# bioMASON biobrick

Over 1.23 trillion fired clay bricks are produced each year, sending over 800 million tons of $CO_2$ into the atmosphere due to the burning of fuel in the firing process. Additionally, the production of Portland cement-based products emits over 4 billion tons of anthropogenic $CO_2$ due to the high fuel consumption in the fired conversion of limestone and shale production of Portland cement. The production of both clay brick and Portland cement also produces PM (particulate matter), attributing to further human health risks—2.4 million premature deaths can be attributed to black carbon every year.

Alternatively, nature is able to produce high-strength natural biological cements, such as coral, without negative impacts to the surrounding environment. At bioMASON, we have developed a technology that utilizes bacteria to produce durable cements in between grains of aggregate as a market-viable, green alternative to cement-based masonry products. Bacteria, which provide a precise environment to form in combination with a nutrient, nitrogen and calcium source allow for the formation of natural cement in ambient temperatures, taking less than 5 days to produce a pre-cast material, currently in masonry form.

The inputs for biocements are inexpensive, globally abundant, and may be sourced from waste byproducts. Our business model includes manufacturing the biologics (bacteria and nutrient feed stocks) and providing proprietary technical licenses for existing masonry manufacturers. There are over 67,500 masonry manufacturers (including both clay and concrete block) in the US alone. Over 40% of the cost of manufacturing traditional brick is in the fuel for kiln firing, and manufacturers are seeking alternative solutions to harden final product while reducing commodity-driven fuel dependency.

The raw input materials used in biocement production include sporosarcina pasteurii (bacteria anaerobically grown with NaCl, yeast extract), while cementation feed stocks include yeast extract, urea, and calcium chloride. These inputs are inexpensive, globally abundant, and manufactured in ambient temperatures. The water component used to deliver the cementation reagents is recycled in a closed-loop system and reused in the manufacturing process. Biomass ammonium byproducts are captured in a closed-loop system.

Since biological cements are formed in a different crystalline process than Portland based cements, recent tests have been successful with seawater. The production of yeast extract is a byproduct of the brewing industry and/or fermented in high volumes with yeast cells lysed with sodium chloride. The nitrogen component is currently sourced from urea, and may be sourced from wastewater (each human produces over 20g/L daily) or agricultural resources from swine and poultry production. Calcium, the final input for cementation is sourced from industrial grade Calcium Chloride, and can be sourced from an array of waste byproducts ranging from desalination brine effluent to calcium acetate.

All of the biologics are sourced from the US close to our Research Triangle Park laboratory high-volume fermenters. Additional cementation and water sources for growing cements, and aggregates, are locally sourced on-site. bioMASON is continuously working to reduce costs in the production of biologics and currently produces materials at .22/standard brick unit at small volume scale.