Industrial Crystallization: Some Fields of Problems – Polymorphs, Pseudopolymorphs and Impurities

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In industrial crystallization it is mostly the aim to separate or purify substances. The process of crystallization is used in the production of a wide range of materials, ranging from bulk commodity chemicals to pharmaceuticals. For different purposes particular substances with specific crystal size distributions or even certain crystal shapes are demanded.

The previously mentioned aspects are linked, which can easily be seen if solid/liquid phase separation is discussed. Crystals exhibiting a rather large and uniform size are best to be separated from impure residue mother liquor. However, often even small amounts of impurities have great effects on crystal morphology. Besides crystal morphology, also solubility, metastable zone width, crystal growth etc. can be influenced by impurities.

This applies also to polymorphs and pseudopolymorphs. Impurities – or additives, if deliberately present – can affect crystal shapes as well as the conditions that determine the stable forms in terms of thermodynamics (polymorphs: temperature, pressure; pseudopolymorphs: temperature, pressure, solvent composition). Often e.g. a simple change in temperature might lead to phase transformations. However, these transformations do not only occur in suspension, but also during subsequent process steps like filtration. During vacuum filtration, which causes a temperature reduction, the possibility of phase transformations is given when exceeding a critical temperature (transition point). Complete or partial transformation does not only have an effect on the filterability and therewith the purity, but also on secondary characteristics such as flow or physical properties.

Besides the already mentioned ways in which additives may exert influence on crystallization processes (solution properties, growth rate, CSD etc.), also transformation rates may vary due to different concentrations of impurities. Therefore, being able to estimate the effects of impurities is crucial. With this knowledge, impurities can be used to improve crystallization processes as well as crystalline products and impurities can become a powerful tool in solids' production.