Bugs and slime to clean poisoned water

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Australian scientists have developed a way to clean up the potentially deadly arsenic that pollutes the drinking water of tens of millions of people around the world.

A new type of water filter that combines microalgae with bacteria taken from soil contaminated with heavy metals could prove an effective, cheap and safe way to rid drinking water of arsenic.

A poster on the technology is being presented by Mr Mezbaul Bahar of the CRC for Contamination Assessment and Remediation of the Environment (CRC CARE) at the CleanUp 2013 conference.

"Known as the 'king of poisons', arsenic has harmed humans more than any other toxic chemical in history," says Mr Bahar, of CRC CARE and the University of South Australia.

"It contaminates groundwater in more than 70 countries, including Bangladesh, India, the USA, South America, China, Thailand and Taiwan. Around 137 million people are poisoned daily by arsenic in their drinking water and food."

Arsenic poisoning causes vomiting, diarrhoea, and long-term exposure can lead to cancer, diabetes, heart disease and death. Also, once polluted, the groundwater is difficult and expensive to clean up.

To help save lives and improve global water security, Mr Bahar and his CRC CARE research team have developed a technology that uses

different types of tenacious bacteria and microalgae to filter the water.

"Two forms of arsenic are commonly found in the environment: arsenic (III) and arsenic (V). Arsenic III is 60 times more toxic than the other form and is highly soluble, which makes it more difficult to remove, as it travels everywhere," says Professor Megh Mallavarapu of CRC CARE and UniSA, the principal supervisor of the research.

"The solution then is to convert arsenic (III) into the less toxic and less soluble form, making it easier to extract from the water," Prof. Mallavarapu explains.

"Conventional technologies use chemicals to convert the arsenic, but this is expensive and often brings unwanted side effects. Scientists have also used bacteria for this task, but these bacteria require carbon to grow, so it's unsustainable unless we keep feeding the bacteria."

Now, CRC CARE researchers have found kinds of bacteria and microalgae that can sustain each other. "We found these bacteria in soil that has been contaminated with heavy metals," Mr Bahar says. "To survive, the bacteria have developed special abilities to defeat the toxicity, including converting arsenic into its less harmful form."

The next step was to find a way to feed the bacteria continuously – and the scientists have found certain microalgae that were ideal.

"Microalgae only need sunlight to sustain themselves," Prof. Mallavarapu says. "They can generate energy using sunlight, and together with water, they'll grow and produce carbon and oxygen to support the bacteria.

"However, when the bacteria break down the organic matter produced by the microalgae as well as from contaminated water, they produce

carbon dioxide, which in turn can be used to feed the microalgae. So it's a wonderful partnership.

"Once arsenic (III) is converted to arsenic (V), we can remove it by absorbing it with a cheap and easily accessible material, such as coir pith made from coconut husks."

Mr Bahar says the bacteria and microalgae can be placed in a bioreactor – a container that allows them to grow. "We plan to test the technology in the laboratory and will find out if it can be used in individual households or villages."

"Arsenic poisoning from natural groundwater is one of the most common and horrific forms of contamination in the modern world, and the successful development of a technology with scope to overcome it could well be counted among Australia's major humanitarian contributions," says CRC CARE Managing Director Professor Ravi Naidu.

"This is a brilliant achievement by Mezbaul and his colleagues – a solution to a major problem that is simple, elegant, cheap and effective. They are to be commended for it."

More information: www.cleanupconference.com/

Provided by CRC for Contamination Assessment and Remediation of the Environment