

TECH OFFER

Membrane System For High Recovery Water Reclamation



KEY INFORMATION

TECHNOLOGY CATEGORY:

Environment, Clean Air & Water - Biological & Chemical Treatment

Environment, Clean Air & Water - Filter Membrane & Absorption Material

Environment, Clean Air & Water - Sensor, Network, Monitoring & Quality Control Systems

TECHNOLOGY READINESS LEVEL (TRL): **TRL5**

COUNTRY: **SINGAPORE**

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OVERVIEW

Reclaimed water is a critical source of water in Singapore and globally. Common practical limit of existing technology based on microfiltration/ultrafiltration-membrane bioreactor (MF/UF-MBR) and reverse osmosis (RO) for water reclamation has 75-85% recovery due to RO membrane fouling.

This technology presents a hybrid system consisting of a high retention nanofiltration-membrane bioreactor (NF-MBR) and RO developed to achieve $\geq 90\%$ of water recovery. NF-MBR produces superior quality effluent because the NF membrane can retain low molecular weight organics and scale forming divalent ions. Thus, membrane fouling in downstream RO process can be alleviated significantly, which allows higher recovery.

TECHNOLOGY FEATURES & SPECIFICATIONS

The NF-MBR+RO system for water reclamation consists of a biological process with side-stream NF membrane unit (NF-MBR) for wastewater processing to produce superior quality effluent as feed water for downstream RO unit to produce clean water.

The key features of the NF-MBR unit are the novel low pressure NF membrane and customized biological process. Conventional NF membranes are not suitable for direct wastewater processing due to high operating pressure requirement and severe membrane fouling potential. However, this novel hollow fiber NF membrane only requires an operating pressure of <2 bar, possesses a positively charged selective layer, molecular weight cut off (MWCO) of <500 Da, and rejection of Mg²⁺ and Ca²⁺ is at ~90%. It has very low rejection of Na⁺ ions (<15%) while maintaining high rejection of the divalent ions, which is the key to achieve such a low operating pressure condition.

In addition, the bioprocess is customized for elevated salt environment in the bioreactor. When coupled with the optimized biological process, the NF-MBR offers several advantages over conventional MF/UF-MBR, including a superior quality of effluent water and less sludge production.

POTENTIAL APPLICATIONS

This technology could be applied in the following areas for significant improvement of micropollutant removal, especially recalcitrant trace organics:

- Wastewater reclamation
- Industrial water recycling

UNIQUE VALUE PROPOSITION

This hybrid system with lower fouling potential of RO feed water offers the following advantages:

- High recovery water reclamation
- Lower chemical use, less energy consumption associated with RO membrane fouling
- Longer RO membrane lifespan
- Less sludge production
- Reduced water production cost