

Water solutions without a grain of salt

24 July 2019



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Monash University researchers have developed technology that can deliver clean water to thousands of communities worldwide. This solar steam generation system produces clean water from salty (ocean) water with almost 100 per cent salt removal. It provides a solution to water shortages in regional areas where grid electricity isn't available.

An estimated 844 million people don't have access to clean [water](#), while every minute a newborn dies from infection caused by lack of safe water and an unclean environment.

Seawater desalination and wastewater recycling are two ways to ease the problem of water shortage, but conventional approaches are energy-intensive and based on the combustion of fossil fuels. In fact, water treatment uses about 3 per cent of world's [energy supply](#).

Researchers at Monash University have developed energy-passive technology that's able to deliver clean, potable water to thousands of communities, simply by using photothermal materials and the power of the sun.

Led by Professor Xiwang Zhang from Monash University's Department of Chemical Engineering, researchers have developed a robust solar steam generation system that achieves efficient and continuous clean water production from salty water with almost 100 per cent salt removal.

Through precisely controlling salt crystallisation only at the edge of the evaporation disc, this novel design also can harvest the salts.

The feasibility and durability of the design have been validated using seawater from Lacedpede Bay in South Australia. This technology is a promising solution to [water shortages](#) in regional areas where grid electricity isn't available.

The findings were published in the international journal *Energy & Environmental Science*.

"Water security is the biggest challenge the world faces in the 21st century, especially as population grows and the effects of climate change take shape. Developing and under-resourced communities feel the effects of these factors the most," Professor Zhang said.

"Utilising solar energy for water treatment has been widely considered as one of the sustainable solutions towards addressing the scarcity of [clean water](#) in some communities, without sacrificing our environment or resources.

"Despite the significant progress achieved in material development, the evaporation process has been impeded by the concentration of salt on the surface, which affects the quality of water produced."

Researchers created a disc using super-hydrophilic filter paper with a layer of carbon nanotubes for light absorption. A cotton thread, with a 1mm diameter, acted as the water transport channel, pumping saline water to the evaporation disc.

The [saline water](#) is carried up by the cotton thread

from the bulk solution to the centre of the evaporation disc. The filter paper traps the pure water and pushes the remaining salt to the edges of the disc.

The light absorbance was measured to 94 per cent across the entire solar spectrum. The disc also exhibited a rapid temperature increase when exposed to light in both dry and wet states, rising from 25C to 50C and 17.5C to 30C respectively within one minute.

This technology has also great potential in other fields, such as industry wastewater zero liquid discharge, sludge dewatering, mining tailings management and resource recovery. Future studies will look to extend the technology to these applications with industry support.

"Our study results advance one step further towards the practical application of solar steam generation technology, demonstrating [great potential](#) in seawater desalination, resource recovery from wastewater, and zero liquid discharge," Professor Zhang said.

"We hope this research can be the starting point for further research in energy-passive ways of providing clean and safe water to millions of people, illuminating environmental impact of waste and recovering resource from waste."

More information: Yun Xia et al, Spatially isolating salt crystallisation from water evaporation for continuous solar steam generation and salt harvesting, *Energy & Environmental Science* (2019). [DOI: 10.1039/c9ee00692c](https://doi.org/10.1039/c9ee00692c)

Provided by Monash University

APA citation: Water solutions without a grain of salt (2019, July 24) retrieved 21 October 2019 from <https://techxplore.com/news/2019-07-solutions-grain-salt.html>

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