The WAVE – Water Vapor Condenser

Shawna Brierly(Civil), Bianca Castagna(Environmental), Ryan Kimmel(ECE), Dan Miller (RBE)

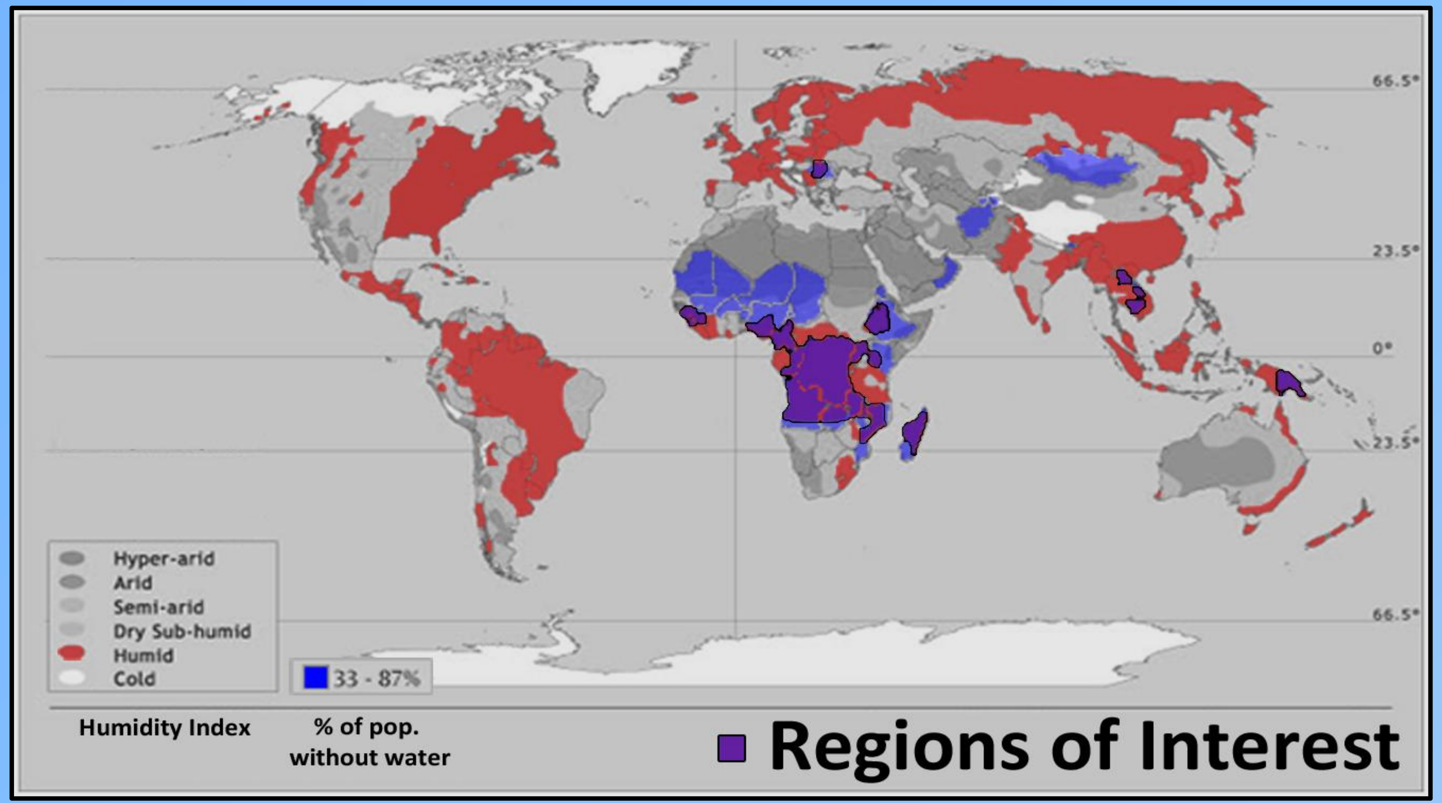
Advisor: Professor Richard Sisson (Mechanical Engineering)

Continuum Technologies

Abstract

The Earth is almost completely covered in water, but only 0.007% is accessible drinking water. Sadly, in many of the world's developing countries, there is a serious scarcity of clean drinking water. Many of their possible sources have become contaminated due to poor sanitation throughout the developing world and is one of the main causes of this scarcity.

