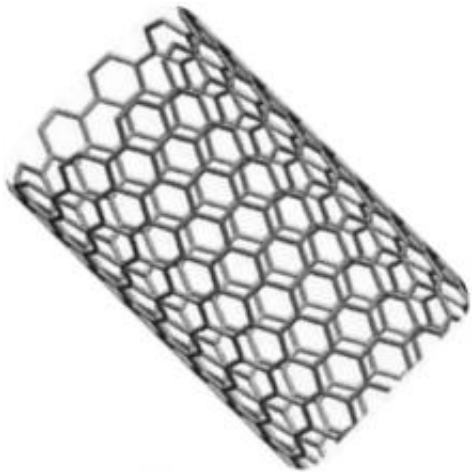
Can engineered carbon nanotubes help to avert our water crisis?

March 17 2015



Carbon nanotube (CNT) membranes have a bright future in addressing the world's growing need to purify water from the sea, researchers say in a study published in the journal Desalination.

"Currently, about 400 million people are using desalinated water and it has been projected that by 2025, 14 percent of the global population will be forced to use sea water," said Md. Eaqub Ali, from the University of Malaya's Nanotechnology and Catalysis Research Center in Kuala Lumpur, Malaysia. He says engineered CNT membranes have the potential to tackle the current and future challenges in water purification.

For efforts to review the state of carbon nanotube membrane technology and push the field forward, Ali and his colleagues have been selected for an Elsevier Atlas award.

Desalination plants already provide much of the water used by people in many parts of the world, especially in Israel, Saudi Arabia, and Australia. Climate change is only increasing the demand for desalinated water as greater evaporation and rising seas further limit freshwater supplies for a growing world population. But current methods to desalinate water come at a very high cost in terms of energy, which means more greenhouse gases and more global warming.

Existing desalination plants rely on reverse osmosis, vacuum distillation, or a combination of the two. But those methods are energy intensive and costly.

Carbon nanotubes are tiny hexagonal tubes, made by rolling sheets of graphene, said Rasel Das, first author of the paper. They require little energy and can be designed to specifically reject or remove not only salt, but also common pollutants.

"The hollow pores of the CNTs are extremely, extremely tiny," Ali said. "However, because of their amazing chemical and physical properties, they allow frictionless passes of water through the pores, but reject most salts, ions, and pollutants, giving us purified water, probably in its best form."

That frictionless property is also what gives CNTs the potential to purify water with so little energy. And carbon nanotube membranes come with other perks, Das added, including self-cleaning properties.

"What makes CNTs special is that they have cytotoxic properties," he said. That means that the membranes naturally kill microbes that might

otherwise foul up their surfaces. As a result, carbon nanotube membranes have the potential to last longer and may be reusable.

There are hurdles yet to overcome, co-author of the paper Sharifah Bee Abd Hamid said. CNT membranes are now costly to produce, especially for large-scale uses. Research is also needed to produce the membranes with pores of a more uniform distribution and size.

"Most progress in desalination research is focused on demonstrating [the capability of CNT membranes] at a small scale," she said.

For larger scale operations, work is needed to produce CNT membranes on thin films or fiber cloth composites. Getting the membranes ready for use will require effort on material design, operational requirements, and more.

If someday, these membranes can be put to use in water-filtering pitchers or bottles, "to directly treat salty water at point of use," Hamid says, "it is a dream come true for many."

The Editor-in-Chief of *Desalination*, Nidal Hilal, said about the research, "The available supplies of water are decreasing due to increased population growth, low precipitation, competing demands from industry and more stringent health based regulations for agricultural and urban development. We have to seek alternative sources of water such as seawater, storm water, wastewater, and industrial wastewater. Membrane filtration is considered among the most promising and widely used processes for water treatment and desalination...Carbon nanotubes (CNT) have shown great potential in water, wastewater treatment and desalination as they have many attractive key physicochemical properties with the ability to be functionalized to enhance their affinity and selectivity."

More information: "Carbon nanotube membranes for water purification: A bright future in water desalination." www.sciencedirect.com/science/ … ii/S0011916413006127

Provided by Elsevier