COOLING JUG

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ABSTRACT

In the old days, a clay pot cooler (also called a zeer or pot-in-pot cooler) was often used for keeping foodstuffs fresh in very hot and dry areas. Water was used to cool the inner pot as it flowed through a porous surface (such as sand) and subsequently evaporated. What is the minimum temperature that can be achieved using such a device and what does this minimum temperature depend upon? Explain what determines the rate of cooling?

Keywords : *Zeer Pot, Refrigerator, Moisture, Thermal mass*

1. Introduction

In zeer pot, water evaporates through sand which has filled the gap between the inner pot and the outer pot, out of the outer pot. The water serves as refrigerant .The sand is considered as a thermal mass and helps moisture up the wall of outer pot's surface.

The zee rot will work better under direct sunlight because it will transfer a significant amount of energy to the system.

2. Theory

2.1 Relative Humidity

The water that is moving among sands, will evaporate much better in environment with low humidity in comparison to the high one. Because relative humidity is a measure that shows how much water can be held in the air. So if we put cooling jug in a low humidity place, the water will evaporate faster so the jug will be cooler faster and the temperature reduce more than when we put it in a high one (Fig. 1).

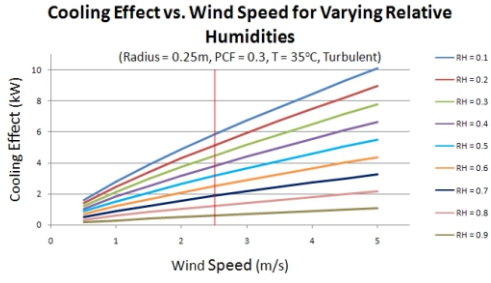

Fig. 1:(Cooling Effect vs. Wind Speed for varying Relative Humidity Levels (Device Radius = 0.25m, Permeability Correction Factor = 0.3, Ambient Temperature = 35 degrees Celsius, Turbulent Flow)

2.2. Permeability

Evaporate occurs through the outer pot, so the type of clay that pot has made out of is very important because of the "permeability". It is better that clay be permeable and porous so water can evaporate through it more easily, because water must keep going through the sand to replace the moisture that has evaporated and passed out through the outer clay. So the important measures here are diffusion rate and the permeability of the clay. The best type of clay that we can use is Earthenware (Fig. 2) .

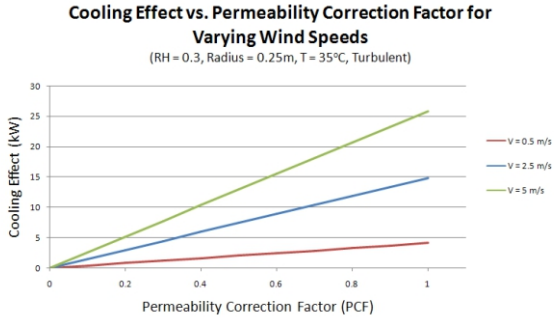

Fig. 2: (Cooling Effect vs. Permeability Correction Factor for varying Wind Speeds (Device Radius = 0.25m, Ambient Temperature = 35 degrees Celsius, Relative Humidity = 0.3

2.3. Area available for Evaporation

The pot surface area that evaporation occurs through it approximately calculated as:

Total Area = Surface Area of Spherical Portion of Outer Pot

+ Surface Area of Cylindrical Portion of Outer Pot

+ Surface Area of Exposed Sand in between Pots

The radius of the outer pot has been selected to vary the area available for evaporation (Fig. 3).

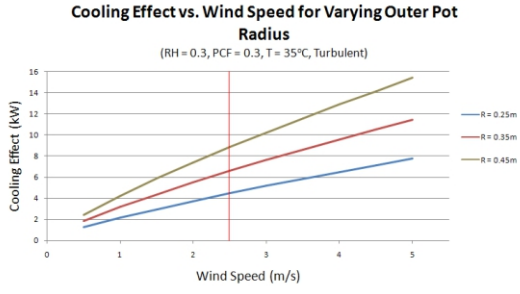

Fig. 3: (Cooling Effect vs. Wind Speed for varying Device Radii (Permeability Correction Factor = 0.3, Relative Humidity = 0.3, Ambient Temperature = 35 degrees Celsius, Turbulent Flow)).

So by increasing the area surface, the evaporation increases and according to that, the cooling effect increases too.

3. Conclusion

So if we put the pot-in-pot that is made out of earthenware with a good permeability in an area with low relative humidity and high velocity of wind and put it the way that the area available for evaporation exposes as much as possible, the device will work ideal. And the minimum temperature will reach by using these conditions and by using the temperature reader, we can determine the temperature and the minimum temperature that is reached is 4F.