THERMAL LABS

BOMB CALORIMETER

Location: Basement of Richards building.

Objective: To measure the enthalpy of combustion of methanol. To compare these results to those developed theoretically.

Method: The enthalpy of combustion of a fuel is measured by burning a known amount of fuel under controlled conditions in a container which is immersed in a known mass of water. Using an energy balance on the closed system of the container, mass of water and by measuring the temperature rise of the water, one can determine the enthalpy of combustion of the fuel. In order to perform this experiment the heat loss from the closed system is controlled to be zero.

The device used to perform this type of experiment is known as a bomb calorimeter (Figure 1). To insure that the bomb and water mass form an adiabatic system a logic unit senses the temperature difference between the mass of water and the water in the surrounding jacket. It controls the flow of hot and cold water to the jacket so that the temperature in the jacket follows that of the bucket. The impeller in the bucket minimizes thermal gradients. The starting temperature should be close to room temperature. The contribution of the gelatin capsule containing the fuel and the fuse wire used to ignite the fuel must be taken into account in this energy balance.

Operating Procedure:

1. Prepare sample
   a. Weigh empty gelatin capsule and record weight.
   b. Pour approximately 1 gm. of Methanol into capsule.
   c. Cut 11 -15 cm of fuse wire and wire bomb as shown in Figure 2.

2. Charge system
   a. Add 1 ml. of distilled water to the bottom of the bomb as a sequestering agent.
   b. Make sure sealing O-ring is clean and in place.
   c. Press fitting of O_2 line to bomb and charge bomb to 450 Psi.

3. Preparing the calorimeter
   a. Fill the bucket with 2000 gm. of room temperature water.
   b. Place the bomb carefully into the bucket and connect the fuse wires.
   c. Close lid and start the calorimeter as instructed.

Results:

1. Briefly explain why the heat transfer between the bomb / water system and its surroundings can be neglected.

2. Using an energy balance on the combined bomb / water system calculate the enthalpy of combustion of methanol. Correct this value to include the heat released by the gelatin capsule and fuse wire. State all assumptions made.

3. Use your thermodynamics text and look up the enthalpy of combustion. Discuss any discrepancies between this value and that obtained in question 2.

4. Are the corrections for the heat released by the gelatin capsule and fuse wire significant?

Data:
Mass of Bomb = 3002.2g
Mass of Bucket = 831.1 g
Specific heat of steel = .39 KJ/Kg K
Volume of Bomb = 340 ml
Heat contribution of gelatin capsule = 4600 cal /g
Heat contribution of fuse wire = 2.3 cal /cm