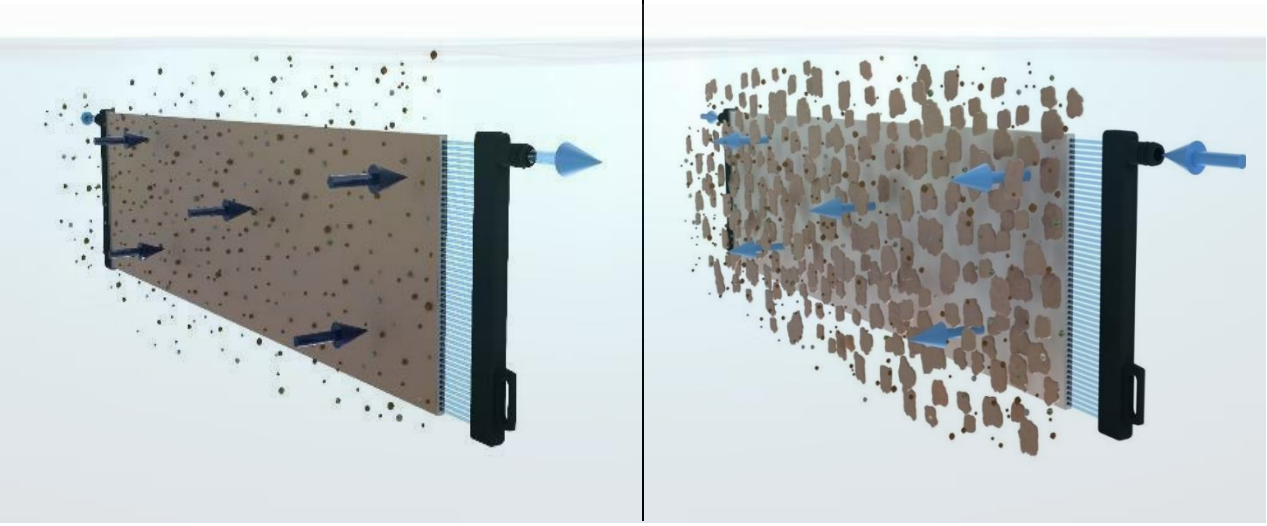


Figure 15: Membrane principle of the filtration and backwash processes.

Filtered water from each single plate is collected inside the module housing and transported to the header set through 4 filtered water channels integrated in both module housing sides.

Filtered water from all 4 filtered water channels is transported to both module fronts and enters into each single plate.

