

New Wonder Material Makes Salt Water Potable

The military could provide troops with clean drinking water using a new material called graphene and purification systems that it already owns.

■ By Maj. Jamie Schwandt

What is the one thing that we all need to survive? What is also the most important asset required for winning any conflict? It is not a weapon system or even a bomb. Undeniably, that asset is potable water.

The human body is approximately 60 percent water, and it needs water for cells, tissues, and organs to live. Water is also needed to neutralize chemical, biological, radiological, and nuclear threats.

Considering that 70 percent of Earth's surface is covered by ocean, you would think we would have more than enough water. However, only 2.5 percent of all water on Earth is fresh water, leaving approximately 97.5 percent as undrinkable salt water. Essentially, our most important asset is scarce, and the military should pursue technology to take advantage of Earth's abundant salt water.

Transporting Bottled Water

During a 2016 study, researchers at the Homeland Defense and Security Information Analysis Center found that the Department of Defense spends more than \$500,000 per day transporting and supplying bottled water for 20,000 troops. In fact, just transporting bottled water is a huge threat; enemy combatants regularly target supply convoys.

Although its primary method of providing potable water to troops appears to be transporting bottled water, the Army does have water purification systems. The Army uses semimobile water purification sys-

tems that can be transported by military vehicle. But its largest system, the reverse osmosis water purification unit, uses diesel generators and vast amounts of energy and resources.

According to the Homeland Defense and Security Information Analysis Center study, the smaller semimobile systems (the lightweight water purification system and tactical water purification system) can remove a variety of contaminants, but they lack the ability to remove sodium.

Researchers found that only one system in the U.S. military has high levels of both filtration and mobility: the Marine Corps' small unit water purifier. However, they found that its intricate system housing makes fielding problematic.

Wonder Material

Our planet provides an abundance of water, yet the military is not using technology to take advantage of it. The military should adopt existing technology to make use of sea water. A new wonder material called graphene is capable of turning deadly salt water into potable water. Graphene is an exceptionally flexible and thin material currently being used for a wide range of purposes.

A 2011 study from the American Chemical Society discussed how graphene could be used to speed up the differentiation of human mesenchymal stem cells, which develop human tissue. It is also being used for (or studied for) display screens, medical and chemical enhancements, so-

lar cells, and many other applications.

Graphene is one of the strongest materials ever discovered. It is an extremely thin sheet of carbon consisting of a single layer of carbon atoms positioned in a hexagonal pattern similar to a honeycomb. It also has the potential to effectively and efficiently purify salt water.

Water Purification Process

The primary technique to purify water is desalination through reverse osmosis. In normal osmosis, water flows across a membrane from areas of low sodium to areas of higher sodium. Conversely, reverse osmosis takes place when salt water is pressurized and forced to go in a direction it does not normally go. It is forced through special membranes in order to isolate the water from the sodium. This process works, but it is inefficient, energy-dependent, and expensive.

The military's water purification systems depend on filters. Graphene would be useful as a filter and would improve efficiency, specifically for the military's portable systems. Graphene filters are essentially nanoparticle filters. In a 2017 *Nature.com* article, "Graphene membranes for water desalination," Shahin Homaeigohar and Mady Elbahri report that carbon nanoparticles are lightweight, abundant, and inexpensive. Graphene filters would remove pollutants, salts, and other harmful chemicals while allowing water to pass through.

If the military were to adopt graphene filters, its water purification systems could be both mobile



Soldiers from the 209th Aviation Support Battalion, 25th Combat Aviation Brigade, assemble a water pump while training on the tactical water purification system on Feb. 27, 2018, near Dillingham Airfield, Hawaii. (Photo by Sgt. Ian Ives)

and efficient. A completely new system would not be required because graphene filters could be incorporated into existing systems.

3-D Printed Filters

If the military decides to use graphene filters in its water purification systems, then it should also use 3-D printing technology (also known as additive manufacturing) to make the filters. Massachusetts Institute of Technology researchers have used graphene to print 3-D objects. They have discovered that graphene has 10 times the strength of steel but is extremely lightweight; graphene is only one atom thick. They also found that 3-D printers can use graphene to print water purification devices.

Additive manufacturing has been around for quite a while now, but the

military has not taken full advantage of it. With 3-D printing technology becoming cheaper every year, it is time to fully adopt this technology because it offers immediate and long-term benefits.

Specifically, 3-D printing lessens the need to keep large inventories of materiel, greatly reduces shipping costs, can create stronger and more complex items, and can deliver items to customers much faster than normal processes can. In essence, 3-D printing sets the conditions for success for the military by ensuring freedom of maneuver, extending operational reach, and prolonging endurance for military operations.

Using 3-D printers and graphene, the U.S. military could print technologically advanced water purification

system filters to make use of Earth's abundant salt water. This would save the military both money and possibly some lives. This technology could significantly reduce the need to send convoys to carry bottled water to troops, which would reduce convoy attacks and protect logisticians. Most importantly, this technology provides the military with immediate access to the most essential resource in existence: clean fresh water.

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