

BASIC KNOWLEDGE

CRYSTALLISATION

Crystallisation is a fundamental operation in thermal process engineering, and is mainly used for separation and cleaning but also for shaping substances. A characteristic feature of crystallisation is the formation of a new solid phase (crystallisate). The crystallisate can develop from a solution, a liquefied material or vapour. In industrial process and chemical engineering, the main focus is on technical mass crystallisation from liquid phases, particularly solutions. Crystallisation plays a crucial role in the production of crystalline bulk goods such as sugar, cooking salt and fertilisers from aqueous solutions.

A solvent (e.g. water) is able to dissolve a certain quantity of a material (salt) at a fixed temperature. As long as the solvent's maximum capacity to absorb the dissolved substance (saturation concentration) is not reached, there is only a single liquid phase. If the saturation concentration is exceeded, the dissolved substance begins to crystallise. This results in a second, solid phase – the crystallisate.

Crystallisation can be achieved using three methods:

■ **Cooling crystallisation**

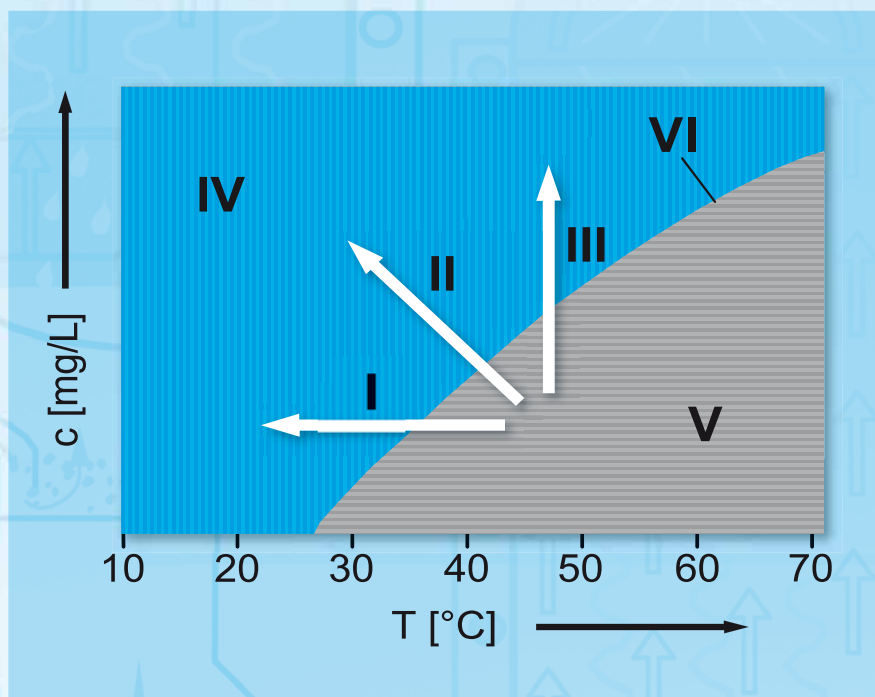
If solubility is highly dependent on temperature, the saturation concentration of the solute can be exceeded by cooling.

■ **Evaporation crystallisation**

Part of the solvent is evaporated until the dissolved quantity of material in the remaining solution exceeds the saturation concentration. This method is used if solubility is only slightly dependent on temperature.

■ **Vacuum crystallisation**

This method uses a combination of the effects described before. Relaxation in a vacuum evaporates part of the solution. The removal of the latent heat of evaporation has a cooling effect on the solution. This method is particularly beneficial for temperature-sensitive substances as evaporation in a vacuum occurs at lower temperatures.



Simplified illustration of crystallisation process in temperature/solubility diagram:

T temperature, c dissolved material, I cooling crystallisation,

II vacuum crystallisation, III evaporation crystallisation,

IV oversaturated solution, V unsaturated solution, VI solubility curve