

Water Technologies

Petro™ MBR System  
For The Petroleum  
And Chemical  
Industries

**SIEMENS**



The Petro™ membrane bioreactor (MBR) system was specifically designed to meet the goals of petroleum and chemical industry operators with flexibility and ease of operation. A unique two-phase jet and fluid renewal process evenly distributes liquid, solids and air within the membrane module and to all membrane modules in the system. No other MBR system in the industry provides this control over the membrane environment and puts the operator in such control.

The Petro™ MBR system is ideally suited to a wide range of refinery, petrochemical and production water treatment applications including water reuse, upgrades, retrofits and compliance-driven projects. The system is a petroleum industry-grade system designed by our process experts that have been working with petroleum and chemical industry wastewaters and designing equipment to industry standards for over 30 years.

However, using a membrane system to treat petroleum and chemical industry wastewater requires special consideration to remove oils and create the best operating environment for membranes. Pre-treatment *must* be incorporated into a membrane treatment system for this industry, and Siemens Water Technologies has the expertise needed to design a complete pre-treatment system that will work properly.

### CHOOSE PETRO™ MBR SYSTEM

Replacing conventional clarification processes with membrane separation offers several benefits - system footprint is dramatically reduced, sludge production is decreased and operational stability is improved, all in addition to exceptionally high-quality effluent production.

### PETRO™ MBR EFFLUENT CAN MEET:

- Turbidity < 0.2 NTU
- BOD < 5 mg/l
- COD < 50 mg/l
- TSS < 1 mg/l
- Nutrient removal as low as 5 mg/l total nitrogen

Our Petro™ MBR process achieves these benefits by allowing the biological processes to be operated at elevated mixed liquor concentrations by providing positive liquid/solids separation through ultrafiltration membranes. Careful management of the membrane environment is designed into our systems to prevent solids buildup and dehydration on aerated membrane surfaces, and to provide continuous fluid transfer at the membrane surface, which is critical for stable long-term membrane operation.

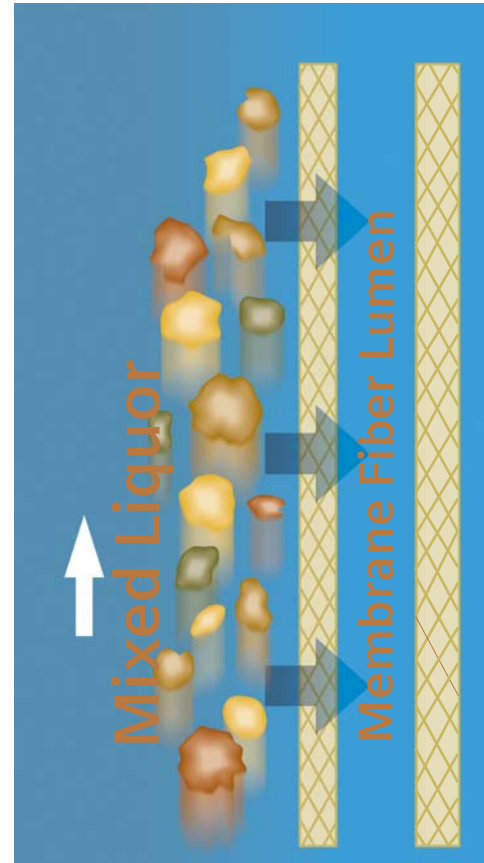


*B30R Membrane Rack with Integral Air/Filtrate Header*

### FEATURES & BENEFITS

- Continuously controlled environment around membrane system equalizes load on each module
- Positive two-phase transfer into fiber bundles keeps membranes clean, extends life and reduces operating costs
- Cross-flow dynamics maximize scouring efficiency, keeping membranes on-line longer
- Continuous removal of oil and grease from membrane operating environment protects membranes
- Automated, in-place membrane cleaning process means reduced labor
- Safe environment for plant operators
- Flexibility in biological process selection/optimization
- Small footprint