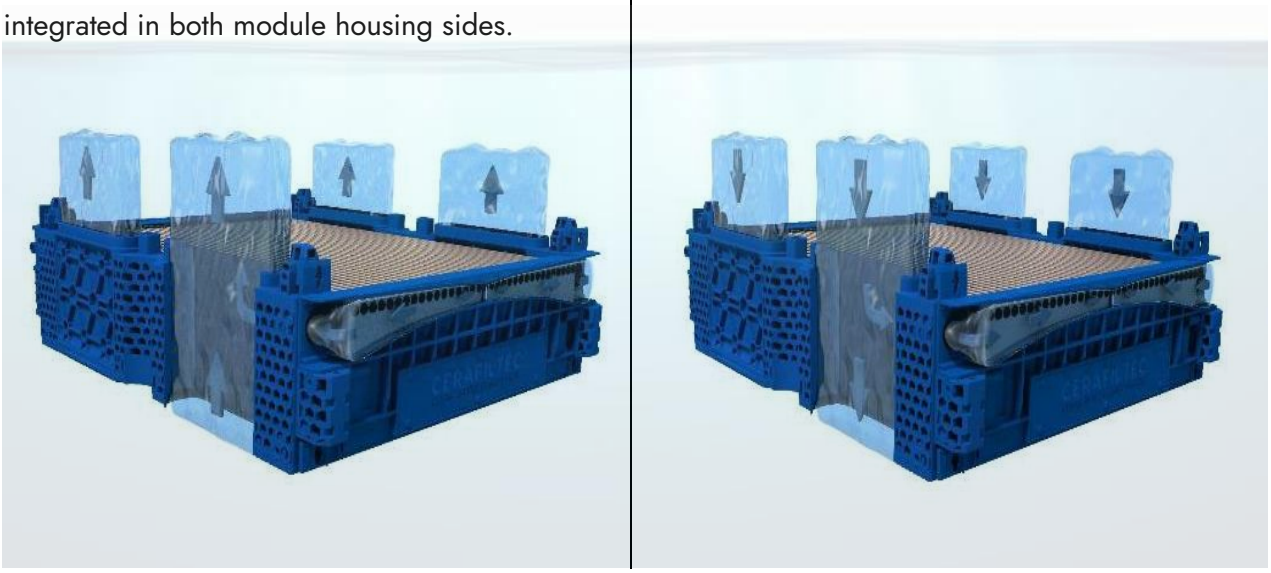


Figure 16: Module principle of the filtration and backwash processes.

The filtration towers are fully submerged in a tank (filtration train) which contains the feed (raw) water. All towers are connected at the top with a common header pipe. The filtered water is

A small portion of the produced filtered water is taken from the filtered water tank and is transferred

transported through the header set of each tower to the top and from there through the common header pipe to the tank outside where a filtration pump is connected to transfer the clean water to the filtered water tank.

by a backwash pump through the common header pipe into each filtration tower.

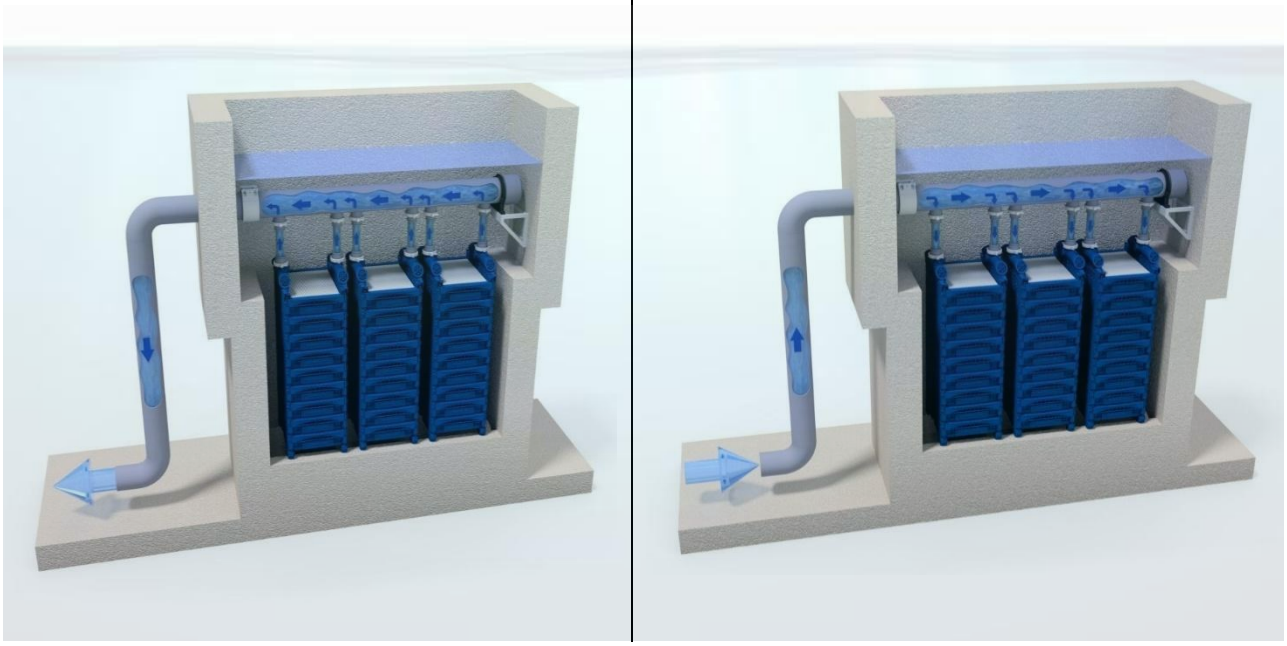


Figure 17: Train principle of the filtration and backwash processes.

