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

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Summary

[Problems] The kinetics of precipitations in the recovery of dissolved resources in seawater have been studied recently. 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 concentration of sodium chloride, residence time of reactants, and stirrer speed on the crystallization kinetics of $Mg(OH)_2$ and to make clear the effect of the concentrations of anions or the ion strength 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. Mixed solutions of $MgCl_2$, $MgSO_4$ and NaCl(model solution of sea water) 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 of reactants. Agglomerated particles obtained were photographed by the scanning electron microscope and their sizes were analyzed by a digitizer. The particle size distribution of agglomerated $Mg(OH)_2$ is expressed by $\Delta L$ law when the attrition by stirrer does not influence or by Bransom model when the attrition affects appreciably. The apparent particle growth rate G and the apparent nucleation rate $B^0$ were obtained by either model.

[Results and Discussion] The apparent growth rate and nucleation rate of agglomerated paticles decrease with increasing residence time owing to the decrease in feed rate. The growth rate decreases and the nucleation rate increases with increasing concentration of sodium chloride. The relations between $B^0$ and G with concentrations of anions as a parameter are expressed by the power law model, that is, $B^0=kG^i$. The kinetic order i increases with increasing concentrations of chloride ion or the ion strength by the following correlation:

$$i=0.121\mu^{0.307} \qquad (1)$$

[Conclusion] Kinetic order i of agglomerated $Mg(OH)_2$ particles made by precipitating $MgCl_2$, $MgSO_4$ and NaCl with $Ca(OH)_2$ is correlated with the ion strength.