to separate isomers, strict requirements about the equipment and high cost are inevitable. However, the large difference between the melting temperatures of isomers makes melting crystallization an applicable and highly efficient separation method, with 2 to 10 times smaller reflux ratio as well as smaller energy consumption.

Finally, high separation efficiency is also one of the most remarkable advantages of melt crystallization. Theoretically, absolute pure product could be obtained within one separation step for eutectic systems which account for 54.3% of the known two-component organic mixtures. Although 31.6% of the binary systems tend to form molecular compounds or to have peritectic and eutectic points, only 14.1% of them belong to a solid solution forming system, which could only be purified step by step and be operated like a distillation process to achieve high purity.

However, melt crystallization also has its disadvantages. The uncrystallized melt or impurities are easily included into the crystal layers because of the fast crystal growth rate. Also, impurities or uncrystallized melt can readily adhere to the crystal surface as a result of the high viscosity and high slurry density of the melt system. Meanwhile, high viscosity and high slurry density of the melt system also makes the transportation and downstream processing more difficult than in solution crystallization. It also results in a more complicated structure of melt crystallizer. Therefore, multistage crystallization or post crystallization treatments are necessary for a melt crystallization process.

11.1.3 Material Selection

Theoretically, melt crystallization could be used for all the systems which are stable in their molten state. However, as mentioned before, since the crystalline products are usually obtained in their liquid form for melt crystallization, the melt crystallization technique is mainly used for the purposes of purification or ultra-purification, separation or concentration. Nowadays, distillation has been developed as the standard and mature unit operation in most chemical separations. Therefore, melt crystallization has been typically used in purification applications where distillation becomes difficult,[10,11] such as:

1. Isomers with close boiling points
2. Azeotropic systems
3. Temperature sensitive substances
4. Components that tend to polymerize
5. Explosive substances

So far, some successful industrial applications of melt crystallization include acrylic acid, bisphenol A, caprolactam, cresol, dichlorobenzene, fatty acids, naphthalene, paraffin, xylene, juice, beer, dairy, and so on.[12]