In order to address these water shortages, our group has designed two water vapor condenser models, the "Refrigerator Style Model" (Model A) and the "Metal Nalgene Bottle Model" (Model B), with Model B being the most feasible. Both of our designs condense water vapor from the air and produce clean potable water. However, each design has its own characteristics, and in order to compare them, we used a decision matrix. These designs are still in the developing stages, and require extensive prototyping and analysis in order to optimize water production. Our target areas are where there is both a high demand for water, and the air is humid for most of the year



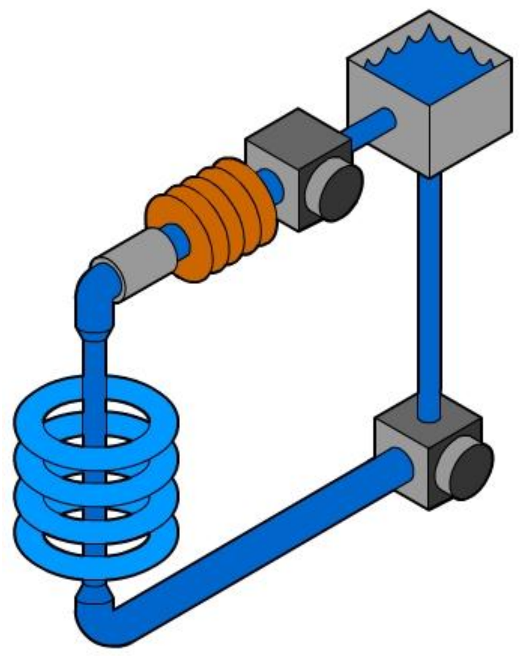
Background

- 1 in 6 people do not have access to clean water
- Only .007% of the Earth's supply of water is available for consumption
- Humans cannot survive for more than one week without water
- Why is there a lack of potable water in the developing world?
  - Overcrowding
  - Improper disposal of waste
  - Lack of funds to invest in water distribution (i.e. pumps, filters, pipes etc.)
  - Contaminated sources from animals
- Effects of thirst:
  - Disease (i.e. Malnutrition, Cholera, Typhoid, Hepatitis A)
  - Inhibits education, success in business, formation of relationships.
  - Neck and back problems due to transportation of large amounts of water.
  - Death

Methods/Process- Model A

The Refrigerator Style Model

This design works just like the refrigerator in your average kitchen. It begins by pressurizing a refrigerant to the point where it becomes a liquid, cooling it with the copper cooling fins, then allowing it to expand into a gas, cooling it even further. The coolant then passes it through a series of glass tubes cooling the surface of the tubes, where water then condenses.



The water then drips off of the tubes and through a charcoal filter, where it is then stored for later consumption.

Although we estimated that this model would produce more water than Model B, it would be much bulkier, harder to repair require significantly more electricity, and much more costly.

Project Objectives

- Goal: To provide potable water in an effective, inexpensive, maintainable way
- Where: Villages which do not have safe water readily available but are humid for most of the year(See map left)
- How: Design a machine that will condense, filter and store water extracted from the air (See Methods/Process panels)
- Power Source: Solar panels as our primary energy source because they are easily scalable and low maintenance

Decision Matrix

Our team implemented a decision matrix in order to compare the two models. A decision matrix is a chart that rates a certain devices or processes in a number of categories in order to compare qualitative data in a quantitative manner.

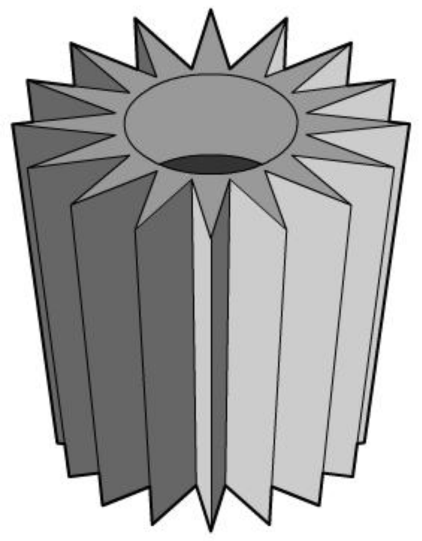
For our matrix, we chose water production, complexity, power consumption and cost as our categories. We found that they best summarized our models, and easily expressed their strengths and weaknesses. You can see an example chart below.

Global Ratings

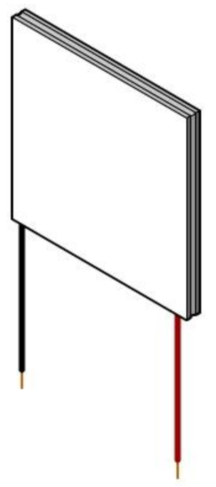
Model	Water Production	Complexity	Power Consumption	Cost	Average
	10= Lots of Water	10= Very Simple	10= Little Power Required	10= Inexpensive	10= Perfect
Model A	7.75	4.00	4.50	4.25	5.13
Model B	5.50	7.75	7.50	7.75	7.13
	0= No Water	0= Overwhelmingly Complex	0= Power Hog	0= Very Costly	0= Bad

Methods/Process- Model B

The Metal Nalgene Bottle Model



Unlike the first design, a Peltier cooler would be attached directly to the inside of a large piece of metal with maximized surface area (left). The cold metal would condense water out of the air which would then drip down, pass through a charcoal filter and be collected into a large storage container.



The Peltier cooler (Right) operates on a standard 12 volts, but can work at almost any voltage. When powered, the Peltier cooler transfers all of the heat from one side of the plate to the other, leaving one side hot and the other cold. We plan to cool the heated side with a large copper heatsink, which will cool the cold side even further.

Conclusions/Recommendations

- Final Design - Model B
- Further analysis needed- Prototypes and water production measurement
- Speculative Numbering to be done once prototypes are made
- Solar efficiency analysis

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