

10.16: Saturated and Supersaturated Solutions

We often find that there is a limit to the quantity of solute which will dissolve in a given quantity of solvent. This is especially true when solids dissolve in liquids. For example, if 36 g KCl crystals is shaken with 100 g H₂O at 25°C only 35.5 g of the solid dissolves. If we raise the temperature somewhat, all the KCl will dissolve, but on cooling to 25°C again, the extra 0.5 g KCl will precipitate, leaving exactly 35.5 g of the salt dissolved. We describe this phenomenon by saying that at 25°C the **solubility** of KCl in H₂O is 35.5 g KCl per 100 g H₂O. A solution of this composition is also described as a **saturated** solution since it can accommodate no more KCl.

Under some circumstances it is possible to prepare a solution which behaves anomalously and contains more solute than a saturated solution. Such a solution is said to be **supersaturated**. A good example of supersaturation is provided by Na₂S₂O₃, sodium thiosulfate, whose solubility at 25°C is 50 g Na₂S₂O₃ per 100 g H₂O. If 70 g Na₂S₂O₃ crystals is dissolved in 100 g hot H₂O and the solution cooled to room temperature, the extra 20 g Na₂S₂O₃ usually does not precipitate. The resulting solution is supersaturated; consequently it is also unstable. It can be “seeded” by adding a crystal of Na₂S₂O₃, whereupon the excess salt suddenly crystallizes and heat is given off. After the crystals have settled and the temperature has returned to 25°C, the solution above the crystals is a saturated solution—it contains 50 g Na₂S₂O₃.

Another example of crystallizing salt out of a supersaturated solution can be seen in the following video. In this case, a supersaturated solution of sodium acetate is poured over a crystal of sodium acetate. These crystals provide the lattice structure “seed” which causes the sodium acetate ions in solution to crystallize out.

The salt begins to crystallize, forming a large sodium acetate structure from the precipitation of the ions out of solution. When the sodium acetate crystallizes, the oppositely charged ions are brought closer together by the crystal structure. Since formation of a [crystal lattice](#) lowers potential energy by placing like charges close together, the system releases the excess energy in the crystallization process. Thus, the structure ends up being warm to the touch from this excess energy.



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