Thermoelectric PRE Questionnaire

Oxana Pantchenko and Prof. Ali Shakouri

Student's name_____ Student ID_____

1. What is the name of the device that converts electrical energy to heat?
    a. Hydtoelectric converter
    b. Thermoelectric converter
    c. Photoelectric converter
    d. Chemoelectric converter
2. At what temperature Celsius does water freeze?
    a. -273C
    b. -50C
    c. 0C
    d. 50C
    e. 100C
3. At what temperature Celsius does water boil?
    a. -50C
    b. 0C
    c. 50C
    d. 100C
    e. 212C
4. If you were to calculated heat energy? What units would you use for temperature value?
    a. Kelvin
    b. Celsius
    c. Fahrenheit
    d. Ranhine
    e. Delisle
5. How much energy is needed when heating up 1 liter of water from 5C to 15C? Consider c= $4\frac{J}{g \times C}$
    a. 1/4KJ
    b. 10KJ
    c. 40KJ
    d. 1000KJ
    e. 40,000KJ

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EE-80J: Renewable Energy Sources

Thermoelectric Laboratory Experiment

Oxana Pantchenko and Prof. Ali Shakouri

Student's name_____ Student ID_____ Grade _____ / _____

ABSTRACT

In this laboratory experiment, students will become familiar with the Seebeck effect, the Peltier effect, and thermal capacitors. They will also calculate heat energy of thermoelectric system. Students will learn how thermoelectric convertors operate and will convert heat energy into electrical energy.

INTRODUCTION

"*A transformation whose only final result is to transform into work heat extracted from a source which is at the same temperature throughout is impossible.*"

-Lord Kelvin

This was Kelvin's statement of the Second Law of Thermodynamics. The second law has been stated in many, seemingly unrelated ways; but in the end, all have been shown to be different ways of expressing the same principle. In its most general form, the Second Law tells us that no physical process will occur if it decreases the disorder –or *entropy* – of the universe. Conservation of energy, as expressed in the First Law of Thermodynamics, holds for every physical process. But many processes which would conserve energy do not occur. The Second Law describes this phenomenon. [1]

LIST OF MATERIALS

1. Cups (2)
2. Thermoelectric Converter (1)
3. DC Power Supply (1)
4. Thermometer (1)
5. Ice

Figure 1 These are the supplies needed for the lab. Make sure your box has all the listed components. If something is missing inform your TA.

PROCEDURE

1. Add supplied hot water to a cup
2. Measure its temperature _____°C
3. Measure the mass of the hot water

   $mass_{cup+water}$-$mass_{cup}$=$mass_{water}$

   $Mass_{cup}$=_____kg

   $Mass_{cup+water}$ =_____kg

   $Mass_{water}$= _____kg

4. In the other cup place ice and water.
5. Measure its temperature _____°C
6. Measure the mass of the cold water

   $Mass_{cup+water}$-$mass_{cup}$=$mass_{water}$

   $Mass_{cup}$=_____kg

   $Mass_{cup+water}$ =_____kg

   $Mass_{water}$= _____kg

7. Place the two cups next to each other.
8. Insert the thermoelectric converter so that each leg is in a different temperature cup. Note: If the fan is facing you, the right-side leg should be in hot water and the left leg should be in cold water.
9. Flip the switch on the thermoelectric converter to position "A" ($\Delta T \rightarrow E$)
10. After flipping the switch, did your fan move? _____
11. If the fan did not move, give the fan a push in the clockwise direction.
12. Why does the fan require a "jump start" in order to spin?

    _____
    _____
    _____

13. Take the thermoelectric converter out of the two cups.
14. Measure the temperatures of the hot water cup _____°C
15. Measure the temperature of the cold water cup _____°C
16. Calculate the heat energy of each cup:

    a. Calculate the ΔT between the hot cups _____ °C

    b. Calculate the ΔT between the cold cups _____ °C

c. Given the "c" is a constant and is 4.185 $\frac{J}{g \times C}$, calculate the heat energy of the

BE SURE TO CONVERT KG TO GRAMS!!!

d. hot cup _____J

and cold cup _____J

Figure 2 Layout diagram

17. Mix both cups of water together and place the thermoelectric converter into the mixed water cups.
18. Does the fan spin? _____
19. Describe what is happening now to when you had two cups of different temperatures.
20. Remove the thermoelectric converter from the water and let it cool to room temperature.
21. Once the legs of the thermoelectric converter have reached similar temperatures, connect the DC supply to the red and black terminals on the thermoelectric converter to demonstrate the Peltier effect. During the Peltier effect, a current through the thermoelectric heat pump of the Converter causes a temperature different.
22. Flip the switch to position "B" (E→ΔT)
23. Let it sit for a two minutes.

    (Do not leave the power supply on for more than two minutes. Do not exceed 8 volts.)
24. After two minutes, remove the DC power supply and flip the switch to position "A" (ΔT → E).
25. Record/explain how this thermal capacitor worked.

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