GR8 Guide to Water-from-Air Basics

This guide increases your familiarity with some important technical and scientific aspects of water-from-air machine operation. This makes you a better informed purchaser and user of the equipment. The knowledge in this guide helps you make cost-effective decisions about using the freshwater resource that resides in the moist air all around us.

WATER TECHNOLOGIES INTERNATIONAL, INC.

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PURPOSE

This guide increases your familiarity with some important technical and scientific aspects of water-from-air machine operation. This makes you a better informed purchaser and user of the equipment. The knowledge in this guide helps you make cost-effective decisions about using the freshwater resource that resides in the moist air all around us.

WHY WATER-FROM-AIR?

NEW WATER SUPPLY SOLUTIONS NEEDED

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 the next section, 'Water Resources Comparison'. But, even so, there are many applications where water-from-air can be the ideal choice.

IDEAL APPLICATIONS

Water-from-air machines have already been used in these roles:

- Emergency water supplies after natural disasters (USA, Haiti)
- Military troop water supplies produced at site of need; Reduces 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
- Alternative to bottled water machines; No need to transport and lift heavy 5-gallon (20 Liter) bottles; Avoidance of environmental burden of bottled water
- Water supply for a school in Guam
- Clean drinking water supply for a village in India

Potential applications abound:

- 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, 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; Avoids environmental impact of surface and groundwater withdrawals
- Livestock watering
- Hydroponic greenhouse irrigation
- Pour-flush latrines
- Cleaning dry latrines

WATER-FROM-AIR MACHINES COMPARED TO DEHUMIDIFIERS

Online discussions focusing on some advance in water-from-air technology sometimes contain comments like, "Nothing new, dehumidifiers have been around for decades." What is the difference?

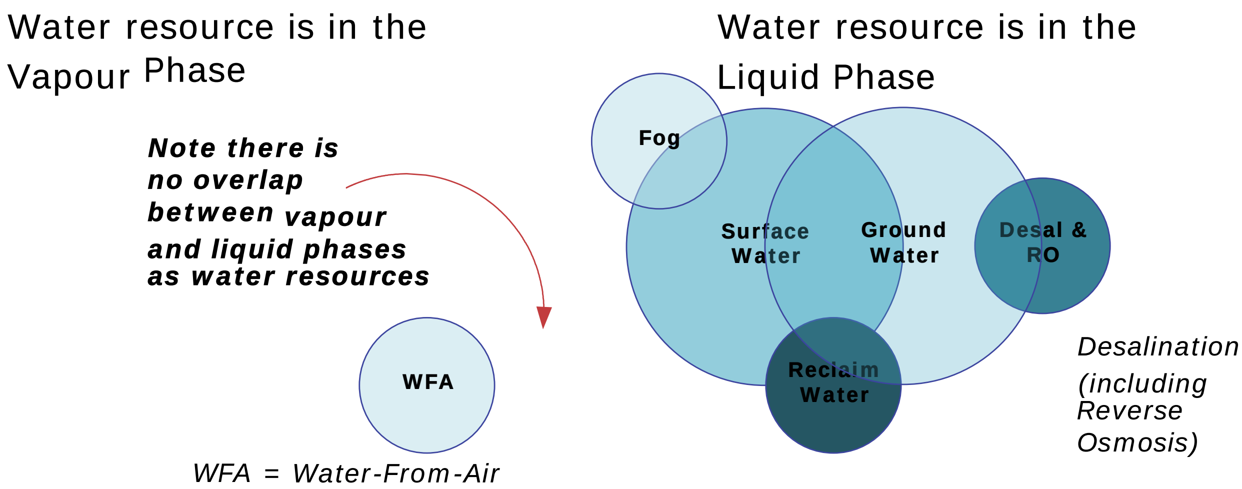
While mechanical dehumidification technology is often at the core of water-from-air (WFA) systems the WFA machine is purpose-designed and built for the following characteristics:

- 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, chlorination)
- Secure storage of treated water
- Stored water meets national or international drinking water quality guidelines
- Water quality maintenance protocol

