

TRIALLING CAPACITIVE DEIONISATION (CDI) AS AN IMPROVED DESALINATION TECHNOLOGY.

Location: Gaza, OPTI.

Timeframe: 2020 – 2022

Project Status: Ongoing

1. PROBLEM/GAP BEING ADDRESSED:

97% of groundwater in the Gaza Strip is contaminated by salinity and/or nitrate and therefore unfit for consumption (WHO). This is a relatively new phenomenon – in 2000 98.3% of Gaza had safe access to drinking water through the public water network. This now stands at 10.5% (UNICEF JMP). As a result of over abstraction, the water table is 10-15 m below sea level and there are now over 200 public and private reverse osmosis (RO) treatment systems required to desalinate groundwater and make it fit for consumption. Existing brackish RO systems are further compounding the problem though, as 30-40% of water pumped out of the ground is wasted. This exacerbates aquifer depletion and results in saline water being discharged into the drainage network reducing the suitability of wastewater to be reuse for agriculture. Consequently the Palestinian Water Authority is phase out brackish water desalination systems which abstract groundwater, in favour of seawater RO desalination, but this will take upto a decade to achieve and alone will arguably be insufficient to meet growing needs.

2. SOLUTION:

Oxfam's [Desalination review and roadmap](#), highlighted the potential of capacitive deionisation (CDI) and recommended trials within Oxfam programmes. CDI is a charge based process system similar to electrodialysis, whereby positive and negative charged ions (dissolved salts) are manipulated into a waste stream and removed from water. Its potential benefits (compared to RO) include lower energy requirement to operate (therefore lower operating cost) and higher water recover (less waste).

3. RESULTS:

We have engaged with an industrial partner and pioneer of CDI technology (Idropan) which has given a better understanding of CDI and its current limitations. Idropan is reluctant to deploy a CDI unit where the water quality exceeds 1,200-1,500ppm TDS. This is significantly lower than the upper limit within the Desk review (3,500ppm) and it therefore limits the range of suitable sites. This has necessitated a reorientation of the proposed works.

Idropan has identified efficiency improvements that could be made to existing RO treatment plants by improving pre-treatment, specifically targeting water sources where alkalinity is high. De-alkalisers, commonly associated with reducing corrosion in industrial boilers, operate in a similar way to ion exchange water softeners. By removing carbonate and bicarbonate alkaline salts, overall TDS can be reduced to a point which is within the limits of CDI or where a more efficient (lower energy/higher recovery) RO configuration can be applied.

There have been considerable delays during the planning process of this project due to availability of partners and time sourcing and sharing information. The escalation in hostilities with Israel has compounded this and suspended activities by a further 6 months as the focus of Oxfam OPTI is on humanitarian response. This will be reviewed in November 2021:

Upon resumption it is planned to install a new de-alkaliser-RO combination in parallel to an existing RO treatment plant at Al Amal. It is estimated that water recovery will increase from 70% to 88% with a TDS reduction from 981 to 180mg/l. Dealkalisation alone is anticipated to improve TDS to 350mg/l with a recovery of 97%, which alone may make the water suitable for consumption (*subject to palatability and nitrate concentration)

Based on the success of this trial the next phase would be to introduce a CDI system alongside RO.

4. LEARNING/APPLICABILITY ELSEWHERE:

De-alkalisation and CDI are only suitable for certain types of source water (where alkalinity constitutes a significant percentage of the overall TDS, where TDS is less than 1,500mg/l and source water being alkaline and/or low TDS (not exceeding 1,500mg/l). This limits how widely either technology can be deployed.

5. ADDITIONAL INFORMATION:

[Desalination technical briefing note](#). Project documents ([Box](#)). CDI is still an emerging technology so it is expected that its range and application will expand and increase as the technology evolves. There is value therefore in being an early adopter.

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