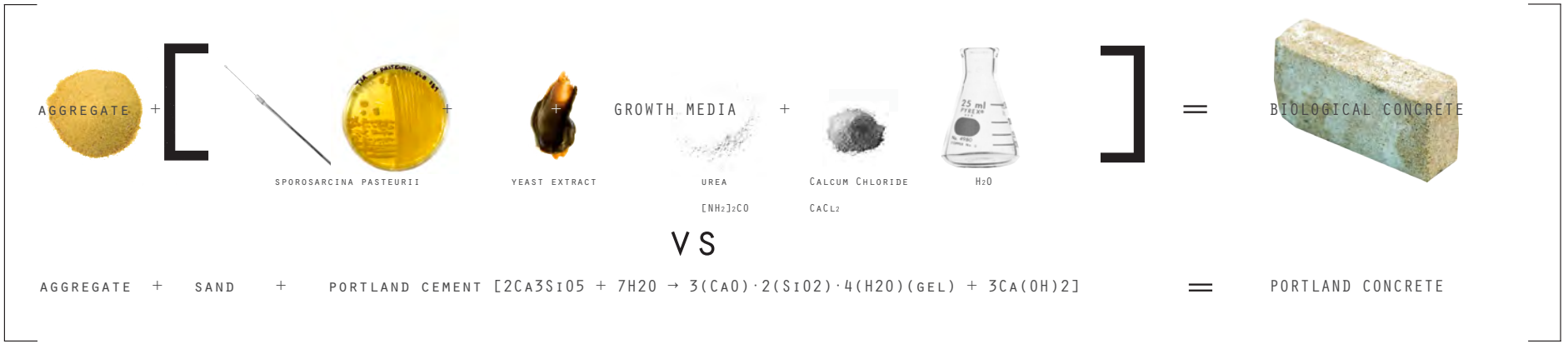
# Ginger Dosier

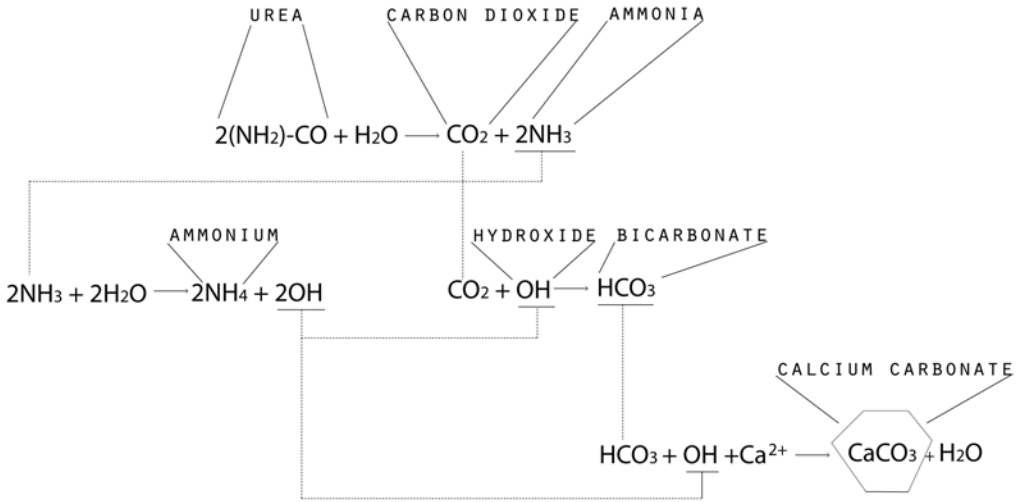
American University, UAE

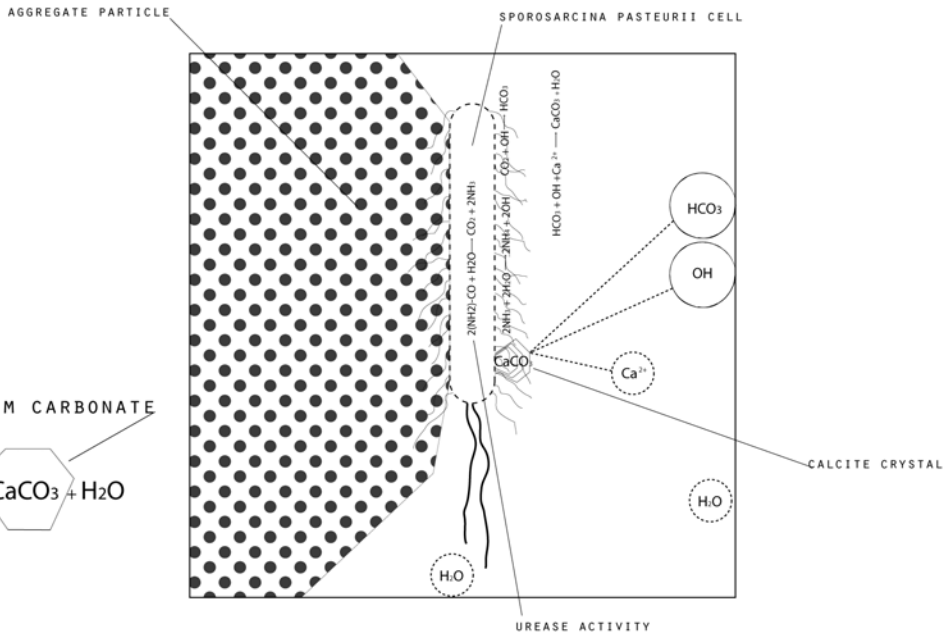



_Sporosarcina Pasteurii [DSMZ 33] a nonpathogenic, common-soil bacterium naturally has the ability to induce the production of calcite through a chemical reaction, fusing loose aggregate. a hardened material is formed in a process known as microbial induced calcite precipitation [MICP] [Stocks-Fischer et al, 1999].

_The produced material acts as a binder, similar to Portland cement within concrete.

_The material can be manufactured within a range of temperatures, with minimal materials, and can work with a variety of aggregates.