Submerged vacuum-driven (negative pressure) filtration and positive backwash pressure.

6.2.2Sprinkler System

The integrated sprinkler system is used as water jet to enhance the removal of cake layers during on-air backwash. It prevents sludge clogging or accumulation due to the cake layer and deposits inside the filtration during backwash.

Figure 18: Sprinkler Mode and Chemical filling for CIP using the sprinkler system.

6.2.3Cleaning

To ensure stable long-term operation, the membrane system incorporates several cleaning procedures. These are designed to control cake layer growth, restore membrane permeability, and maintain consistent filtration performance under varying feed water conditions.

6.2.3.1 Periodic Backwash Drain

Inside the filtration tank, the membranes separate solids from the liquid. These solids accumulate on the membrane surface in the form of a cake layer, including substances such as TEP, EPS, and other retained particles.

This accumulation increases filtration resistance and can lead to a reduction in membrane performance. To maintain stable filtration performance, the increasing resistance must either be compensated by higher operating pressure or controlled through appropriate cleaning measures. For this purpose, periodic backwashing is performed.

The objective of periodic backwashing is to remove the accumulated surface layer and flush the membrane pores by briefly reversing the filtrate flow.

Membrane backwashing is usually carried out by stopping the filtration pump, reversing the flow direction, starting the backwash pump, and opening the drain.

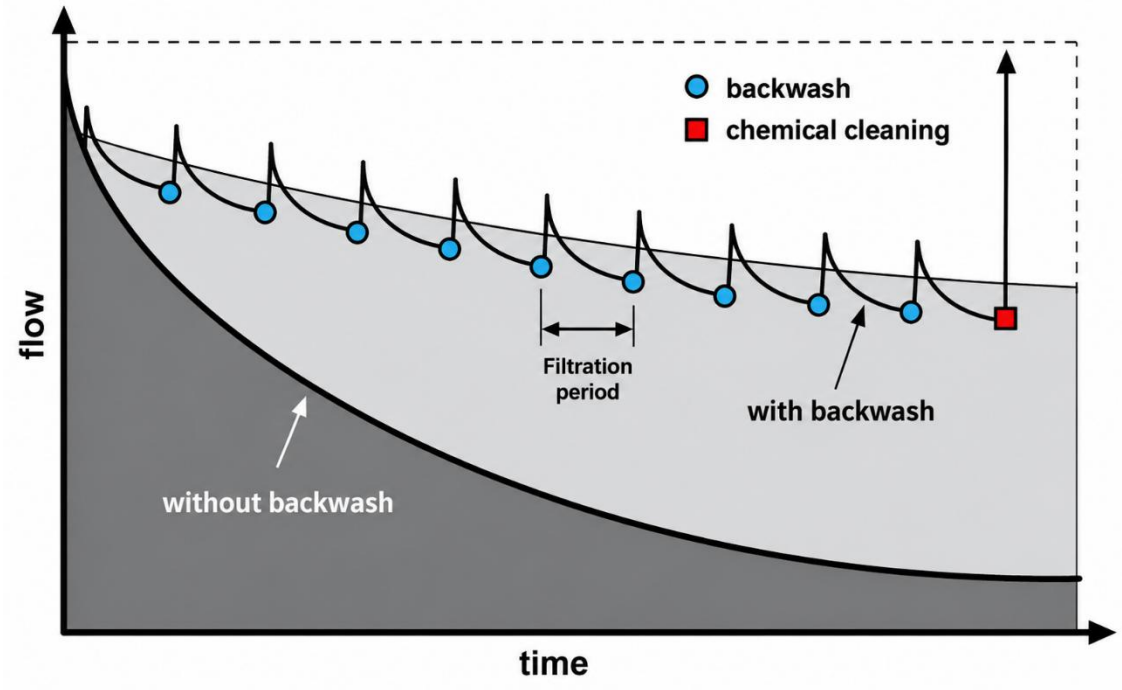


Figure 19: Flow diagram filtration process with periodical backwash.

