VICI Labs WaterSeer™ Collider Competition

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The Challenge

The focus of this initiative is to refine the *WaterSeer*™ potable water condenser. We are confident the Berkeley Collider project will improve the design and performance of this transformational technology.

Similar to natural atmospheric condensation, *WaterSeer*™ collects water from the air even in extremely arid regions of the world. Atmospheric condensate is distilled water and is potable, without impurities, and safe for infants, children, and adults. A proof-of-concept of the *WaterSeer*™ device was tested in 2014 with good results, 2.3 liters of pure water per day in a relatively humid climate.

Your challenge is to design and prototype a device that improves water extraction through condensation by using the temperature gradient between the air temperature and the underground. The current *WaterSeer*™ technology framework for the proof-of-concept device is included in Background Information

Data

Proof-of-concept field tests in India extracted an average of 1.75 liters of water per day using a 9 Sq. Meter surface. A special coating was applied to the condensing surface. ($BaSo_4$) Super-hydrophobic coatings were considered but have not been tested.

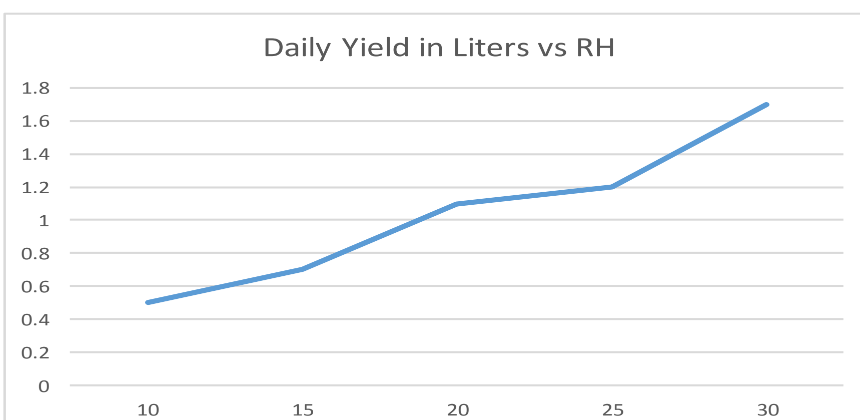

Figure 1: Average Daily Yield Compared to Relative Humidity

Figure 1 depicts the results of a field test conducted in 2014. The figure depicts the daily water extraction in liters compared to air – underground temperature gradient). Average conditions were a wet bulb humidity of 79% and an air temperature of 62F. Best collection was the early morning.

Conditions and Requirements

1. Device must be beautiful and suitable for high end urban, resort and recreational markets (something you would be proud to see on the Berkeley campus). The design must be highly functional, appealing to very high-end clients and simple to implement in developing countries where clean water is scarce.
2. Device must produce 3.7 liters per day from 9 Sq. Meter surface in the San Francisco climate.
3. Design is unconstrained. Keep shipping/packing and assembly in mind. All shapes (spiral, cone, ribbon, corrugation, etc.) will be considered. One current design is an interlocking modular system with each piece no larger than 8” in length and width, so that larger structures can be developed (Lego™ type design).
4. Device must be operational without additional power from any artificial source (batteries or electrical power) – passive solar can be considered.
5. Condensate inducing coating such as newer super-hydrophobic coatings are encouraged to be explored, testing increased yields vs. materials with no coatings.
6. Device must be nearly maintenance free.
7. Materials used must be durable for use in extreme environments for extended periods (over five years).
8. Materials must be usable in all climates when above freezing (arid, semi-arid, temperate, high temperature).
9. Water produced must be cheaper than US consumer pays for tap water by volume.
10. A key driver for success is to secure buy-in from at least one of the following market segments: everyday/urban gardeners, commercial recreational areas, resorts, survivalists, extreme adventurists, municipalities, and public recreational areas in developed countries. The device must be beautiful in form and function and cheaper than tap water. In developing country subsistence communities – the device must be simple, easy to use, and inexpensive. The marketing plan must take this framework into consideration.

    1. A working prototype with design specifications, illustration/graphic, and your field test results for yield and performance.
    2. Marketing plan for your target customer segment.
    3. Technical report from your field test.
    4. Recommendations for further improvements

Scoring

Production Score (75%)

The higher the volume of the water produced daily through condensation, the higher the score. Design specification and details regarding production comparability to current test results will be considered carefully.

Marketing Score (15%)

Innovative marketing approaches are encouraged. Current marketing approach is 'buy one for yourself and we will provide two to an individual in a developing country where pure water is scarce'.

Report Score (10%)

The report is an opportunity for you to show your understanding of the problem and the approach you pursued to solve it. You should consider the report to be a technical summary of your work . There is a five-page limit to the final report. Raw data and results may be in an appendix.

Background Information

We believe pure water can spark innovation and entrepreneurship in developing countries. The business concept surrounding the device is that for every device sold in developed countries two are made available in developing countries, where through micro loans, people will be able to start businesses around pure water.

Our planet is covered in water, but most of that water is either undrinkable or inaccessible. One in three people, more than 2.3 billion, don't have clean, safe drinking water.