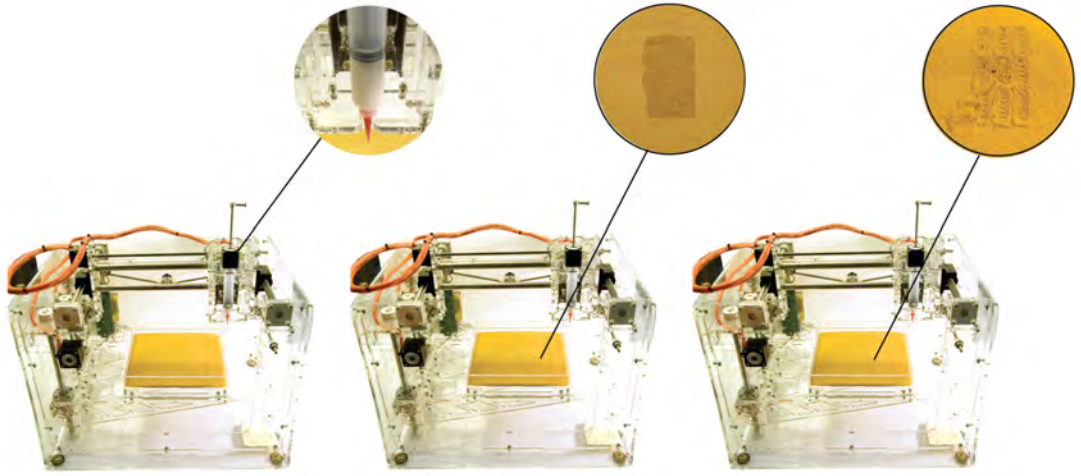

_The urease-producing microorganisms are mixed in a solution of urea and calcium chloride. The bacteria use urea as a source of energy, producing ammonia and carbon dioxide; increasing the pH level of the solution. The rise in pH forms a mineral ‘precipitate’, combining calcium with carbon dioxide [Ramachandran, et al, 2001].

_The bacteria then act as nucleation sites, attracting mineral ions from the calcium chloride to the cell wall, forming calcite crystals. Mineral growth fills the gaps between aggregate particles, biocementing the aggregate together.

