

A comparison of the heat capacity of Aluminum and Water

Lab 06

Our experiment today is a very simple exploration of the comparison of heat capacity of water as compared to aluminum. The purpose is to understand one of the remarkable properties of water which is that it takes a lot of energy to heat water up by 1 °C. A key issue here is does hot metal contain more energy than hot water? In fact this number has been classically measured and it has the value of about 4200 J/kg °C . This is called the “specific heat” of water although a similar concept is that of heat capacity. Specific heat also goes by the name mechanical equivalent of heat due to work by James Joule.

If we consider 1 kg of water, then it will take 4200 J to heat the water by 1 degree C. Remembering the work from last week, we can make a quick comparison for energy requirements with the following question: How far would a 1 kg mass need to be raised to give this amount of energy?

$$\text{Solution: } E=4200\text{ J}=1\text{ kg}\times g\times h\Rightarrow h=420\text{ m} .$$

We could also ask the same for a 70 kg (154 lb) person. The answer here is

$$h=\frac{4200}{70\times 10}=6\text{ m} .$$

Now we have a basis for understanding what exactly water in a thermal solar panel will do for us quite aside from heating up. In fact, since it requires so much energy to heat water, this provides a most excellent storage mechanism for our energy. Later in this course, we will see how to transport this energy for free but for right now we want to make a comparison to show this.

Procedure: We will heat an aluminum cylinder and an amount of water with the same mass as the aluminum up to boiling (100 C). We will have two cups of water with identical masses at room temperature. Into one cup, we will pour the heated water. Into the other cup, we will place the heated aluminum. We will stir both cups and look for the highest temperature obtained in each. We will record this and determine the %difference in temperatures reached. A comparison of this with an expected value will provide insight into the significant difference of the heat capacity of water vs aluminum. We will assume that both cups of water are otherwise the same.

Your paragraph today will consist of the title with your name.

Each person today will write your own paragraph.

Then, with single sentences combined into a paragraph provide the following (in order):

- (a) A description of the purpose of this investigation
- (b) A description of the key issue.
- (c) A description of the different viewpoints of specific heat and heat capacity.
- (d) A sentence regarding the results of our experiment. Include below a screen capture of the spreadsheet below your paragraph.
- (d) Explanation of the key concept.
- (e) An statement of the key assumption.
- (f) A statement (based upon your data) that will lead you to choose between water and other materials.
- (g) A description of what the outcome means for using water in solar panels.
- (h) A link to the instructions for this lab which will be the reference for today.