

Triggering the Growth of Magnesium Hydroxide Crystals in Stirred Tank Crystallizers using Sodium Hydroxide Solutions

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Magnesium (Mg) has been listed by the European Commission as one of the 30 critical raw materials for its high supply risk and relevance to the European economy. Mg is extracted from magnesium-rich minerals that are mainly located in China. In this context, alternative sources are urgently sought to strengthen the domestic European supply.

Industrial or natural brines (or bitters) have been identified as key candidates due to their high Mg concentration. Mg can be extracted from brines/bitters in the form of Magnesium Hydroxide ($Mg(OH)_2$) via reactive crystallization by using an alkaline solution, namely sodium hydroxide (NaOH). The use of NaOH allows highly pure $Mg(OH)_2$ products to be synthesized. On the other hand, products were always characterized by nano-globular or flakes morphology. These characteristics do not comply with the flame retardant market that requires large hexagonal $Mg(OH)_2$ crystals. The present work introduces an experimental campaign aiming at triggering $Mg(OH)_2$ crystal growth by controlling reactive crystallization operative conditions. The challenge is to favour the crystal growth and, at the same time, to limit the nucleation mechanisms. Relatively concentrated synthetic sodium hydroxide and magnesium chloride reactant solutions were employed and let to react in a stirred tank crystallizer fed in single and double modes. The influence of the reactant concentrations and flow rates was analysed. Precipitated particles were characterized by laser diffraction, dynamic light scattering and electron microscopy techniques.

Nano-flakes $Mg(OH)_2$ crystals with a mean size of $50\div 70$ nm were produced in single-feed configurations. Conversely, for the first time in the literature, grown well-defined $Mg(OH)_2$ hexagonal platelets characterized by a mean size of $300\div 360$ nm were successfully synthesized in double-feed mode, see attached Figure.

Results pave the road to the industrial production of $Mg(OH)_2$ hexagonal crystals recovered from brines/bitters via NaOH solutions.

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