_The resulting material exhibits physical properties similar to those of natural sandstone. This form of biocementation can take less than a few days to complete, and strength can be increased with additional time.

## MICP PROCESS

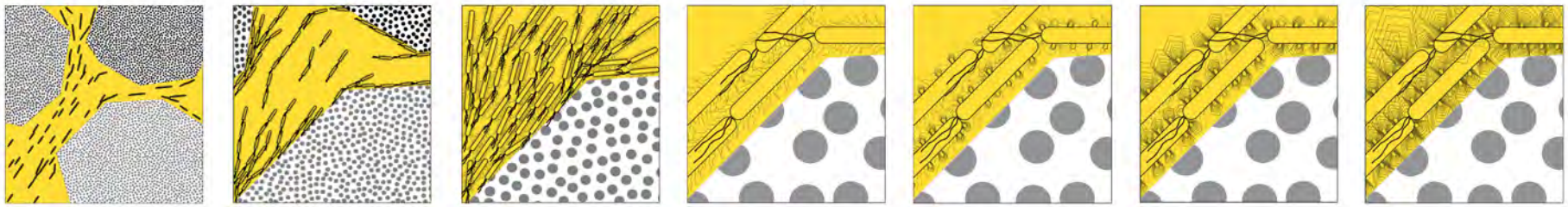
## CHEMICAL EQUATIONS

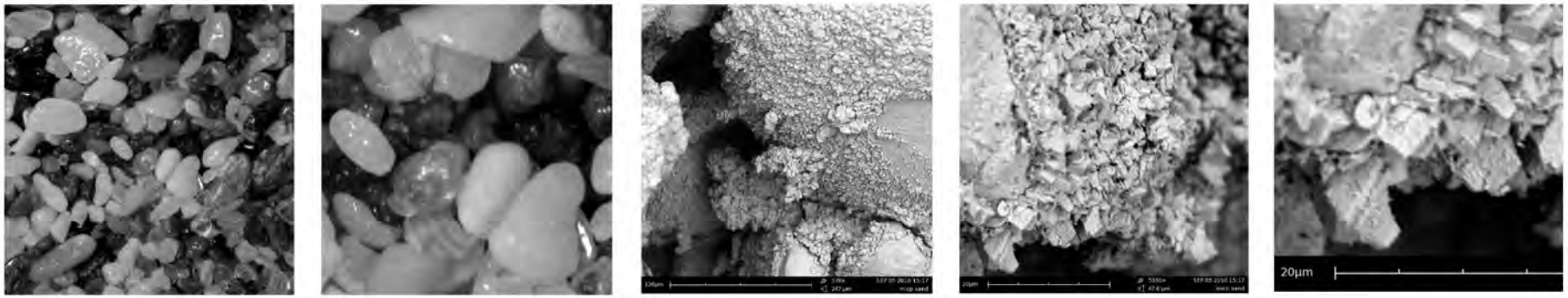



_Biomanufactured materials are either achieved utilizing manual casting methods, or automated by digital tooling to fabricate layered units  with a programmed material composition [Krieg-Dosier, 2008].

_The use of 3D printing technologies is economically  driven as it does not require formwork, generates little waste, accommodates a variety of potential materials, provides a high degree of accuracy, and allows for infinite variation.

[TECHNICAL CONCEPT] FABRICATION PROCESS [MANUAL VS AUTOMATED]






BENEFITS

_urease producing bacteria can be grown efficiently in a range of temperatures
_micp coatings retard water absorption
_locally sourced sand and aggregate material reduces the weight of materials requiring delivery to the site.
_biomanufacturing eliminates need for costly expendable formwork
_micp exhibits potential self-healing properties
_the material does not shrink during curing, a common problem in concrete construction
_cementation can be evidenced in less that 24 hours, depending on cell, urea, and CaCl2 concentrations
_micp can work with a variety of aggregates [results include: sand, glass, and various stone.]

[TECHNICAL CONCEPT]

GROWTH PROCESS_SEM