Microgravity Investigation of Cement Solidification (MICS)

A MSFC Materials & Processing Laboratory (EM31) Experiment Proposed for the International Space Station

Introduction

Concrete is the most widely used construction material on Earth. Cement/concrete hardens through a series of very complex chemical and crystal growth processes.

Not all Cement Crystals are Good!

Secondary Ettringite is Detrimental

- Its formation is still not fully understood.
- Closely linked to fluid transport through pores?

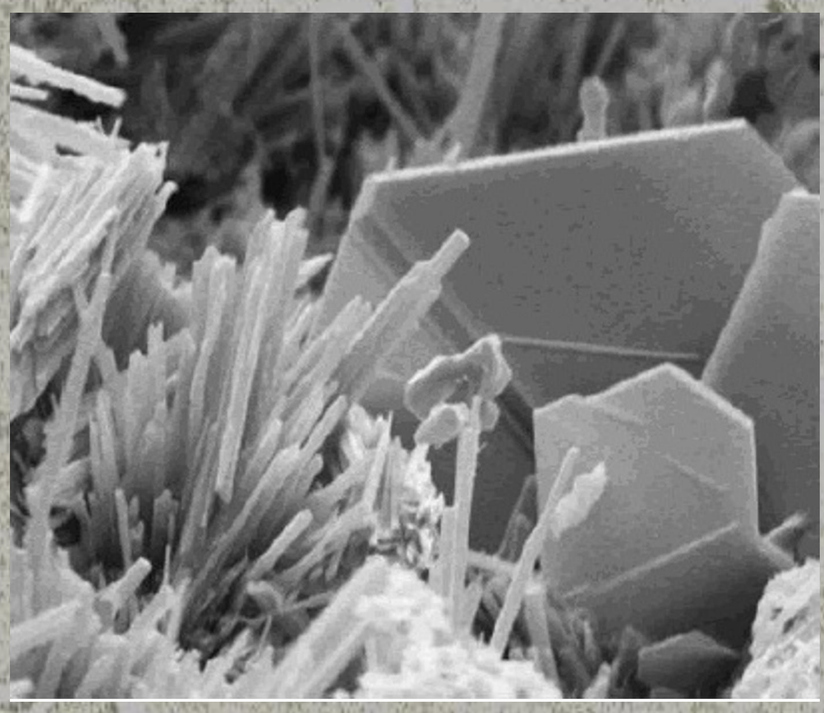
On the Space Station:

- Gravity driven flow eliminated.
- Buoyancy effects eliminated.

Microstructural development will be affected.

- Better understand the hydration reaction.
  - ♦ Crystal phase selection
  - ♦ Crystal growth dynamics

Ideally conducted in a "Glove Bag" on the ISS



SEM image of cement paste showing flat calcium hydride and needle-like ettringite phases. Powers, T.C., Brownyard, T.L. (1947)Journal of American Concrete Institute Vol. 43, p. 669 (PCA Bulletin 22).

Proposed Space Station Experiments

ISS Experiments being conducted in a "Glove Bag"

Water and Cement Separated by a Burst Seal

Mixing Water with the Cement

Finished Product

Can you mix it?
Do you think the Astronauts can mix it?

Investment Return

1) Basic questions related to cement solidification will be answered.
   - A small gain in understanding cement/concrete technology could have enormous implications.
2) Additions of simulated lunar and Mars regolith will be added to some packets.
   - Results will provide a baseline toward utilizing in-situ resources for construction purposes on extraterrestrial bodies.

Background: Calcium carbonate crystals formed as a result of C-S-H carbonation. Rouhollah Alizadeh