If a decrease in flow and/or an increase in transmembrane pressure reaches a defined limit, chemical cleaning is required.

The typical maximum transmembrane pressure during filtration is 0.5–0.7 bar, depending on the water source and process configuration. The project-specific maximum filtration pressure is specified in the applicable technical projection document.

6.2.3.2 Chemical Cleaning

Due to the asymmetric membrane structure, potential macro-fouling or blocking effects occur primarily on the outside of the membrane. Operational experience, test results, and reference installations have shown that fouling typically forms as a cake layer on the membrane surface, while the membrane body itself is generally not affected by fouling, blocking, or internal accumulation.

Biological and colloidal fouling refers to the accumulation of colloidal and dissolved substances on the membrane surface, resulting in the formation of a slimy film. This type of fouling is often caused by bacterial growth supported by nutrients present in the feed water. Biological fouling can occur wherever moist surfaces are present and is common in technical systems that are not operated under sterile conditions.

Deposits on the membrane surface can reduce the effective pore diameter and lead to a decrease in membrane flux. Fouling-related membrane blocking can generally be removed by cleaning with an oxidizing agent. As a rough indication, this type of fouling may be assumed when:

$p(\text{permeate}) \approx p(\text{backflush})$

Scaling refers to the formation of inorganic salt deposits on the membrane surface and within the pore structure. Scaling is caused by inorganic precipitation when the solubility limit is exceeded at the membrane surface, typically in the form of sulfates, carbonates, or phosphates.

Since inorganic salts cannot be biologically degraded and their solubility cannot always be improved by adjusting the pH value, scaling must be controlled by appropriate process design and operation. In any case, salt concentrations should be monitored to detect potential scaling risks. If scaling occurs, the deposits can generally be removed using acidic cleaning solutions. As a rough indication, scaling may be assumed when:

$p(\text{permeate}) < p(\text{backflush})$

Chemical cleaning can be performed as chemically enhanced backwash (CEB) or cleaning in place (CIP). The required cleaning frequency depends on the characteristics of the feed water, including the concentration of inorganic, organic, and non-oxidized compounds.

Chemically enhanced backwash (CEB) is the standard regular/daily cleaning process in which chemicals are dosed into the backwash or filtration line and pushed backward into the filters. Capclean (CC) is an alternative chemical cleaning procedure in which the chemicals are dosed in the sprinkler system.

The process is faster and needs less water but the cleaning effect may not be as good as in a CEB. In special cases, CEB & CC are both considered to optimize the cleaning results for the system.

Cleaning in place (CIP) is a more intensive chemical cleaning procedure. Similar to CEB, chemicals may be dosed into the backwash or filtration line and pushed backward into the filters. Alternatively, the chemicals may be added directly into the membrane tank, either manually or semi-automatically.

CIP is an intensive cleaning mode with a longer soaking time in a filled tank. It is performed periodically according to the project design, typically after 1 to 3 months of operation, or whenever the membrane can no longer be sufficiently cleaned by periodic backwash drain or CEB. Cerafiltec will recommend the most suitable cleaning method based on the specific water characteristics and operating conditions.

Table 6: General Cleaning Recommendations.

a) Chemical Enhanced Backwash

OXIDANT	ACID	
Organic fouling, Disinfection	Inorganic fouling	
Sodium Hypochlorite (NaOCl)	Hydrochloric Acid (HCl)	Sulfuric Acid (H_2SO_4)
20 - 3000 ppm as free chlorine	pH-range: 1 – 2.5 typical: pH 2.3	
Soaking: 5 -15 min	Soaking: 15 min	

b) Cleaning in Place

ACID			BASE	OXIDANT	SURFACTANTS
Inorganic fouling			Organic Fouling		
Hydrochloric Acid (HCl)	Sulfuric Acid (H_2SO_4)	Oxalic Acid Citric Acid	NaOH (Opt. NaOCl)	NaOCl +(NaOH)	Sodium lauryl-sulphate + NaOH
pH-range: 1.5 – 2.5		4 g/l (at pH 2.0)	pH-range: 9-12	50 – 100 ppm as free chlorine	2 – 4 g/l (at pH 12)
Soaking time: 2 – 12 h					
Temperature: < 40 °C / temperature change: < 1 °C/min					

