MF/UF INTRODUCTION
**CLASSIFICATION OF FILTRATION TECHNOLOGIES**

**Particle Size Log Scale**
- 100 µm
- 10 µm
- 1 µm
- 0.1 µm
- 0.01 µm
- 0.001 µm

**Measurement TEP**
- Dissolved Organic Compounds
- Colloids
- Germs and Bacteria
- Transp. Exopolym. Part. (TEP)
- Precipitated Fe & Mn compounds and HMO

**MF/UF pore size range**
- Sand Filtration
- Micro Filtration
- Ultra Filtration
- Nano Filtration
- Reverse Osmosis

**Sand Filtration**
- Removal of suspended solids and disinfection
- Sand media; Gravity flow or pressurized operation

**Micro Filtration**
- Cartridge filter in steel, polymer or other materials; Pressurized operation
- Polymer flat sheet membrane; Submerged suction pressure operation
- Ceramic flat sheet membrane; Submerged suction pressure operation

**Ultra Filtration**
- Polymer hollow fibre membrane; Submerged suction pressure operation

**Nano Filtration**
- Polymer or ceramic tubular membrane; Pressurized operation

**Reverse Osmosis**
- Polymer NF/RO elements; Pressurized operation

**Typically used as pre-filtration for NF and RO**

**MF/UF INTRODUCTION**

**Removal of suspended solids and disinfection**

**CLASSIFICATION OF FILTRATION TECHNOLOGIES**

**MF/UF INTRODUCTION**
CHALLENGES
CURRENT WATER TREATMENT

Sea water

Freshwater

Limited use of dirty water resources

Suspended solids;
Iron & Manganese;
Temperature; pH;
Oil & grease;
Biological contaminations;
Turbidity

Large pore sizes
Sensitive materials
High pressure operation

Extremely high operational expenses

High chemical consumption
High maintenance & service efforts;
Frequent replacement
High power consumption

Huge losses (wasted resource)

Typically more than 10% generated waste;
Additional waste recovery systems needed for loss reduction

Moderate quality

Less quantity

Limited suitability for direct use as drinking water or subsequent NF/RO treatment or other re-use purposes
SOLUTION
CERAFILTEC’s INNOVATIVE FILTRATION SOLUTION

Very low operational expenses

- Less chemical consumption
- Durable and reliable operation
- Less power consumption

Use of any water resources

- Sea water
- Freshwater
- Sewage

Insensitive against high concentrations and variations in:
- Suspended solids
- Iron & Manganese
- Temperature; pH
- Oil & grease
- Biological contaminations
- Turbidity

UF 0.1 µm small pore size
Robust ceramic material
Low suction pressure operation

Lowest losses (saving of precious water resource)

Recovery rate of up to 99.5% which requires no additional waste recovery systems; Minimal size of waste storage, e.g. evaporation ponds

Best quality
Free of suspended solids; Real disinfection - Physical barrier for germs & bacteria

Ideally suited for drinking water and subsequent NF/RO treatment or other high quality re-use purposes

Maximum quantity

Innovative filtration solution offers:
- Very low operational expenses
- Use of any water resources
- Lowest losses (saving of precious water resource)
- Best quality
- Maximum quantity
Technology package with innovative ceramic flatsheet membrane filtration

**UF single ceramic flatsheet membrane plate with 0.1 µm pore size**

**Module 6.0 S**
For up to 60°C

**Module 6.0 H**
For hot water applications of up to 99°C

Possibility to change single plates;
Internal filtered water collector system;
1,000+ LMH high flux design;
NFC tag system for performance monitoring and support

**Tower-Rack**
Single towers equipped with modules;
Fully modular design - several towers can simply be connected with common filtered water header to form a rack;
Integrated sprinkler and air-scouring piping;
Rack design without surrounding frame;
Fully made in plastic - Free of steel parts and hoses suitable for harsh applications, like ground and seawater or other industrial applications

**Filtration Train**
With installed racks and Smart Box location;
The operator simply will connect a smart phone or tablet to the technology online portal by holding the mobile device close to the Smart Box;
The access enables a review of installed equipment and train performance (history records) and adding of new performance values into the online train database
COMPARISON
Sand filtration vs. CERAFILTEC

- Sand media; Large pore size; Depth filtration - whole media body is used for separation process
- UF membrane with 0.1 µm pore size; Out-to-In surface filtration process

- About 100 times smaller pore size - Best filtered water quality, free of suspended solids
- Real disinfection - Physical barrier for germs & bacteria
- About 15 times lower flow through velocity - Extremely slow filtration with less than 0.2 mm/s leads to maximum removal efficiency
- Reliable filtered water quality - Insensitive against feed water quality variations
- Maximum filtered water output - Lowest backwash waste means highest recovery rate
- Most compact design - Up to 5 times smaller footprint
- Simple single-storey filtration basin without nozzle bottom

Due to the very compact design of CERAFILTEC existing sand filter plants can be easily rehabilitated using existing civil work structure but highly increasing filtered water quality and quantity.
Submerged polymer membranes vs. CERAFILTEC

- Insensitive against chemicals and temperature
- Reliable filtered water quality without decline (no material ageing)
- Capability of high-pressure backwash leads to efficient membrane performance recovery without use of chemicals (no process stop)
- Highest flux rates - Up to 15 time less filter area
- Insensitive against high Fe, Mn concentration and turbidity
- Maximum filtered water output - Lowest backwash waste means highest recovery rate
- Very long life time - Less maintenance, service and replacement efforts

