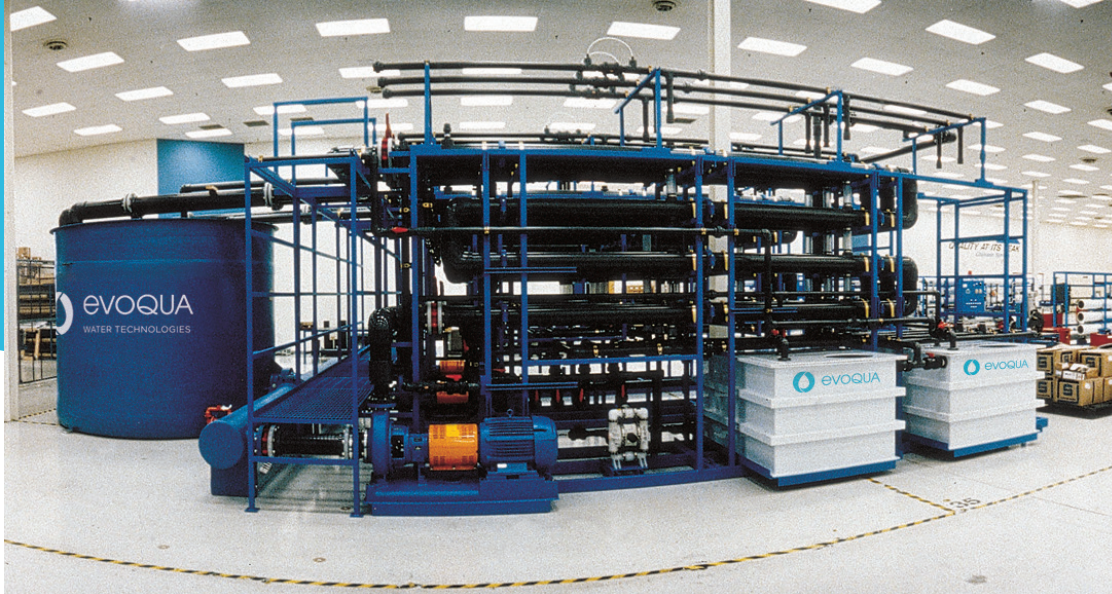




evoqua
WATER TECHNOLOGIES



ADVANCED MEMBRANE FILTRATION



Memtek®
EFC-Series
Microfiltration
System

A MAJOR ADVANTAGE FOR RELIABLE WASTEWATER TREATMENT OR PROCESS FILTRATION

SYSTEMS THAT GIVE YOU GREATER FLEXIBILITY AND BETTER PERFORMANCE

E-Series Membrane Filtration Systems

Evoqua Water Technologies offers the Memtek® E-Series systems incorporating proprietary crossflow tubular membranes which remove precipitated contaminants and produce a high quality filtrate suitable for discharge or further treatment. The modular components can stand alone, work together or work with existing equipment. The stand alone units are ideally suited for integrating with existing reaction tanks or settlers for effluent polishing. Membrane filtrate from an E-Series system can be discharged from the plant or reused directly in non-critical rinses. The filtrate is also suitable as a feed to reverse osmosis where from 75-90% of the water can be recycled and reused within the plant. Standard E-Series systems accommodate flow rates up to 400 gpm while custom designed systems are available to handle larger flow capacities. These Memtek systems are easy to operate and provide for continuous solid/liquid separation with minimal operator attention.

EF Advanced Membrane Filtration Systems

The basic EF system is a skid-mounted package consisting of membrane modules, recirculation pump, in-place cleaning loop, backpulse mechanism, instrumentation and controls. The skid-mounted design is compact and requires minimal floor space.

