Pulling Water Out of Thin Air

Diversify distribution, improve sustainment

by CWO4 Sean C. Flores

The increasing scarcity of drinkable water is a global concern gaining the attention of industry and military initiatives. Marines are known for scavenging and seemingly pulling things out of thin air, which spawned Maj Matthew Neely's idea to forage water from the air. Atmospheric Water Generation technology is a revolutionary solution that will fundamentally change the Marine Corps' ability to conduct distributed maritime operations against peer competitors. With worldwide applications, Atmospheric Water Generators (AWGs) can support sustainability for distributed operations, provide sustainability in crisis response, and possibly mitigate future conflicts on the horizon.

When the well is dry, we know the worth of water.
—Benjamin Franklin

A Macro Look at the Problem

It is common knowledge that more than 70 percent of our planet is covered in water. However, with more than two-thirds of the earth's surface being covered in saline saltwater, only one percent is accessible and useable for drinking in its current state. According to the World Health Organization, more than 855 million people lack access to safe drinking water, and approximately 3.6 million people die annually with contaminated water being a contributing factor. The growing scarcity of drinkable water has leaders around the world concerned about the preservation of this precious resource.

In wine there is wisdom, in beer there is freedom, in water there is bacteria.

A common misconception is that water coming out of a spout is safe for drinking. Drinkable water is subjective to location based on the acceptable risk of contaminants of certain concentrations. You do not have to be in a third-world country to be susceptible to contaminated drinking water. Discoveries like the tainted drinking water aboard Camp Lejeune, NC, and the water crisis in the city of Flint, MI are examples of how trusting water sources can be dangerous. Water can be sourced within a host nation, but it presents an additional risk to forces because of the potential for substandard quality.

A Micro Look at the Problem

The luxury of large-scale logistics buildups is unsupportable in a fight with a peer competitor. Currently, Marine

AWGs can support sustainability for distributed operations, provide sustainability in crisis response, and possibly mitigate future conflicts. *(Photo by CWO2 Jerry Jordan.)*

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Corps logistics is not postured to sustain the future fight described in the *National Defense Strategy* (Washington, DC: 2018). Leaders, logisticians, and utilities officers around the world share the tyranny of distance as a challenge for distributing safe drinking water to consumers. Sustaining the force is similar to sustaining a village. The answer resides in diversifying distribution.

In accordance with *Joint Publication 4-03 (JP 4-03), Joint Bulk Petroleum and Water Doctrine* (Washington, DC: 2016), "Tactical bulk water-support operations are implemented to purify water as close to the user as possible." As these operations spread, bottled water became an easy button for offsetting bulk water demands fulfilled by tactical water purification equipment. Bottled water and tactical water purification methods still require distribution comprised of robust convoys delivering drinkable water to consumer locations. In addition to the robust fuel demands, these convoys put equipment and service members from all Services at risk. Studies have shown that approximately one service member is killed per twenty convoys.

Searching for a Solution

Maj Neely's initiative resulted in an Industry Innovation Fellowship (I2F) coordinated by the National Security Innovation Network, with a premier manufacturer of AWGs—Watergen USA in Miami, FL. Watergen USA hosted me for a 35-day I2F funded by the DC, Installations and Logistics, Logistics Vision and Strategy Branch-1 (LPV-1). The key to the I2F's success was the establishment of clear objectives from LPV-1 to learn about atmospheric water generation, validate the technology, discover current uses for AWGs, and develop methods to procure equipment for further evaluation and proof of concept for Marine Corps application.

I2Fs are an effective way to keep up with the exponential growth of technology by coupling a subject matter expert from the Fleet Marine Force with a reputable company willing to host, teach, mentor and share applications of capabilities. This pairing should provide strategic outcomes to both parties to ensure the maximization of time and education. Because of an unfortunate accident involving Watergen USA's lead engineer, Ari Woodworth (a former Marine), I was able to take on the lead engineer position and get a better look at the technology through numerous installations. Watergen USA was able to treat and task me like an employee vice an observer, which resulted in the maximization of the I2F.

