13 Crystallization

Crystallization is a process aimed to separate one or more solid phases from a solution on the basis of their solubility. It is particularly suitable to obtain pure compounds since crystals have constant composition no matter how the solution is composed.

There are two main ways for the crystals to precipitate (cf. Figure 13.1):

- Evaporation of the solvent;
- Cooling of the solution.

Crystals formation involves both nucleation and growth processes controlled by kinetics. Precipitation occurs only if the solution is supersaturated enough to overcome the activation energy barrier needed for formation and growth of stable crystals. Therefore a second curve, the so called "supersaturation curve", exists and it doesn't depend on the compounds but on the operating conditions only.

At industrial level the nucleation is always heterogeneous since impurities are always present. However, we don't want nucleation to overwhelm growth since we need crystals that correspond to the required specification. Thus nucleation is substituted by seeding consisting in the addition of already formed crystals to the solution in order to enhance the growth phenomenon. This way the crystals size increase can be related to the residence time and the crystallization process can be easily controlled.

13.1 Growth ratio estimation

Let's consider 1 kg of crystal seeds whose granulometric distribution is reported in Table 13.1. Using the conversion Table 13.2 and supposing that the crystal growth does not depend on crystal dimension (Delta-L law validity) it is namely required:

- To evaluate crystals final mass after a 0.080 mm growth;
- To calculate the growth corresponding to a final growth ratio ($\frac{W_f}{W_0}$) equal to 1.5.

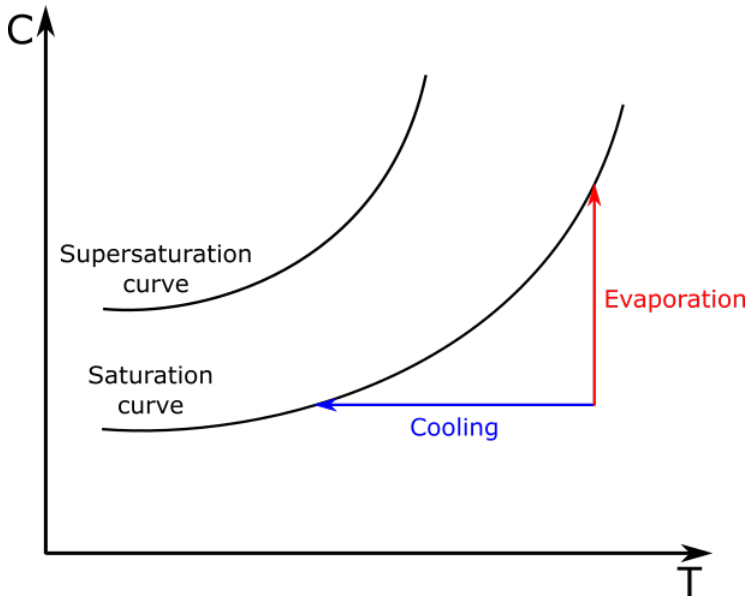

Figure 13.1: Saturation and supersaturation curves

mesh -	**mesh +**	**Mass fraction**
	<14	0.002
14	20	0.023
20	28	0.183
28	35	0.285
35	48	0.341
48	65	0.124
>65		0.042
tot		1

Table 13.1: Seeds granulometric distribution

mesh	**Size [mm]**
14	1.345
20	0.921
28	0.617
35	0.493
48	0.334
65	0.241

Table 13.2: Mesh to size conversion table