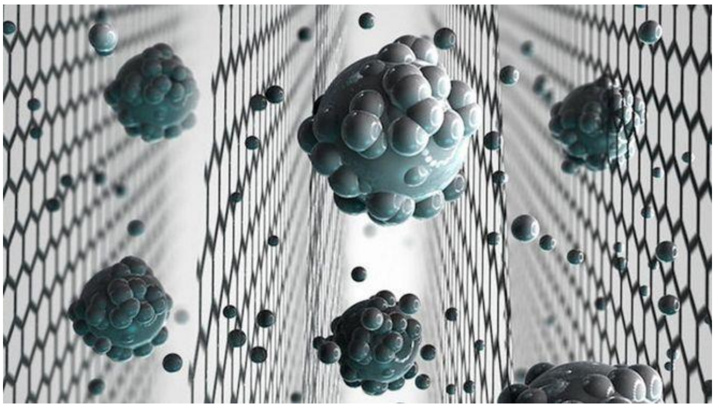
WAMTech Bulletin 17, Volume 4
11 April 2017

Water and Sanitation in the News

New technology could be a game-changer for the future of drinking water

A UK-based team of researchers has created a graphene-based sieve capable of removing salt from seawater. The sought-after development could aid the millions of people without ready access to clean drinking water. The promising graphene oxide sieve could be highly efficient at filtering salts, and will now be tested against existing desalination membranes. It has previously been difficult to manufacture graphene-based barriers on an industrial scale.

Reporting their results in the journal Nature Nanotechnology, scientists from the University of Manchester, led by Dr Rahul Nair, show how they solved some of the challenges by using a chemical derivative called graphene oxide.



Isolated and characterised by a University of Manchester-led team in 2004, graphene comprises a single layer of carbon atoms arranged in a hexagonal lattice. Its unusual properties, such as extraordinary tensile strength and electrical conductivity, have earmarked it as one of the most promising materials for future applications. But it has been difficult to produce large quantities of single-layer graphene using existing methods, such as chemical vapour deposition (CVD). Current production routes are also quite costly.

On the other hand, said Dr Nair, "graphene oxide can be produced by simple oxidation in the lab". He told BBC News: "As an ink or solution, we can compose it on a substrate or porous material. Then we can use it as a membrane. "In terms of scalability and the cost of the material, graphene oxide has a potential advantage over single-layered graphene." Of the single-layer graphene he added: "To make it permeable, you need to drill small holes in the membrane. But if the hole size is larger than one nanometre, the salts go through that hole. You have to make a membrane with a very uniform less-than-one-nanometre hole size to make it useful for desalination. It is a really challenging job."

The idea of using graphene-oxide membranes for desalinization isn't new — their atom-scale pores are perfect for the job — but this is the first successful attempt to make it happen. When previous membranes were immersed in water, they'd absorb it, swelling up and enlarging the pores, ruining their ability to catch tiny salt molecules. The University of Manchester's team, led by Rahul Nair, has solved this problem by building walls of epoxy resin around the membrane to keep its atoms dry when underwater.

This allows the tiny capillaries of the graphene-oxide membranes to block the salt from flowing through along with the water. "Water molecules can go through individually, but sodium chloride cannot. It always needs the help of the water molecules. The size of the shell of water around the salt is larger than the channel size, so it cannot go through," said Dr Nair. By contrast, water molecules flow exceptionally fast through the membrane barrier, which makes it ideal for use in desalination.

By 2025 the UN expects that 14% of the world's population will encounter water scarcity. As the effects of climate change continue to reduce urban water supplies, wealthy modern countries are also investing in desalination technologies. Current desalination plants around the world use polymer-based membranes. "This is our first demonstration that we can control the spacing [of pores in the membrane] and that we can do desalination, which was not possible before. The next step is to compare this with the state-of-the-art material available on the market," said Dr Nair.

Sources: BBC, 03 April 2017; Big Think, 05 April 2017

WAMTechnology has been providing water asset and operations management systems and associated services for the past 10 years. We assist in responsible water management and the use of our water operations system; thereby improving service delivery and water conservation. The Municipal Assistant™ system provides many useful modules and tools (e.g. asset module, water demand module, staff and skills, suppliers, CRM, calculators, etc.) that helps to ensure that assets are correctly operated and maintained. By implementing the system, a holistic approach is followed where not only a valuable management and information technology system is being utilised, but the underlying principles of sustainable utilization of water resources in local municipalities are also addressed.

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