"Reactive crystallization in the recovery of dissolved resources in seawater"

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Summary

[Problems] Few studies have been made of the kinetics of precipitations in the recovery of dissolved resources in seawater. Magnesium hydroxide is produced industrially by the precipitation from brine with calcium hydroxide. To make clear the characteristics of the precipitation kinetics is important for better design and more efficient operation of recovery of magnesium hydroxide from brine.

The objectives of this work are to discuss the effect of the operating factors, that is, the initial concentration of feeds, residence time of reactants, feed ratio of reactants, and concentrations of hydroxide, chloride and sulphate ions on crystallization kinetics of $Mg(OH)_2$ and to make clear the effect of the concentrations of anions on the kinetic order in the power law model.

[Experimental methods] The crystallizer was a 1 ℓ stirred tank reactor considered to be a continuous MSMPR reactor. $MgCl_2$, $MgSO_4$ and $Ca(OH)_2$ as feed solutions were pumped into the crystallizer continuously to produce $Mg(OH)_2$.

Experiments were conducted with stoichiometric feed ratio and variable feed ratio of reactants. Crystals obtained were photographed by the scanning electron microscope and their sizes were analyzed by a digitizer. The CSD of $Mg(OH)_2$ is expressed by Bransom model, so that the crystal growth rate G and the nucleation rate B^0 are obtained.

[Results and Discussion] As the crystal form of $Mg(OH)_2$ is composed of disklike units and its crystal structure is CdI_2 type, the standard unit of $Mg(OH)_2$ crystal is considered to be a disk. The ratio of diameter to thickness of the disk of crystal unit is nearly constant. The crystal volumes were calculated for the unit numbers of disks n_u, so that the volume shape factors were obtained as a function of n_u. Average unit number of disk $\tilde{n}_u$ is expressed by a function of concentrations of anions. The relations between B^0 and G with concentrations of anions as a parameter are expressed by the power law model. The kinetic order i increases with increase of concentrations of anions.

[Conclusion] Kinetic order i of $Mg(OH)_2$ made by precipitating $MgCl_2$ and $MgSO_4$ with $Ca(OH)_2$ is correlated with the concentrations of anions.