Desalination study authors explore fabricated membrane

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Credit: Tiago Fioreze / Wikipedia

Have scientists found a new way to purify sea water with materials that don't rely on electricity and are cheap enough to be manufactured in most countries? Might their work contribute to the search for a new, inexpensive water source?

The paper drawing interest among news sites is titled, "Desalination of simulated seawater by purge-air pervaporation using an innovative fabricated membrane." The authors, from Alexandria, Egypt, are Mona Naim, Mahmoud Elewa, Ahmed El-Shafei and Abeer Moneer. Their paper has been published in *Water Science & Technology*.

Al-Fanar Media said, "Moneer and a team of fellow researchers in Alexandria say they have created a new membrane that can extract more fresh water from the sea and improve the energy efficiency of doing so."

The authors said they invented an innovative polymeric membrane. It's described as a breakthrough; it involves the pervaporation process. They said It can desalinate simulated seawater of exceptionally high concentration to produce a high flux of potable water with over 99.7% salt rejection in a once-through purge-air pervaporation process.

There's nothing new about pervaporation, said *Gizmag*; the process "involves filtering the liquid through a ceramic or polymeric membrane," although the membrane used has been expensive and complicated to manufacture.

Digital Trends also said, "The method of pervaporation has been in use since the early 1990s." It is being used in wastewater treatment to separate organic solvents from industrial waste water.

Lynda Delacey in *Gizmag* said the importance of their work lies elsewhere than just pervaporation. "The breakthrough in this research is the invention of a new salt-attracting membrane embedded with cellulose acetate powder for use in step one of the pervaporation process. Cellulose acetate powder is a fiber derived from wood pulp and is, according to the researchers, cheap and easy to make in any laboratory."

What is more, the materials, can be mass produced in printed and cut sheets for widespread use, said Bryan Lufkin in *Gizmodo*.

The technology is based on membranes which contain cellulose acetate powder, produced in Egypt. The powder, in combination with other components, binds the salt particles as they pass through. The technique is being considered as useful for desalinating seawater.

Why is their study considered as important? Any attempt to find a desalination method that is (1) not environmentally unsafe and (2) not too expensive to manage and maintain is obviously welcomed, at a time when planners look at how much of the planet's water is actually fit for drinking and farming.

"New ideas of water treatment methods are always welcome: Desalination is an expensive process that also uses a ton of energy: more than 200 million kilowatt hours per day around the world," said *Gizmodo*.

A 2013 UNDP report, "Water Governance in the Arab region," talks about managing water scarcity and securing the future. "Current projections show that by the year 2025 the water supply in the Arab region will be only 15 per cent of what it was in 1960."

The report commented on desalination: "Nonconventional water resources include desalination, treated wastewater, rainwater harvesting, cloud seeding and irrigation drainage water. The Arab region leads the world in desalination, with more than half of global desalination capacity. Desalinated water is expected to expand from 1.8 per cent of the region's water supply to an estimated 8.5 per cent by 2025."

The report pointed to the difficulties that desalination presented, as a process which is "energy- and capital-intensive," although technological advances have brought down production costs. "While desalination plants reduce pressure on conventional water resources, they have harmful environmental effects, including pollution and greenhouse gas emission."

Quoted in *Digital Trends*: "Using pervaporation eliminates the need for electricity that is used in classic desalination processes, thus cutting costs significantly," said Ahmed El-Shafei, one of the study authors.

More information: Mona Naim et al. Desalination of simulated seawater by purge-air pervaporation using an innovative fabricated membrane, *Water Science & Technology* (2015). DOI: 10.2166/wst.2015.277

ABSTRACT
An innovative polymeric membrane has been invented, which presents a breakthrough in the field of desalination membranes. It can desalinate simulated seawater of exceptionally high concentration to produce a high flux of potable water with over 99.7% salt rejection (%SR) in a once-through purge-air pervaporation (PV) process. A set-up was constructed for conducting the desalination experiments and the effect of initial salt solution concentration (Ci) and pervaporation temperature (Tpv) on the water flux (J), %SR, separation factor, and pervaporation separation index were determined. The membrane was prepared by the phase-inversion technique, of a specially formulated casting solution consisting of five ingredients, after which the membrane was subjected to a post-treatment by which certain properties were conferred. The results confirmed that the salinity of the pervaporate was independent of Ci (all %SR above 99.7). The best result was at Tpv = 70 °C, where J varied from 5.97 to 3.45 l/m2 h for Ci = 40–140 g NaCl/l, respectively. The membrane morphology was confirmed to be asymmetric. The contact angle was immeasurable, indicating the membrane to be super-hydrophilic. Activation energies computed using Arrhenius law were, under all conditions investigated, less than 20 kJ/mol K.