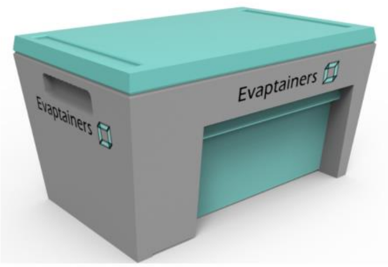


Evaptainers

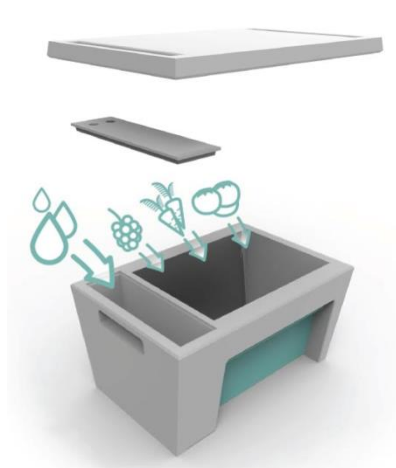
http://www.digitaltrends.com/home/evaptainer-is-an-electricity-free-refrigerator/#ixzz3Wvns4RCA

What do you get when a student from a top-ranking university decides he wants to do something cool? MIT student Quang Truong created the Evaptainer, a mobile, cooler-style device that operates on sunshine and water. An extensive globetrotter, Truong has seen the consequences of food spoilage in developing nations firsthand. Due to the high costs and unpredictability of electric refrigeration, small farms reportedly lose out on profits each year, because they can't keep their goods cool. In parts of Africa, 40 percent of produce spoils before it reaches the consumer, according to the Food and Agriculture Organization.

The Evaptainer can help to combat this problem, because it operates using an evaporative cooling process, hence its name. Traditional devices, called zeer pots, are made of terra cotta; a layer of wet sand keeps the internal pot cool as the water evaporates and draws heat away from it. Lighter and less breakable, the Evaptainer also extracts heat out of the unit's interior but instead uses highly conducive aluminum plates and special fabric.

Ideal for off-grid, rural areas, the alternative refrigeration system requires six liters of water to work and keeps food cold and fresh for 12 hours. It's reportedly able to hold 60 liters of produce, which amounts to a lot of tomatoes — about 150 of them. Adding to its accessibility, Truong designed the device to work without fans, pumps, or anything breakable.

Together with his business partner, Quang has invested $20,000 in to the Evaptainer's commercial development, which is currently underway. The devices should cost $10 to $20. A pilot program is taking place in Morocco with two units.



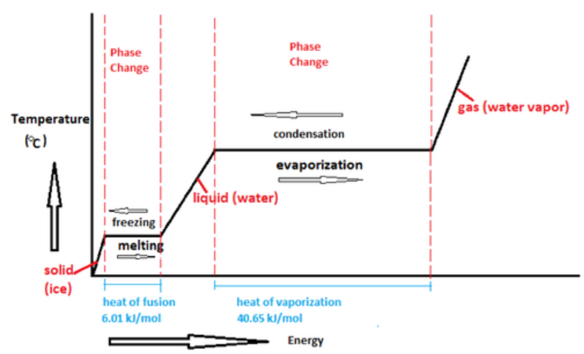
"Previous studies on evaporative cooling technologies and zeer pots show an average income increase of 25 percent. We estimate a payback period of two months per unit, based on increased income from reduced spoilage," Truong told CNN.

Evaptainers combine time tested evaporative cooling techniques with modern design and production to create a lightweight, efficient cooling system that can be used in a wide variety of applications.

The diagram to the right shows the Evaptainer's basic construction.
We are currently in the final development phase of our first commercially available unit. We are excited to bring this product to market and see the impact that it will have on global food systems. For updates on our progress please check our blog.

The Science of Evaporative Cooling

http://www.evaptainers.com/updates/



Evaporative cooling is something that we have all experienced. Wearing a damp tee shirt on a warm but windy day gives us a chill. The phenomenon that causes this is the latent heat of vaporization.

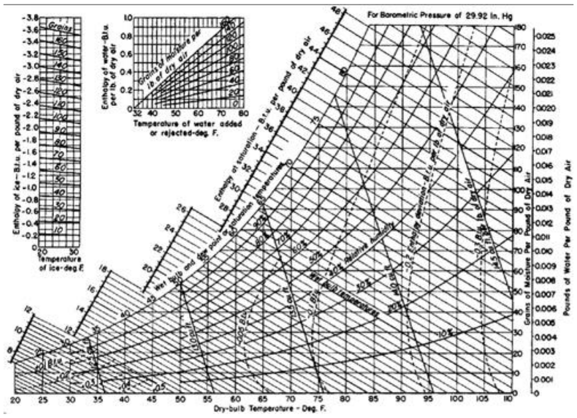
What does this mean?

At critical temperature points in the diagram (0 degrees Celsius and 100 degrees Celsius) water needs to draw in heat energy from the environment to change phase. In order to melt or evaporate the water requires energy from the environment: this is the latent heat of vaporization.

Current research (Jozsef Garai, 2009) suggests that the energy required to free an atom from the liquid is equivalent to the energy needed to overcome the surface resistance of the liquid. You may remember from school that water has relatively high surface tension from its hydrogen bonds, thus water needs to absorb a large amount of energy to go through a phase change.

The reason we care about this in terms of evaporative cooling is that the more energy that water draws the more we can cool the contents of our Evaptainer. By the numbers this shakes out to 1g of evaporated water reducing the temperature of 1kg of water by half a degree Celsius. However, this assumes 100% efficiency. Evaporative coolers are typically slightly less efficient than this (60-80% efficiency).
What impacts this rate of efficiency is ambient conditions or "Wet Bulb to Dry Bulb."

What does that mean?



Psychometric chart - Don't worry if it looks confusing, it is.

The potential for evaporative cooling depends on the difference in wet bulb and dry bulb temperatures of the air. Humid air has a high relative humidity, and not as much capability to evaporate moisture. As the relative humidity of the air increases, the performance of the system will decrease, limiting its application in moist climates. Evaporative cooling is most effective in climates where average relative humidity is less than 30%. As humidity increases, and the cooling capability declines, the temperature difference between the outside and inside of the chamber decreases. To test if evaporative cooling will be effective, the wet bulb temperature can be measured by placing a moist cloth on the end of a thermometer and waving it through the air. The temperature read by the thermometer is the theoretical minimum temperature that can be achieved through evaporative cooling. For a visual representation of this phenomenon we can use psychometric charts. psychometric charts are a useful tool for predicting a particular wet-bulb temperature given the outside ambient conditions: pressure, temperature, and humidity.
Above and beyond pyschometric charts (which only have 3 variables), anything that increases the rate of evaporation of a system will make evaporative cooling more effective.

This includes:

- Lowering ambient humidity
- Decreasing atmospheric pressure
- Increasing ambient temperature (though this one is obviously counterproductive)
- Increasing surface area of evaporation
- Choosing different evaporative media
- Adding air movement/wind

Using all of these variables we are able to optimize the cooling effect of our system across the widest range of applications.