Research and development of an MSMPR crystallization of NaCl for the purpose of purification of suspended crystals

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Summary

An experimental apparatus of an MSMPR crystallizer was newly constructed in order to develop the operation to purify the suspended NaCl crystals. The apparatus can control the operative pressure that also fixes the operative temperature in crystallization vessel. The operative supersaturation can be controlled by heating power input and residence time that is determined by strong tube pumps. The apparatus performed very good crystallization with stable state. The possible operative variables in our experiments are vaporization rate, residence time, slurry density, impurity concentration of the solution. Impurity components are Ca, Mg, and K of chloride salts. Vaporization rate, residence time and slurry density were fixed in early stage experiments. The operative variable was impurity concentration in this experiments.

We obtained CSD (crystal size distribution) of product NaCl crystals at different impurity concentrations. The CSD ranged from 100mm to 1000mm. The CSD data were correlated by the population balance equation, and could be adjusted by a linear relationship between crystal size and population density. We considered the effect of impurity concentration on growth rate and nucleation rate. When impurity concentration increased in the solution, slurry density in the solution decreased essentially. Consequently, the growth rate increased but the nucleation rate decreased as impurity concentration increased.

Generally, impurity concentration in the suspended crystals increased proportionally to impurity concentration in the solution, but the decrease of crystal density due to impurity contents in the solution may decrease the crystals' contact probability. This matter should be significant to design an evaporative MSMPR crystallizer, and we will conclude in the next project. In addition, we have already observed that the attrition growth increased the mother liquor inclusion ratio for KCl crystals such as NaCl crystals. Impurity concentration of NaCl crystals increased with the crystal size increasing.