



Datalogging with Handheld Technology.

KS3 Science
Unit 8F
Compounds and mixtures
Cooling of stearic acid

In Unit 8I Heating and cooling, students investigate temperature changes using ice and salol. To provide variety, the alternative activity of cooling pure and impure stearic acid has been chosen as a datalogging opportunity in Compounds and mixtures. The following extract from the unit specification sets the scene:-

<i>Learning Objectives Pupils Should Learn</i>	<i>Possible Teaching Activities</i>	<i>Learning Outcomes Pupils</i>	<i>Points To Note</i>
<ul style="list-style-type: none"> ◆ that elements and compounds melt and boil at particular temperatures ◆ that mixtures do not melt or boil at fixed temperatures <p style="text-align: center;">****</p> <ul style="list-style-type: none"> ◆ to decide how many measurements to make ◆ to relate results to scientific knowledge and understanding ◆ to consider whether there was other evidence they could have collected 	<p style="text-align: center;">****</p> <ul style="list-style-type: none"> ◆ Provide pupils with two liquids A and B ---. Tell them that they are going to investigate how temperature changes as they cool --- and use this and any other sample tests to find out as much as possible about the liquid. Ask the pupils to plan what to do, including how frequently they will make measurements, and to produce an account of what they did, tables and graphs of results and to use all their results to draw conclusions about the liquids. 	<ul style="list-style-type: none"> ◆ identify the melting and boiling points of a range of elements and compounds ◆ explain that these are characteristic of the element or compound ◆ describe how the melting point or boiling point of a mixture varies with composition <p style="text-align: center;">****</p> <ul style="list-style-type: none"> ◆ identify differences between the graphs and explain that these show one is a pure liquid and the other is not ◆ suggest additional tests ---, explaining what these might show 	<p style="text-align: center;">****</p> <ul style="list-style-type: none"> ◆ (reference to ice/salt mixtures) <p style="text-align: center;">****</p> <ul style="list-style-type: none"> ◆ A temperature sensor attached to a computer could be used in this activity. ◆ As an additional or alternative activity, some pupils could investigate the cooling of pure and impure stearic acid.

A further opportunity for datalogging in this unit

- ◆ The use of a carbon dioxide sensor in an investigation into the ventilation of rooms

Safety

- ♦ teachers will need to check pupils' plans for health and safety before practical work begins.
- ♦ eye protection should be worn.

Datalogging kit

- ♦ TI-73, TI-82, TI-83 or TI-83plus graphing calculator.
- ♦ CBL or CBL2.
- ♦ 2 x temperature sensors.
- ♦ TI-GRAPH LINK™ software and cable to link to computer.
- ♦ chembio application (TI-83 plus) or program group (TI-73, TI-82 and TI-83).
- ♦ TI InterActive!™ or spreadsheet application.
- ♦ (optional; a ViewScreen™ plus VS calculator to project calculator screen via an OHP, to show real-time graph.)

Apparatus Required

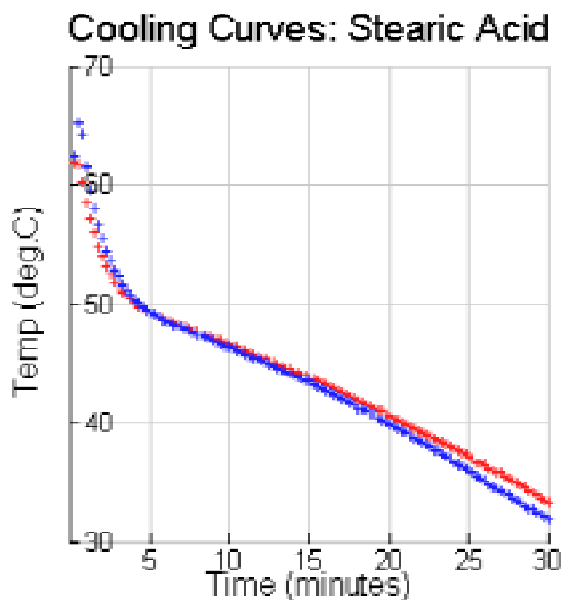
- ♦ solid, pure stearic acid in a boiling tube.
- ♦ an equal quantity of solid, impure stearic acid (for example, stearic acid + cooking oil) in a second boiling tube.
- ♦ beaker; to hold boiling tubes surrounded by boiling water, to melt the stearic acid.
- ♦ bench mat.
- ♦ electric kettle.
- ♦ test tube rack or second beaker to hold cooling tubes.

Useful web sites

www.ti.com/calc/docs/graph.htm
www.vernier.com
www.oxford-educational.co.uk
www.qca.org.uk

Activity:
Cooling of pure and impure stearic acid.

After the stearic acid has melted, the boiling tubes should remain in boiling water to further raise the temperature. This will enable the first, rapid cooling, section of the graph to be fully displayed.



In this example, the data lists have been imported into TI InterActive!™, and used to construct the graph. Alternatively, using TI-GRAPH LINK™ software the lists can be converted into .txt files and imported into a spreadsheet application.

- ♦ Pure stearic acid.
- ♦ Impure stearic acid

Technique

1. Attach the calculator to the CBL/CBL2.
2. Open the chembio application/program and press enter to get to the following screen:-

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***MAIN MENU***
1:SET UP PROBES
2:COLLECT DATA
3:VIEW GRAPH
4:VIEW DATA
5:FIT CURVE
6:RETRIEVE DATA
7:QUIT
  
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3. Insert the temperature sensors into channels 1 and 2, select SET UP PROBES and follow the on screen prompts to complete the process.
4. Select 2: COLLECT DATA from the MAIN MENU.
5. Select 2: TIME GRAPH.
6. Follow the on screen prompts to enter the sampling schedule; for example, 120 samples @ 15 second intervals.

7. Then selecting 1: USE TIME SETUP, set Ymin=30; Ymax=70; Ysc1 =5.
8. **Place the sensors in the stearic acid.**

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SET Y-AXIS
Ymin=?30
Ymax=?70
Ysc1=?5

PRESS [ENTER] TO
BEGIN COLLECTING
DATA.

```

9. Press ENTER and after a time interval a real-time graph appears on screen.

At the end of the sampling period,

this screen appears

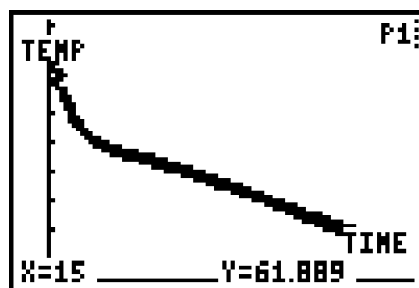
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TIME IN L1
CH1 IN L2 (DOT)
CH2 IN L3 (CROSS)

[ENTER]

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followed by a graph after pressing ENTER.



10. To quit the application/program, press ENTER, select ****REPEAT**** 1: NO, and then 7: QUIT.

Using the calculator, the format of the graph can now be changed, and the data and curves explored. In addition, the lists can be imported into TI InterActive!TM or using TI-GRAPH LINKTM software converted into .txt files and opened in a spreadsheet application.

Possible Extension Work.

- Other tests associated with this investigation into how temperature changes with cooling; for example:
 - ★ increasing the amount of cooking oil in the mixture.
 - ★ testing a range of mixtures, each containing a different impurity.
 - ★ increasing the number of components in the mixture.

Links.

- *Unit 8I Heating and cooling.*
- *Unit 9M Investigating scientific questions.*