

Research and Development of an MSMPR crystallization of NaCl for the purpose of purification of suspended crystals, 2nd Report

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Summary

An experimental apparatus of an MSMPR crystallizer was constructed in order to develop the operation to purify the suspended NaCl crystals. The apparatus performed very good crystallization with stable state. The operative variables in our experiments were impurity concentration in the solution and slurry density (as a function of residence time). As for the concentration process of seawater, the membrane process is the primary method in Japan. Therefore, K component is the significant since impurity components are Ca, Mg, and K in seawater.

We obtained CSD (crystal size distribution) of product NaCl crystals at different operative conditions. The CSD ranged from 100 μm to 1,000 μm . The CSD data were correlated by the population balance equation, and could be adjusted by a linear relationship between crystal size and population density. 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. Impurity concentration in the suspended crystals increased proportional to impurity concentration in the solution, and distribution coefficients of K increased with impurity contents in the solution. Impurity concentration had a minimum value as a function of crystal size. Small crystals had much impurity, and impurity concentration decreased immediately with crystal size, and it increased slightly with crystal size again. The inclusion mechanism of NaCl crystals was similar to both KCl crystals with attrition growth and KDP crystals with aggregation of small crystals. We also considered the hardness of NaCl crystals as a function of crystal size, too.