REVERSE OSMOSIS DESALINATION FOR YEMEN

TECHNOLOGY DESCRIPTION

TECHNICAL DESCRIPTION

Desalination technologies are becoming more and more popular everywhere particularly where the lack of fresh water is overwhelming. A series of industrial processes are conducted to remove all sodium chloride and other dissolved constituents from seawater, brackish water, wastewater, or contaminated freshwater.

Reverse osmosis (RO) is the most widely used membrane desalination technology.The process stems from pressure being used to drive water molecules across the membrane in a direction opposite to that they would naturally move due to osmotic pressure. Because osmotic pressure must be overcome, the energy needed to drive water molecules across the membrane is directly related to the salt concentration. However, the energy efficiency and economics of RO have improved markedly with the development of more durable polymer membranes, improvement of pretreatment steps, and implementation of energy recovery devices. In many cases, RO is now more economical than thermal methods for treating seawater.

The main parts of a reverse osmosis filter are a sediment filter, two carbon filters, a reverse osmosis membrane, a water supply connector, a shut-off valve and check valve, a drain line, a flow restrictor, and a drinking water faucet. Optional reverse osmosis components include a water storage tank, a pressure booster pump, a pressure regulator, a remineralization filter, a UV disinfection light, and a TDS monitor.[1]

CURRENT TECHNOLOGY READINESS LEVEL OR COMMERCIAL READINESS INDEX

The Technology Readiness Level (TRL) ranges between (6-7), indicating a demonstration stage or limited application in a relevant environment. The Commercial Readiness Index(CRI) might be 2 or 3, reflecting early commercial trials or initial market scaling.

CLIMATE RATIONALE OF THE TECHNOLOGY

Yemen faces a severe water crisis, exacerbated by both natural and man-made factors. With per capita water availability at a critically low level of just 125 m^3 annually—far below the international threshold for water scarcity—Yemen is one of the most water-stressed countries in the world. This critical situation is further aggravated by the ongoing armed conflict, which has destroyed essential water infrastructure and restricted access to safe water sources, leaving an estimated 16 million people in need of humanitarian assistance for clean water in 2018, including 11.6 million in acute need.

The escalating impacts of climate change add another layer of urgency to Yemen's water scarcity challenge. Rising temperatures and decreasing precipitation rates threaten already fragile groundwater reserves, intensifying the need for sustainable, climate-resilient water solutions. Desalination technology, especially when powered by renewable energy, presents a crucial opportunity to address these intertwined challenges.

[1] https://waterfilterguru.com/parts-of-ro-water-purifier/

Desalination as a Climate-Resilient Intervention:

1. **Consistent and Scalable Water Supply:** Desalination offers a steady supply of potable water, independent of rainfall variability or groundwater depletion, making it an ideal solution in the context of climate-induced water shortages.
2. **Relief for Groundwater Resources:** By reducing reliance on overexploited aquifers, desalination helps conserve groundwater, mitigating long-term ecological degradation and ensuring water availability for future generations.
3. **Public Health and Economic Stability:** Reliable access to clean water reduces the prevalence of waterborne diseases, supports public health, and enhances livelihoods, contributing to Yemen's social and economic resilience amid ongoing challenges.

AMBITION OF THE TECHNOLOGY

SCALE FOR IMPLEMENTATION AND TIMELINE

The preliminary target is to enable Yemen's -coastal zones to produce water of 100,000 m^3 per day through seawater desalination plants by 2030.

AMBITION FOR TECHNOLOGY READINESS LEVEL OR COMMERCIAL READINESS INDEX

The ambition of TRL ranges between 8-9 to archiving full-scale implementation and operational reliability in Yemen. The ambition of CRI ranges between (4-5) to growing commercial readiness, where the technology sees clear market acceptance and established demand.

