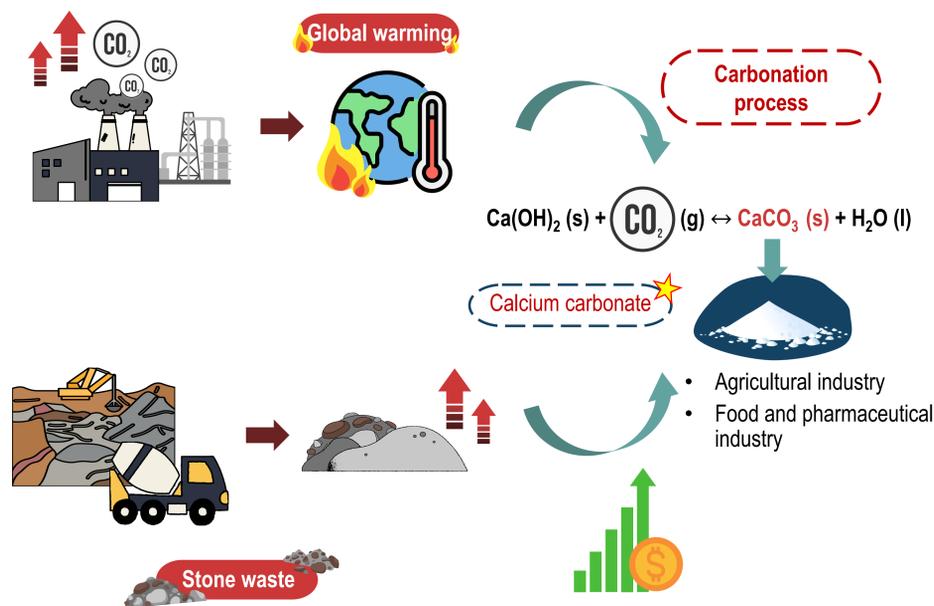


## Abstract

This research has investigated calcium carbonate production from stone waste using a pH-swing method involving acid and base treatments. Calcium ions are leached from solid stone waste using two acid solutions: hydrochloric acid (HCl) and acetic acid (CH<sub>3</sub>COOH). The carbonation process is then initiated by bubbling carbon dioxide gas through the solution, under pH control, in sodium hydroxide (NaOH) or ammonium hydroxide (NH<sub>4</sub>OH) solutions. The as-synthesized calcium carbonate samples were characterized to determine their crystal structures, morphologies, and elemental compositions using X-ray diffraction (XRD), scanning electron microscopy (SEM), and energy-dispersive X-ray spectroscopy (EDS), respectively. The XRD patterns confirmed the high crystallinity of both calcite and vaterite calcium carbonate phases. Moreover, SEM analysis revealed spherical and cubic morphologies of the fine samples. EDS analysis further confirmed the presence of Ca, C, and O, which are consistent with the XRD and SEM results. Under the HCl and NH<sub>4</sub>OH conditions, about 90% yield of calcium carbonate was produced, and 4.7 g of CO<sub>2</sub> is permanently stored per 5 g of solid stone waste. These findings highlight the potential of the pH-swing carbonation process for effective CO<sub>2</sub> capture and the valorization of stone waste, contributing to advancements in sustainable waste management strategies and carbon capture technologies.

## Introduction

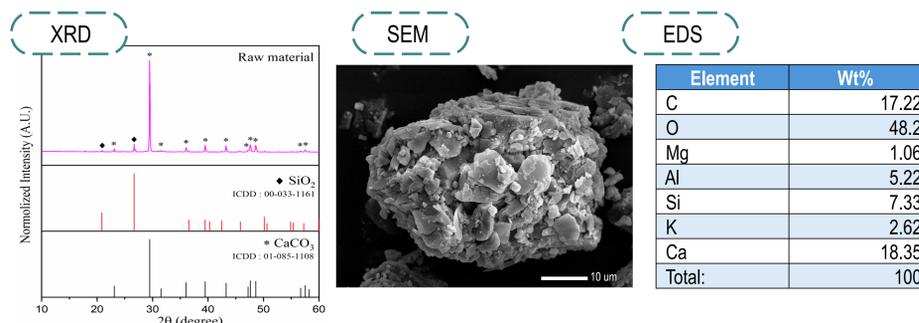


## Objective

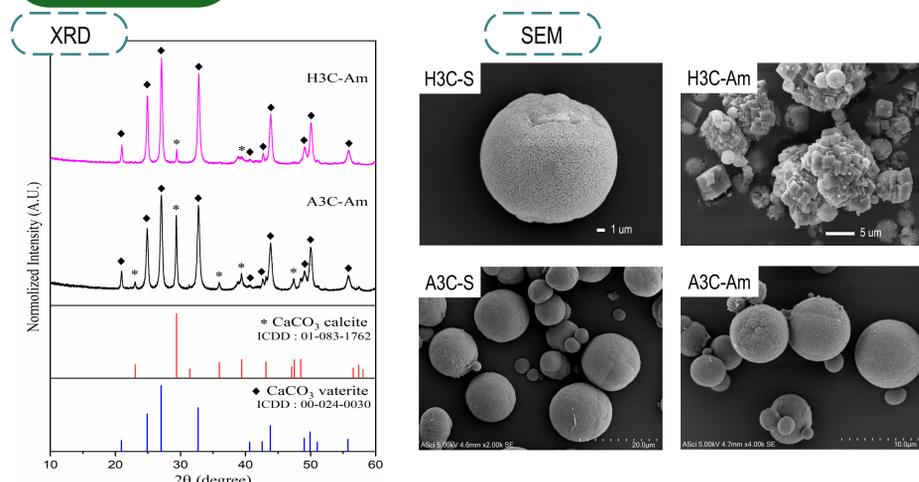
- To study the synthesis of calcium carbonate from stone waste using a carbonation process and analyze the characteristics of the calcium carbonate.
- To study and explore the influence of base type on the yield of calcium carbonate.

