

**AMERICAN INTERNATIONAL UNIVERSITY–BANGLADESH (AIUB)**

**FACULTY OF SCIENCE & TECHNOLOGY**

**DEPARTMENT OF PHYSICS**

**PHYSICS 2 LAB**

**SPRING 2022-2023**

**Section: X, Group: 03**

**LAB REPORT ON**

*Determination of the specific heat of a liquid by the method of cooling.*

**Supervised By**

**NUSRAT JAHAN**

**Submitted By**

|  |  |  |
| --- | --- | --- |
| **Name** | **ID** | **Contribution** |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Date of Submission:

February 15,2023

**TABLE OF CONTENTS**

|  |  |
| --- | --- |
| **TOPICS** | ***Page no*.** |
| 1. **Title Page** |  |
| 1. **Table of Content** |  |
| 1. **Theory** |  |
| 1. **Apparatus** |  |
| 1. **Procedure** |  |
| 1. **Experimental Data** |  |
| 1. **Analysis and Calculation** |  |
| 1. **Result** |  |
| 1. **Discussion** |  |
| 1. **References** |  |
|  |  |

1. **Theory**

When a hot body is placed in a constant temperature surrounding, it loses heat by conduction, convection, and radiation. If the body be kept in such a way that the heat lost by conduction and convection may be neglected, then the quantity of heat emitted by the body in the given time depends only on the temperature of the body and that of its surrounding the area and the nature of the surface exposed, and is completely independent of the nature of the liquid. The specific heat capacity refers to the amount of heat required to cause a unit of mass (say a gram or a kilogram) to change its temperature by 1°C. If the difference of temperature between the body and its surrounding is not large, then according to Newton’s law of cooling, the rate of emission of heat is proportional to the temperature difference.

Diagram

Description automatically generated

Let, the mass of the calorimeter along with the stirrer = m kg

Specific heat of the material of the calorimeter and the stirrer = S J/kg/K

Mass of the experimental liquid in the calorimeter = kg

Specific heat of the liquid = J/kg/K

Time taken to cool the liquid from temperature to = sec

Mass of water having volume equal to that of the liquid = kg

Specific heat of water = J/kg/K

Time taken to cool water from temperature to = sec

So, rate of cooling of the liquid = J/s

So, rate of cooling of water = J/s

According to Newton’s Law of cooling, rate of cooling in these cases is equal. So

J/s = J/s

1. **Apparatus**

The components required to carry out this experiment include: -

* + Calorimeter along with stirrer
  + Chamber consisting of two walls
  + Sensitive thermometer
  + Electronic Balance
  + Electronic heater or burner
  + Stopwatch

1. **Procedure**
2. A dry and clean calorimeter is taken and weighed along with a stirrer.
3. Water is then poured into another container and heated between 70°C to 75°C and then poured into the calorimeter, filling it up to a chosen mark. Calorimeter is then stationed into a two-walled chamber.
4. Using the stirrer, water is carefully and slowly stirred, and the temperature of the water recorded in 1°C intervals. As the water temperature is higher than the surrounding room temperature, the water temperature assumes a steady decrease. Following this way, 20 to 25 readings of temperature are recorded and subsequently the weight of the calorimeter plus water is measured. The difference between the two weight readings gives the weight of water.
5. Water is now removed from the calorimeter and the calorimeter is subsequently cleaned and dried. The experimental heated liquid which is heated up to the same temperature as the water (70°C to 75°C) is now poured into the calorimeter up to the same mark (as water) and the calorimeter along with the liquid is then placed inside the two-walled chamber.
6. The liquid is now slowly stirred and, using the same approach as with water, temperature is recorded in 1°C intervals. Again 20 to 25 temperature readings taken for the liquid.
7. The weight of the calorimeter plus the liquid is subsequently measured and this weight deducted from the weight of just the calorimeter (plus stirrer) to determine the weight of the liquid.
8. **Experimental Data**