c) Suspended Solids Mitigation

Solids Concentration	2 - 500 mg/l	>1 g/l	2 g/l	20 g/l	> 20g/l
Module Type	Module 6.0	Module 6.0	Module 6.0	Module 6.0	Module 2.8T
Cleaning Consideration	Intermittent Backwash with/without scouring	Intermittent backwash with scouring	Continuous Aeration	Drain backwash	Continuous aeration

6.3 Pre-treatment

Cerafiltec is not responsible for pre-treatment, post-treatment, or biological treatment processes.

However, based on the specific water conditions, Cerafiltec may provide recommendations to optimize system operation and protect the membranes and modules.

6.4 Data Recording

Data recording is essential for reliable system operation. It provides insight into system performance, helps identify potential issues at an early stage, and supports informed decision-making for maintenance and optimization.

Unless otherwise specified separately in writing, the minimum required operating data must be recorded and kept up to date from the time of installation until final shutdown of the system, or at least until the end of the warranty period for warranty purposes.

Continuous or electronic operating data must be recorded for each train, as specified in Table 7 and 8, including at least the following:

- Pressure during filtration, backwash, and chemical cleaning
- Flow during filtration, backwash, and chemical cleaning
- Filtration tank water level
- Aeration flow and pressure for air scouring
- Coagulant dosing rate, if applicable

For each chemical cleaning sequence performed, the following data must be recorded:

- Chemical cleaning pump flow and duration
- Type and concentration of chemicals used
- pH value and chemical concentration in the membrane tank during soaking
- Water quality and operating parameters as specified in Table 7 and 8.

Cerafiltec reserves the right to request additional data where necessary to assess any claims submitted.

In the event of a claim, the buyer bears the burden of proof that the plant was installed and operated in accordance with the applicable warranty terms and conditions.

Table 7: Water Parameters Logging Intervals.

Parameter	Inlet	UF Filtrate	Cleaning Solutions
pH	3 min	-	1s
Temperature	3 min	-	
Turbidity	3 min	3 min	
TSS	24h	7days	
COD	24h	24h	
DOC	24h	24h	
ORP	3 min	3 min	1s

Table 8: Operational Parameters Logging Intervals.

Parameter	Filtration	Backwash/CEB
Backwash pressure	3 min	1s
Filtration pressure	3 min	
Flowrate filtration	3 min	
Flowrate backwash		1s
Flowrate air scouring	3 min	1s
Pressure air scouring	3 min	1s
Membrane tank level	3 min	1s

7. Maintenance and Shutdown

Cerafiltec modules require very little maintenance or replacement when they are handled properly and operated under stable conditions in accordance with Cerafiltec recommendations.

However, this section describes the required actions for cases in which maintenance, service work, or shutdown procedures cannot be avoided.

7.1 Maintenance

Regular maintenance and service activities are required to ensure the safe operation of the ceramic ultrafiltration system and to protect system components from damage.

The required maintenance work mainly consists of status checks, functional checks, and verification of operating parameters. All checked status conditions, functions, and operating parameters must be documented in the logbook.

Deviations from target values and any malfunctions must be recorded in the logbook and corrected immediately by the responsible maintenance personnel. Malfunctions that may adversely affect safety must be reported immediately to the responsible qualified personnel.

All specified inspection intervals and maintenance duties relating to parts and components supplied by Cerafiltec must be observed. In addition, unusual conditions, such as abnormal noises from pumps, blowers, compressors, or other components, must be recorded.

The operating instructions described in this manual must be followed for all maintenance and service tasks.

