Producing 2,000 litres of water at 14 paise per litre through renewable energy?

By *HARI PULAKKAT*, ET Bureau | Updated: Dec 15, 2016, 12.57 AM IST

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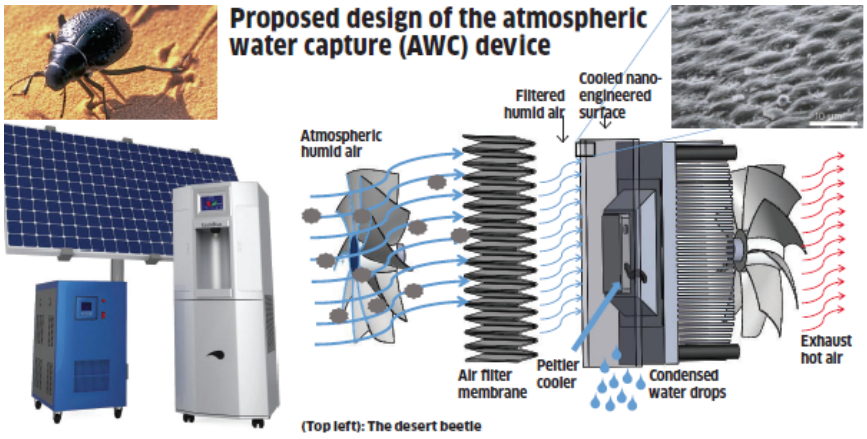
When T Pradeep, professor at IIT Madras, began to work on solving the world's water scarcity problem, one of his first inspirations was the darkling beetles living in deserts. These tiny creatures have learned to live in the driest of environments, by developing a mechanism to draw water out of thin air. Humanity will have enough water if it learns to mimic the insects, and yet do it in a large scale with minimum energy consumption. It is a tall order, but Pradeep and his team set to work on the problem two years ago.

Making water at 14 paise a litre is a challenge that requires deep science and engineering. Engineers will have to apply knowledge from many fields and try to make the materials cheaply.

Pradeep is a chemist who develops and probes nanostructures, surfaces that show their properties at scales of a few billionths of a meter. He had made a surface on which water droplets would collect, and was working on developing a device when he heard about an XPrize challenge to draw water from the atmosphere. IIT Madras quickly assembled a 30-member team with Pradeep as the lead. They would have two years to develop a product that can draw 2,000 litres of water from the atmosphere in one day. The XPrize challenge was announced late last month, and its parameters went well beyond what anybody could do at the moment.

The winning team has to use only renewable energy, and has to produce 2,000 litres of water costing two cents (roughly 14 paise) per litre. There are a large number of water capture devices selling around the world, but none that could work at this efficiency and cost. "To make water at two cents a litre is audacious," says Zenia Tata, executive director of global development at XPrize. Several companies around the world make and sell atmospheric water capture devices. In India, the first product was launched in 2004 by WaterMaker, a Mumbai-based company.



It had bought the technology initially from a US company called Air Water Corp that later closed down. WaterMaker was primarily an exporter of a water capture device to the middle-east, but set up its first plant in Jalimudi in Andhra Pradesh. Last year, it set up another plant at Gandhinagar in Gujarat, and it produces 2,400 litres of water a day. The smallest device of the company is about four feet tall, and can make 120 litres of water in a day. In the last few years, WaterMaker has been joined by other startups. Electrowater Technologies, founded in Mumbai by IIT Delhi graduate Amit Asthana and a partner, had a prototype that is being developed into a commercial product. WaterMaker and Electrowater produce water at costs between Rs 2 and Rs 8 a litre, depending on the humidity and electricity cost. The costs are well above the requirements of an XPrize, primarily because of the costs of electricity. Making water at 2 cents a litre would require free electricity, apart from cheap raw materials.

And an efficient process too. Difficult Task So making water at 14 paise a litre is a big technical challenge that requires deep science and engineering. Engineers will have to apply knowledge from many fields, and yet find a way to make the materials cheaply. The IIT Madras team has two other professors apart from Pradeep: material scientist TG Thomas and applied mechanics professor AP Baburaj. It has students from other institutions as well. “Large-scale engineering of the device is a big challenge,” says Pradeep.

The atmosphere holds enough water for humanity’s use. Even dry air has plenty of water that condenses on the surface of leaves at night. Plants and insects often depend on this water for survival, and nature has solved the problem through some intricate engineering. Grass, for example, has tiny pointed tips that are cooler than the rest of the surface, allowing water to condense. Insects have a surface with tiny bumps where water droplets can condense, and troughs nearby where the condensed water runs off and collects. It is exquisite and efficient, but nature works at slow speeds. It also had hundreds of millions of years at its disposal. Engineers try to solve the problem in many different ways. Some companies use a cool surface without nanostructures, some use a nanostructure, and some others use a solvent in which water can dissolve.

Electrowater Technologies uses a solvent and then a membrane to separate the water from the solvent, and the company has three patents on its process. It is a method used by other companies and organisations around the world. For example, Sanakvo, a not-for-profit foundation based in Switzerland, uses a liquid that can absorb the water and then heats up the liquid to release the water. Sanakvo’s device collects the water at night in the solvent and releases it during the day using the sun’s energy. “We use technologies that can be used at economies of scale,” says Jan-Marc Lehky, cofounder of Sanakvo and member of its board. The device needs no electricity, and can make five litres of water a day per square metre. The product is not commercially launched, and is aimed to work without using electricity.

Pradeep’s team, on other hand, uses no solvent but tries to mimic nature. One of his students has made a small glass torch that can make a silver metallic grassland where water can condense. They have published the work recently in the journal Advanced Materials, and is beginning to develop a refrigerator-like device that can dispense water collected from the air. The XPrize challenge has now speeded up the development.