Implosion Group

Technology Leading Edge:

Vacuum Desalination System

From Bill Donavan- williamdonavan67@gmail.com

& Dan Winter-
danwinter@fractalfield.com

Private Link: www.fractalfield.com/vacuumdesal

Confidential document for consultancy offer- non-disclosure required
– critical process variables not revealed here.

Features: Assembles multiple breakthrough concepts in water purification/desalination combining extreme energy efficiency – including

- **Accurately engineered efficient partial vacuum dramatically reduces energy cost to vaporize**
- **Heat Exchange option between tanks**
- **Option to generate vacuum with super-efficient Tesla Turbine**
- **Option to use differential standing vertical tower to produce most or even all of the vacuum required from simple gravity**
- **Option to use simple black versus reflective white coatings on the tanks outer surface to generate very significant portion of the energy for the temperature differential**
- **Accurately engineered optimized tradeoff between amount of temperature differential versus vacuum pressure to produce extreme energy efficiency**
- **Engineered tank inner coating to reduce sludge build-up**
- **Engineering to make maximum commercial use of sludge by-products depending on local water chemistry**
- **Note option to add ultraviolet light to connect pipe to take bacterial elimination from 99 to 100 percent.**

Overview:

This project for proof of concept uses a vacuum pump, two tanks, a small water pump for the receiving tank, and a heat exchanger. The scope of the experiment for the proof of concept is to bring the static pressure of the system down to approximately 0.5 PSI. This brings the boiling point of water slightly above ambient room temperature. There is a reason for this: in any distillation system, the majority of the energy is in the heat of vaporization. Adjusting the static pressure to match room temperature uses the ambient energy to do the vaporization. There are various ways this can be accomplished. One is by using a natural heat sink that is lower in temperature than the air for the condensation tank. Another is to use a Tesla turbine configured as a vacuum pump, and keep the evaporator side at a lower pressure than the condenser tank. This effectively makes the system into an evaporative type heat pump, and the heat of vaporization is gained from the environment. A detailed description for each system follows.

Version #1: Gravity Assisted Vacuum Desalination

This version consists of two tanks at an equal height with 10 meter standpipes, one painted black (evaporator) and another white (condenser). During the day the sun heats the evaporator tank above the boiling point of 30 degrees C. or 86 degrees F. A partial vacuum is maintained in the tank, and a vacuum pump is used to purge gases that accumulate during the process. It is anticipated that dissolved gases, such as carbon dioxide as well as oxygen will be released in the process. The vapor is carried to the condenser tank, where water condenses and flows down the standpipe to a catch basin or reservoir. A process heater is also used for night time operation. This heater raises the temperature of the water in the spray head above the boiling point in the evaporator tank. Water that does not flash off is returned to the tank for reuse. A current of process water is also flowing down the standpipe to prevent mineral and pollutant accumulation clogging up the pipe. A smaller, minor current of water rises up the pipe to replace what is lost by evaporation, and the process continues.

Advantages:

This system can use the heat of the sun during the day to run the system. Several studies have been done validating the concept. Additional heat or electrical power is only needed during the night. Clean water is accumulated in a surface reservoir, and can be used directly for agricultural applications, such as crops or livestock watering. It can also be pumped up into a conventional water tower for holding. A variation of this concept uses various methodologies to structure the water after distillation.

Disadvantages: This system is large, and not considered to be portable, requiring 10 meter standpipes.

Version #2: Portable Ground-Based System Without Standpipes

This system uses two tanks, mounted either horizontally or vertically. A vacuum pump is used to initially "pump down" the tanks to working pressure, typically 30 millibars or 0.5 PSI. A heater is used to increase the temperature of the spray water above the boiling point in the evaporator tank. Most of this water flashes off, and the vapor runs through a heat exchanger to bring the temperature down below the system boiling point. It then goes into the condenser tank, which is also below atmospheric pressure. A pump then periodically empties the tank when the level rises above a float switch, and the process continues. On the evaporator tank side, a float switch is also used to keep the level optimal. A solenoid valve opens, and water flows into the evaporator tank to replace what is lost. An optical sensor can be used to gage the turbidity of the water. When the turbidity, or dissolved solids rises above a critical level, the purge pump starts up, and removes the turbid water from the evaporator tank. This triggers the float switch, that opens the supply valve to fill the tank again. The system is automated, and can operate without supervision for long periods of time. As a variation, a temperature sensor can monitor the ambient temperature outside the tanks, and adjust the pressure to minimize energy needed to heat the water in the evaporator tank sprayer. In this case, a pressure switch is used to regulate the partial vacuum in the tanks. If the ambient temperature rises unexpectedly, a solenoid valve can open raising the pressure in the tanks to compensate.