7.1.1 Visual Check

The following visual and functional checks must be performed regularly:

- The distance between membrane plates must be checked daily for clogging.
- The degassing function must be checked daily. The degassing unit must be filled after the backwash sequence.
- The perforated aeration piping should be flushed with water once per week via the flushing connection.
- The aeration system must create a uniform distribution of air bubbles. This must be checked daily.
- The functionality of all related equipment, including pumps, dosing systems, blowers, compressors, and associated components, must be checked daily.

7.1.2 Module Maintenance

Individual membranes and spare parts or maintenance sets may be provided, depending on the purchase scope, for the replacement of defective components identified during operation, maintenance, or service work.

Contact your Cerafiltec representative for guidance and instructions regarding the applicable replacement procedure.

Spare parts information is available on the followimg link: Spare Parts Information.

7.2 Shutdown

During temporary shutdown or system maintenance, the ceramic membranes must be preserved to maintain membrane integrity and long-term performance.
The membrane preservation procedure is as follows:

1. Fill the filtration tank with water. Depending on the expected shutdown period, suitable water sources may include feed water, UF filtrate, service water, or RO permeate. Ensure that the membranes are fully submerged at all times.

2. Depending on the expected shutdown duration and the system condition, additional procedures such as backwash drain or chemically enhanced backwash (CEB) may be required before preservation.

3. Prepare a sodium hypochlorite (NaOCl) solution in accordance with the recommended concentration specified in Table 9.

4. Add the prepared NaOCl solution to the filtration tank.

5. Ensure that the NaOCl concentration in the tank water does not fall below 5 ppm. The concentration must be measured daily, and additional NaOCl must be dosed if required.

6. Keep records of all monitoring results, chemical dosing activities, and preservation measures.

Table 9: Ceramic Membrane Preservation.

	< 24 hours	<2 days	<7 days	>7 days
Wet	Submerged in feed water	Submerged in feed water + NaOCl 100ppm	BW drain, submerged in UF filtrate +100ppm NaOCl	CEB, submerged in service water or RO permeate +100ppm NaOCl 1/w: check + adjust
Dry	< 1h if sun-exposed < 6h indoor		CEB, RO flushing, MIT, PDT test (air flushing filtrate side)	

8. Troubleshooting

Table 10: Troubleshooting Guide

Result	Direct Cause	Indirect Cause	Corrective Action
Less production than design capacity	Negative filtration pressure too high	Failure of pressure sensor	Check pressure sensor; replace if damaged
		Failure of flow sensor	Check flow sensor for: – Replace if damaged – Air passing through the sensor as degassing is not working well
		Membrane blocked	Refer details to "Membrane blocked"
	Negative filtration pressure too low	Failure of pressure sensor	Check pressure sensor; replace if damaged
		Failure of flow sensor	Check flow sensor for: – Replace if damaged – Air passing through the sensor as degassing is not working well
		Flow control (FC) valve is not opening	Check FC valve; replace if damaged
	Train level too low	Level in the distribution channel is too low	Check flow capacity of feed pump, increase flow to match the requirement to fill and feed the trains
		Inlet valve is closed	Check valve; replace if damaged
		Drain valve is open	Check valve; replace if damaged

Result	Direct Cause	Indirect Cause	Corrective Action
	Setpoint for flow too low	Automated setting for negative filtration pressure too high	Check setting and follow as recommended by Cerafiltec
		Wrong setting from operator	Check settings and follow as recommended by Cerafiltec
Membrane blocked	Inorganic scaling	Wrong feed pH value	– Check if acid dosing system is working – Check if enough acid solution in the dosing tank is available – Adjust pH setting to match the feed pH value requirement
		Insufficient chemical cleaning	– Check if cleaning dosing system is working – Check if the cleaning agent used and its concentration are correct. – Check if cleaning settings are correct.
	Organic fouling	Insufficient chemical cleaning	– Check if cleaning dosing system is working – Check if the cleaning agent used and its concentration are correct – Check if cleaning settings are correct
		Insufficient coagulant dosing	– Check if dosing system is working – Check if settings are correct
		Insufficient ultra sand dosing (if applicable)	– Check if dosing system is working – Check if settings are correct
	Thick cake layer	TSS in feed high	– Ensure no overdosing of chemicals (coagulant, ultrasand) – Check if raw water is in bad quality
		Filtration time too long	– Check filtration settings. Follow as recommended by Cerafiltec
		Insufficient sludge removal during backwash drain	– Check if sprinkler is working well – Check if tank empty level is too high. Follow Cerafiltec recommendations.
	Sludge accumulation between plates	Insufficient backwash	– Check backwash settings (flow might be too low and time too short. – Check if sprinkler is working well – Ensure aeration is ON during backwash and aeration pipes are not blocked
Bad Permeate Quality	High dissolved Ferric	Ferric dosing is too high	– Check dosing pump; replace if damaged – Check stock solution concentration (maybe it is too strong) – Check if settings are correct
		Sodium hypochlorite dosing is too low	– Check dosing pump; replace if damaged – Check stock solution (maybe empty or concentration is too weak/old) – Check if settings are correct