- One in five people around the world, more than 1.2 billion, live in areas of water scarcity. 84% of the people who don't have access to improved water, live in rural areas, where they live principally through subsistence agriculture. Clean water is one aspect of improving sustainable food production in order to reduce poverty and hunger.
- Over half of the developing world's primary schools don't have access to water and sanitation facilities. 443M school days are lost each year due to water-related diseases.
- Every day, more than 18,000 people die from a lack of safe drinking water.
- In developing countries, poor women and children walk for 4-6 hours every day to collect the water that they need to live. In fact, almost two-thirds, 64% of households rely on women to get the family's water when there is no water source in the home. Girls under the age of 15 are more likely than boys to be responsible for fetching water.
- The average container for water collection, the jerry can, weighs over 40 lbs. when full. After walking for hours along remote trails, they fill their containers with dirty water, and carry it back to their village, along the same dangerous track, often with young children in tow. Sometimes they make the same trip multiple times a day – just to get enough water for that day for them, and for their family, to drink, cook, bathe, and clean.
- Too often, the water they collect is polluted and disease ridden.

Right now November 2015, in Africa 35 million people are at grave risk from severe climate change, either draught or flooding causing disease and death. The mission of the *WaterSeer*™ device is to transform the quality of life for people living in these extreme environments and provide clean pure water.

What if there was an inexpensive solution that would allow people to collect clean, safe water where they live - directly from the air around them and create entrepreneurial hubs around pure water?

WaterSeer™ implements an innovative approach to accelerate the collection of pure water from condensate. *WaterSeer*™ uses a buried metal ‘comb’ attached to a metal surface, coated to promote rapid condensation and collection. The water production improves as the temperature gradient between the air and condensation surface increases.

The device design ensures the condenser can be installed, maintained, and replicated in a number of configurations to support a number of needs and environments. The devices work similarly to the concept of ‘Lego’ building blocks. The devices can be installed, and configured in unlimited ways and integrated into a system to provide pure water for the village for drinking and agriculture. The individual devices and integrated system be easily maintained by the local population.

Families can expand the number of devices to provide drip irrigation and develop sustained agriculture diversity. The newly available disposable time previously used to transport water opens unlimited possibilities, particularly for poor, rural women and families in developing countries. For young girls this means they can attend school rather than collecting water. Adult women can use the time previously spent to secure access to dirty water for other beneficial activities and entrepreneurial activities.

WaterSeer™ has the capacity to empower people in arid regions to transition to entrepreneurial hub centers around pure water. With *WaterSeer*™ pure water is at the core of self-reliance and innovation in developing countries.

Literature Sources

WaterSeer™ extends the lessons learned from the experiments listed below accelerating the condensate process through an innovative structure that maximizes the temperature difference between atmospheric temperature and the surface of the condenser.

In 2011 Girja Sharan, under funding from Gujarat Energy development Agency, Baroda and World Bank conducted atmospheric humidity yield from passive condensers in a coastal arid Area (Kutch, India). He derived the following conclusions based on three month observations:

- Passive condensers extracted significant amounts of water from the air at night in arid regions.
- Passive condensers made of polyethylene mixed with titanium oxide and barium sulfate (PETB) gives much higher yield - nearly 2.5 times- than the galvanized iron and aluminum surfaces under similar ambient conditions.
- PETB condenser can extract moisture from air with lower humidity than the metal condensers alone.
- High humidity, calm winds, clear sky and relatively warm ambient appear to result in higher condensation yields.

Beysens D; Milimouk I; Nikolayev V; Muselli M; Marcillat J. 2003. Using radiative cooling to condense atmospheric vapor: a study to improve water yield, Journal of Hydrology, 276, I - II.

Beysens D; Milimouk I; Nikolayev V; Muselli M; Marcillat J. 2003. Using radiative cooling to condense atmospheric vapor: a study to improve water yield, Journal of Hydrology, 276, I - II.

Sharan G; Hari Prakash 2003. Dew condensation on greenhouse roof at Kothara (Kutch), Research Note, Journal of Agricultural Engineering, Vol. 40(4), October - December, 75-76.

Nikolayev V S; Beysens D; Gioda A; Milimouk I; Katiouchine E; Morel J P 1996. Water recovery from dew. Journal of Hydrology, 182, 19-35.

Nilsson T M J; Vargas W E; Niklasson G A; Granqvist C G. 1994. Condensation of water by radiative cooling, Renewable Energy, Vol 5 (f), 310-317.

Berkowicz S M; Beysens D; Milimouk I; Hensinkveld B G; Muselli M; Wakshal E; Jacods A F G. Urban dew collection under semi-arid conditions: Jerusalem.

Nilsson T. 1996. Initial experiments on dew collection in Sweden and Tanzania, Sol. Energy Mat. Sol. Cells, Vol. 40, 23-32.

Zangvil A 1996. Six Years of Dew Observations in the Negev Desert, Israel. Journal of Arid Environment, 32, 361-371.

Additional information on collectors is available from the Wikipedia site:

https://en.wikipedia.org/wiki/Air_well_(condenser)