Dehumidifier	**Water-from-Air System**
Air filter Fan Coil (uncoated) Standard quality compressor(s) for chilling the coil; compressors rated to work with mixed outside/inside air Drain pan (not food grade) Plumbing (not food grade) Water storage (minimal, untreated) or simple hose connection to drain Simple micro-processor control of system	Air filter (high quality, cleanable, reusable) Air treatment (e.g., ultraviolet light to sterilize micro-organisms) Fan (optimized design for energy efficiency) Coil with food-grade coating Highest quality, quiet compressors for chilling the coil; compressors are robust enough to work with 100% outside air continuously Drain pan (stainless steel); Pump(s) for water flow Plumbing components certified for potable water Water filtration for particulates and micro-organisms Water treatment to sterilize or kill micro-organisms Onboard storage container sealed; for potable water Drinking water quality components for dispensing Sophisticated micro-processor controls

WATER RESOURCES COMPARISON

Water-from-air (WFA) machines (also called processors of atmospheric water vapour or atmospheric water generators) change the phase of water from gas to liquid. There is an associated energy cost. In tropical regions, for commercial or industrial scale machines, the energy cost of water-from-air is typically 0.4 kWh per liter. An electric meter would show 0.4 kWh of energy consumed for each liter of water produced. This is about 1.53 kWh per US gallon of water produced.

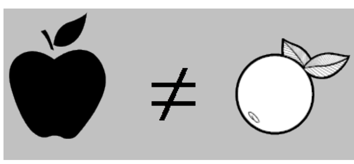


Energy is needed to make the water **change phase** from invisible gas to visible liquid.

Energy is needed for water collection (fans or blowers, pumps) and water treatment (pumps, UV lights, ozone-making, on-site chemical processing)

No energy is needed for a phase change—all of these water resources, including fog, are **already liquid**.

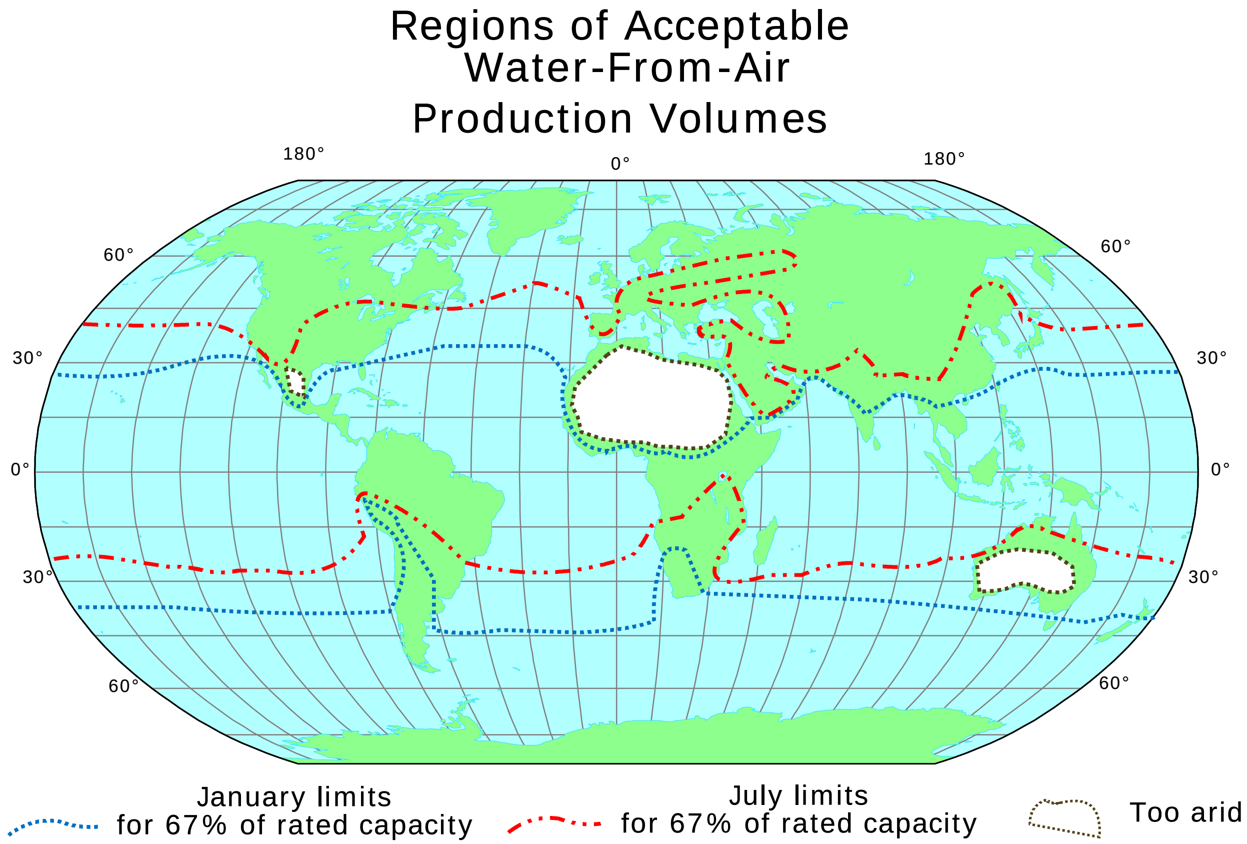
Energy is needed for water collection (pumps) and water treatment (pumps, UV lights, ozone-making, on-site chemical processing)