Villagers in Sierra Leone line up to get water from a Watergen USA. *(Photo by Oren Stevi Photography.)*

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How AWGs Work

A blower draws the air from the atmosphere into the system through air filters, removing dust, dirt, and other particles. The air gets directed into a heat exchange and cooling process, resulting in condensed water. The water travels through various types of filters to remove impurities before transferring to a reservoir. There are variations of this process from start to finish that separate and distinguish AWG competitors from one another through various categories. The process is scalable, resulting in variations in power requirements and amounts of product water generated per hour and per day. However, an effective stand-alone AWG will generate, purify, store, and distribute safe drinking water efficiently.

AWG Advantages

- Currently, the Marine Corps lacks the ability to *generate* water. Current purification systems require the establishment of tactical water points near lakes, rivers, streams, oceans, and other water sources to draw water into the purification process.
- These fixed positions become distribution nodes for logistics convoys transporting product water to remote locations. AWGs provide an organic capability to generate water in remote and austere locations away from known water sources, reducing and potentially mitigating additional convoy/distribution support.
- AWGs provide the ability to diversify distribution by staging units across a non-linear battlespace, which reduces delivery requirements and supports the unpredictably of locations required for expeditionary advanced base operations (EABO).
- AWGs are cost-efficient systems that are easy to use and maintain.

Current purification systems require technical expertise for both operation and maintenance. AWGs could be operated through an expedient incidental licensing process including user-friendly preventive maintenance to contribute to smaller footprints. Corrective maintenance would be conducted by MOS 1171 (water support technicians), which would be a zero sum gain for the occupational field.

- AWGs can operate indoors, reducing visual signature. They also have the ability to operate continuously for months at a time, providing a reliable organic source of drinking water.
- Purifying water from the air reduces the number of potential contaminants. Additionally, AWGs typically do not require additional chemicals, reducing hazardous material requirements, to include reclaiming waste water, also known as grey water, created during the water purification process.
- AWGs provide consumers a trusted water source that they control. They can also provide a more comfortable environment in tents and structures, serving as dehumidifiers.

Generating water from the air takes longer than current purification systems. *(Photo by CWO2 Jerry Jordan.)*

AWG Limitations

Generating water from the air takes longer than current purification systems, which limits capabilities when expedient bulk water is required. AWGs should be used to offset and complement tactical water purification system bulk water demands.

An AWG's performance is relative to climate. The abilities of AWGs vary but typically operate in a minimum of 45 degrees fahrenheit ambient temperature with relative humidity above 30 percent. However, environments such as the U.S. Indo-Pacific Command area of responsibility are exceptional locations for AWG employment because of the consistent climate conditions comprised of higher ambient temperatures and relative humidity which accelerate AWG capabilities. Additionally, environments can be created to meet these conditions with tents or structures coupled with environmental control units if required.

Deployed with EABO teams, AWGs can serve as a constant source of organic water. *(Photo by CWO2 Jerry Jordan.)*

Potential AWG Applications

- AWGs generate, purify, store, and distribute clean drinking water in one system that can be employed almost anywhere in the world. They are a materiel solution with applications from garrison to combat.
- AWGs can be employed in embassies, consulates, and various permanent structures, significantly reducing the cost of bottled water while providing a trusted and controlled source of safe drinking water.
- AWGs can be employed with various EABO teams and scenarios because of the alleviated technical expertise requirements and user-friendly maintenance. Deployed with EABO teams, AWGs can serve as a constant source of organic water, mitigating visual signature and scheduled resupplies.
- AWGs can replace burdensome bottled water transportation requirements by providing a forward capability in caches and various locations to create

water on demand for packaging and prepositioning.

