**SPECIFIC HEAT OF A BRICK MODEL WRITE UP**

**Aim**: To determine experimentally the specific heat of a brick.

**Equipment Required:**

* styrofoam cup - electronic balance
* crushed brick pieces - two thermometers
* beaker - oven

**Procedure:** Refer to the Lab Notes from page 33 of EP

**Results:**

|  |  |
| --- | --- |
| Initial temperature of heated brick pieces | 89.0 +/- 0.5 º C |
| Initial temperature of water in styrofoam cup | 20.0 +/- 0.5 º C |
| Final temperature of water and brick pieces | 25.0 +/- 0.5 º C |
| Temperature rise of water ΔT1 | 5 +/- 1 º C |
| Temperature fall of brick pieces ΔT2 | 64 +/- 1 º C |
| Mass of brick pieces | 73.80 +/- 0.05 g (change to kg for calculations) |
| Mass of water in styrofoam cup | 99.80 +/- 0.05 g (change to kg for calculations) |
| Specific heat of water | 4180 J kg-1 K-1 (no uncertainty for this) |

**Calculations:**

1. Calculations of ΔT1 and ΔT2

Since these involve subtraction we add the uncertainties

ΔT1 = 25 – 20 = 5 ºC uncertainties 0.5 + 0.5 = 1 ºC

ΔT2 = 89 – 25 = 64 ºC uncertainties 0.5 + 0.5 = 1 ºC

1. Change these uncertainties to % errors

Water

% error in ΔT1 = 1 x 100/5 = 20.0 %

Brick

% error in ΔT2 = 1 x 100/64 = 1.56 %

1. Change the uncertainties in mass to % errors

% error in mass of brick pieces = 0.05 x 100/73.80 = 0.07 %

% error in mass of water = 0.05 x 100/99.80 = 0.05 %

1. Calculation of the specific heat of a brick

heat lost by the brick = heat gained by the styrofoam cup + heat gained by the water

Q brick = Q styrofoam cup + Q water

Now the specific heat of the Styrofoam cup is negligible and can be considered to be zero and

Therefore the equation becomes:

Q brick = Q water

Q water = mwaterCwater ΔT1 since this involves multiplication % errors

= 99.8 x 10-3 x 4.18 x 103 x 5 are added together

= 2085.82 J 0.05 % + 0 % + 20.0 % = 20.05 %

Now

Q brick = Q water since this involves multiplication and

mbrickCbrick ΔT2 = Q water division % errors are added together

73.80 x 10-3 x Cbrick x 64 = 2085.82 0.07 % + 1.56 % +20.05 % = 21.68 %

Cbrick  = 441.6 J kg-1 K-1 +/- 21.68 %

Change % error into an absolute error

Error = 21.68 x 441.6/100 = 95.7 J kg-1 K-1

Therefore Cbrick  = 441.6 +/- 95.7 J kg-1 K-1

Using the appropriate significant figures : Cbrick  = 400 +/- 100 J kg-1 K-1

**Evaluation**

The accepted value for the specific heat of bricks (depending upon what they are made of) is in

the range of 700 to 1000 J kg-1 K-1

Clearly the results determined here are outside this range. This means there was another factor

in play. This is heat lost to the environment during the heat transfer process. This can be shown

by assuming the final temperature was 26.0 ºC instead of 25.0 ºC. Repeating the calculation

Cbrick  becomes 538 J kg-1 K-1. It would be easy to lose enough heat to the environment to

reduce the final temperature by 1 or 2 ºC

Clearly a change of method is needed to reduce this effect.

**Questions**

1. When we compare the specific heats of various substances we see that the specific heat of a brick at 850 J Kg-1K-1 is of a medium to high value. Metals such as copper C = 390 J kg-1 K-1 are low to moderate and water C = 4180 J kg-1 K-1 is high. ( 2 marks total 1 for quoting the values and 1 for describing the range of specific heats)

2. Brick homes heat up and cool slowly because they have a medium to high specific heat. They can absorb a fair amount of heat with only a small temperature rise. Likewise they give off a fair amount of heat with only a small temperature fall. (1 mark total)

3. There are several reasons for the observed rates of heating and cooling of brick houses:

* porosity of the bricks - orientation of house
* colour of the bricks - type of roof on house
* location of the house - shades and curtains
* double or single brick walls - garden and trees

(2 marks - any four reasonable answers half a mark each)

4. The brick was broken into smaller pieces to increase the surface area of the brick in contact with the water (1 mark). This will allow for faster (1 mark) and more efficient heat transfer meaning there is less heat lost to the environment (1 mark) (3 marks total)

5. When the brick particles were added to the water, the water rose a small amount (1 mark) This was because the water was filling the air pockets in the bricks. The bricks were porous or had air cavities in them. (1 mark) (2 marks total)

6. It would not be an advantage to build brivk houses where high temperatures occur for long periods of time (1 mark) The house would heat up and remain hot as there was no way for the house to cool down. (1 mark) (2 marks total)

**Conclusion**:

In this experiment the specific heat was determined to be 400 +/- 100 J kg-1 K-1. Given the accepted specific heat of bricks is in the vicinity of 700 – 900 J kg-1 K-1 and the specific heat that was determined outsdie this range, the experiment was unsuccessful. The greatest source of error in the experiment was heat lost to the environment when transferring the bricks into the cup.