This knowledge avoids an “apples to oranges” economic comparison by excluding direct cost comparisons to Municipal Water, Desalination (RO), Solar Distillation, Reclaimed Water (e.g. Singapore, some Australian cities) and similar liquid water sources

Our GR8 machines use mechanical dehumidification, a reliable technology widely used for decades. Condensate is immediately available for drinking water treatment. Mechanical dehumidification is most effective at higher temperatures and humidity characteristic of tropical climates but it can also be used in many temperate locations in the spring, summer, and fall.

WHERE IS WATER-FROM-AIR EFFECTIVE?



Water-from-Air machines produce water year-round in locations near sea level between the latitudes 30°N and 30°S. Water-from-air production decreases with elevation above sea level. Summertime operation is often possible at higher latitudes.

TWO PROPERTIES OF THE AIR YOU NEED TO KNOW

WATER VAPOR DENSITY

Water vapor density [grams of water vapour per cubic meter of moist air; g/m^3] used to be called *absolute humidity*, an ambiguous term that is now obsolete. Water vapor density quantifies the water-from-air resource. It is a water resource equal in stature to a stream, river, pond, lake, or aquifer. Three items of information are needed to calculate the water vapor density: air temperature, relative humidity or dew-point or wet bulb temperature, and air pressure. Here are tables [one for Inch-Pound (I-P) and the other for Système International (SI) units] showing how water vapor density varies at sea level with various combinations of temperature and relative humidity. Remember, knowing relative humidity alone tells you nothing useful about the water-from-air resource at a location. Beware of equipment suppliers that refer only to relative humidity. Their technical grasp of water-from-air technologies is likely to be weak.

Atmospheric Water Vapour Resource

pressure = 14.7 psia (standard barometric pressure at sea level)

	Relative Humidity									
Temp, °F	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
44	0	1	1	1	2	2	2	3	3	3
46	0	1	1	1	2	2	3	3	3	4
48	0	1	1	2	2	2	3	3	3	4
50	0	1	1	2	2	2	3	3	4	4
52	0	1	1	2	2	3	3	4	4	4
54	0	1	1	2	2	3	3	4	4	5
56	1	1	2	2	3	3	4	4	5	5
58	1	1	2	2	3	3	4	4	5	5
60	1	1	2	2	3	3	4	5	5	6
62	1	1	2	2	3	4	4	5	6	6
64	1	1	2	3	3	4	5	5	6	7
66	1	1	2	3	4	4	5	6	6	7
68	1	2	2	3	4	5	5	6	7	8
70	1	2	2	3	4	5	6	6	7	8
72	1	2	3	3	4	5	6	7	8	9
74	1	2	3	4	5	6	6	7	8	9
76	1	2	3	4	5	6	7	8	9	10
78	1	2	3	4	5	6	7	8	9	10
80	1	2	3	4	6	7	8	9	10	11
82	1	2	4	5	6	7	8	9	11	12
84	1	3	4	5	6	8	9	10	11	13
86	1	3	4	5	7	8	9	11	12	13
88	1	3	4	6	7	8	10	11	13	14
90	2	3	5	6	8	9	11	12	14	15
92	2	3	5	6	8	10	11	13	14	16
94	2	3	5	7	8	10	12	14	15	17
96	2	4	5	7	9	11	13	14	16	18
98	2	4	6	8	9	11	13	15	17	19
100	2	4	6	8	10	12	14	16	18	20
102	2	4	6	8	11	13	15	17	19	21
104	2	4	7	9	11	13	16	18	20	22
106	2	5	7	9	12	14	17	19	21	24
	Resource: Water vapour density, grains/ft^3 [Humidity Ratio/Volume of Moist Air]									

Example: At 85°F and 70% RH the water vapour density is 9 grains of water per cubic foot of moist air.