EFC Advanced Membrane Filtration Systems

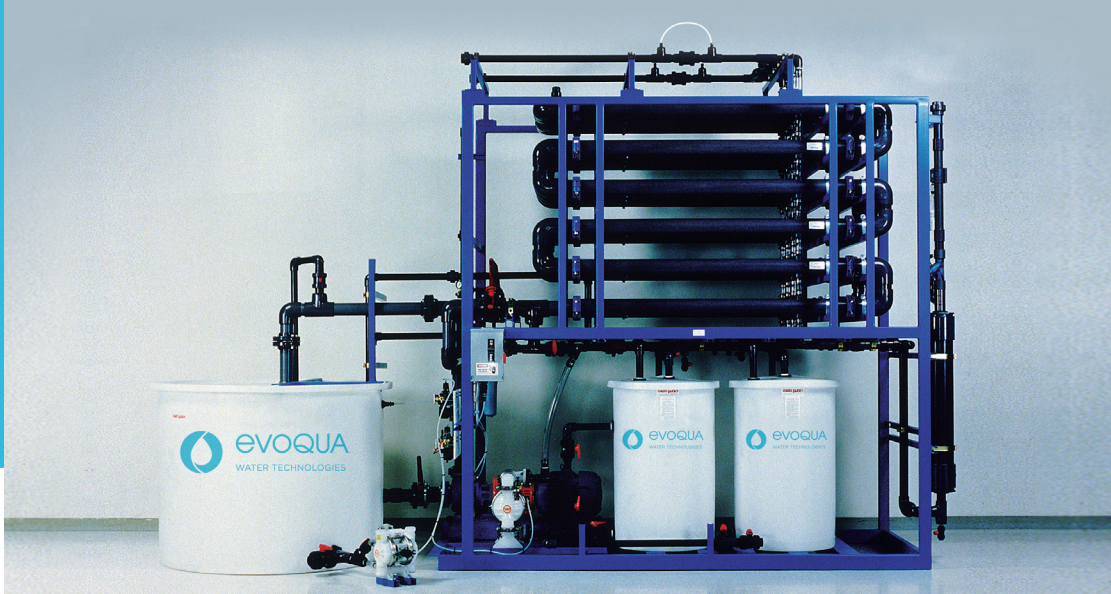
The EFC system includes the EF system equipment plus a recirculation tank with level controls, anti-swirl baffles and slurry transfer pump.

RX and RXP Reaction Systems

These systems are rugged, corrosion resistant tanks equipped with heavy duty mixers; metering pumps; chemical reaction monitors and controllers; level controls and alarms; inlet, overflow and drain ports; control panel; access platform and covers.

Materials of Construction

The rugged fluorocarbon membranes are non-plugging, abrasion and chlorine resistant. The process tanks are fabricated from heavy duty fiberglass reinforced epoxy resins or high density polyethylene. All components in contact with wastewater are PVC, polypropylene, nylon, stainless steel or other corrosion resistant material.



