# Experiment 9

## Aim

To prepare a saturated solution of common salt in distilled water and to determine its solubility at room temperature.

## Theory

A solution in which no more solute dissolves in the given solvent at a particular temperature is a saturated solution. The solubility of a substance in a saturated solution is defined as the mass of solute dissolved in 100 g of solvent. In this experiment we shall prepare a saturated solution of common salt in water at room temperature and then will determine its solubility.

## Materials Required

Common salt or sugar, distilled water, three beakers (250 mL), stirring rod, filter paper, funnel, china dish, watch glass, tripod stand, burner, spring balance ( 0 g – 250 g, preferably having least count of 1 g), a polythene bag, a measuring cylinder (100 mL), and a thermometer (–10 °C – 110 °C).

## Procedure

1. Hang the thermometer freely in the room. Note and record its reading to find the room temperature.

A. Preparation of saturated solution

1. Using a measuring cylinder take 100 mL distilled water in a 250 mL beaker. Dry the measuring cylinder after use.
2. Dissolve some common salt in distilled water with the help of a stirring rod.
3. Warm the solution slightly and keep on adding common salt in the solution with constant stirring till no more common salt dissolves in it.
4. Stop warming the solution and allow the beaker to cool till it comes to the room temperature.
5. Filter the solution into another beaker in order to separate undissolved salt, if any. The filtered solution is the saturated solution of sodium chloride (common salt) in distilled water at room temperature.

B. Determination of Solubility

(i) Density Method

1. Determine the mass of the third beaker of 250 mL. (See Experiment 3 for details), using a spring balance and a polythene bag.
2. Pour 100 mL of prepared saturated solution in the weighed beaker, using the measuring cylinder.
3. Determine the mass of the beaker containing saturated solution (using a spring balance and a polythene bag).
4. Find the mass of the 100 mL of saturated solution.

(ii) Evaporation Method

1. Determine the mass of the china dish, using a spring balance and a polythene bag.
2. Using the measuring cylinder, take 25 mL of prepared saturated solution in a china dish.
3. Heat the china dish until all the water (solvent) evaporates out. The dish will now contain only the solute (common salt).
4. Stop heating the china dish and allow it to cool.
5. Determine the mass of the china dish containing the solute, using the spring balance and polythene bag.
6. Find the mass of solute that was dissolved in 25 mL saturated solution.

## Observations and Calculations


Room temperature = _____ °C = _____ K.

**(i) Determination of solubility by Density Method**

Mass of empty beaker, $m_1$ = _____ g

Mass of the beaker containing 100 mL of prepared saturated solution, $m_2$ = _____ g

Mass of 100 mL of saturated solution, $m_3$ = _____ g

($m_3 = m_2 - m_1$)

Density of distilled water, $\rho$ (given) = _____ 1 g/mL

Mass of 100 mL distilled water (= $\rho \times 100$ mL) = 100 g

Mass of the solute (common salt) in 100 mL of distilled water, $m = m_3 - 100$ g = _____ g.

Solubility of common salt, $m$ g per 100 g of distilled water = _____ g per 100 g of distilled water.

**(ii) Determination of solubility by Evaporation Method**

Mass of empty china dish, $m_1$ = _____ g

Mass of china dish and common salt, $m_2$ = _____ g

Mass of salt in 25 mL of prepared saturated solution, $m_3 = (m_2 - m_1)$ = _____ g

Density of distilled water, $\rho$ (given) = 1 g/mL

Mass of 25 mL distilled water (= $\rho \times 25$ mL) = 25 g.

25 mL (or 25 g) of distilled water dissolves $m_3$ g of common salt to prepare a saturated solution. Thus the 100 mL (or 100 g) of distilled water would require $\frac{m_3 \times 100}{25}$ g of common salt to get a saturated solution at room temperature.

Solubility of common salt, $m$ g per 100 g of distilled water

= $\frac{m_3 \times 100}{25}$ g per 100 g of distilled water

= ___ g per 100 g of distilled water.

## Results

Compare the solubility of common salt in distilled water to form a saturated solution at room temperature obtained by density and evaporation methods. Using density method the solubility of common salt in a saturated solution at room temperature ( ___ °C or ___ K) is _____ g per 100 g of distilled water.

Using evaporation method the solubility of common salt in a saturated solution at room temperature ( ___ °C or ___ K) is _____ g per 100 g of distilled water.

## Precautions and Sources of Error

- The spring balance should be held vertical while taking measurements.
- Before making use of the spring balance it must be ensured that its pointer is at zero mark. If not then ask your teacher to help.
- The readings of the spring balance should be noted only when its pointer comes to rest.
- The measuring cylinder should be placed on a horizontal surface while measuring the volume of the distilled water and solution.
- While preparing the saturated solution, the warming of the solution should be slow and to a temperature slightly (2 °C to 5 °C) more than the room temperature. Similarly the cooling of solution must also be slow.
- While performing evaporation method, heating of saturated solution must be stopped as soon as all the water evaporates from the solution.

## Note for the Teacher

- In place of common salt, some students may be suggested to perform this experiment with sugar.
- Experiment 3 and 4 explains a simple method to find the mass of a measuring cylinder using a spring balance and a polythene bag. Since in this experiment too a beaker and a china dish (empty as well as filled) are to be weighed, it is therefore suggested that students may be asked to perform either of experiment 3 and 4 first.
- If the spring balance is not sufficiently sensitive, students may be suggested to use a physical balance. However a physical balance might be new equipment for them, it is advised to kindly guide them in making use of a physical balance to weigh the objects more accurately.
- In case, if distilled water is not available, the experiment may be performed with filtered water or drinking water. Its density may be assumed as 1 g/mL.
- If students find it lengthy to determine the solubility using both density and evaporation methods, suggest them to perform only one method.

## QUESTIONS

- How does the solubility of a solute in solvent change with an increase in temperature?
- What is a supersaturated solution in your opinion?
- How can a supersaturated solution of salt in water be prepared?
- What will happen if a saturated salt solution prepared at high temperature is (i) cooled slowly? (ii) cooled suddenly?
- Would the solubility of sodium chloride (common salt) in water increase or decrease in presence of water sample containing magnesium/calcium chloride? Give explanation.