Atmospheric Water Vapour Resource

pressure = 1.01325 bar (standard barometric pressure at sea level)

Temp, °C	Relative Humidity 10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
7	1	2	2	3	4	5	5	6	7	8
8	1	2	2	3	4	5	6	7	7	8
9	1	2	3	4	4	5	6	7	8	9
10	1	2	3	4	5	6	7	8	8	9
11	1	2	3	4	5	6	7	8	9	10
12	1	2	3	4	5	6	7	9	10	11
13	1	2	3	5	6	7	8	9	10	11
14	1	2	4	5	6	7	8	10	11	12
15	1	3	4	5	6	8	9	10	12	13
16	1	3	4	5	7	8	10	11	12	14
17	1	3	4	6	7	9	10	12	13	15
18	2	3	5	6	8	9	11	12	14	15
19	2	3	5	7	8	10	11	13	15	16
20	2	3	5	7	9	10	12	14	16	17
21	2	4	6	7	9	11	13	15	17	18
22	2	4	6	8	10	12	14	16	18	20
23	2	4	6	8	10	12	14	17	19	21
24	2	4	7	9	11	13	15	17	20	22
25	2	5	7	9	12	14	16	19	21	23
26	2	5	7	10	12	15	17	20	22	24
27	3	5	8	10	13	16	18	21	23	26
28	3	5	8	11	14	16	19	22	25	27
29	3	6	9	12	14	17	20	23	26	29
30	3	6	9	12	15	18	21	24	27	30
31	3	6	10	13	16	19	23	26	29	32
32	3	7	10	14	17	20	24	27	31	34
33	4	7	11	14	18	21	25	29	32	36
34	4	8	11	15	19	23	26	30	34	38
35	4	8	12	16	20	24	28	32	36	40
36	4	8	13	17	21	25	29	34	38	42
37	4	9	13	18	22	26	31	35	40	44
38	5	9	14	19	23	28	32	37	42	46

Resource: Water vapour density, g/m^3 [Humidity Ratio/Volume of Moist Air]

Example: At 29.4°C and 70% RH the water vapor density is approximately 20.5 grams of water per cubic meter of moist air.

DEW-POINT

Almost everyone has experienced dew-point temperature on a hot humid day in summer when their ice-cold drink glass becomes covered with water droplets—on the outside surface of the chilled glass. Here are the I-P and SI tables relating dew-point to specific combinations of air temperature and relative humidity at sea level air pressure.

The mechanical dehumidifiers in water-from-air machines contain a chilled coil (usually copper or aluminum tubing that is the evaporator stage of a refrigeration circuit) whose surface temperature is several degrees below the dew-point of the ambient air. Water vapor from the air will condense as liquid water droplets on the coil surface.

Freezing of the coil can cause damage to the compressor(s) in the machine. Compressors are the most expensive component of a dehumidifier. Therefore, dehumidifiers are designed to shut off automatically when the coil surface temperature dips below about 41°F (5°C).

Dew-point Temperature

pressure = 14.7 psia (sea level)