Result	Direct Cause	Indirect Cause	Corrective Action
	High turbidity	Broken membrane plates	– Check any mechanical damage from outside; conduct leakage test – Check any sludge accumulation between plates
		Leakage in header piping	– Check for any broken clamp and replace – Check for any loose pipe and replace
		Ferric precipitation in permeate	– Check ferric dosing (maybe it is too high) – Check sodium hypo (maybe it is low)
	High free chlorine	Sodium hypochlorite dosing is too high	– Check dosing pump; replace if damaged – Check stock solution (maybe too strong) – Check if settings are correct
	Wrong pH value	pH sensor reading is wrong	– Calibrate pH sensor; replace if damaged
		Acid dosing is not working well	– Check dosing pump; replace if damaged – Check if enough acid solution in the dosing tank is available – Adjust pH setting to match the feed pH value requirement

9. Disclaimer

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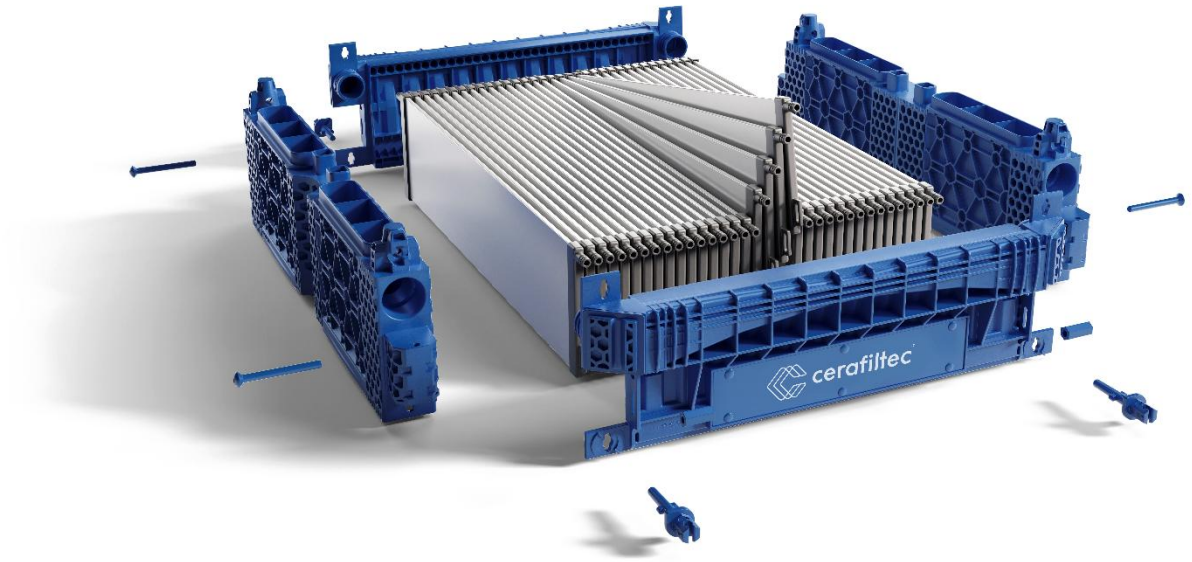
10. Contact Information



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