Technical feasibility of using gallery intakes for seawater RO facilities, northern Red Sea coast of Saudi Arabia: the King Abdullah Economic City site

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ABSTRACT

The Kingdom of Saudi Arabia is dependent on desalination of seawater to provide new water supplies for the future. Desalination is expensive and it is very important to reduce the cost and lower the energy consumption. Most seawater reverse osmosis facilities use open-ocean intakes, which require extensive pretreatment processes to remove particulate and biological materials that cause operating problems such as membrane fouling or shutdown during algal blooms. Subsurface systems, using the concept of riverbank filtration, can be used as intakes. These systems include wells of various designs and galleries that provide natural filtration and biological treatment to improve the quality of feed water before it enters the desalination plant. This reduces operating cost, lowers chemical and energy consumption, and reduces environmental impacts. Technical feasibility of gallery-type intakes, beach and seabed types, for use as intakes to seawater reverse osmosis (RO) facilities was evaluated along the northern Red Sea shoreline of Saudi Arabia. The geological characteristics of the offshore ocean bottom were found to be favorable for the development of seabed gallery systems, but the shoreline geology was not adequate for the development of beach gallery intakes. One of the potentially favorable sites for a seabed gallery system was located in the nearshore area at King Abdullah Economic City (KAEC). Detailed investigation of the site hydrology (tides and wave action), sediment grain size characteristics, and sediment hydraulic conductivity, and access for construction were assessed. It was determined that seabed gallery development is favorable at the site. Based on the seawater that has a salinity of about 41,000 mg/L and a conversion rate of 40%, a conservatively designed gallery cell with dimensions of 100 by 50 m would produce about 25,000 m³/day of filtered seawater and seven cells (6 primary and 1 standby) could support a 60,000 m³/day (permeate) seawater RO plant.

Keywords: Reverse osmosis; Intake; Desalination; Seabed; Offshore gallery

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