EFC Model 424

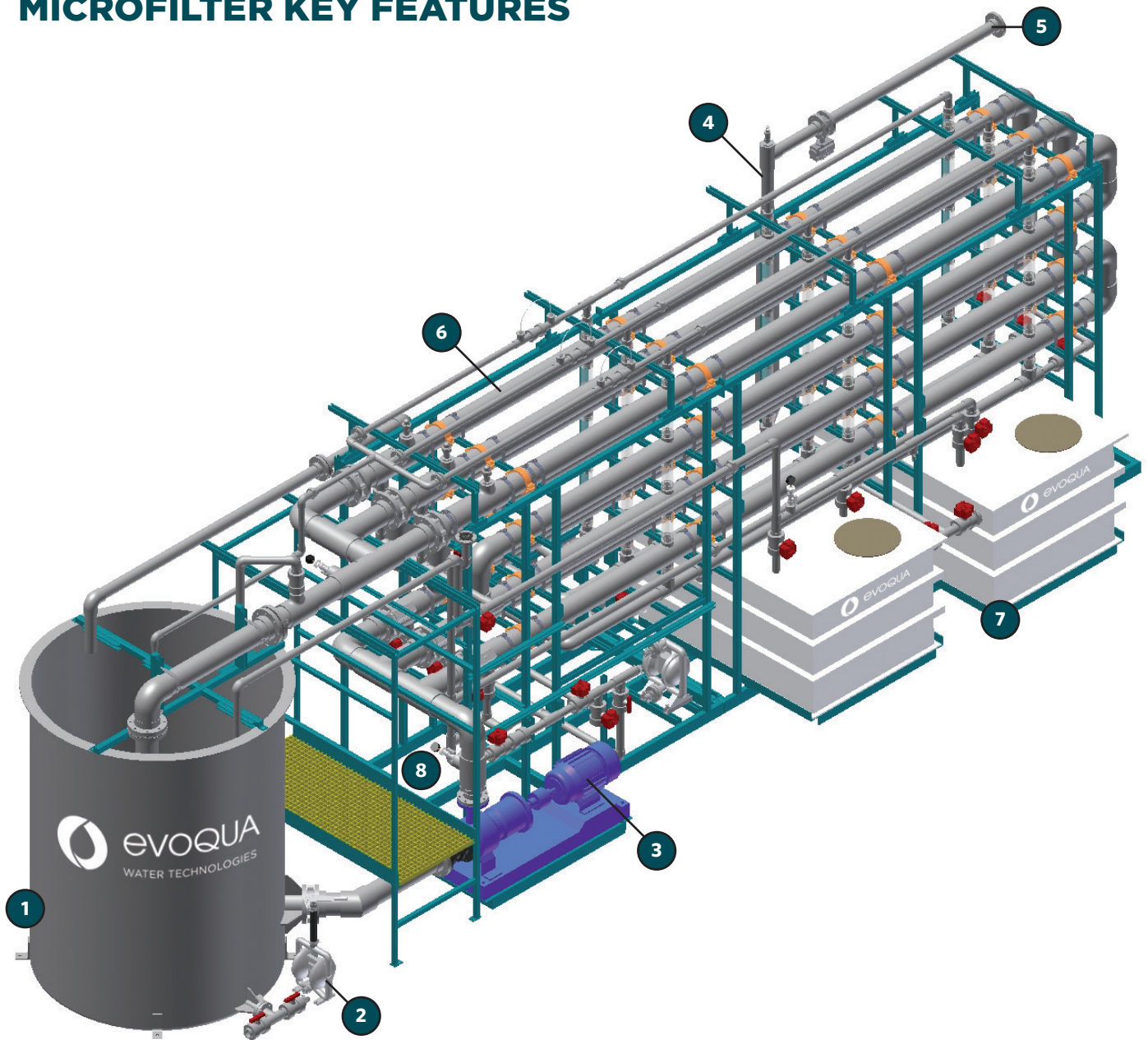
| MARKET | APPLICATION |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Metal Finishing | Removal of heavy metals to less than 0.1 ppm |
| Printed Circuit Board | Removal of heavy metals to less than 0.1 ppm |
| Semiconductor | Arsenic removal to less than 0.1 ppm Fluoride removal to below 5 ppm Cutting fluid recycle from silica grinding and slicing operations Deionized water recycle from wet blast and back grinding processes Heavy metals removal from tin/lead plating onto lead frames |
| Groundwater Remediation | Removal of heavy metals to less than 0.1 ppm |
| Battery Manufacturing | Removal of lead and cadmium from wastewater |
| Automotive | Removal of zinc and phosphate from phosphatizing operations |
| General Industry | Removal of heavy metals from incinerator scrubber water Pretreatment for reverse osmosis water recycling Lime softening of cooling tower blowdown for water recycling General heavy metals removal to less than 0.1 ppm Replacement of clarifier or a clarifier followed by a sand filter |

E-SERIES SYSTEM CAPABILITY*

| CONTAINMENT | WASTEWATER CONC. (mg/l) | MEMTEK® EFFLUENT (mg/l) |
|-------------|-------------------------|-------------------------|
| Aluminum | 10 - 1000 | 0.5 |
| Arsenic | 1 - 50 | 0.005 |
| Cadmium | 25 - 115 | 0.05 |
| Chromium | 3 - 275 | 0.1 |
| Copper | 1 - 1500 | 0.1 |
| Cyanide | 5 - 300 | 0.1 |
| Gallium | 4 - 20 | 0.5 |
| Germanium | 20 - 110 | 0.5 |
| Gold | 1 - 12 | 0.15 |
| Iron | 2 - 1500 | 0.02 |
| Lead | 2 - 100 | 0.05 |
| Manganese | 1 - 10 | 0.02 |
| Mercury | 3 - 30 | 0.005 |
| Nickel | 4 - 300 | 0.1 |
| Rhodium | 20 - 500 | 0.1 |
| Silver | 10 - 200 | 0.1 |
| Tin | 20 - 75 | 0.1 |
| Uranium | 1 - 15 | 0.01 |
| Zinc | 2 - 400 | 0.1 |

*Typical values achieved in practice may vary depending on equipment configuration and pretreatment chemistry

MICROFILTER KEY FEATURES



1. CONCENTRATION TANK

The concentration tank is used to ensure that a constant concentration of solids is being pumped to and from the microfiltration membranes. The tank is equipped with level probes to allow the microfilter feed pump to cycle on and off.