	Relative Humidity									
Temp, °F	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
44	-5	8	16	22	27	31	35	38	41	44
46	-4	10	18	24	29	33	37	40	43	46
48	-2	11	20	26	30	35	39	42	45	48
50	-1	13	21	27	32	37	41	44	47	50
52	1	14	23	29	34	39	43	46	49	52
54	2	16	24	30	36	40	44	48	51	54
56	4	17	26	32	38	42	46	50	53	56
58	5	19	27	34	39	44	48	52	55	58
60	6	20	29	36	41	46	50	54	57	60
62	8	22	30	37	43	48	52	56	59	62
64	9	23	32	39	45	50	54	58	61	64
66	10	25	34	41	47	52	56	60	63	66
68	12	26	35	43	49	54	58	62	65	68
70	13	28	37	45	51	55	60	64	67	70
72	15	29	39	46	52	57	62	65	69	72
74	16	31	41	48	54	59	64	67	71	74
76	17	32	42	50	56	61	66	69	73	76
78	19	34	44	52	58	63	67	71	75	78
80	20	35	46	54	60	65	69	73	77	80
82	21	37	48	55	62	67	71	75	79	82
84	23	39	49	57	63	69	73	77	81	84
86	24	40	51	59	65	71	75	79	83	86
88	26	42	53	61	67	72	77	81	85	88
90	27	44	54	62	69	74	79	83	87	90
92	28	45	56	64	71	76	81	85	89	92
94	30	47	58	66	73	78	83	87	91	94
96	31	49	60	68	74	80	85	89	93	96
98	32	50	61	70	76	82	87	91	95	98
100	34	52	63	71	78	84	88	93	97	100
102	35	53	65	73	80	85	90	95	98	102
104	37	55	66	75	82	87	92	97	100	104
106	38	57	68	77	83	89	94	99	102	106
	Dew-point, °F									

Example: At 85°F and 70% RH the dew-point is approximately 74°F.

Dew-point Temperature

pressure = 1.01325 bar (standard barometric pressure at sea level)

Temp, °C	Relative Humidity 10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
7	-20	-13	-8	-5	-2	0	2	4	5	7
8	-20	-12	-8	-4	-2	1	3	5	6	8
9	-19	-11	-7	-3	-1	2	4	6	7	9
10	-18	-11	-6	-3	0	3	5	7	8	10
11	-17	-10	-5	-2	1	4	6	8	9	11
12	-17	-9	-4	-1	2	4	7	9	10	12
13	-16	-8	-4	0	3	5	8	10	11	13
14	-15	-8	-3	1	4	6	9	11	12	14
15	-15	-7	-2	2	5	7	10	12	13	15
16	-14	-6	-1	2	6	8	11	13	14	16
17	-13	-5	-1	3	7	9	11	14	15	17
18	-13	-5	0	4	7	10	12	15	16	18
19	-12	-4	1	5	8	11	13	15	17	19
20	-11	-3	2	6	9	12	14	16	18	20
21	-10	-2	3	7	10	13	15	17	19	21
22	-10	-2	4	8	11	14	16	18	20	22
23	-9	-1	5	9	12	15	17	19	21	23
24	-8	0	5	10	13	16	18	20	22	24
25	-8	1	6	10	14	17	19	21	23	25
26	-7	1	7	11	15	18	20	22	24	26
27	-6	2	8	12	16	19	21	23	25	27
28	-6	3	9	13	17	20	22	24	26	28
29	-5	4	10	14	18	20	23	25	27	29
30	-4	5	11	15	18	21	24	26	28	30
31	-4	5	11	16	19	22	25	27	29	31
32	-3	6	12	17	20	23	26	28	30	32
33	-2	7	13	18	21	24	27	29	31	33
34	-2	8	14	19	22	25	28	30	32	34
35	-1	9	15	19	23	26	29	31	33	35
36	0	10	16	20	24	27	30	32	34	36
37	0	10	17	21	25	28	31	33	35	37
38	1	11	17	22	26	29	32	34	36	38
	Dew-point, °C									

Example: At 29.4°C and 70% RH the dew-point is approximately 23.5°C.