## Results and Discussion

### Raw material



### Product CaCO<sub>3</sub>



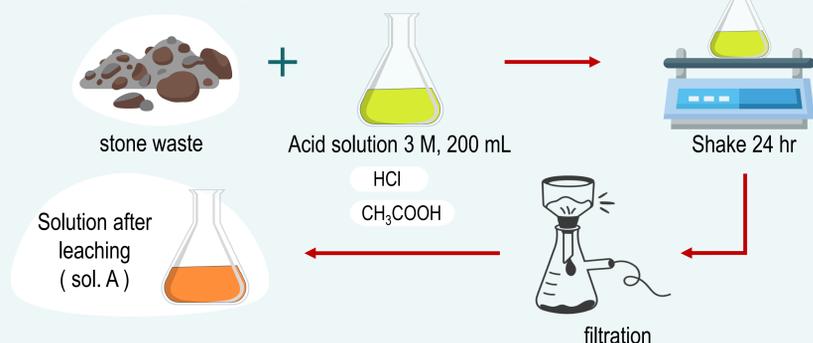
### Calcium carbonate yield from synthesis by stone waste 5 g

Name	Weight of CaCO <sub>3</sub> (g)	%yield of CaCO <sub>3</sub>	Weight of CO <sub>2</sub> (g)
H3C-S	0.7158	14%	0.3147
H3C-Am	4.6713	92%	2.0540
A3C-S	0.6988	14%	0.3073
A3C-Am	3.8862	77%	1.7088

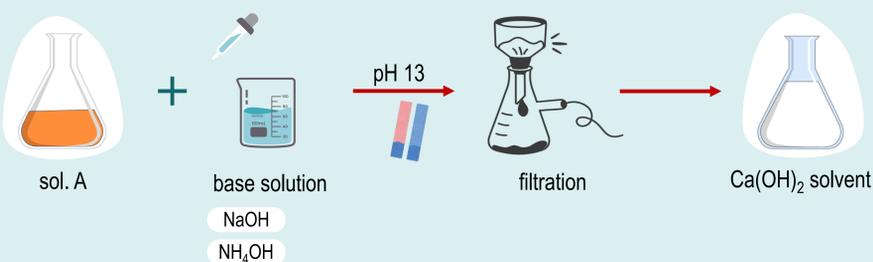
★ The best conditions for CaCO<sub>3</sub> production are HCl acid and NH<sub>4</sub>OH base, with over 90% synthesis and a CO<sub>2</sub> capture of 2 g.

## Experiment

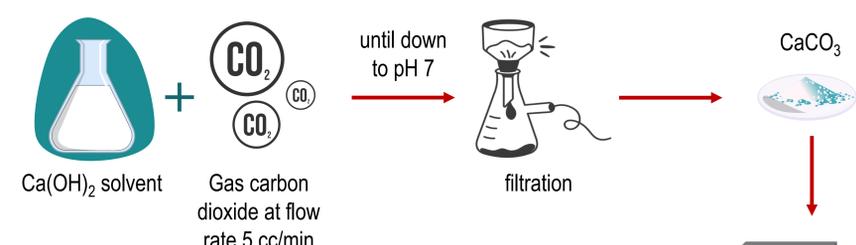
### step 1 : Acid leaching process



### step 2 : pH control process



### step 3 : Carbonation process



### condition synthesis calcium carbonate

Acid	Base	
	NaOH	NH <sub>4</sub> OH
HCl	H3C-S	H3C-Am
CH <sub>3</sub> COOH	A3C-S	A3C-Am

★ Product CaCO<sub>3</sub>

## Conclusion

- CaCO<sub>3</sub> was successfully produced from stone waste via CO<sub>2</sub> gas, as confirmed by XRD SEM.

**Morphology**  
Spherical : H3C-S, A3C-S, A3C-Am  
Cubic and Spherical : H3C-Am

High crystalline and purity phase

- Under ammonium hydroxide base condition

HCl > CH<sub>3</sub>COOH

The best conditions for CaCO<sub>3</sub> production are H3C-Am.

92%

## Acknowledgement

I would like to thank Asst.Prof. Dr.Yothin Chimupla and Ms.Pemika Chaichana for their ideal and experimental support. I would like to thank Asst. Prof. Dr. Adisak Saiyakul and all PTEM Laboratory members for their kindness while I started this project in PTEM Laboratory

## Reference :

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