Advantages:

Compact, scalable to suit any need from home or motor home use to large process water needs. Pressure can be varied to suit the environment.

Disadvantages:

Uses the Carnot cycle under reduced pressure. Requires energy input, unlike standpipe version.

Version #2.1: Portable Ground-Based System Without Standpipes, Using Pressure Differential

This version varies from 2.0 in that instead of needing a process heater for the spray head, it uses a pressure differential between the tanks. A vacuum pump initially pumps both of the tanks down to the optimum static pressure in the beginning of the cycle and then once this is reached, a “blower” is used between the tanks to create a pressure differential. This pressure differential is used to adjust the boiling point in the evaporator tank below ambient, and therefore it uses the ambient thermal energy to evaporate the water. No process heaters are needed in this version. A differential of less than 20 millibars is all that is needed. This can be accomplished with a Tesla pump configured into a high volume, low pressure blower between the tanks. In this version, the evaporator tank always runs below ambient temp, and can be used as a source of cooling. If placed underground, it will absorb heat from the surrounding earth to process the water, acting as a heat pump. The same arrangement of tank float switches will be used for pumping out the clean water, and inputting water to be processed.

Advantages:

It is a heat pump, and this process may prove to be more efficient than 2.0 using heaters on the spray nozzle.

Disadvantages:

It is more of an active system, requiring a process controller to monitor tank pressures and temperatures.

==

Conclusion:

This system and its variants will prove to be more efficient than room pressure distillation or desalination. Numerous studies have been done, and this concept awaits further development. It is a mature technology requiring no further research.

Appendix note: these systems will naturally eliminate up to 99 percent of unwanted bacteria in the water- our system offers an engineered ULTRAVIOLET light system in the connect pipes- to complete the bacterial elimination.

References:

Waste to water: a low energy water distillation method, January 2007. Brandon A. Moore, Eiki Martinson, Daniel Raviv. Department of Electrical Engineering, Florida Atlantic University, 777 Glades Road, Boca Raton, Florida 33431, US. Tel. +(954) 683-9073.

M. Taub, “The world’s largest SWRO desalination plant”, Proc. Of Innovations and Applications of Sea-Water and Marginal Water Desalination, in: 8th Annual Conf., in: R. Semiat and D. Hasson (Eds.) Israel Desalination Socieity, Haifa, 2006.

A Solar Powered Distillation Plant and Pump Station for Use in Ocean Side Desert Areas. Dr. John A Dearien, Mechanical Engineering, Idaho National Engineering Laboratory, Idaho Falls, Idaho. Dr Stephen J. Priebe, Energy Programs, Idaho National Engineering Laboratory, Idaho Falls, Idaho. DOE Contract number DE-AC07-76ID01570.

“And Now It Is Pond Power”, Time Magazine February 25, 1980, pp 39.

Munson, Richard< “Israel’s Solar Ponds Grow Larger”, Environment, Volume 26, No. 1, January/February 1984, pp 41-42.

Manoj Sharma, Kartik Srivatsa, IIT Madras. Shaastra 2004. Solar Water Purifier.

Reclaiming Potable Quality Water from Impaired Waters by Low Temperature Distillation Method. Veera Gnaneswar Gude and n. Nirmalakhandan. This research was funded by a grant from the New Mexico Water Resources Research Institute. (This system produced 12 L/day of reclaimed water continuously, without any energy input from the grid. This paper has an extensive bibliography.)

Vacuum Boosters for Distillation Processes. Everest Transmission, B-44, Mayapuri Industrial Area, Phase-1, New Delhi-110064, India. Web: www.everestblowers.com.

Vacuum Desalination System Ver. 2.0