Quentin OLIER Group A

PW Calorimetry

Introduction:

This practical works deals with calorimetry. It is important to precise during all this PW we are using an adiabatic calorimeter. The objectives of this PW is to determine the calorific capacity of two metals (Zinc and aluminium). When manipulating hot stuffs, we always use gloves lab coats etc.

Preparatory question:

What's the calorific capacity of a metal?

-It's the amout of energie in the form of heat which are necessary to increase the temperature of 1 mole or 1 kg (C molar ou thermal capacity)

How do we express U and H ?

-$dU=Cv.dT$ and $dH= Cp.dT$

Experiment 1:

First we need to determine µ (equivalent mass) of the calorimeter before look for the value of the calorific capacity of metals. In order to do that we will mix two source of water, one hot and one cold measure the temperature and the weigh of the hot, cold ones. Then the mix the two and calculate µ

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Protocol:

We use for our experiment:

calorimeter, thermometer, a clamp, a balance, a graduated flask.

-First we withdrawn 200mL or 6,7628oz with the graduated flask and we weigh the flask (m1)

-Then we put it in the calorimeter and we are waiting for the temperature equilibrium.

-With the thermometer we measure the temperature of the cold source (T1)

-Then we do the same with the hot source (measure m2 and T2)

-Finally we wait for the temperature equilibrium of the calorimeter and take the finale temperature (T3)

We will do this experiment 3 times in order to average the value.

To calculate μ:

with the definition of a calorimeter

ΔQtot=ΔQcalo+ΔQ1+ΔQ2=0

we use the first law of Joule: ΔH=Qtot

ΔHtot=ΔHcalo+ΔH1+ΔH2=0

and finally

$$\mu = \frac{-m1(T3-T1)+m2(T3-T2)}{T3-T1}$$

Try number	T1 °C	T2 °C	T3 °C	m1 g	m2 g	μ g
1	20,8	38,9	28,6	199,32	197,2	52,5
2	19,2	38,0	28,7	201,3	198,3	111,3
3	18,5	38,0	28,9	199,5	196,2	87,1

We have done 3 more experiment and we found μmoy=58,96g

The value of μ is consistent with the mass of water. We will now consider μ=58,69g for the rest of the experiment but we are keeping in mind this can be a major source of uncertainty for the next part.

Experiment 2

Now we have μ, we can determine the capacity of metals. We are doing the same experiment but instead of hot water for the hot source we are taking hot metals which are in an oven

Protocol:

We use for our experiment:
calorimeter, thermometer, a clamp, a balance, an oven, a graduated flask.

-First we withdrawn 200mL or 6,7628oz with the graduated flask and we weigh the flask (m1)
-Then we put it in the calorimeter and we are waiting for the temperature equilibrium.
-With the thermometer we measure the temperature of the cold source (T1)
-Then we take in the oven some piece of hot metals (measure mA or mZ, T2=100°C temperature of the oven)
-Finally we wait for the temperature equilibrium of the calorimeter and take the finale temperature (T3)

Calculate Cp' of metals:

with the same method:
ΔQtot=ΔQcalo+ΔQ1+ΔQ2=0 *
So

Cp'= $\frac{(-\mu+m1)*Ceau*(T3-T1)}{m2(T3-T2)}$

We only have done 1 try because it take too much time to increase the temperature of the metals to 100°C.

metals	T1 °C	T2 °C	T3°C	m1 g	m metal g	Cp' J K^{-1} Kg^{-1}
aluminium	20,1	100	30,2	199,7	217,69	715,2
Zinc	20,8	100	28,4	198,26	346,26	434,5

Those numbers are not familiar to me so in order to get an idea of if we are close to the real value we compare with some found on internet. Reference value for the Zinc is Cp'Z=380 J K^{-1} Kg^{-1} and for the aluminum Cp'A=897J K^{-1} Kg^{-1} and we are really close to this. Furthermore we can see that Cp'A> Cp'Z on internet and in our studies so the numbers are consistent with each other.

Conclusion:

The values for Cp'Z and Cp'A we found are really close to the real ones. If we wanted to be more precise we could have precise the value of µ because using an experiment value in an other experiment increases imprecision. We could also redo the second experiment and average the value to precise Cp' of metals.