Title: Heating and Cooling Curve of Stearic Acid Lab

Introduction

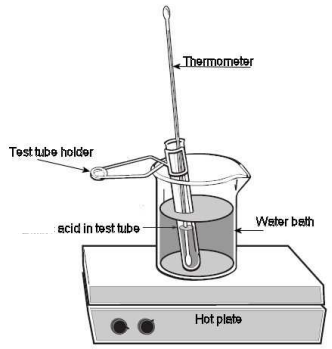
Part 1 Stearic acid will be cooled (heat removed) at a constant rate. Starting with the substance in its liquid phase at a temperature well above its freezing point, temperature readings will be made at regular intervals until the substance changes to its solid phase and cools to a temperature well below its freezing point. The temperature readings will thus show the effects of removing heat from a pure substance in the liquid phase, during a phase change (liquid to solid) and in the solid phase.

Part 2 (IF TIME ALLOWS) The procedure is reversed in this part, and stearic acid, in its solid phase, will be heated at a constant rate and temperature readings will be made until the substance is in its liquid phase at a temperature well above its melting point.

Target: Students will observe the cooling of a pure substance through a phase change and use the experimental data to construct a cooling curve (graph).

Equipment

Test tube of stearic acid
Hot Plate
Beaker (250 mL)
Stop watch
2 Thermometers



Procedure: Cooling Curve

1. Fill 400 mL beaker three-quarters full of cold tap water and place it on a hot plate. Place a thermometer in the beaker so you can record the temperature. **Note: Throughout this experiment, you should try to read temperatures to the nearest 0.2^{o}C.**
2. Obtain a test tube containing a sample of the substance (stearic acid) to be studied. Place a thermometer inside this test tube and put the test tube in the beaker of water.
3. Heat the sample carefully in the beaker of water until the all stearic acid melts. Be sure the temperature does **NOT** go above 80 degrees. **DO NOT OVERHEAT** [**Caution**: Before heating ensure that the mouth of the test tube is pointing away from yourself and others.]
4. When all the stearic acid has melted, remove the beaker with test tube from the hot plate and place it on the table. The final temperature of the sample should be less than 80^{o}C. If it is higher, wait until it drops to this temperature before proceeding with step 5.
5. At this point in the experiment, one group member will call out the time every 30 seconds. Another group member can record temperature data in the Data Table. The other partner will **keep stirring** the test tube and read off the temperature of the stearic acid **AND** the water at each half-minute interval.
6. Continue this procedure until the temperature of the stearic acid reaches 40^{o}C. Remove the test tube from the water and let stand in a test tube rack.

Data:

Cooling – Part 1

Time (min)	T (^{o}C) Stearic Acid	T (^{o}C) Water	Time (min)	T (^{o}C) Stearic Acid	T (^{o}C) Water	Time (min)	T (^{o}C) Stearic Acid	T (^{o}C) Water
0			10.5			21.0		
0.5			11.0			21.5		
1.0			11.5			22.0		
1.5			12.0			22.5		
2.0			12.5			23.0		
2.5			13.0			23.5		
3.0			13.5			24.0		
3.5			14.0			24.5		
4.0			14.5			25.0		
4.5			15.0			25.5		
5.0			15.5			26.0		
5.5			16.0			26.5		
6.0			16.5			27.0		
6.5			17.0			27.5		
7.0			17.5			28.0		
7.5			18.0			28.5		
8.0			18.5			29.0		
8.5			19.0			29.5		
9.0			19.5			30.0		
9.5			20.0			30.5		
10.0			20.5			31.0		

Calculations:

Use a piece of graph paper to plot all of your data. Plot the temperatures along the vertical axis and times along the horizontal. Be sure to label both axes. Carefully calibrate your axes to use as much of the paper as possible. Draw a smooth curve through the points.

Referring to your graph, determine the point that stearic acid freezes. Can you also determine the melting point temperature?

Explain the diagonal parts of the cooling curve in terms of changes in kinetic and potential energy. Do the same for the horizontal portions of the cooling curve.

What phase changes are exothermic? Endothermic?

In which phase of a substance do its particles have the greatest average kinetic energy?