# Petro™ MBR System For The Petroleum And Chemical Industries



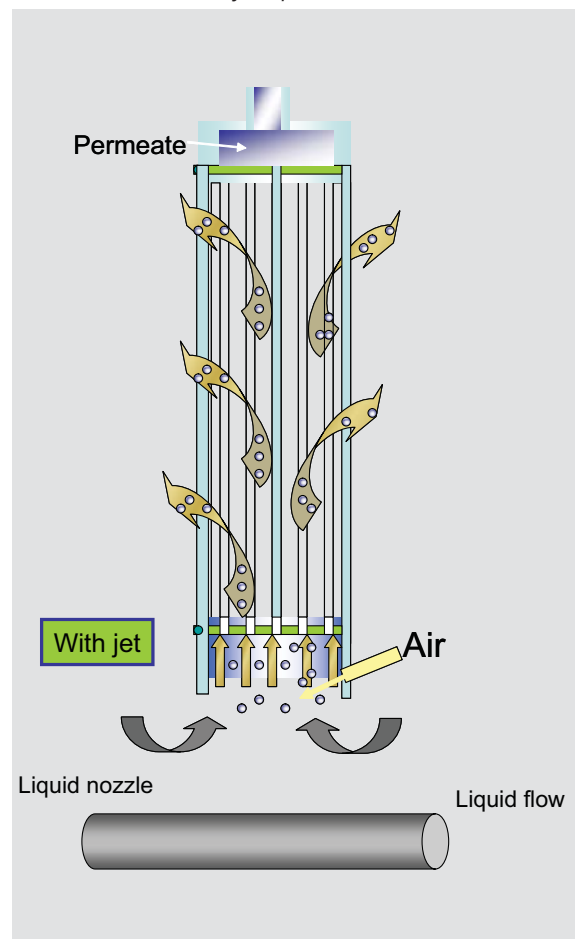
Cross flow pattern

## FLUID RENEWAL SYSTEM

The unique fluid renewal system of the Petro™ membrane bioreactor optimizes system performance and provides both fluid transfer in the form of mixed liquor, and air scour energy through two-phase jetting (typical) action. The two-phase jet system introduces both air and mixed liquor directly into the bottom of each membrane module. The air bubbles blend with the mixed liquor and rise up through the membrane bundle, providing scouring energy and fluid renewal to the membrane surface as well as inducing a cross flow pattern on the membrane surface to prevent solids accumulation.

In any membrane bioreactor, the filtration process dewateres the mixed liquor at the membrane surface producing clean water (permeate) as the water moves across the membrane barrier. If this surface is not continuously replenished with liquid, the solids will quickly thicken and foul the membrane surface. As certain areas of the membrane module foul in this way, they become more resistant to water passing through the membrane. For the system to pass the required volume of water, other areas of the membrane must operate at increased flow rates (flux). This resulting boost in flux consequently increases their fouling rate, which can result in reduced performance and increased maintenance. To avoid this situation, our two-phase jet introduces two phase fluid/air continuously to all membranes through openings in the fiber bundles, arranged to allow air and fluid to move up and between individual membrane fibers. The continuous fluid renewal prevents the dewatering of mixed liquor and consequent fouling of the membrane surface.

Module with jet operation





Solids concentration-with jets



Solids concentration-without jets

## CROSS FLOW DYNAMICS

Cross flow dynamics of the Petro™ MBR system also reduce membrane fouling. The system's two-phase jet generates an upflow of fluid across the ultrafiltration modules within the tank as mixed liquor is introduced into the bottom and overflows the top of the basin. This upflow of liquid parallel to the membrane surface creates a cross flow pattern that prevents solids accumulation at the membrane surface and reduces air scour requirements. Replenishing liquid at the bottom also eliminates areas of conflicting currents (that can create dead zones, causing poor fluid transfer and resulting in fouling), and enhances cross flow dynamics. A flotation effect is also created by the mixed liquor and air upflow, which moves grease, scum, and other membrane fouling constituents to the tank surface, where they are removed from the membrane environment.

## UNIFORM SOLIDS DISTRIBUTION

Uniform mixed liquor distribution in the Petro™ MBR system, through a two-phase distribution process, ensures consistent operation. Air and liquid are introduced into the two-phase jet, creating back pressure and even distribution of air and mixed liquor to each membrane module in the membrane tank. This even distribution across the membrane tank ensures consistent operating conditions for all membrane modules in the system.

## EFFICIENT CIP

Thorough mixing provides a highly-efficient cleaning mechanism for the membrane Clean in Place (CIP) system, reducing cleaning time and effort. CIP system operation in the Petro™ MBR system is done without removing membrane modules, disconnecting pipes and fittings, or the use of high-pressure hoses.

Our sludge distribution system is also used in CIP process, and just as it provides equal flow to all membranes during operation, it provides cleaning to all membranes during CIP. Ensuring equal flow of CIP chemicals to each membrane ensures equal, efficient cleaning as well.

And, the separated membrane process design allows the membranes to be totally isolated from the biological process and protects sensitive biology from strong oxidizing chemicals such as chlorine or acid.

The efficient automated CIP system is safe and convenient for plant operators, allowing the membranes to be fully cleaned in four to six hours vs 18-24 hours for other systems.

In addition, the CIP process cleans all of the membranes on a common suction header together and *equally*—an important feature that prevents accelerated membrane fouling of clean membranes when working together with fouled membranes during CIP, as some systems are designed.

## SEPARATED MEMBRANE PROCESS

- Places membrane system in an independent tank for process optimization
- Allows independent optimization of biological and membrane process
- Automated CIP with membrane in place
- Flexible – allows implementation of the best biological processes for each application

# Services



*Petro™ MBR pilot unit*

## SERVICE

Our service philosophy is to work with our customers to optimize operation and to provide the most efficient and cost-effective solution to your wastewater treatment needs. Our process optimization includes:

- Clean-In-Place (CIP) system
- Biological process support
- Membrane analysis of existing membranes and advice on extending membrane life
- Continuous monitoring of system performance to ensure long-life and reduced maintenance

We have a full staff of trained field-service technicians and engineers experienced in working with petroleum and chemical industry wastewaters. Our staff is dedicated to meeting your installation and start-up requirements as well as providing operator training, maintenance, long-term support and service requirements.

## FROM PILOT TESTING TO DAY-TO-DAY OPERATION, WE'RE THERE FOR YOU

- Treatability pilot and lab scale studies
- Full service analytical laboratory
- Process evaluation and cost analysis
- Pre-design support
- Process/system design engineering
- Quality manufacturing  
ISO 9001: 2000 certified
- Plant start-up and operator training
- Post installation and field support
- Process optimization
- Telemetric process oversight

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