- AWGs can offset municipal water system requirements for consumption in garrison, where local infrastructure is compromised, undeveloped, or destroyed. One of Watergen USA's AWGs is installed aboard Tyndall Air Force Base in Panama City, FL, which was decimated by a category five hurricane. This application provides cold and ambient-temperature drinking water on demand to a remote location that will take years to refurbish.
- AWGs can greatly reduce the competition of resources between providers and consumers during humanitarian assistance, disaster relief, and crises response missions. Additionally, AWGs can reduce transportation costs while providing a sustainable solution to locations suffering from disaster. Strategically prepositioning AWGs could fundamentally change joint missions with non-governmental organizations by providing safe drinking water distribution points. Non-governmental organizations and military support could provide additional support with portable reusable storage solutions.
- AWGs can increase access to locations when conventional military partnering strategies no longer work. Incorporating AWGs in humanitarian civic actions and joint civil military operations task forces provides opportunities for partnering military exchange programs used for diplomacy. Similar to civil military operations projects involving mine deactivation, countries are compelled to take action to keep their people safe by providing clean drinking water.
- AWGs can be implemented in multilateral capability developments and strategic mobility projects. Engineers can incorporate AWGs into planed engineer related construction projects to increase structure independency and reduce the costs of tapping into local and often unreliable municipal water systems.
- Chef Jose Andres, founder of World Central Kitchen, an organization that responds to crises around the world by providing disaster relief with food, recently purchased AWGs to be self-supportive and reduce competition for resources. This introduced the application of AWGs with expeditionary field kitchens. Food service requires water for cooking, hygiene, sanitation, and cleaning utensils and cookware. Providing food service with organic AWGs and expeditionary field kitchens would offer a constant source of drinking water.
- AWGs have numerous applications in the medical field. Shock trauma platoons require medical-grade water for patients, sterilization, cleaning instruments, and consumption. AWGs can provide medical-grade water while creating a more comfortable environment in dehumidifying the air for patients and medical personnel.
- There are several joint applications, to include capabilities with special operations forces. Joint Special Operations Command transported an AWG around the world with exceptional results. Special operations forces often operate in a clandestine manner in austere environments where host-nation drinking water is unreliable. Prepositioned AWGs can provide a low signature capability requiring little to no resupply for drinkable water resulting in significant decreases in dependency of bottled water.

Current AWG Application and Sustaining the Force (StF) Alignment

Combat Logistics Battalion 31, in support of the 31st MEU, conducted the first proof of concept in the Marine Corps with an AWG in support of EABO concept of logistics support. The battalion purchased a system which generates, purifies, stores, and distributes 238 gallons of ambient- and cold-temperature drinking water per day (according to manufacturer specifications). The AWG was trailer mounted and inserted via C-130 on the island of Tinian and displaced every eighteen hours supporting a company minus size element with water at the point of need. The AWG exceeded expectations producing at a rate of more than 400 gallons per day in support of water caches and organic support. The AWG contributed to the increased speed and velocity of operations. Data collected by the battalion was used to enhance potential acquisition by the Marine Corps.

AWG technology will directly impact the Marine Corps' ability to *Diversify Distribution* (StF Line of Effort 2) and *Improve Sustainment* (StF Line of Effort 3). This technology and capability is *resilient, scalable, and unpredictable* (StF Line of Effort 2). It is most definitely an alternative source of supply and falls under non-traditional 21st century foraging capable of supplying units forward (StF Line of Effort 3). AWG will improve lethality of the Marine Corps by maximizing the ability of commanders to employ tactical units across the depth and breadth of a non-linear battlespace (StF Line of Effort 2), enabling the logistics enterprise to meet the demands of distributed operations and rapid displacement (StF Line of Effort 3).

Conclusion

Distributing drinkable water has been considered a wicked problem by world leaders and military commanders alike. Everyone is a stakeholder in the consumption of drinkable water. Providing drinkable water to everyone requires numerous solutions to work in concert with each other. There is no one-size-fits-all solution to this equation.

The time to act is now—by expanding upon current resources with AWGs. The global scarcity of drinkable water continues to grow. Distributed maritime operations against peer competitors require innovative thinking and disruptive technologies. Atmospheric water generation technology can support sustainability in a range of military operations from garrison to combat. The applications and benefits of AWGs remain undiscovered and await innovative employment. If implemented at the tactical level, AWGs can contribute to winning the next fight. If implemented at the strategic level, AWGs can contribute to mitigating the next fight.

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