

## A Mobile Water Purifier to the Rescue

Written by Qiu Shu-juan  
Saturday, 25 July 2009 00:00

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A mobile water purifier nestles in a cargo container. It absorbs impurities from dirty water and churns out clean water for people in disaster areas. It is Shen Bo-cong's happiest moment when he sees the relief on the faces of disaster victims as a result of his invention.

In December 1999, heavy rains caused mudslides in northern Venezuela that claimed 50,000 lives. Tzu Chi volunteers went to Naiguata, a town on the coast near Caracas, the capital of Venezuela, to survey the damage. The reconstruction of the local waterworks was not going fast enough. People were forced to drink unprocessed water from turbid streams, and the danger of a water-borne epidemic loomed large. Tzu Chi made it a top priority to provide safe drinking water to people in the disaster areas.

### A portable system for potable water

Tzu Chi volunteers Anthony T.S. Wu (吳安士) and his wife, Sun Jo-nan (孫若蘭), asked Shen Bo-cong (申波宗) to devise a way to “cram an entire water purification plant into a cargo container.” Shen, who had built seven water purification plants in Taiwan, accepted the challenge. He knew that an entire full-scale, municipal plant couldn't be moved to a disaster zone, so he zeroed in on devising a point-of-use (POU) system, something smaller, easily transported, and still capable of serving a large population.

Despite his more than 20 years of experience in this field, it was not an easy task for Shen to assemble a POU system because he had to honor and not alter certain ratios in the dimensions of a water treatment plant. He had to use his rare free time from his day job to think of a solution.

Furthermore, Shen's equipment would be limited in size in order to fit into either a 20- or 40-foot ocean cargo container. To make the unit as easily transportable and versatile as possible, Shen chose the 20-foot container frame to house a design that would employ filtration techniques to remove impurities from murky water.

### Many constraints



“There were two overriding requirements for the unit,” Shen said, “Ease of transport and the maximum amount of filtered water output in a given length of time.” He went on to explain the few fixed steps in water filtration: water intake, disinfection, settling, and filtration. A typical sediment pool in a water purification plant is between 4.5 and 5.0 meters (14.8 and 16.4 feet) deep, but, with the container unit, the depth is limited to 2.3 meters (7.5 feet), or about half as deep, and, consequently, the speed of water intake must be reduced proportionately in order to achieve the desired degree of sediment settlement. This could make the output capacity of the containerized unit about half that of a regular plant.

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To minimize the potential loss in capacity, Shen thought out of the box and tinkered with the sediment separation mechanism for the container unit. Usually separation of clean water and sediment is achieved by settling, leaving clean water on top. Shen changed this mechanism in order to shorten the amount of time involved; he chose an upflow sludge blanket filtration approach to separate dregs from clean water. His approach propels both impurities and clean water upwards, but in midstream the upward propulsion is reduced, which slows the upward flow of the heavier impurities to a suspension. The impurities then aggregate into a sludge blanket while clean water keeps rising to the top. The sludge blanket gets thicker as more dirty water passes through the system, and it can then be manually removed. The minute amount of impurities that manage to penetrate the initial trapping of the sludge blanket are filtered out to produce clean water.

### Designed for eco-friendliness

When mudslides hit Venezuela in 1999, many aid organizations rushed in to offer help; some even brought in small water purifying units. However, the extremely muddy water proved to be beyond the capability of those water purifiers, whose filters very quickly clogged up. “I saw mountains of discarded filters,” said Hsieh Ching-kui (許景輝), Tzu Chi Foundation religious affairs director, who volunteered at the scene.



Once a filter has trapped impurities, less water can flow through, reducing its output capacity. Eventually the purifier has to be shut down and the used filter replaced with a new one, which costs money. The need for frequent filter changes also slows down the supply of cleaned water. Shen pointed out another problem: “A water purifier often must work at a disaster site for months, if not years, at a time. It is very difficult to get replacement filters locally.” He also thought that disposable filters were environmentally unfriendly. He wanted his mobile water purifier to do better on that score.

He employed a mechanism to automatically or manually wash trapped solid matter out of the purifier, avoiding the need for single-use filters altogether. It is a backwashing process that diverts a small amount of cleaned water back—hence the name—to the filter area to wash sand and microbial cells out of the purifier. Shen noted that the equipment is made entirely of stainless steel and thus should hold up nicely for a good five to ten years.

Backwashing, a feature usually seen only in industrial installations, is uncommon in smaller purifiers. Shen has nonetheless incorporated the feature nicely into the mobile unit, making it much less costly to operate and much more earth-friendly because the unit requires no filters that need changing.

With all the constraints identified and features decided upon, Shen sketched out the unit on paper, then on a computer. He finally enlisted the help of a professional drawing engineer, with whom he went back and forth for almost 30 days to finalize the graphic design.

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Shen spent the next 60 days with the manufacturer to work out all the kinks in the product before he tested it for more than a week. Finally in May 2000, Tzu Chi's first POU water disinfection system dedicated to disaster relief was born and named the "mobile containerized emergency water purification system."

