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Success in the Maldives

By Silvia Bollen
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Project produces drinking water from waste heat

In February, government officials from the Republic of Maldives joined representatives from the Aquiva Foundation, memsys, Aquaver and the local power company, Stelco, for the official commissioning of a desalination facility on the island of Gulhi that will bring a sustainable and reliable supply of drinking water to its residents.

The project marked the successful partnership of vacuum multi-effect membrane distillation technology and waste heat as the energy source to produce up to 10 tons of drinking water per day from seawater for drinking, cooking and hygienic purposes.

According to Aquiva Foundation CEO Florian Bollen, the project sets the stage for a roll-out of the program to other islands in the Maldives and beyond.

Water, Water Everywhere

An island nation in the Indian Ocean, the Republic of Maldives consists of more than 1,000 tiny coral islands grouped into 26 geographic atolls that run north to south in an area between India and the Chagos Archipelago. Spreading more than 90,000 sq km, the country is one of the world's most geographically dispersed. About 200 of its islands are inhabited; 87 are used as resorts, and a few are used for industrial or agricultural purposes.

Gulhi, which measures approximately 600 by 300 meters, is home to about 1,200 residents as well as a shipyard and a growing number of guesthouses. Before the commissioning of this facility, Gulhi relied primarily on imported water for drinking because its only natural freshwater source is seasonal rain, which does not provide an adequate year-round water supply.

"The plan for the Maldives is to install a small desalination plant on every island, providing a safe and reliable source of drinking water in cogeneration with the electricity supply. Water for sanitary use would still be generated through rainwater collection and, if necessary, from groundwater," Bollen said.

Groundwater is found in freshwater lenses underlying the atolls and floating on top of the saline water, but heavy abstraction has depleted these lenses, causing saltwater intrusion. Although groundwater is recharged by rainfall, it becomes contaminated while percolating through the soil, which generally is polluted with organic and human wastes.

Waste Heat to Produce Drinking Water

Stelco is one of two state-owned electricity companies that provide the power supply in the Maldives. It operates generators that service more than 40% of the population.

Approximately 40% of the primary energy supplied to the generators in the form of diesel is being converted into electrical energy. The remaining 60% is blown into the environment through the cooling cycle with ventilators and exhausts. This energy can be captured by heat exchangers and used for desalination, increasing the overall efficiency of the generators to more than 80%.

The new desalination system taps into the cooling cycle of the local diesel generators to retrieve this waste heat. At about 85°C, this waste heat drives a desalination process under vacuum using membrane distillation modules developed and provided by the German/Singaporean company memsys. This robust process results in high-purity distilled water.

This distillate then is mineralized using local coral sand for a Maldivian taste. The water is distributed under the brand "Aquiva fushi"—fushi standing for the pure island taste created by coral sand in the mineralization process.

The drinking water is made available to the public in water kiosks—light wooden houses in the traditional style of the Maldives located in accessible locations on the island. Distribution is done through a number of taps at which customers can fill their containers. This distribution system uses only reusable containers in sizes from 1.5 to 20 liters, chosen to prevent polluting the pristine Maldivian nature with plastic waste from single-use bottles.

The water kiosks provide a sales point and also a disinfection bath for the reusable containers. Each kiosk has a desk for the operator with a till for collecting and registering the payments for the water. Additionally, it provides a resting bench that invites communication between customers and creates a community meeting point. A local delivery service also can be arranged for a small fee.

With the new desalination system, kiosks can provide the drinking water for about \$0.05 to \$0.07 per liter on a sustainable basis. This means a significant reduction in the cost of drinking water, as bottled water costs between

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\$0.25 and \$0.50 per liter on inhabited islands, and often \$2.50 or more per liter in the resorts. Transportation to the islands and the cost of disposable bottles contribute to the high price, which creates an economic hardship. Much of the population must spend a large amount of their income (up to 50% or more) for safe drinking water. As a result, many people opt for cheaper, unsafe water supplies, resulting in sickness.

Desalination Technology

The desalination system uses a vacuum multi-effect membrane distillation process developed and provided by memsys, which uses the waste heat of the generators to create an efficient and environmentally friendly desalination process.

In addition to using waste heat as a primary driver for the process, the plant needs little pretreatment of the seawater, thereby reducing the chemical load on the brine that goes back to the ocean. A further plus is the high quality of the produced water, as it is a condensation/distillation process that, by definition, creates perfect distilled water.

Wolfgang Heinzl, the developer of the memsys technology, noted that the memsys process is being applied in many industries for wastewater treatment, ethanol separation and cooling processes. "In light of the growing water problems in this world, sustainable desalination was one of the most important issues on our minds when developing the memsys process. We are committed to supporting efforts to make this a reality," he said.

A Sustainable Business Model

Not only is the Maldives project sustainable from a water production and ecological point of view; it also is set up to work as a sustainable business model. Collaborating with existing aid organizations and governments at the local and international levels, the U.K.-based Aquiva Foundation used a micro-finance approach to this and other projects in its portfolio.

Aquiva provides the technology, training and support needed to generate safe water for personal, industrial and agricultural use. Aquaver and memsys support the foundation by providing their vacuum multi-effect membrane distillation technology and plants on an "at-cost" basis.

The success of the project on Gulhi is expected to initiate a fast rollout of projects of similar structure and technology across all inhabited islands of the Maldives and in other nations to provide safe, sustainable drinking water year around.

"We believe that this program is a good example of how water problems can be solved sustainably on a local level, even in situations where no freshwater is available," Bollen said. "We say thank you for the joint effort of all parties involved in this project."

Edgar Konijnendijk, responsible for the drinking water program at Aquaver, agreed. "Providing remote communities with clean drinking water requires a simple and robust system [that is] low in maintenance and easy to use," he said. "This is what we have achieved with our plants; their ability to utilize waste heat makes them suitable for other remote communities all around the world."

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Aquiva Foundation CEO Florian Bollen



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