

# Application of hybrid systems techniques for cleaning and replacement of a RO membrane

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## Abstract

An optimal system design as well as advanced fault tolerant control is required to propose a cost-effective design and control of a seawater reverse osmosis (SWRO) desalination plant. Contrary to the steady-state model which is useful for only design, a dynamic model is essential to complete a plant design that includes embedded model-based control as well as analysis of transient behavior of a SWRO plant. In this paper, a model for fouling factors (i.e., water and salt transport permeability factors) is proposed to consider the membrane degradation influenced by not only temperature but also time variant fouling. The cycle NCR (Normal operation – Cleaning – Replacement) is also modeled by means of a hybrid automaton for a fault tolerant control. The simulation results of the model, which are generally satisfied to explain the membrane degradation effect, show that it can be feasible to obtain the optimized control using the dynamic hybrid model and applicable to operational cost-saving for SWRO desalination plants.

**Keywords:** Reverse osmosis (RO) membrane; Fouling dynamic model; Hybrid supervisor

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