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Retrofits to improve desalination plants

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ABSTRACT

Legacy seawater reverse osmosis (SWRO) desalination plants used turbine-type energy recovery devices (ERDs) connected with a shaft to the high-pressure pump. These ERDs, commonly known as Pelton wheels or energy recovery turbines, were default equipment in SWRO plants until quite recently. Today, however, over 80% of new SWRO plants are being designed and built to utilize isobaric-chamber ERDs. Isobaric ERDs such as Energy Recovery, Inc. (ERI's) PX Pressure Exchanger (PX) device are positive displacement devices that operate with energy transfer efficiencies as high as 98%. High SWRO plant operating efficiency can be obtained over a wide range of membrane water recovery rates, typically between 35% and 50%. Recovery rates can be adjusted in response to changes in seawater temperature or salinity or as the membrane elements age. Flexible recovery and low-recovery operation are tremendous advantages for low-cost SWRO operation provided by isobaric ERD technology. Removing legacy ERDs and installing modern isobaric ERDs makes it possible to reduce the power consumption of existing systems by as much as 60%. Such retrofits can also significantly increase the capacity of existing systems while adding little or no additional power requirements. These benefits can be realized at a fraction of the cost of constructing new plants. For these reasons, many owners of legacy desalination plants worldwide are upgrading their processes by incorporating isobaric ERD technology. The authors recognize that each energy recovery technology comes with its own unique advantages and disadvantages, which should be compared and studied for each individual system. This paper, therefore, provides detailed analyses comparing SWRO energy consumption with various ERDs. It presents many examples of retrofits, including replacements of Pelton turbines and turbocharger devices. It also estimates the potential energy savings and capacity increase benefits for retrofitting some of the largest SWRO projects in the world including facilities in Fujairah, UAE and Trinidad.

Keywords: Energy recovery; Retrofit; SWRO; Efficiency

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