**Table:** Time - Temperature record.

|  |  |  |  |
| --- | --- | --- | --- |
| **No. of**  **Observation** | **Time**  **(min)** | **Temperature ()** | |
| **Water** | **liquid** |
| 1 | 0 | 74 | 73 |
| 2 | 1 | 72 | 72.5 |
| 3 | 2 | 70.5 | 71 |
| 4 | 3 | 69.5 | 69.5 |
| 5 | 4 | 68.5 | 68 |
| 6 | 5 | 67.5 | 66.5 |
| 7 | 6 | 67 | 65.5 |
| 8 | 7 | 66 | 64 |
| 9 | 8 | 65 | 63 |
| 10 | 9 | 64.5 | 62 |
| 11 | 10 | 63.5 | 61 |
| 12 | 12 | 62.5 | 59 |
| 13 | 14 | 61 | 57 |
| 14 | 16 | 60 | 55 |
| 15 | 18 | 58.5 | 54 |
| 16 | 20 | 57.5 | 52.5 |
| 17 | 22 | 56.5 | 51 |
| 18 | 24 | 55.5 | 50 |
| 19 | 26 | 54.5 | 48.5 |
| 20 | 28 | 53.5 | 47.5 |
| 21 | 30 | 53 | 46.5 |
| 22 | 33 | 51.5 | 45 |
| 23 | 36 | 50.5 | 44 |
| 24 | 39 | 49.5 | 42.5 |
| 25 | 42 | 48.5 | 41.5 |
| 26 | 45 | 47 | 40.5 |

Liquid

water

1. **Analysis and Calculation**

Measurements:

Mass of the calorimeter + stirrer, m = 73.9 gm

SP of the material of the calorimeter, S = 0.0909 cal

Mass of the calorimeter + stirrer + water, m2 =165.3 gm

Mass of water, M2 =  – m = 91.4 gm

Specific heat of water, cal

Mass of calorimeter + stirrer + liquid, = 162.2 gm

Mass of the liquid, = – m = 88.3 gm

From the graph,

Time taken to cool by the liquid, min

Time taken to cool by the water, min

So, the specific heat of liquid

= 0.547 cal

1. **Result**

The specific heat of the given liquid is 0.547 cal

1. **Discussion**

This experiment was conducted to determine the specific heat of a liquid via the method of cooling. Specific heat is the quantity of heat required to raise the temperature of one gram of a substance by one Celsius degree or one kelvin. The unit of specific heat are usually calories or joules per gram per Celsius degree. Newton’s law of cooling states that the rate at which an object cools is proportional to the difference in temperature between the object and the object’s surroundings. Simply put, a glass of hot water will cool down faster in a cold room than in a hot room. The specific heat capacity varies from material to material. While stirring the liquid or water, the stirrer is made sure not to meet the base and sides of the container to avoid loss of heat to surrounding. The water and liquid are stirred to ensure even distribution of heat. The calorimeter is made sure to be kept dry before weighing it to ensure accurate measurements and to ensure no trace of other foreign liquid is present. Measurements can be repeated, and a mean taken to get reliable data. Equal volumes of water and liquid must be taken otherwise errors and anomalous readings will occur. A black base of the calorimeter will ensure the most heat absorption and radiation which yields in the efficiency of the experiment. It is better not to take a volatile liquid as their low boiling temperature does not aid in the experiment instead hampers it. Systematic error (zero error) of the electronic balance, stopwatch may result in inaccurate readings. Human parallax error will also contribute to inaccurate readings. Relatively a low-risk experiment however adequate safety precautions must always be appropriated. If the liquid sample taken is toxic, goggles and mask can be worn. Gloves can be worn so as to not directly come into contact with the liquids at high temperatures.

1. **References**

Resources for the:

* Fundamentals of Physics: 18.4 Adsorption of Heat (Chapter: 18, Page: 524,525).
* Practical Physics (by Dr.Giasuddin Ahmed & Md. Shahabuddin): Exp. 26: To determine the specific heat of a liquid by the method of cooling(Page-146)