The fully modular and highly compact design of CERAFILTEC enables a direct replacement of polymer membrane systems using existing filtered water tank and achieving at least same filtered water output.
Pressurized membranes vs. CERAFILTEC

- Insensitive against high Fe, Mn concentration and turbidity - No risks of membrane module clogging
- No compaction of formed cake layers - Up to 10 times higher flux rate
- Very low transmembrane pressure - Especially deformable/jelly-like particles cannot be forced into the membrane pores or even pass the filter
- Very long filtration duration without need of backwash - Highest recovery rate means maximum filtered water output
- (Semi) dead end filtration - Save on feed pump capacity
- Low suction pressure operation - High energy savings
- Easy maintenance options, e.g. use of high-pressure water jet

In any emergency case CERAFILTEC's single plate module concept enables to simply change separate flatsheet membranes with lowest efforts in maintenance, service and replacement costs
Other ceramic flatsheet membranes vs. CERAFILTEC

- Maximum flexibility due to fully modular concept with free selection of modules per tower and towers per rack
- No corrosion of rack equipment - Suitable for harsh applications, like ground and seawater or other challenging industrial applications
- Simple maintenance and service due to lift option of single towers (remaining towers stay in operation)
- Hydraulic design of up to 1,500 LMH - Up to 3 times higher module flow
- NFC tags on each module, tower, rack and train with access to mobile service portal for simplifying operation, maintenance and permanent performance monitoring
- Cost efficient replacement of single ceramic plates

**Most compact, flexible and highest performing design in the market**

Source: Meiden; meidensha.co.jp  
Source: ItN Water Filtration; itn-nanovation.com
Ceramic Alumina (Al₂O₃) membranes vs. CERAFILTEC (SiC)

- Highly negatively charged membrane surface
- Always negative Zeta potential for complete operating pH range
- Ensured anti clogging effect - Highest and stable flux operation at pH below 7
- Ideal operation conditions - Ferric Chloride dosage below pH 6 for maximum coagulation and removal of DOC and TEP and still negatively charged membrane surface of -25 to -30 mV
- No additional requirements of extended pre-treatment steps, like ozonation - Easy removal of all negatively charged water contents, like bacteria, algae, TEP or oil

CERAFILTEC’s SiC membrane is the ideal ceramic material choice for surface water, seawater and other applications with pH operation below 7
DESIGN CONCEPTS
Existing sand filter building with 12 basins
Existing total capacity of 70,000 m³/d;
Rehabilitation required to improve filtered water quality for subsequent RO process and to implement new Ra removal system

Independent rehabilitation concept
Use of 2 existing sand filter basins (4 new C-UF trains installed);
Installation of new Ra removal system beside existing building;
During execution the remaining 10 sand filters are in operation with capacity of around 57,000 m³/d;
4 new C-UF trains with capacity of 35,000 m³/d

Completed phase 1
Simple expansion for project phase 2 using 2 additional sand filter basins to achieve existing total capacity of 70,000 m³/d;
Further option by using all remaining basins to achieve maximum new capacity of up to 180,000 m³/d
Smallest required size of filtration train - Minimal efforts for civil works, piping connections and lowest costs for total UF building due to smallest building length with about 50% train size reduction in comparison to competing ceramic designs.

Installation and lift of single towers - Minimal cost efforts for required crane (mobile option with up to 500 kg only required).

Most compact train dimension - Maximum recovery rate of more than 99% can be achieved which leads to smallest required size and costs for backwash and chemical cleaning equipment as well as new evaporation ponds.

CERAFILTEC is the leading and most experienced ceramic flat sheet membrane technology provider which delivers the complete process and engineering design support to ensure an easy and fast project execution by EPCs, systems integrators and OEMs as well as operation by O&Ms.
- Improved filtered water quality in comparison to sand filters - Extended RO lifetime
- Reduced waste water - C-UF operation with recovery rate of 99.4%
- Increased RO blending flow due to improved filtered water quality
- Higher plant output of about 25%
- Simple and most compact train design - Minimal efforts for civil works and piping connections compared to other membrane systems
- Use of existing pre-treatment - Aeration and chlorination without any modifications
- Prepared for HMO dosing - Future option for targeted removal of Ra for additional improvement of filtered water quality
Novel Flow Through Concept (FTC) in C-UF trains for most compact tank design - Space savings of about 40% as circulating flow inside a filtration tank is no longer required.
Besides the continuous developments of ceramic membranes, modules and filtration processes CERAFILTEC is developing new process combinations with leading technology partners. One of the current developments contains the direct combination of FeCl₃ flocculation and PAC dosing with the targets of a highly shrinked plant size and improved filtered water quality due to the replacement of flow velocity dependent lamella separators.
Invented by CERAFILTEC

- Targeted inflow from biological tank to bottom channels inside C-UF train
- Operation of aeration tank (biology) at higher MLSS due to onetime concentration inside filtration tower
- Filtration tank overflow wall for direct and complete discharge of sludge accumulations removed from membrane surface during backwash and relaxation mode - Stable high flux operation
- Fast tank drain through circulation pumps for process-integrated on-air chemical cleaning CapClean - Double sprinkler line for chemical spray on membrane surface for fast and efficient membrane recovery