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Science news

# Affordable safe drinking water

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Safe drinking water at 130 rupees (US\$ 2.5) for the whole year for a family of five without any need for electricity.

No, that isn't a dream. Chemists at the Indian Institute of Technology Madras (IIT-M) in Chennai have developed a novel and affordable water purification device for domestic use that they say could eradicate waterborne diseases. And it will cost the consumer just 5 paise per litre.

Based on composite nanomaterials, the device not only destroys bacteria and viruses but also scavenges toxic chemical contaminants such as lead, iron, and arsenic in water<sup>1</sup>. "The device is currently undergoing field trials," Thalappil Pradeep, who led the research team told *Nature India*. "This gadget makes use of new nanoscale materials which are totally green — made in water at room temperature using no electrical energy. This is the result of nearly five years of work," he said.

It has long been known that trace quantities of silver ions are effective in killing a wide spectrum of bacteria and viruses. Ion release can happen effectively from silver nanoparticles. While a number of silver based biocidal compositions have been synthesized, their actual commercial use has been hampered mainly due to scale formation on the surface of the nanomaterials that makes sustained release of silver ions difficult.

Pradeep and co-workers overcame this problem by using novel composite materials. Their anti-microbial composition consists of an 'aluminium oxyhydroxide (AlOOH)-chitosan composite' embedded with silver particles of size 10-20 nanometers (one nanometer is one billionth of a meter). The researchers said they found that chitosan, a biopolymer, along with AlOOH can create cage-like composites in which silver nanoparticles are trapped.

The caging effectively shielded the nanoparticles surface from scalants yet allowing sufficient interaction with water enabling sustained release of silver ions for removal of micro organisms. Pradeep said the concentration of silver ion leached into drinking water from the composite is significantly less than the maximum permissible limit of 100 parts per billion. "This drug-like constant release of silver ions, without even traces of nanoparticles getting into the filtered water is the uniqueness of this composite structure," he said.

The researchers tested the composite for antibacterial activity in batch mode for more than 400 trials continuously. They also assessed the performance of their device by fabricating the filter in the form of a cartridge containing 50 grams of the composite. This filter was able to deliver 1500 litres of clean water. "Therefore, by using 120 grams of composite, safe drinking water can be provided for a family of 5 for 1 year (assuming daily drinking water consumption of 10 litres)," the report said. This, according to Pradeep, translates to an annual expense of Rs 130 (\$2.5) per family of five.

According to the scientists, the life of the cartridge can be enhanced — thereby further reducing the cost — by "reactivating" this composite either by a simple heat treatment or using a few drops of lemon juice, a common



The researchers with a prototype.  
Front (L to R): Amrita, Shihab, Sahaja.  
Standing (L to R) Udhaya Sankar,  
Anshup, Pradeep, Anil Kumar &  
Kamalesh.  
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household item. The reactivation will remove traces of scalants which deteriorate the performance of the composite.

While the silver embedded AlOOH — chitosan composite was meant for removing bacteria and viruses from drinking water, the researchers have developed several other composites to scavenge other harmful chemical contaminants such as arsenic, pesticides, mercury, lead and iron. These unique composites — depending on the region where the contaminant is present — may be added to the device so that chemically and microbiologically pure water is obtained by the user. Such all-inclusive purifiers, at a slightly higher cost, may be deployed as domestic or community units.

The paper concludes that "the proposed device and materials present a compelling solution for achieving United Nations millennium development goal of sustainable access to safe drinking water." According to the report, construction and assembly of the water filter devices including production of composites, are simple and can be done locally and generate large employment opportunity in villages.

## References

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