ASHES TO ASHES

LAB FORENSICS 11
From Forensics with Vernier

OBJECTIVES

- Identify the likely accelerant in an arson
- Identify a solution, based on evaporation rate
- Understand that evaporation rate is a characteristic property of a liquid

MATERIALS

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labquest</td>
<td>6 pieces filter paper cut into 2 x 2 cm</td>
</tr>
<tr>
<td>2 Vernier temperature probes</td>
<td>6 small rubber bands</td>
</tr>
<tr>
<td>Accelerant samples-4 suspects</td>
<td>Masking tape</td>
</tr>
<tr>
<td>Accelerant samples-crime scene</td>
<td>lint free tissues</td>
</tr>
<tr>
<td>Small Test tubes</td>
<td>test tube rack</td>
</tr>
</tbody>
</table>

PROCEDURE

**CAUTION:** Obtain and wear goggles during this experiment. The compounds used in this experiment are flammable and poisonous. Avoid inhaling their vapors. Avoid touching them with your skin or clothing. Be sure there are no open flames, heat sources, or sparks in the lab during this experiment. Notify your teacher immediately if an accident occurs.

In order to determine whether any of the accelerants found with the suspects matched the accelerant found at the crime scene, you will need to compare the evaporation rate of each suspect’s sample with the evaporation rate of the sample from the crime scene. You will compare the samples by, first, graphing the temperature change of each sample as it evaporates and, second, comparing the graphs of each sample to look for a match.

1. Connect the temperature probe to the Labquest and choose New from the File Menu. If you have older sensors that do not auto-ID manually set up the sensors.

2. On the Meter screen, tap Length. Change the data-collection length to 240 seconds. Select OK.

3. Prepare the samples to be tested.
   a. Obtain 5 small test tubes and a test tube rack.
   b. Label a separate test tube for each of the four suspects and a fifth test tube for the crime scene.
   c. Pour a small amount of each of the four accelerants into their respective test tubes. Pour a small amount of the accelerant found at the crime scene into the test tube marked “crime scene”.
   d. Secure the five test tubes in a test-tube rack.
4. Prepare 2 pieces of masking tape, each about 10 cm long, to be used to tape the probes in position during Step 7.

5. Wrap the tip of each Temperature Probe with a square of filter paper. Role the filter paper around the probe tip in the shape of a cylinder. **Hint:** First slip the rubber band up on the probe, wrap the paper around the probe, and then finally slip the rubber band over the wrapper paper. The filter paper should be even with the tip of the probe.

6. Place Temperature probe 1 into the test tube for Suspect 1. Place Temperature Probe 2 into the test tube for Suspect 2. The filter papers should be covered by the liquid in the bottom of the test tubes.

7. Collect temperature data.
   a. When the probes have been in the liquid for at least 30 seconds, start data collection.
   b. Leave the probes in the test tubes for 15 seconds to establish the initial temperature of the liquids.
   c. Pull the probes from the test tubes, and tape each to the table so the tip of the probe extends over the edge of the tabletop.

8. When data collection has finished, roll the rubber band on each probe up the probe shaft and dispose of the filter paper as directed by your instructor.

9. Determine the maximum and minimum temperatures for each of the data sets.
   a. Choose Statistics from the Analyze menu to determine the maximum ($T_{max}$) and minimum ($T_{min}$) temperature values for the accelerants.
   b. Record the maximum ($T_{max}$) and minimum ($T_{min}$) for all accelerants in your Evidence Record.
   c. For each of the liquids, subtract the minimum temperature from the maximum temperature to determine the temperature change during evaporation. Record these values in the Evidence Record.

10. To store the data that you collected during this run, tap the File Cabinet icon.

11. Repeat Steps 5-10 with the accelerants from Suspects 3 and 4.
12. Disconnect Temperature Probe 2 from the interface and repeat Steps 5-9 with the accelerator from the crime scene. Do not store the last run of data.

13. Tap Run 3 and select All Runs to view a graph that displays all of the data.

14. To examine the data pairs on the displayed graph, tap any data point. As you tap each data point, the temperature and time values are displayed to the right of the graph. Compare the plots on the graph to determine which of the suspects had an accelerator that is likely to be the same as the accelerator used at the crime scene. If one of the suspects’ accelerants produces a plot that matches the shape of the plot from the crime scene accelerator, it could be the accelerator that was used.

**EVIDENCE RECORD**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Tmax (°C)</th>
<th>Tmin (°C)</th>
<th>Tmax – Tmin (°C)</th>
<th>Cooling Rate Graph Match?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspect 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspect 2</td>
<td></td>
<td></td>
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<tr>
<td>Suspect 3</td>
<td></td>
<td></td>
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<tr>
<td>Suspect 4</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Crime Scene</td>
<td></td>
<td></td>
<td></td>
<td>N/A</td>
</tr>
</tbody>
</table>

**CASE ANALYSIS**

1. Which of the suspects’ accelerants best matches the accelerator from the crime scene?

2. Did any of the suspects’ accelerants appear to be the same liquid? If so, which ones?

3. Why may the graphs of the crime scene accelerant and primary suspect’s accelerant match exactly?
4. In what other ways can you examine the accelerants to determine which one was used in the crime?