2. SLUDGE WITHDRAWAL PUMP

In order to maintain the right solids concentration (typically 3-5% solids) in the microfiltration recirculation loop for proper system operation, an automatic sludge withdrawal pump is supplied with timers. The sludge or solids removed from the concentration are either pumped to a sludge storage tank or directly to a filter press.

3. FEED PUMP

A reliable pump is used to provide the adequate crossflow through the membrane tube.

4. BACKPULSE

The microfilter is equipped with an automatic backpulse mechanism. The permeate flow rate is periodically reversed through the membrane. This results in maintaining higher flow rate and extends the time between cleaning cycles.

5. PERMEATE

The microfilter permeate (membrane filtrate) usually contains heavy metal that is less than 0.1 ppm. After final neutralization, the permeate can be discharged to drain, reused for non-critical rinses or further processed by reverse osmosis (RO) for water recycle.

6. MEMBRANE/MODULES

The membrane is a rugged polyvinylidene difluoride (PVDF) material attached to a porous one inch substrate. The membrane tubes are bundled together either in a 4 or 10 tube arrangement and placed inside a PVC or CPVC housing.

7. CLEAN-IN-PLACE

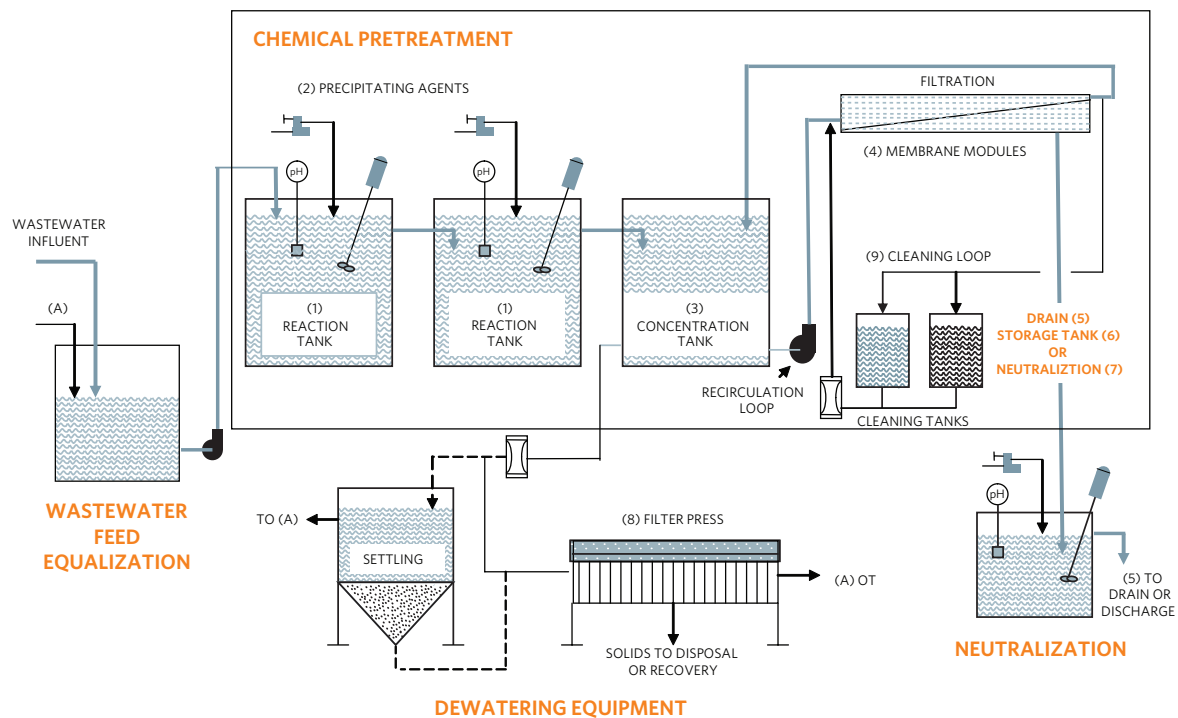
The on-board clean-in-place system consists of two cleaning tanks. One tank is used to make up the cleaning solution; while the other tank contains fresh water to flush the membranes after cleaning. The membranes can be cleaned with acids, caustic, bleach and other various cleaning agents. Automatic cleaning is also available as an option.

8. MODULAR DESIGN

The system is fully skid-mounted and includes the membrane modules, backpulse mechanism, recirculation pump, clean-in-place system, air diaphragm pump, concentrate recirculation tank, electrical power controls, instrumentation and PLC controller. The system is fully piped, wired and equipped for operation.

