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TUESDAY 16 APRIL 2019

NTU's new portable device tests drinking water quality in 5 minutes

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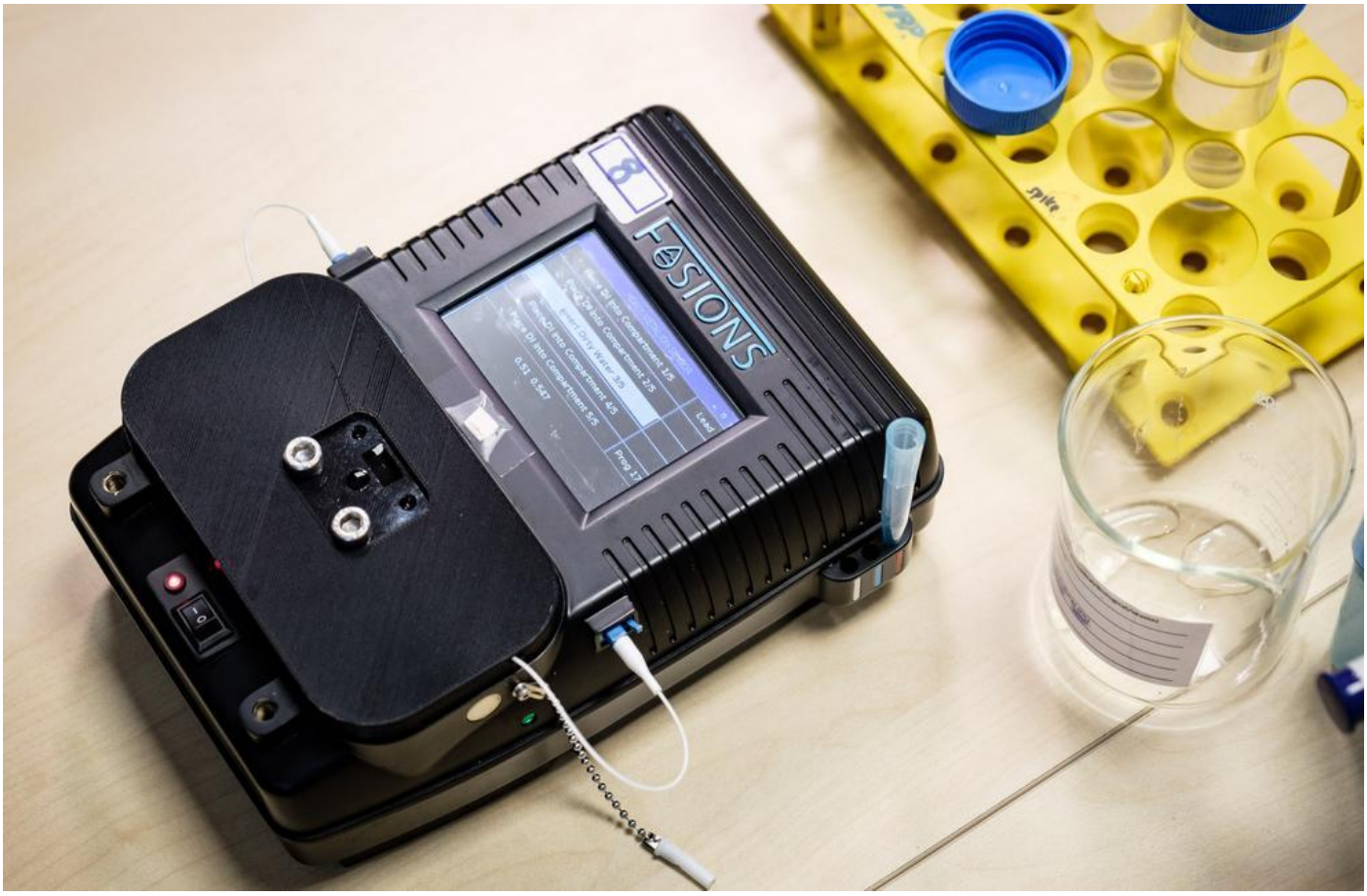

The NTU device works in the field and requires just a few drops of a water sample into a disposable sensor cartridge to detect heavy metals at parts-per-billion precision.

Published **15 APRIL, 2019** UPDATED 15 APRIL, 2019

SINGAPORE — Scientists at the Nanyang Technological University (NTU) have developed a portable device that can detect trace levels of heavy metals in drinking water in just five minutes.

The university said in a press release issued on Monday (April 15) that the unnamed device generates test results quickly without requiring samples to be taken to a laboratory. As such, the device can be used for on-site water testing and could in future be used in countries where water quality is an issue.

It could also be integrated into appliances for domestic use, such as home water filtration systems and electric kettles.

Inspired by the human body's metal sensing mechanism, the handheld device's "secret" lies in an organic substance within the circulating human bloodstream called a chelating agent, which can detect and bind to heavy metal ions, said NTU.

After binding, the substance prevents the heavy metal ions from interacting with other molecules and enzymes in the body and marks it for excretion from the body.

The device's developers, Associate Professor Yong Ken-Tye and Professor Tjin Swee Chuan from NTU's School of Electrical and Electronic Engineering, had modified an optical fibre sensor with a chelating agent and a laser that shines through it. The sensor is connected to a processing unit that displays the results of the water quality test.

The invention requires just a few drops of a water sample into a disposable sensor cartridge to detect heavy metals at parts-per-billion precision.

"Our device is capable of conducting on-site water quality tests quickly and can detect up to 24 types of metal contaminants, which is double the capacity of other commercially available water sensors," said Assoc Prof Yong.

"Using a chelating agent in the device ensures that its sensor is as sensitive in detecting heavy metals as the body's natural defence mechanism against metal intoxication."

INNOVATIVE TECHNOLOGY

Drinking water quality is typically monitored via laboratory tests as heavy metals cannot be identified by colour, taste or odour, unless high levels are present. While highly accurate, these tests take at least a day to complete.

While existing portable devices can detect heavy metal contaminants quickly, they require the additional step of mixing water samples with buffer solution before tests can be performed.

The sensor for such kits has to be used within 30 minutes after it is exposed to air as its effectiveness can be affected by air, heat or humidity.

Other mobile alternatives include those that use metal electrodes such as mercury as a sensing probe, but these may introduce contaminants into the environment. Some also use test strips that change in colour when they come into contact with heavy metals, but the results may then rely on subjective readings of the strip.

NTU's new device surpasses these limitations as it is able to detect heavy metals at parts-per-billion precision and requires just a few drops of a water sample.

The level of sensitivity is in line with Singapore's safety limit requirements that fall within the World Health Organisation's standards. For example, it can detect lead levels of five parts per billion, which is lower than the 10 parts per billion limit stipulated by the Environmental Public Health Act here.

The sensitivity of the device's sensor is also not limited by exposure to air and remains effective up to a temperature of 40°C.

WHAT'S NEXT

Prof Tjin said that the device can be "easily integrated into any existing in-line water treatment plant".

"While our product is competitive enough to penetrate the market, we are still working to enhance and expand our water sensor product line."

He added that the NTU team is exploring ways to translate the developed technology for domestic use.

After filing two patents, the team has successfully incorporated a spinoff business, Waterply, and is working with other local companies to collect more data to improve the device's accuracy.

Waterply is also collaborating with a state-owned company in China to develop "next-generation" water sensors that can tackle water pollution.

The research project was supported by NTU's Nanyang Environment and Water Research Institute, and NTUitive, the university's innovation and enterprise company.