Geophysical Research Abstracts
Vol. 17, EGU2015-7020, 2015
EGU General Assembly 2015

Characterization of saline groundwater across the coastal aquifer of Israel as resource for desalination

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In arid countries with access to marine water seawater desalination is becoming an important water source in order to deal with the water scarcity and population growth. Seawater reverse osmosis (RO) facilities use open seawater intake, which requires pretreatment processes to remove particles in order to avoid fouling of the RO membrane. In small and medium size desalination facilities, an alternative water source can be saline groundwater in coastal aquifers. Using saline groundwater from boreholes near the shore as feed water may have the advantage of natural filtration and low organic content. It will also reduce operation costs of pretreatment. Another advantage of using groundwater is its availability in highly populated areas, where planning of large RO desalination plants is difficult and expensive due to real-estate prices. Pumping saline groundwater underneath the freshwater-seawater interface (FSI) might shift the interface towards the sea, thus rehabilitating the fresh water reservoirs in the aquifer.

In this research, we tested the potential use of saline groundwater in the coastal aquifer of Israel as feed water for desalination using field work and desalination experiments. Specifically, we sampled the groundwater from a pumping well 100 m from the shore of Tel-Aviv and sea water from the desalination plant in Ashqelon, Israel. We used an RO cross flow system in a pilot plant in order to compare between the two water types in terms of permeate flux, permeate flux decline, salt rejection of the membrane and the fouling on the membrane. The feed, brine and fresh desalinated water from the outlet of the desalination system were chemically analyzed and compared. Field measurements of dissolved oxygen, temperature, pH and salinity were also conducted in situ. Additionally, SDI (silt density index), which is an important index for desalination, and total organic carbon that has a key role in organic fouling and development of biofouling, were measured and compared. The results have shown that using saline groundwater underneath the FSI as a resource for RO desalination process is beneficial in terms of fluxes: the flux reduction in the seawater desalination was 16% of the initial flux, while the flux reduction with the saline groundwater was only 9%. The SDI and total organic carbon were lower in saline groundwater than in seawater, which support the flux results. Therefore, using saline groundwater as feed water for desalination may be advantageous because of lower operational costs and reduced applied pressure needed and energy usage.