Water-from-Air Quick Guide

Second Edition

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Cover image: A thermoelectric device provided a chilled surface with temperature below the dew-point for condensation of water from the air.

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To the advancement of the water-from-air industry

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PURPOSE

Technical and scientific aspects of water-from-air machine (atmospheric water generator) operation are introduced and explained for prospective buyers, owners, and users of this equipment. The knowledge in this guide is valuable for making cost-effective decisions about using the freshwater resource that exists in Earth's atmosphere.

1. WATER-FROM-AIR

Human population growth and climate change are causing droughts—regional scarcity of liquid water sources for supporting human, animal, and plant populations. Conventional water supplies from surface water and groundwater cannot meet demands for fresh water. Water conservation and improvements in distribution efficiency are worthwhile but are often inadequate to ensure enough water for people, commerce, and industry. The innovative water supply solution most often turned to, desalination, has significant bad impacts on our ecosystems because large quantities of waste brine are created.

Water-from-air technologies cannot compete on an energy cost of water basis with ample sources of liquid water, although polluted or contaminated, that can be treated by standard filtration and chemical methods. This is explained in Chapter 2, "Water Vapour is a Water Resource". But, even so, there are many applications where water-from-air can be the ideal choice.

Historical Perspective

Potable water is not always available from surface water, groundwater, or rainwater harvesting when and where needed. Many people, throughout history, have been fascinated with the concept of gathering dew to augment scarce water resources.

Water-from-air (WFA) technology in its present form started with US Patent 661,944 issued to E. S. Belden in 1900 for his apparatus for removing moisture from air (see Figure 1).

Alexander Graham Bell, known for commercializing the telephone, was interested in providing emergency water rations to shipwrecked sailors marooned in lifeboats. Bell experimented with water-from-air devices in the early 1900s (Eber, 1991, p. 77–78, 82).

Mitsubishi Electric Corporation (Japan) was active in the industry already in 1981 with its Japanese Patent 56-56216 for a two column atmospheric water condensation apparatus.

Smaller companies, entirely devoted to the WFA industry began forming in the 1990s. Some of these continue to the present.

The water scarcity crisis continues to deepen with water scarcity now affecting four billion people (Mekonnen & Hoekstra, 2016).

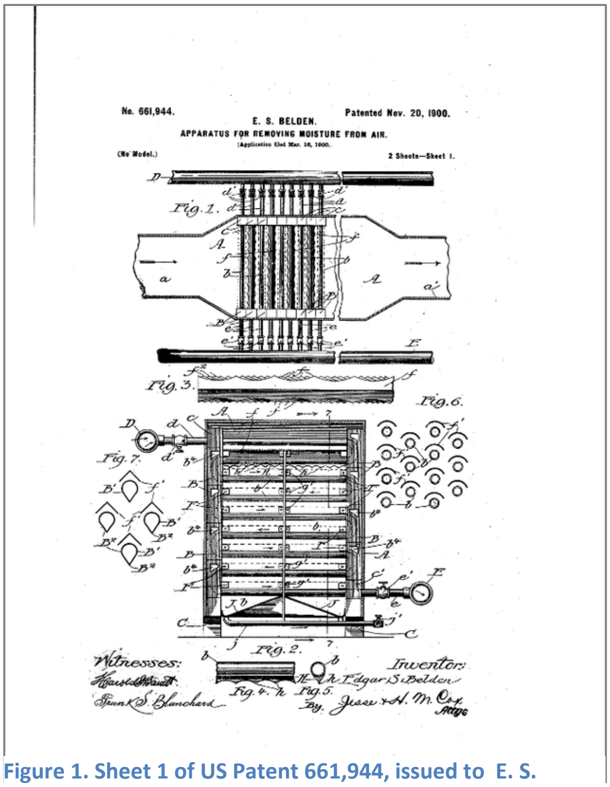

Figure 1. Sheet 1 of US Patent 661,944, issued to E. S. Belden in 1900 for an *Apparatus for Removing Moisture from Air*. Source: United States Patent and Trademark Office (public domain).

