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Impact of well intake systems on bacterial, algae, and organic carbon reduction in SWRO desalination systems, SAWACO, Jeddah, Saudi Arabia

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ABSTRACT

The intake system can play a significant role in improving the feed water quality and ultimately influence the performance of downstream components of the seawater reverse osmosis desalination processes. In most cases, open-ocean intakes produce poor feed water quality in terms of the abundance of naturally occurring organic matter, which increases the risk of membrane fouling. An alternative intake is the subsurface system, which is based on the riverbank filtration concept that provides natural filtration and biological treatment of the feed water prior to the entry of the water into the desalination plant. The use of subsurface intakes normally improves the raw water quality by reducing suspended solids, algae, bacterial, and dissolved organic carbon concentrations. Therefore, the risk of biofouling caused by these substances can be reduced by implementing the appropriate type of intake system. The use of well intake systems was investigated along the Red Sea shoreline of Saudi Arabia in the Jeddah region. Data were collected from a seawater reverse osmosis (SWRO) plant with a capacity of 10,000 m^3/d. The well system produces feed water from an artificial-fill peninsula that was constructed atop of the seabed. Ten wells have been constructed on the peninsula for extracting raw seawater. Water samples were collected from nearby surface seawater as a reference and from selected individual wells. The percentage of algae and bacterial removal by induced filtration process was evaluated by comparison of the seawater concentrations with the well discharges. Transparent exopolymer particles and organic carbon fractions reduction was also measured. The quality of raw water extracted from the well systems was highly improved compared with the raw seawater source. It was observed that algae were virtually 100% removed and the bacterial concentration was significantly removed by the aquifer matrix. The detailed analysis of organic carbon fraction using liquid chromatography-organic carbon detection instrument showed a high-percentage removal of the organic fractions consummate with the molecular weight.

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The results of this study can be used to improve the intake system design of existing SWRO facilities that might require expansion in future or new facilities that will be located along the Red Sea coastline.

Keywords: Seawater reverse osmosis desalination; Pretreatment; Well intake systems; Membrane biofouling; Transparent exopolymer particles