WATER-FROM-AIR MACHINE BASICS

Entering air 85°F; 70% RH; Dewpoint = 74° F; Water vapor density = 21 g per cubic meter		Leaving air 58°F; 100% RH; Dewpoint = 58°F; Water vapor density = 12 g per cubic meter
• Fan draws ambient air into machine at rate of 1,800 cubic feet per minute (0.85 cubic meters per second) • Note that the relative humidity alone is not of use when discussing the water-from-air resource; Three variables must be known: air temperature, relative humidity or dew point or wet bulb temperature, and air pressure; Often sea level pressure of 1 atmosphere is assumed unless the site of interest is above about 1500 feet elevation.	• Air passes through a mechanical dehumidifier's evaporator coil chilled to 58°F; Water molecules in the air lose kinetic energy and their average speed is slowed; This allows intermolecular forces to act and promote hydrogen bonding of the water molecules—changing their phase from gas to liquid; Hydrogen bonding prevents internal rotation of the molecules so rotational energy is rejected as heat that can be sensed • Liquid water is collected and treated with ultraviolet light and ozone so the water meets drinking water quality guidelines	• During the passage of one cubic meter of air through the chilled coil 9 g of water vapor changes phase to liquid water • During 24 hours, this process results in over 650 L of water collected from the air. The calculation of the collection rate is: rate = (0.85 m^3/s) x (86,400 s/day) x (9 g/m^3) x (1 L/1000 g) = 661 L/day; Compare the similar result in the 'Calibration' column of the computer simulation on page 12

Re-mineralize condensed water or not? : "No. The human body gains the minerals necessary to good health primarily through eating foods, not through drinking water. The body may absorb or use the minerals in water but, in most cases, the amount would not be significant. In order for a person to obtain sufficient minerals from water, it would be necessary to drink many gallons daily. In general, neither a water with a high mineral content, nor a fully softened water, could be considered a significant source of minerals. In contrast, one glass of milk provides the mineral equivalent of multiple gallons of ordinary well water. (Water Quality Association, International Headquarters and Laboratory, Lisle, Illinois, USA)

ADVANTAGES OF WATER-FROM-AIR SUPPLIES

- Allows a decentralized, modular approach to drinking water supply planning —an attractive alternative to centralized, capital intensive projects
- Easy retrofitting of smaller scale water supplies
  - Ice and water dispensers can be installed anywhere in a building without having to fit waterlines
  - Augment water supplies in neighborhoods lacking waterlines to dwellings

- During emergencies and disasters—set up trusted water supplies post-disaster during relief efforts
- Psychology—people prefer WFA as a 'clean' source—their glass of water did not originate with polluted water containing sewage—perception trumps economics

USES OF WATER-FROM-AIR

Typical uses of water-from-air systems and daily requirements are shown in this table.

Application	Water use (L/head/day)
Individuals	15–25
Schools	15–30 L/pupil/day
Hospitals (with laundry facilities)	220–300 L/bed/day
Clinics	Out-patients 5; In-patients 40–60
Livestock: large (cattle)	20–35
Livestock: small (sheep, pigs)	10-25
Greenhouse: Tomato plant (mature)	1.2–2.5 L/plant/day

COMPUTER SIMULATIONS FOR DECISION-MAKING

Climate, Refrigeration Load, and Water Production Model—WFC-10 Atmospheric Water Generator

Kunming, Yunnan, China

Elevation*…………………………………… 1891 metres above sea level Lat: 25° 01' N

Standard atmosphere……………………… 1.013 bar Long: 102° 41' E

Delta T is adjustable to maximize water production

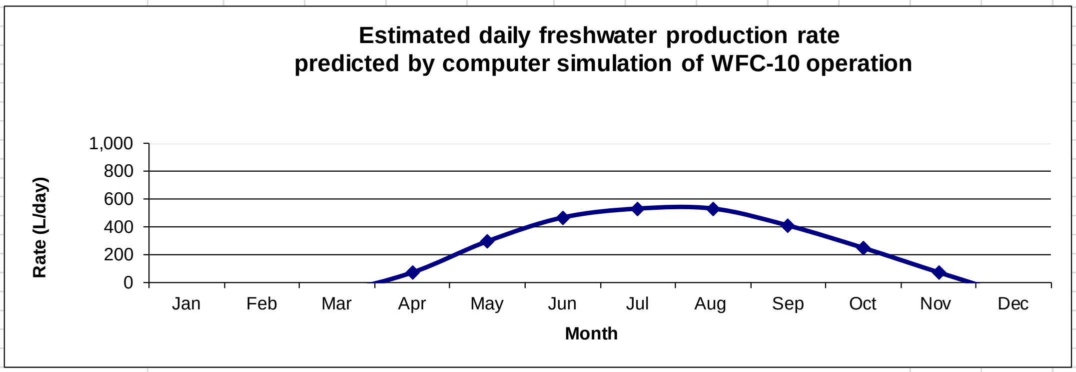
Delta T = air temperature - leaving air temperature

