



**Figure 11.18** Pastille crystallization process.

this case, pastilles which have similar size could help to improve the flow conditions and promote washing efficiency in the purification process afterwards. Besides, crystals grow faster during the solidification process under higher sub cooling degree and help to increase production capacity. Also, with an easily realized granulation process and better washing effect, the pastille crystallization method can be operated continuously. However, the granulation device could be complicated and expensive, which will increase the capital cost.

#### 11.4.3.2 Eutectic Freeze Crystallization (EFC)

The eutectic freeze crystallization method (EFC),<sup>45–47</sup> a double crystallization method (generates two kinds of crystals simultaneously), was firstly proposed for brine disposal in the 1970s. The basic principle is that when the aqueous solution is cooled slowly, both ice and salt will crystallize out due to the eutectic property of the system, and they can be easily separated because of the huge density difference between salt and ice. In this case, the eutectic composition is no longer the separation limit for freeze (melt) crystallization. This concept could also be used for a ternary or multi-component system. Hengstermann<sup>9</sup> found that the addition of ice to an acrylic acid bed could optimize the properties of crystal bed and improve the performance of the solid–liquid separation process significantly.