

HIGH EFFICIENCY ENERGY RECOVERY DEVICES IN MEMBRANE DESALINATION OPERATIONS

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Membrane desalination is a pressure-driven process. A significant amount of the energy imparted into the feedwater flowing to the reverse osmosis (RO) membranes leaves the membranes in the concentrated reject water. A number of devices have been developed to recover pressure energy from the reject stream of seawater RO processes. Turbine-based, centrifugal energy recovery devices have been employed since the early 1980s. These devices are still in use where inexpensive power is available. However, it is the widespread adoption of positive-displacement “isobaric” energy-recovery devices since 2002, together with improved membrane performance, that has made membrane desalination an affordable and widely-accepted technology deployed around the world.

Isobaric energy recovery devices such as the ERI PX Pressure Exchanger® device can reduce the energy consumption of a seawater RO system by as much as 60% compared to a system with no energy recovery device or by as much as 30% compared to a system with a centrifugal energy recovery device. Since energy prices are rising and energy consumption can comprise as much as 75% of the total operating costs of a seawater RO plant, it has become almost inconceivable to build a seawater RO process without using isobaric energy recovery technology. In addition to cost savings, isobaric energy recovery devices provide significant operating flexibility by maintaining high energy transfer efficiency performance over a wide range of flow rates and membrane recovery rates. PX technology also provides fail-safe redundancy. Should a device go offline for any reason, the remaining units will still operate offering energy recovery savings.

The authors present an overview of energy recovery devices for RO applications with examples drawn from several seawater applications, including a mining project in South Africa. Process energy consumption and operational flexibility are discussed. Cost benefit analyses are provided for seawater RO systems to identify best available energy recovery technologies for various operating conditions.