S1.6.1 The Use of Center Port Vessels in Brackish Water RO System Design

Richard Chmieleski, Daniel Gilson
Protec-Arisawa Americas

Brackish water RO systems operating at high recovery have been traditionally been designed using multi-element pressure vessels arranged in a tapered array with feedwater introduced into one end of the vessel and concentrate leaving the vessel at the opposite end. Most commonly vessels with six, seven or occasionally eight membranes are arranged in a single vessel. The vessels are arranged in a “tapered” array. Typically a multiple of 2-1, or a 4-2-1 array may be used for higher recovery. This design provides for similar hydraulic flowrates in each stage or bank of the array.

This concept results in the membrane elements in the leading positions in the vessels having flowrates which are higher than optimum as they are providing flow and pressure to the downstream membranes linked in series in the vessel. Hydraulic losses are proportional to the number of membranes linked in series. While this design has proven to work successfully in thousands of installations world-wide, it is not the only or most efficient membrane array. This design with feed at one end and concentrate at the other will be referred to as “Conventional Design”.

Protec-Arisawa has developed a center port vessel design which allows for an alternate design of the membrane array. The center port vessel allows the feed water to be fed to each end of the vessel with the concentrate removed in the center port. Alternatively, the feedwater can be fed to the center of the vessel (with flow splitting at the center) and concentrate removed from each end. The center port vessels may hold 4, 6 or 8 membranes with individual membrane path lengths of 2, 3 or 4 membranes on each side of the center port.

This approach, sometimes called split feed or center feed, can result in a more energy efficient membrane system resulting in lower operating pressure. This paper will discuss the design of the center Port Vessel, and will give examples where a center port design is compared to a Conventional Design. The advantages in terms of reduced operating pressure will be demonstrated. Capital costs will be compared for the two design concepts and payback periods estimated.