Model Input value

MaximizeWater Production

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Calibration
Airflow, cfm	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800
Airflow, m³/s	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Temperature*, db, °C	8	10	13	16	19	20	20	20	18	16	12	8	29.4
Relative Humidity, %	61%	54%	51%	55%	64%	73%	78%	78%	77%	72%	71%	66%	70%
Wet bulb, wb, °C	4.5	5.4	7.5	10.6	14.4	16.6	17.2	17.2	15.3	12.8	9.1	4.9	25.0
Air pressure, bar	0.806	0.806	0.806	0.806	0.806	0.806	0.806	0.806	0.806	0.806	0.806	0.806	1.013
Delta T (°C) - adjusted for cooling cap. ≤ 10 Tons and leaving air temp ≥ 5°C	3.0	5.0	8.0	11.0	14.0	15.0	15.0	15.0	13.0	11.0	7.0	3.0	15.1
Leaving air temp, db, °C	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	14.3
Leaving RH, % - conservative setting	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Dew-point*, t_4, °C, of entering air	1	1	3	7	12	15	16	16	14	11	7	2	23.4
Total cooling capacity, Tons	-0.3	0.2	1.4	3.2	5.8	7.4	7.9	7.9	6.5	4.7	2.3	-0.1	10.0
water vapor density, g/m³	5.1	5.0	5.8	7.5	10.4	12.7	13.5	13.5	11.9	9.9	7.6	5.5	20.7
Estimated water production, L/day	Water production unreliable			**73**	**298**	**469**	**533**	**533**	**411**	**250**	**74**	unreliable	**687**

* Climate data and altitude input to model (various sources, believed to be accurate)



Disclaimer: Operational factors beyond our control may cause actual water-from-air production to be different from model results.

Notes about water production during January –March and December: Our WFC-10 Atmospheric Water Generator uses the process of mechanical dehumidification to get water from the air. Mechanical dehumidifiers have a refrigerated coil on which water droplets collect. When the dew-point temperature of the air entering the machine is less than about 5°C, much of the coil will have surface temperatures below the freezing point of water. Some of the water collected on the coil freezes. To protect the compressor(s) in the machine, all well-designed mechanical dehumidifiers have built-in safety features to turn the machine off when freezing happens. The chart above shows also how the amount of water available in the air (water vapor density in grams per cubic metre) decreases as the dew-point temperature approaches the freezing point of water.

A site-specific computer model reveals seasonal influences on the water-air-resource and the resulting water production for a specific machine, in this case the WFC-10. This knowledge may influence decisions about deployment of the machines.

At some sites, an hourly model is likely to show episodes of water production are possible during the periods where the coarser monthly model shows little or no production.

GLOSSARY

Psychrometrics is the name of the scientific field which studies properties and processes involving moisture in the air. It has its own special vocabulary. Some essential terms are explained in this glossary. Because technology from the heating, ventilation, and air-conditioning (HVAC) field is often used to process water vapor into drinking water, HVAC terminology is included also. Drinking water technology terminology has its place in the glossary as do some terms from the atmospheric sciences.

Absolute humidity—See Water Vapour Density

Air—the atmosphere; mixture of gases (nitrogen, oxygen, argon, carbon dioxide, water vapor, etc.) surrounding Earth

Alkalinity—the sum of bicarbonate, carbonate, and hydroxide ions in water

Ambient—outdoor (air, temperature, relative humidity, dew-point, pressure, etc.)

British Thermal Unit (Btu)—amount of heat to raise temperature of one pound of water by 1°F. Also a measure of the amount of heat removed in cooling one pound of water by 1°F so it is used as a measure of refrigerating effect

CFM—cubic feet per minute (measurement of airflow)

CFU—colony forming units (of bacteria in drinking water); used to assess drinking water quality

Climate—for a specified region; the statistical collection of weather conditions (temperature, precipitation, humidity, pressure, sunshine, wind velocity) during a specified time period; Compare definition for 'Weather'

Coefficient of performance (COP)—ratio of heating (or cooling) effect produced to the energy supplied (same units must be used in numerator and denominator)

Coil—in mechanical dehumidification; the evaporator coil in a refrigerant circuit; chilled coil in a chiller; any cooling (or heating) element made of pipe or tubing connected in series; the coil is cooled below the dew-point of the ambient air resulting in condensation onto the coil surface of some of the water vapor contained in the air