TECHNICAL INFORMATION

| Model Number | EF/EFC 400 | EF/EFC 424 | EF/EFC 1200 | EF/EFC 2400 | EF/EFC 3600 | EF/EFC 4800 | EF/EFC 7200 | EF/EFC 10800 |
|-----------------------------------------------------------|-------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|-------------------------------------------|--------------------------------------------|---------------------------------------------|
| Low Density Tube Capacity (nominal) | 4 - 15 gpm 0.9 - 3.4 m ³ /h | 8 - 30 gpm 1.8 - 6.8 m ³ /h | 12 - 36 gpm 2.7 - 8.2 m ³ /h | 24 - 72 gpm 5.5 - 16 m ³ /h | 36 - 108 gpm 8.2 - 25 m ³ /h | 48 - 144 gpm 11 - 33 m ³ /h | 72 - 216 gpm 16 - 49 m ³ /h | 108 - 324 gpm 25 - 74 m ³ /h |
| Low Density Tubes per Module | 4 | 4 | 10 | 10 | 10 | 10 | 10 | 10 |
| High Density Tube Capacity (nominal) | 4 - 18 gpm 0.9 - 4.1 m ³ /h | 18 - 37 gpm 4.1 - 8.4 m ³ /h | 17 - 52 gpm 3.9 - 12 m ³ /h | 35 - 105 gpm 7.9 - 24 m ³ /h | 52 - 157 gpm 12 - 36 m ³ /h | 70 - 210 gpm 16 - 48 m ³ /h | 105 - 315 gpm 24 - 72 m ³ /h | 157 - 472 gpm 36 - 107 m ³ /h |
| High Density Tubes per Module | 5 | 5 | 14 | 14 | 14 | 14 | 14 | 14 |
| Module Quantity (min-max) | 4 - 12 | 12 - 24 | 6 - 12 | 12 - 24 | 18 - 36 | 24 - 48 | 36 - 72 | 54 - 108 |
| Concentration Tank Volume | 275 gal 1.0 m ³ (HDPE) | 550 gal 2.1 m ³ (HDPE) | 660 gal 2.5 m ³ (FRP) | 1,375 gal 5.2 m ³ (FRP) | 1,700 gal 6.4 m ³ (FRP) | 2,600 gal 9.8 m ³ (FRP) | 4,280 gal 16.2 m ³ (FRP) | 5,000 gal 18.9 m ³ (FRP) |
| (Note: Concentration Tank Included with EFC Series only.) | | | | | | | | |
| Process Pump(s) | Qty. 1 7.5 HP | Qty. 1 15.0 HP | Qty. 1 20.0 HP | Qty. 1 30.0 HP | Qty. 1 50.0 HP | Qty. 2 30.0 HP | Qty. 2 50.0 HP | Qty. 3 50.0 HP |
| Dimensions (L x W x H) | 11'-10" x 4'-10" x 8'-11" | 18'-3" x 5'-4" x 11'-7" | 24'-7" x 5'-10" x 9'-10" | 25'-5" x 7'-1" x 10'-0" | 33'-0" x 8'-1" x 11'-10" | 26'-9" x 9'-6" x 11'-3" | 37'-10" x 17'-1" x 11'-11" | 39'-4" x 25'-3" x 11'-11" |
| Shipping Weight | 1,000 lbs 450 kg | 2,000 lbs 900 kg | 7,500 lbs 3,400 kg | 10,000 lbs 4,550 kg | 15,000 lbs 6,800 kg | 18,000 lbs 8,160 kg | 29,000 lbs 13,150 kg | 43,000 lbs 19,500 kg |
| Operating Weight | 4,000 lbs 1,810 kg | 8,000 lbs 3,630 kg | 18,000 lbs 8,160 kg | 26,000 lbs 11,800 kg | 34,000 lbs 15,420 kg | 52,000 lbs 23,590 kg | 73,000 lbs 33,110 kg | 98,000 lbs 44,450 kg |



