

**NUS Graduate School for Integrative Sciences and Engineering
Research Project Write-up**

Title of Project : The study of new desalination membrane technologies:
membrane distillation and forward osmosis

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Short Description

The freshwater scarcity is a growing problem all over the world. Both rapid population growth and the impairment of existing freshwater sources cause many dry regions to turn to the ocean as a source of freshwater. However, the current desalination technologies are prohibitively expensive and energy intensive. Reverse osmosis, a commonly used desalination technology, is significantly more expensive than the standard treatment of freshwater for potable use. Less expensive methods of desalination are needed to make desalination technologies more competitive with freshwater treatment.

Membrane distillation (MD) is a new desalination technology that separates water vapor from a liquid saline aqueous solution through the pores of hydrophobic membranes. The driving force is the vapor pressure difference created by temperature difference across the membrane. The fundamental operating parameters of the MD process are the temperature of the hot feed; the mass flow rate of the feed solution; the air/vapor gap thickness; and the mass flow rate of the coolant; and/or the circulating sweeping velocity. The scope of this research is to (1) characterize potential materials for the MD process; (2) understand the effect of process parameters on separation performance of MD; (3) investigate the optimization design of MD process to decrease its cost; and (4) study the effects of some conditions, such as membrane aging, fouling, and feed water contamination, on membrane stability during a long-term experimental running.

In addition, forward osmosis (FO) has drawn much attention recently as a potential desalination technology. By employing the osmotic pressure as a driving force, FO can operate without high hydraulic pressures which are necessary in the reverse osmosis process. Membrane, as the barrier between the draw solution and the feed solution to transport water and reject solute, play an important role on the realization of FO. Efforts will be given to study the science and engineering of FO materials and developing FO hollow fiber membranes for desalination and water recycle.