SPECIFIC HEAT CAPACITY OF METALS BLOCK

AIM: To determine specific heat capacity of metal blocks

APPARATUS: Metal block D, thermometer, lagging C, Calorimeter cup and stop watch

THEORY:

PROCEDURES:

1) M_{Cal} was measured and recorded, the mass of a day and empty calorimeter

2) The mass of the aluminium, copper and lead samples were measured

3) A thread was attached to each of the metal samples and of the samples was suspended into boiling water. The samples were allowed a few minutes in boiling water to heat thoroughly.

4) The calorimeter was approximately filled with full or half of cool water and the water was used to cover fully the metal sample.

5) Temperature of cool water (T_{cool}) was measured and was recorded

6) Immediately after temperature measurement, one metal sample was removed from the boiling water. It was quickly wiped dry and suspended into cool water in the calorimeter. The sample was completely submerged into water but it did not touch the bottom of the calorimeter.

7) The water was stirred with a calorimeter and the final temperature (T_{final}) was recorded.

8) Immediately after taking the temperature, the total mass of the calorimeter, water and mental sample was measured and recorded.

DATA ANALYSIS

	Copper	Lead	Aluminium
M_{cal}	14.3g	14.3g	14.3g
M_{sample}	191.5g	228.5g	198.1g
T_{cool}	23°c	23°c	23°c
T_{final}	27.5°c	25.0°c	33.5°c
M_{total}	460.2g	489.6g	466.0g
M_{water}	254.4g	246.8g	253.6g
ΔT_{water}	4.5°c	2 °c	10.5°c
ΔT_{sampl}	69.5°c	72°c	63.5°c
C	0.086cal/g.k	0.03cal/g.k	0.212cal/g.k

Temperature of water: 97°c

Calculations

For Copper

a) $M_{water} = M_{total} - (Mcal+M_{sample})$

$=460.2g-(14.3g+191.5g)$

$=$ **<u>254.4g</u>**

b) $T_{water}=T_{final}-T_{cool}$

$=27.5-23$

<u>= 4.5°c</u>

c) $T_{sample}=97°c- T_{final}$

$=97°c-27.5°c$

$=$**<u>69.5°c</u>**

Lead

a) $M_{water}=M_{total} - (Mcal+M_{sample})$

$=489-(14.3+228.5)$

$=$**<u>246.8g</u>**

b) $T_{water}=T_{final}-T_{cool}$

$=25-23$

$\mathbf{=2^{\circ}c}$

c) $T_{sample}=97^{\circ}c-T_{final}$

$=97^{\circ}c-25$

$=\mathbf{72^{\circ}c}$

Aluminium

a) $M_{water}=M_{total}-(Mcal+M_{sample})$

$=466-(14.3+198.1)$

$\mathbf{=253.6g}$

b) $T_{water}=T_{final}-T_{cool}$

$=33.5-23$

$\mathbf{=10.5^{\circ}c}$

c) $T_{sample}=97^{\circ}c-T_{final}$

$=97^{\circ}c-33.5$

$=\mathbf{63.5\ ^{\circ}c}$

Copper

$(M\ sample)(Csample)(\Delta T_{sample})=(M_{water})(C_{water})(\Delta T_{water})$

$(191.5)(C_{sample})(69.5)=(254.4)(1.0)(4.5)$

$13309.25\ C_{sample}=1144.8$

$C_{sample}=\frac{1144.8}{13309.25}$

$= 0.0860154cal/g.k$

$= \mathbf{0.086cal/g.k}$

Lead

(M sample)(Csample)(ΔT_{sample})=(M_{water})(C_{water})(ΔT_{water})

(228.5g)C_{sample}(72) =(246.8)(1.0)(2)

16452 C_{sample}=493.6

$=\frac{493.6}{16452}$

=0.0300024cal/g.k

=0.030cal/g.k

Aluminium

(M sample)(Csample)(ΔT_{sample})=(M_{water})(C_{water})(ΔT_{water})

(198.1)Csample)(63.5)=(253.6)(1.0)(10.5)

12579.35 C_{sample}=2662.8

Csample = $\frac{2662.8}{12579.35}$

=0.2116802cal/g.k

= **0.212cal/g.k**

Question

1) The specific heat of the sample is less than that of water
2) The unwanted loss of heat that might have affected the results could be from wiping the samples. Heat could have also been lost to the surroundings.

Discussion

The specific heat capacity was calculated using the formula (M sample)(Csample)(ΔT_{sample})=(M_{water})(C_{water})(ΔT_{water}).And the specific eat capacity of copper, lead, and aluminium were found to be 0.086cal/g.k, 0.030cal/g.k and 0.212cal/g.k respectively. There were some experimental errors, which were a result of loss of heat to the surrounding during the transfer of the sample from the boiling water to the calorimeter. The loss of eat can be minimized by providing extra insulation

Conclusion

The technique used for measuring the specific heat of a solid is to raise the temperature of the substance to some value, place it into a vessel containing cold water of known mass and temperature, and measure the temperature of the combination after equilibrium is reached. Then use that temperature to calculate the specific heat capacity. The experiment was a success in that the specific heat capacity of the metals copper, lead and aluminium were successfully calculated.

Reference

Mr. Siantuba, MR. Simpembe PH110 module one PH110 lab manual (2016), Directorate Education and Open learning and Copper belt University, Kitwe, Zambia.