

수성 에탄올과 이소프로판올 용액에서의 탄산칼슘 특성에 관한 연구

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A Study on the Characteristics of Calcium Carbonate in Aqueous Ethanol and Isopropanol Solutions

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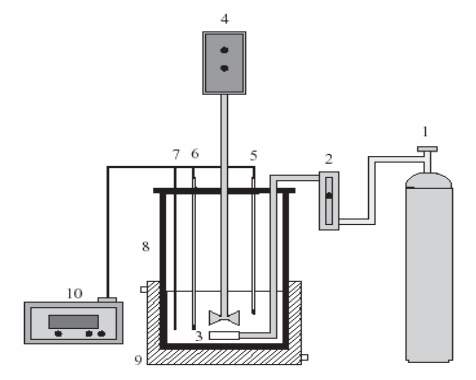
Introduction

Calcium carbonate, as one of most widely existed biominerals produced by organisms, has three crystal phases calcite, aragonite, and vaterite[1,2]. The calcium carbonate used in industries could be classified into limestone powder, ground calcium carbonate, and PCC by their shape, particle size and preparation method. PCC is synthesized by modifying the morphology of calcium ore and by using the compound that has a calcium and carbonate radical. Due to its properties such as uniform shape and size, which are more effective than any other type CaCO_3 , applications of PCC are as diverse as rubber, plastics, paper, paints, food, adhesives, and so on.

From an aqueous slurry of Ca(OH)_2 suspension, CaCO_3 can be synthesized via a couple of processes such as coprecipitation or the carbonation route [3-5]. The coprecipitation method is often adapted in a laboratory study because of its simplicity of operation or its ease in the control of process variables. The most widely used method to synthesize CaCO_3 on an industrial scale is the carbonation route [6,7] which consists of bubbling CO_2 gas through the aqueous slurry of Ca(OH)_2 in a batch process, due to its low cost and the availability of the raw materials[8]. This paper intends to investigate the effect of aqueous ethanol and isopropanol solutions as a solvent on the morphology of precipitation of calcium carbonate in the carbonation process. We focus on the synthesis of PCC in ethanol and isopropanol as a solvent and how PCC was synthesized at constant experimental conditions.

Results and discussion

To investigate the effect of ethanol and isopropanol solution as a solvent on the morphology of PCC at constant experimental conditions in the carbonation process, the calcium carbonate was precipitated in pure ethanol, in pure water and in the five kinds of ethanol(20~80mol%)-water mixing solutions. Also calcium carbonate was precipitated in the four kinds of isopropanol(2~10 mol%)-water mixing solutions. Each solution, a suspension of 30g of $\text{Ca}(\text{OH})_2$ (Junsei, EP.) in 500ml of each solvent, was prepared in the Pyrex reactor($\phi=120\text{mm}$; $h=150\text{mm}$) as shown in Fig. 1.



1. CO_2 gas cylinder. 2. Gas regulator. 3. Sparger.
4. Stirrer. 5. Thermometer. 6. pH meter.
7. EC meter. 8. Reactor. 9. Water bath.
10. Recorder.

Fig. 1. Experimental apparatus for precipitation of calcium carbonate.

1. Precipitation of CaCO_3 in pure water and in ethanol water mixing solution as the solvent

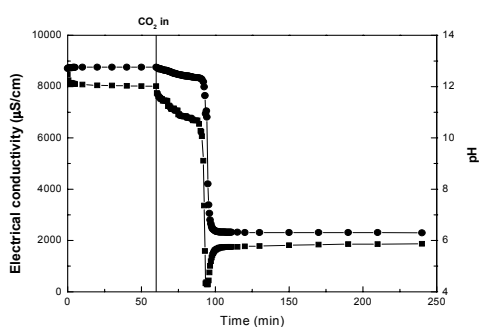


Fig. 2. Variation of EC (■) and pH (●) with reaction time in $\text{Ca}(\text{OH})_2$ -pure water slurry by introducing CO_2 gas.

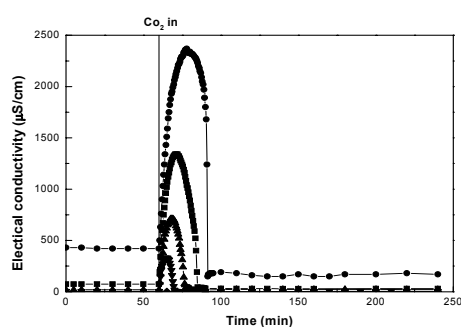


Fig. 3. Variation of EC with reaction time in $\text{Ca}(\text{OH})_2$ -ethanol-water aqueous slurry by introducing CO_2 gas.

The traditional carbonation experiment in pure water was carried out at 25°C . It's EC and pH variations are shown in Fig. 2 and the traditional carbonation trend clearly appears. After 36min of carbonation reaction, the dissolving rate of CO_2 is larger than its consumption rate, owing to the limited amount of Ca^{2+} , resulting in the accumulation of HCO_3^- , CO_3^{2-} , and H^+

4mol %) brought colloidal calcium carbonate. Also, in case of isopropanol additive system, calcite, which was the most stable form of PCC, was dominant. This mean that particle size of PCC and PCC type can be controlled in the isopropanol-water system. However, effect of reaction temperature, $\text{Ca}(\text{OH})_2$ concentration, CO_2 flow rate etc.. may have to be considered to create equal particle.

Conclusion

Particle size and types of PCC could be controlled in ethanol-water and isopropanol-water solution systems. In the aqueous solution of less than 40 mol% ethanol, PCC is all calcite; therefore, water has dominant effect as the solvent. On the other hand, in the solution of more than 60 mol% ethanol, the solvent acts as the pure ethanol and calcite, aragonite and vaterite can be precipitated.

PCC from homogeneously dispersed $0.1\mu\text{m}$ to heterogeneous $0.2\mu\text{m}$ could be obtained in isopropanol-water system. When calcium carbonate was formed in the low concentration of isopropanol (less than 2mol %), it appeared as the cubic type. However, the high concentration of isopropanol (more than 4mol %) brought colloidal calcium carbonate.

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