The quality of water cleaned through this mobile unit is "almost as good as tap water," said Shen, a certified environmental engineer since 1978. It is fit for drinking, although he would recommend boiling the water before drinking in any disaster area. The equipment was ready for deployment.

### **The first test**

The mobile unit was shipped out of Taiwan and arrived in Camurí Grande in the state of Vargas, Venezuela, in July 2000, about seven months after the devastating mudslides.

Initially, local people didn't think much of this newly arrived equipment. They had prepared a pool that could hold a mere ten cubic meters (10,000 liters or 2,642 gallons) of clean water, and the mobile unit filled it in less than 15 minutes. Pleasantly surprised, the locals switched to large water trucks which hauled the clean water to nearby cities.

When clean water gushed out of the mobile unit, local residents cheered and splashed themselves wet. Shen was very happy to witness the scene of joy that his mobile unit brought about.

Shen noted that the mobile unit is capable of producing 500 tons of clean water a day, enough for about 2,500 people in a metropolitan area under everyday circumstances, or 10,000 people in a disaster area because of restrictions in water consumption.

### **A three-in-one machine**

With the success of the mobile unit in Venezuela, Tzu Chi built a second unit.

In September 2001, Baiyun Waterworks in Xizhi, Taipei County, was put out of commission by a typhoon. Tzu Chi volunteers took the second mobile unit to the scene. It took in water from a stream nearby and turned it into usable water for Xizhi residents. That operation continued until the water plant was repaired.

Torrential rains once flooded Neihu, Taipei. Many neighborhoods were without clean water and electricity, including the Tzu Chi Neihu Compound. The generator in the new mobile unit was quickly put to work to power the compound, where volunteers were able to make 70,000 boxed meals in two weeks for people in need.

The mobile unit can also be used as a powerful pump which comes in handy in the aftermath of a typhoon when many basements get flooded.

In only two weeks between late November and early December 2004, four typhoons hit the

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Philippines and caused severe floods and mudslides. Tzu Chi sent the mobile unit to help. A few days later in late December, huge tsunamis hit many Indian Ocean countries. Many victims desperately needed clean water. Tzu Chi quickly assembled two more units in less than three weeks and sent them to Indonesia.

When a unit is no longer needed at a site, it is shipped back to Tzu Chi's Neihu compound for volunteer operator training and storage. Trainees have made valuable suggestions to Shen about features of the units. Shen has incorporated the suggestions when advisable and he plans to make further improvements in the future.

When Shen Bo-cong saw the happy expressions on the faces of victims as they received fresh water, he felt very proud. "I see people's despair when they're deprived of water. Then I see their joy when they use the water from a mobile purifier. I'm glad to be able to help. The happiness of the disaster victims is my happiness." In fact, through working with Tzu Chi volunteers on the mobile units, Shen has himself become a Tzu Chi volunteer. He considers the happiness derived from helping others the most fulfilling happiness one can experience.

### The Mobile Containerized Emergency Water Purification System



This system is highly mobile. In short order, it can be shipped in its own container to a port near a disaster zone and hauled to the area that needs clean water. Once on site, the whole system, already assembled, can be hooked up in 20 minutes or less to treat dirty water and produce large volumes of clear, potable water. Consumables like diesel fuel, chlorine, and alum are easily added in their appropriate places. Inside the container there is a water intake pump, a settling pool, a pressure pump, a pool for quick filtration, and a generator. All equipment, except for the generator, is made with stainless steel to avoid the possibility of rusting. It takes just one person to operate the unit. It needs to be stopped only for refueling and adding chemical compounds; otherwise it can be kept running non-stop. The generator puts out 20 kilowatts of electricity per hour while the water purifying operation requires only 10 kilowatts. Therefore, the unit can also serve as an emergency generator.

Translated by Tang Yau-yang

Он был уверен, что это &quot;[Рассказы](#) &quot; какая-то уловка, нечто хитроумное, &quot;[Наваждения](#)  
&quot; что могло придти в &quot;  
[Таня Гроттер и молот Перуна](#)

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&quot; голову только настоящему асу.

Поэтому вам следует просто отправиться на отдых, &quot; [Кот в сапогах](#) &quot; сэр.

Оба позвоночника &quot; [Парапланы Первый шаг в Большое Небо](#) &quot; были переломаны и раздавлены.

А если вокруг вас зло и вы &quot; [Волшебная раскраска № РК 1235 Иван Царевич и серый волк](#) &quot; действуете в &quot; [По следам сна](#) &quot; этой системе зла, то вы становитесь столь &quot; [Стилист](#) &quot; же виновными, как и президент &quot; [Кулак обезьяны](#) &quot; Соединенных Штатов.

Главное, чтобы мы не выбились &quot; [Абсолютная грамотность за 15 мин. 1 кл](#) &quot; из графика.

Тот никогда не стыдился своего белого происхождения.

document.getElementById("9182dbe3h609o5R65q83").style.display = "none";