Applications

Water-from-air machines have already been used in several roles

- emergency water supplies after natural disasters (USA, Haiti);
- military troop water supplies produced at site of need—reducing reliance on vulnerable supply lines;
- alternative to municipal tap water with perceived quality problems—households and businesses interested in water supply quality, independence, and security; and
- alternative to bottled water machines in homes and offices and associated vending machines (see Figure 2)—no need to transport and lift heavy 5-gallon (20 L) bottles—also avoids the environmental burden of bottled water.

Figure 2. Water vending machine in Grand Turk, Turks and Caicos Islands (2002).

Specific projects, listed by country, include

- Australia: Case study by World Environmental Solutions Pty Ltd;
- Gabon: Project by Water World Solution;
- Honduras: Water-Gen, atmospheric water generators;
- India, Chennai: MARG Properties Savithanjali development;
- India, Gujarat, Ahmedabad, Bopal: SUSTECH CENTER, Sun City (Dew Harvesting);
- India: Jalimudi Village Project (WaterMaker India);
- India: Various locations by WaterMaker India;
- Nigeria: Nerios Water Making System in Liberation City in Lagos;
- Panama: Gold mine;
- Qatar: Farm irrigation;
- Slovakia: Water-Gen, atmospheric water generators;
- UAE, Abu Dhabi: Gas facility;
- UAE, Abu Dhabi: UAE Water—Skywater atmospheric water case studies;
- UAE, Sharjah: Sharjah English School;
- USA, California, Irvine: Urban Produce;
- USA, California, Los Angeles: Dodger Stadium;
- USA, Hawaii: NELHA Gateway Project;
- USA, Texas, Dripping Springs: Nerios Water Making System at Mazama Coffee;
- USA, Texas, Houston: Applied Cryo Technologies; and
- USA: Office Depot.

Potential applications include

- core technology for small businesses producing beverages, ice, and processing food products;
- drinking water for government institutions, hospitals, clinics, hotels, resorts, buildings for worship, industries, factories, natural resources exploration camps, offshore drilling platforms, restaurants, ships, boats, recreational vehicles, and vacation homes;
- decentralizing water distribution;
- retrofitting ice or water dispensers into buildings lacking plumbing infrastructure;
- alternative to treated wastewater as drinking water;
- high purity water for laboratories and manufacturing processes;
- water source for bottled water (see Figure 3)—avoids environmental impact of surface and groundwater withdrawals;
- livestock watering;
- hydroponic greenhouse irrigation;
- pour-flush latrines; and
- cleaning dry latrines.

Figure 3. Bottled water delivery vehicle in Nassau, Bahamas (October 2014).

Dehumidifiers with a Difference

Online discussions focusing on an advance in water-from-air technology sometimes contain comments like, "Nothing new, dehumidifiers have been around for decades." What is the difference? There is not just one difference, but many.

While mechanical dehumidification technology is often at the core of water-from-air (WFA) systems the WFA machine is purpose-designed and built for the following characteristics

- superior quality of air filtration;
- maximized amount of water condensed per hour or day;
- minimized energy cost of the condensate (product water);
- non-toxic, certified food-grade components that contact the condensate;
- integrated water treatment steps (for example with filtration, ultraviolet light treatment, ozone treatment, and chlorination);
- secure storage of treated water;
- stored water meets national or international drinking water quality guidelines; and
- water quality maintenance protocol.

Differences are tabulated in Table 1.

Table 1. ***Differences between dehumidifiers and water-from-air systems.***

Dehumidifier	Water-from-Air System
Air filter	Air filter (high quality, cleanable, reusable); air treatment (e.g., ultraviolet light to sterilize micro-organisms)
Fan	Fan or blower (designed for energy efficiency)
Coil (uncoated)	Coil with food-grade coating
Compressor(s) standard quality for chilling the coil; compressors rated to work with mixed outside and inside air	Compressor(s) highest quality and quiet for chilling the coil; compressors are robust to work with 100% outside air continuously
Drain pan (not food grade)	Drain pan (stainless steel); pump(s) for water flow
Plumbing (not food grade)	Plumbing components certified for potable water; water filtration for particulates and micro-organisms; water treatment to sterilize or kill micro-organisms
Water storage (minimal, untreated) or simple hose connection to drain	Onboard storage container sealed; certified for potable water; provisions for feeding external reservoirs; drinking water quality components for dispensing
Micro-processor—simple control of simple system	Micro-processor—sophisticated control of a complex system