Innovatively Simple, Low-Cost Technology for P Recovery Using Amorphous Calcium Silicate Hydrates (A-CSHs)

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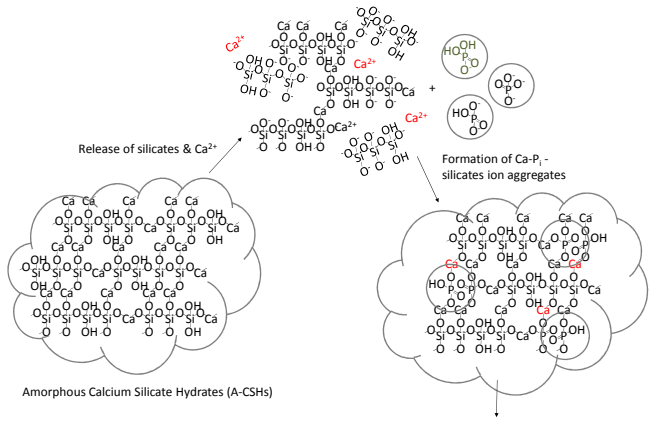
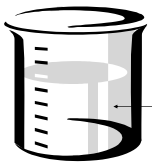
Concrete sludge: a waste generated in construction sites.
Steelmaking slag: a byproduct in the iron and steel industry.



Okano, K. et al., Separation and Purification Technology, in press.

Acid-treatment

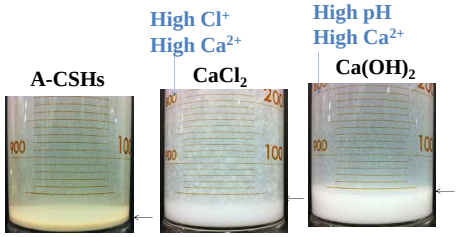


1 M HCl

A-CSHs

Anaerobic digester

Mobile pilot plant



Ten-min precipitation without adding chemical coagulants

Okano, K. et al., Water Research (2013)

Recovered P product

A simple, low-cost technology for P recycling has been developed using amorphous calcium silicate hydrates (A-CSHs) in Japan. Laboratory experiments have revealed that chemically synthesized A-CSHs can serve not only as a P adsorbent but also as an aggregation agent (Okano et al., 2015). A-CSHs can be obtained simply by treating crystalline calcium silicates such as concrete sludge and steelmaking slag with acids. Concrete sludge is a waste generated in construction sites, while steelmaking slag is a byproduct in the iron and steel industry.

The high reactivity and settleability of A-CSHs made the P recovery process very simple and cost-effective. The P recovery from aqueous solutions requires only 10-min mixing and 20-min settling, followed by 30-min filtration using a filter-cloth bag. Demonstration experiments have been performed at a wastewater treatment plant using a mobile pilot-scale plant. Experimental results have showed that approximately 80% P could be recovered from anaerobic digestion liquor using the simple process.

The recovered P product can be directly used as a byproduct phosphate fertilizer. The contents of heavy metals have never exceeded their standards in commercial phosphate fertilizer. It can also be used for the manufacture of organic fertilizer by mixing the recovered P product with wood waste composts. Further study is needed to automatize and scale up the simple process for the full application to P recycling.

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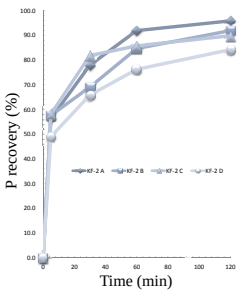

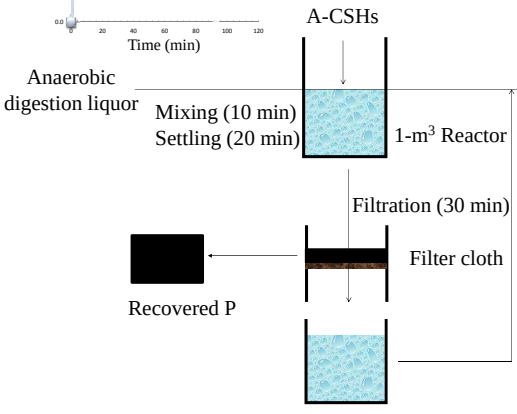

No carbonate inhibition on P recovery (pH7-9)

Wood waste compost

Fertilizer application