

Dissolution and Crystallization of Carbonate Using CO₂ Micro Bubbles

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Summary

With the development of micro-scale bubble generation technology (below 50 μ m), remarkable attention has been paid for the utilization of the so-called "micro bubbles". Several micro-bubble techniques have been applied for water purification of enclosed area (lake, marsh and inner bay) and resuscitation of ecosystem in regard with biological characteristics. In these applications, the common concept of micro-bubble technique lies in the utilization of oxidation effect by oxygen in air. Meanwhile, the researches about the particle size and morphology of calcium carbonate have been widely carried out. Furthermore, dissolution of calcium carbonate has been investigated. The reason is that calcium carbonate is one of the scaling factor in crystallizer. In this study, for the purpose of a development of new production process utilizing micro bubbles of water-soluble acid gas, dissolution and crystallization of calcium carbonate using CO₂ micro bubbles was investigated. Carbon dioxide (CO₂) was selected as a gas feed source of carbonate ion and ammonia was used as adjustment gas of pH, and calcium carbonate was produced by semi-batch type reaction in which CO₂ micro bubbles are continuously supplied. The solution temperature was kept constant at 298K, and feed rate of CO₂ (F_{CO_2}) and molar ratio of mixture gas (CO₂/NH₃) were varied as a operating parameter. After CO₂ feeding was employed at a specified time, the precipitated particles were filtrated, and dried at 343K for 60 minutes under reduced pressure. To clarify the progress of crystallization and dissolution, various physicochemical measurements were carried out with regard to solution properties (pH, concentrations of carbonate and calcium ions) and solid product characteristics (total weight, shape observation by scanning electron microscope, size distribution, and identification by X-ray diffraction). Selectivity of the polymorphism of calcium carbonate was calculated from the peak strength of the X-ray diffraction.

Consequently, it was cleared that following: 1) Reactive crystallization of CaCO₃ was occurred when pH was adjusted by micro bubbles that mixed NH₃ into CO₂. 2) At CO₂ feed moles below 60 mmol, the selectivity of vaterite was higher independent of the amount of CO₂ feed moles. 3) A smaller size of vaterite crystal (2.4 μ m) was obtained by feeding of CO₂/NH₃ micro bubbles. 4) In the case of CO₂ micro bubbles, dissolution of produced CaCO₃ was occurred when pH shifts to acidic range due to the progress of CO₂ absorption. 5) In the case of NH₃/N₂ micro bubbles, recrystallization of CaCO₃ was occurred when pH shifts to alkaline range due to the progress of NH₃ absorption.