Source : www.thehindu.com Date : 2019-07-07

IS DESALINATION REALISTICALLY A HELP IN HARNESSING POTABLE WATER FROM THE SEA?

Relevant for: Geography | Topic: Distribution of key natural resources - Water Resources incl. Rivers & related issues in world & India

The Seawater Desalination plant in Minjur, Chennai. FILE | Photo Credit: R_Shivaji Rao

The story so far: With warnings from India's top policy-makers and reports of major cities in India struggling to stave off a water crisis, there's talk about exploring technologies to harness fresh water. The one idea that's been around for a while is desalination, or obtaining freshwater from salt water. Desalination technology is not an esoteric idea — the city of Chennai already uses desalinated water. However, it only has a limited application, given the operation costs.

To convert salt water into freshwater, the most prevalent technology in the world is reverse osmosis (RO). A plant pumps in salty or brackish water, filters separate the salt from the water, and the salty water is returned to the sea. Fresh water is sent to households.

RO desalination came about in the late 1950s. While the principle is simple, engineering such plants have to factor in various constraints, for instance, salt levels in the source water that is to be treated, the energy required for the treatment and disposing of the salt back into the sea.

Osmosis involves 'a solvent (such as water) naturally moving from an area of low solute concentration, through a membrane, to an area of high solute concentration. A reverse osmosis system applies an external pressure to reverse the natural flow of solvent and so seawater or brackish water is pressurised against one surface of the membrane, causing salt-depleted water to move across the membrane, releasing clean water from the low-pressure side'. Seawater has Total Dissolved Solids (TDS) — a measure of salinity — close to 35,000 parts per million (ppm), or equivalent to 35 g of salt per one litre/kg of water. An effective network of RO plants reduce this down to about 200-500 ppm. There are about 18,000 desalination plants in the world across 150 countries and nearly half of Israel's water is sourced through desalination.

Years of water crises in Chennai saw the government set up two desalination plants between 2010 and 2013. These were at Minjur, around 30 km north of Chennai, in 2010, and Nemmeli, 50 km south of Chennai, in 2013. Each supplies 100 million litres a day (MLD); together they meet little under a fourth of the city's water requirement of 830 MLD. Buoyed by the success of these plants, the city's water authorities are planning to install two more plants with capacities of 150 MLD (to be operational by 2021) and 400 MLD, at a cost of around 1,260 crore (funded by the German agency, KfW) and 4,000 crore (funded by the Japan International Cooperation Agency), respectively.

Last November, Gujarat Chief Minister, Vijay Rupani, announced plans of setting up a 100 MLD RO plant at the Jodiya coast in Jamnagar district. This would go a long way in 'solving' the water availability problems in the drought-prone Saurashtra region. Other plants of a similar size are expected to come up in Dwarka, Kutch, Dahej, Somnath, Bhavnagar and Pipavav, which are all coastal places in Gujarat. There are also a slew of desalination plants that cater to industrial purposes. For now, India's real-world experience with desalination plants is restricted to Chennai.

Because RO plants convert seawater to fresh water, the major environmental challenge they pose is the deposition of brine (highly concentrated salt water) along the shores. Ever since the

Chennai plants have started to function, fishermen have complained that the brine being deposited along the seashore is triggering changes along the coastline and reducing the availability of prawn, sardine and mackerel. Environmentalists second this saying that hyper salinity along the shore affects plankton, which is the main food for several of these fish species. Moreover, the high pressure motors needed to draw in the seawater end up sucking in small fish and life forms, thereby crushing and killing them — again a loss of marine resource. Another unexpected problem, an environmentalist group has alleged, was that the construction of the RO plants required troves of groundwater. This was freshwater that was sucked out and has since been replaced by salt water, rendering it unfit for the residents around the desalination plants.

On an average, it costs about 900 crore to build a 100 MLD-plant and, as the Chennai experience has shown, about five years for a plant to be set up. To remove the salt required, there has to be a source of electricity, either a power plant or a diesel or battery source. Estimates have put this at about 4 units of electricity per 1,000 litres of water. Therefore, each of the Chennai plants needs about 400,000 units of electricity. It is estimated that it cost 3 to produce 100 litres of potable water.

In the early days of RO technology, there were concerns that desalinated water was shorn of vital minerals such as calcium, magnesium, zinc, sodium, potassium and carbonates. They are collectively referred to as TDS. Higher quantities of these salts in desalination plants tend to corrode the membranes and filtration system in these plants. So ideally, a treatment plant would try to keep the TDS as low as possible. Highly desalinated water has a TDS of less than 50 milligrams per litre, is pure, but does not taste like water. Anything from 100 mg/l to 600 mg/l is considered as good quality potable water.

Most RO plants, including the ones in Chennai, put the water through a ‘post-treatment’ process whereby salts are added to make TDS around 300 mg/l. Several of the home-RO systems that are common in affluent Indian homes, too employ post-treatment and add salts to water.

The alternative desalination technology used is thermal energy sourced from the ocean. There is a low-temperature thermal desalination (LTTD) technique for instance which works on the principle that water in the ocean 1,000 or 2,000 feet below is about 4º C to 8º C colder than surface water. So, salty surface water is collected in a tank and subject to high pressure (via an external power source). This pressured water vapourises and this is trapped in tubes or a chamber. Cold water plumbed from the ocean depths is passed over these tubes and the vapour condenses into fresh water and the resulting salt diverted away.

The National Institute of Ocean Technology (NIOT), a research organisation based in Chennai, has been working on this technology for decades. In 2005, it set up a 100,000 litre-a-day plant in Kavaratti, Lakshwadeep islands and this has been providing water to about 10,000 residents. Other than the plant at Kavaratti, there are plants of similar capacity proposed at Minicoy and Agatti islands. There are also 1.5 lakh litres a day plants proposed at Amini, Androth, Chetlat, Kadamat, Kalpeni and Kiltan islands.

However, the most ambitious research project is a 10 million litre a day plant that is proposed to be built in the deep ocean, 50 kilometres away from the Chennai coast. This exploits an approach called Ocean Thermal Energy Conversion. While the LTTD technique draws power from diesel sets, this massive new plant will draw power from the vapour generated as a part of the desalination process. This vapour will run a turbine and thereby will be independent of an external power source. While great in theory, there is no guarantee it will work commercially. For one, this ocean-based plant requires a pipe that needs to travel 50 kilometres underground in the sea before it reaches the mainland. The NIOT has in the past had significant problems in managing such a pipe. Then, RO is commercially proven and the dominant technology and therefore it could be hard to convince private players to invest in such a technology.

END