Electrical conductivity of salt solutions

Experiment: Calibration Curve of Current vs Salt Concentration

Aim

To construct a calibration curve of **current (A)** versus **salt concentration (%m/m)** for an aqueous solution and to determine the relationship between ion concentration and current.

Background

The electrical current through an aqueous salt solution is proportional to the number of ions present. Increasing the concentration of a soluble ionic compound, such as NaCl, increases the number of charge carriers which in turn increases the current measured flowing through the solution at a fixed voltage.

Materials

- 2 X Electrodes (carbon)
- 4 X alligator leads to connect ammeter to power supply
- 1 X Power supply (DC)
- 1 X Ammeter (or multimeter set to current)
- 4 X Beakers (50 mL)
- 6 X Beakers (200 mL)
- Sodium chloride (NaCl) solid
- 1 X spatula
- 1 X electronic balance (+/- 0.01 g)
- Distilled water
- 1 x Stirring rod
- Water-proof marker or adhesive labels
- 1 X 100mL measuring cylinder
- 50mL each of two standard salt solutions with concentrations 23% m/m and 13% m/m.

Safety

-Handle electrical equipment with care.
-Avoid spilling water near electrical connections.
-Wear lab coat, safety goggles and gloves.
-Do not exceed low voltage (6 V) to prevent hazards.

Method

1. **Preparation of Standard Solutions**

   Prepare a series of NaCl solutions of known concentrations (%m/m)

2. Place a 200 mL beaker on an electronic balance and add exactly 100 g of distilled water at room temperature .

3. While the beaker is on the electronic balance carefully add 1.00 gram of NaCl using a small spatula.

4. Stir the solution with the stirring rod until all the salt is dissolved.

5. Using the water proof marker label the beaker with the correct salt concentration (%m/m) and set aside.

6. Repeat steps 2 - 5, five more times with salt masses of 5.00g, 10,00g, 15.00g, 20.00g and 25.00g.
7. Connect the circuit shown in fig. 1.

8. Take the beaker with the 100g of distilled water and 1.00 g of salt and measure out 50mL of solution into each of the 4 100 mL beakers using the measuring cylinder.

9. Stir each solution gently to ensure uniform ion distribution.

10. Apply a constant voltage (6V) across the electrodes.

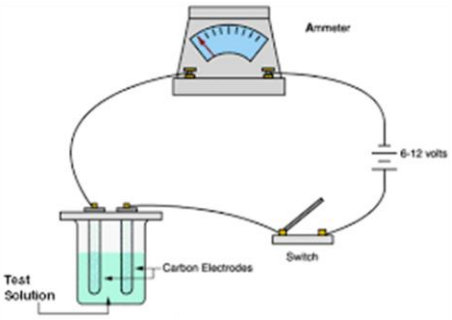

Figure 1 – setup of the apparatus

11. Record the **current (A)** from the ammeter of each of the four 50 mL solutions

12. Repeat step 8-11 with the four other concentrations.

1. On this page construct an appropriate, well formatted table of data for your investigation. *4 marks*

2. On the next page is graph paper to be used for the construction of a properly formatted graph to represent the data you have collected. *4 marks*

Graph

- Heading
- Plot Average Current (A) on the y-axis
- Plot NaCl Concentration (M) on the x-axis
- Draw a line of best fit
- The slope indicates the relationship between current and concentration.

3. Write a hypothesis for this task.

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_____*3 marks*

4. Identify the:

DV _____ and IV_____ *2 marks*

5. Identify four controlled variable

_____ *1mark*
_____ *1mark*
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6. Consider the calibration curve produced by your data.
    a. Explain the need for a calibration curve

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_____ *2 marks*

b. Another group using the same setup but different ammeter and power source conducts the same experiment on a different day and obtains precise results for the conductivity of two unknown salt solutions.

i. Define precision.

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ii. Define validity

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_____ *1 mark*

iii. Explain whether your calibration curve could be reliably used by the other group to determine the concentration of an unknown salt solution. In your answer, refer to the factors that may affect the validity of the calibration curve.

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_____ *3 marks*

7. Write a discussion.

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_____*6 marks*

8. Write a conclusion

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_____*2 marks*

9. Using the two standard solutions provided for you,
    a. test the accuracy of your calibration curve by comparing the derived results with the true value.

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    b. discuss which one of the two has the greater validity and explain why.

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