Microfiltration Wastewater Treatment System

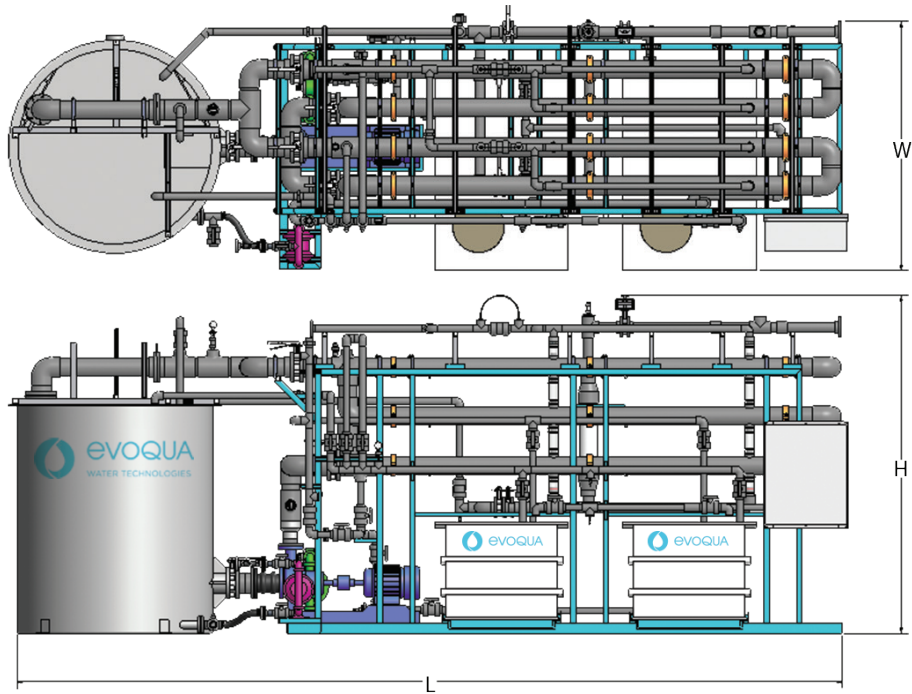
E-SERIES SYSTEM OPERATION

Pretreatment in RX and RXP Systems

The process begins with the transfer of wastewater to one or more reaction tanks (1). Pretreatment chemistry (2) is selected considering the nature of the wastewater and is controlled automatically and continuously.

Filtration in EF and EFC Systems

The chemically pretreated wastewater then flows to the concentration tank (3). From there, the water is pumped continuously through the tubular membrane filtration modules (4) at a high fluid velocity. At the



normal operating pressure (20 - 40 psi), clean water is forced through the pores of the membrane while the particulate contaminants remain suspended in the recirculated stream. The filtration piping also includes a backpulse mechanism which reverses the flow of filtrate to maintain higher flow rates and extend the time between cleaning cycles. The clean water (membrane filtrate) flows by gravity from the membrane modules to drain (5), storage tank (6) or the final neutralization tank (7). The concentration of the wastewater slurry recirculated in the membrane modules is typically maintained between 2-5% solids. Under normal operating conditions, a portion of the slurry is periodically removed from the system, usually to a filter press (8). Every E-Series filtration system includes a convenient integral cleaning loop (9) consisting of a pump, two tanks and the necessary piping and valving to permit in-place cleaning of the membrane modules.

E-SERIES SYSTEMS ARE KEY ELEMENTS OF TREATMENT UPGRADES

Wire and Cable Manufacturer, Jacksonville, FL

A manufacturer of high carbon steel wire products is using the E-Series system to treat rinsewaters from the acid cleaning and descaling of wire rod and processed wire. The E-Series system consistently produces effluent at less than half the discharge limits for all metals. The management staff wanted assurance that the waste treatment system would operate in compliance. Memtek® products demonstrated detailed

knowledge of the company's wastewater and confirmed their design concept with treatability testing on actual samples of the wastewater. Memtek products provided turnkey installation, startup and operator training. The system provides the customer with the confidence that the effluent is consistently well below discharge limits.

Parts Manufacturer, New Haven, IN

A leading manufacturer of industrial, automotive, aerospace defense fluid connectors, as well as automotive and commercial custom engineered molded extruded plastic products is using the Memtek E-Series microfiltration system to treat metal bearing wastewaters. Since startup, the treatment system has consistently met the required effluent limitations at operating costs that are lower than conventional technologies.

Printed Circuit Board Manufacturer, Raleigh, NC

A major manufacturer of printed circuit boards, recently upgraded their wet processing operations with new, state-of-the-art equipment. The customer also replaced their wastewater treatment system, which was based on ion exchange, with a Memtek E-Series microfiltration system. The customer needed a reliable waste treatment system to meet very low compliance limits. The E-Series microfiltration system has reduced operating costs and generated sludge with high copper content. As a result, sludge disposal costs are significantly lower than expected.



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