



## Guidelines for hydraulic analysis of treatment plants equipped with ultrafiltration and reverse osmosis membranes

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### ABSTRACT

Despite all recent developments to improve the hydraulic performance of components in ultrafiltration and reverse osmosis plants, from advanced membrane modules to complex energy recovery devices, only little attention is being paid to enhance the plant operation as a fully integrated system. In practice, different hydraulic devices are chosen based on their individual performances without considering associated hydraulic interactions among the devices. This becomes a matter of concern, especially during transient events when a change in the operation of one device may lead to unacceptable pressure and flow rate fluctuations through the plant and eventually costly damages. Although several excellent books have been written on fluid transients for pipeline systems, there is still a need for a guideline on the hydraulic analysis of ultrafiltration and reverse osmosis plants which include complex and vulnerable hydraulic components such as UF and RO membranes, energy recovery devices, and solenoid valves. This study provides a guideline for the integrated hydraulic design of plants with a focus on modeling of UF and RO units, which leads to a more robust, reliable, and water-tight system.

*Keywords:* Ultrafiltration; Reverse osmosis; Desalination and treatment plants; Transient flow; Hydraulic analysis; Water hammer

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