11.3 Post-crystallization Processes

In practice, absolute solid–liquid separation is unrealistic. The separation efficiency of the melt crystallization process could be decreased dramatically as a result of the inevitable adhering and liquid inclusions of the residual melt in crystals forming by three mechanisms:[2]

1. Nucleation processes at high supercooling
2. High crystal growth rates
3. Adherence of residual melt at the end of process

Therefore, additional purification steps including sweating and washing (post-crystallization processes) are necessary to obtain the desired purity.

11.3.1 Sweating

Sweating is a temperature induced purification process.[2,18,26] After the crystallization process, the temperature of cooled surface is raised to close to the melting point of the pure component. Due to the lower melting point of impurity-rich part of the crystal layer, the impurities included during the nucleation step, as well as the liquid inclusions could remelt and flow out. All the liquid, including the adhering melt residue, will drain off under gravity, which leaves the crystal product with a higher purity. Besides, higher temperature decreases the viscosity of the liquid phase, which further helps the draining of contaminated liquid. According to Ulrich and Delannoy *et al.*, with the sweating process, the distribution coefficient could decrease from 0.4 to 0.2, or 0.6 to 0.3 under different crystal growth rates, which means that sweating could have the same purification effect as a recrystallization process in some cases.

Along with the purity increasing, more crystals will be remolten and drain off, causing a decrease of yield. Therefore, a balance needs to be achieved from both economic and technical points of view. Compared to recrystallization, the sweating step performs much faster (about 1/3 to 1/9 of a crystallization process) and it does not need another phase transformation (the product has to be remolten anyway), saving both time and energy. Hence, the sweating operation is widely used in almost every melt crystallization process.

11.3.2 Washing

When talking about washing, it can be divided into two different processes, rinsing and diffusion washing.[2,18,26] In a rinsing step, the contaminated liquid adhering to the crystal surfaces is substituted by a purer washing