EXPECTED IMPACTS OF THE TECHNOLOGY

1. Reduce Yemen's freshwater deficit by providing a reliable supply of drinking water, and ensure more equitable water distribution.
2. Sustain agriculture and industrial needs, crucially supporting Yemen's economy.
3. Enhance hygiene and public health with more reliable water access, improving community hygiene and reducing the spread of waterborne diseases.
4. Improve the quality of life and social stability through access to fresh water, fundamental to a higher quality of life.
5. Relieve stress on limited groundwater supplies, allowing aquifers to recharge and supporting long-term environmental sustainability.
6. Stimulate economic growth by enabling sustainable development across sectors.

POLICY ACTIONS FOR TECHNOLOGY IMPLEMENTATION

EXISTING POLICIES ABOUT THE TECHNOLOGY

There are no specific policies and laws for desalination, but there are general laws for water. These laws are:

1) The National Water Sector Strategy and Investment Program (NWSSIP 2005–2009): This strategy proposed a set of institutional, financial, and other measures, which aim at addressing discrepancies in the five sub-sectors to protect the interests of all stakeholders in the resources. The program aimed to address the following main

problems in the five sub-sectors[2], water resources, water and sanitation in urban areas respectively rural areas, irrigation, environment, and human.

2) National Water Sector Strategy and Investment Program NWSSIP II Update (2008) for the period (2008–2015): During the process of monitoring and evaluation of NWSSIP implementation, it was realized that some performance indicators were unattainable during the main constraints for the limited progress were the restricted implementation capacities through the utilities and lack of finance. Therefore, NWSSIP I has been updated for the period (2008–2015) to the program NWSSIP II. Its revised goal is "to improve the Yemeni population's sustainable and economically efficient use of the nation's scarce water resources.

The implementation of the NWSSIP II investment program failed due to misaligned donor funding mechanisms and the limited capacity of implementing agencies. Political instability and security issues further disrupted or halted most investment efforts in recent years.

3) The Water Law No. (33) was established in 2002 as orderly legislation to prevent water resource depletion and organize the various water uses. Unfortunately, implementing this law and by-law has been interrupted due to 28 YEMEN WATER SECTOR – DAMAGE ASSESSMENT STAGE III PART 1 – RESILIENCE STRATEGY REPORT the long period between issuing the law in 2002 and the by-law in 2009, besides other political and social aspects that needed to be considered.

4) Water Law No. (41) of December 2006 provides regulations and guidelines for efficient economic water use and its protection. It further determines the rights for the use of water resources.

PROPOSED POLICIES TO ENHANCE TECHNOLOGY IMPLEMENTATION

1. Desalination Development and Implementation Strategy to create a dedicated strategy within the national water sector strategy to encourage the establishment and scaling of desalination facilities.
2. Institutional and Regulatory Framework for Desalination to establish regulations specific to desalination operations and their environmental and social impacts.
3. Renewable Energy Integration for Desalination policy to promote the use of renewable energy to power desalination, making it both cost-effective and environmentally friendly.
4. Update the national water strategies to include desalination technologies among the key priorities of the country.
5. Update the water law to include desalination technologies.
6. Facilitate the financing sources and develop financial models to provide financial support to encourage investment in desalination technology.
7. Enhance quality control and management by developing manuals and guidelines for the technologies and provide technical support for the responsible entities to activate their quality control.
8.

USEFUL INFORMATION

CONTACT DETAILS

TNA Coordinator: Abdulwhid Arman (Climate Change Director)
E: abarman94@gmail.com
+967 775504173

TNA Associate: Suha Yaseen Ali (Projects and Programmes Director)
E: suha.yassin90@gmail.com
+967 739660778 ; +967 779471124

[2] The low water resources availability and groundwater overdraft; Vulnerability of irrigated agriculture; Inefficient service and inadequate coverage; High fiscal subsidy or water supply and sanitation in urban areas; Poor sustainability of water supply and sanitation in rural areas.

Technology Champion: Ministry of Water and Environment
E: mwe@mwe-ye.org
+967227585

LINKS TO TNA REPORTS

https://tech-action.unepccc.org/country/yemen/

Field Code Changed