Coliform—a type of bacteria used to index water quality

Compressor—part of a mechanical refrigerating system that receives the refrigerant vapor at low pressure and compresses it into a smaller volume at higher pressure; The energy used in compressing the vapor enables the refrigeration circuit to remove energy from the air passing through the evaporator coil

Condenser—heat transfer device that rejects energy from a refrigerant into a heat sink such as the atmosphere

Condensate—liquid formed by condensation of a vapor, for example on the cooling coil of a water-from-air system

Condensation—change of phase of vapor into liquid by extracting heat from the vapor

Cooling capacity—total cooling capacity; refrigeration capacity; the designed work per unit time for equipment removing heat from the air passing through it under specified conditions of temperature, water vapour density, and pressure; [Btu per hour, tons or watts]

Dehumidification—removal of water vapor from air

Dehumidifier—an air cooler for lowering the moisture content of the air passing through it; Some dehumidifier designs use liquid or solid desiccants to absorb or adsorb (respectively) moisture from the air

Dew-point temperature—Temperature at which water vapor has reached the saturation point (100% relative humidity); Note that condensation occurs only if the vapor is cooled *below* the dew-point

Dry-bulb temperature—air temperature as measured by an ordinary thermometer

Energy—capacity for doing work; energy = power × time [Btu or kWh]; Compare 'Power'

Evaporator—a refrigeration component into which the refrigerant evaporates while heat is transferred to it

Fan—an air-moving device

Filter—a device to remove solid material from a flowing fluid (air, water) by a straining action

Filtration—process of passing a fluid through a porous material to remove suspended solids from the fluid

Fog—airborne liquid water droplets formed by condensation of water vapor

Hardness—the sum of the calcium and magnesium ions in water

Heterotrophic Plate Count (HPC)—an index for pathogens of concern (based on the number of heterotrophic bacteria in a unit volume) in drinking water; Heterotrophic bacteria cannot fix carbon (by photosynthesis) and need organic carbon for growth

Horsepower—unit of power equal to 746 watts

Ion—an electrically charged atom or group of atoms

Kilowatt—unit of electrical power equal to 1000 watts

Moisture—water vapor; small quantity of water in liquid or vapor form but not bulk water or flowing water

pH—the logarithm of the reciprocal of the hydrogen ion concentration of a solution; pH below 7: acidic; pH above 7: alkaline; Experience has shown water-from-air to be slightly acidic as carbon dioxide is absorbed into the product water; Drinking water pH from 6.5 to 8.5 is considered acceptable by various drinking water guideline publications

Phase—one of the three phases of matter (solid, liquid, gas)

Power—work done per unit time; power = work/time [horsepower, watt]; Compare 'Energy'

Pressure—force per unit area [inches of mercury, inches of water, pascals, atmospheres)

Refrigerant—medium of heat transfer in refrigerating system; Picks up heat by evaporating at a low temperature and pressure; Gives up heat by condensing at a higher temperature and pressure

Relative Humidity—ratio of actual amount of water vapor in the air to the amount present if the air were saturated at the same temperature; Note that this definition yields no information on the mass (ounces, grams) or volume (gallons, liters) of water in the air

Temperature—thermal state of two adjacent substances that determines their ability to exchange heat (where heat is a form of energy)

Ton of Refrigeration—refrigeration equivalent to melting 1 ton of ice per 24 hours (288,000 Btu per day, 12,000 Btu per hour); 12,000 Btu per hour = 3.517 kW

Total Dissolved Solids (TDS)—refers to the inorganic substances dissolved in water

Vapor—substance (for example, water) in its gas phase

Water vapor—water in the vapor or gas phase

Water vapor density—mass of water vapor per unit volume of moist air [grains/cubic foot or grams per cubic meter]; Sometimes called 'absolute humidity' (obsolete term)

Weather—state or condition of the atmosphere (temperature, precipitation, humidity, pressure, sunshine, wind velocity) at a measurement site for a defined unit of time; Compare definition for 'Climate'

Wet-bulb temperature—measured by a thermometer with a water-saturated wick; Airflow over the wick is specified to be 900 feet/minute (4.5 m/s)

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