

## Self-cleaning beach gallery design for seawater desalination plants

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### ABSTRACT

Surface water intakes are a major capital cost for seawater desalination facilities, and their performance can greatly impact the operation of the entire system. Alternative intakes, based on the riverbank filtration concept, are increasingly being implemented because they are less expensive than conventional intakes and can also provide natural filtering of feedwater prior to the entry of water into the treatment plant. The basic concept is to use vertical or horizontal wells or galleries located near the seawater source to produce feed water, while taking advantage of the natural sand filtration provided by the beach sands and other sediments. Although conceptually simple, the successful design of beach gallery intakes must consider a variety of sedimentological and hydrogeological factors. Production rates are dependent upon both the hydraulic conductivity of the beach sediments and the length of the flow path from the seawater source to the gallery. Beach galleries constructed inland above the high tide line thus require relatively great lengths or areas to produce a given amount of seawater. Inasmuch as beach galleries act as slow sand filters, they are subject to clogging at the sediment-water interface. Carbonate scaling has been a major problem in some systems constructed in carbonate sediments in tropical settings because of the supersaturation of seawater with respect to calcite. Beach sedimentation patterns can also impact the long-term performance of beach galleries. Improperly designed or constructed beach galleries may be exposed or damaged in beaches that experience erosion under normal or storm conditions. Prograding beaches are more problematical as the galleries become increasingly distant from the seawater source, which reduces potential production rates. The self-cleaning beach gallery overcomes some of the inherent limitations of beach galleries constructed above high tide line. The gallery is a horizontal collection system within a single trench that is constructed between the low and high tides lines. The normal wave action keeps the sediment-water interface above the gallery clean by mechanically removing fine-grained sediment and marine organisms. The daily tidal cycle keeps the sediment above the gallery saturated and maintains a short travel time. The top of the gallery is set at about 4 m below normal low tide, so erosion should not be a concern and scaling can be managed. However, progradation of the beach may still adversely impact system performance. The design of the self-cleaning beach gallery requires field testing to obtain site-specific data on the hydraulics of surficial sediments. The field testing should involve aquifer performance testing and a small-scale pilot test. Hydraulic flow modeling is necessary to evaluate potential gallery design options and potential water yields. An assessment of shoreline sedimentation dynamics should also be performed, which may involve a literature review or field investigations.

*Keywords:* Reverse osmosis; Desalination; Intake; Beach gallery

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