The Creation of Longer Lasting Concrete: An Analysis on the Infusion of Bacteria and Aggregates Into Cement Concrete to Increase Durability at Varying Temperatures by Examining the Substances Following Water Absorption

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Inducing bacteria into cement concrete can increase concrete durability and therefore its lifespan by preventing microcrack formation from the absorption of water. Bacteria have cell walls with the ability to produce $CaCO_3$, which can increase the compressive strength of a substance they inhabit and eventually, solidifying their structures as cells die. However, there is a lack of adequate data available to conclude which specific bacterium will increase the durability of a substance the most. Thus, the effects of four bacteria that each have unique properties (specifically Bacillus subtilis, Sporosarcina ureae, Staphylococcus epidermidis, and Synechococcus sp. PCC 7002) on cement concrete durability were assessed. A standard test to find the percentage of water absorption is modeled by the equation $(W1-W)/W \times 100$ where W is the initial mass and W1 is the mass after absorbing water for x days. This water absorption test was used to infer that both Sporosarcina ureae- and Staphylococcus epidermidis-infused concrete had the lowest average water absorption at a 0.17% decrease in mass (g) after a five-day period submerged in water. A similar 2-day water absorption test, when compared with the 5-day test, showed progressive differentiation between groups containing different bacteria. In addition, trials had absorbed water at three distinct temperatures to model different natural environments for cement concrete (specifically 04ºC, 21ºC, and 37ºC). The concrete at 21ºC tended to absorb less water than at 04ºC and 37ºC. Overall, this study indicates the strain of bacteria imbedded into cement concrete and the temperature at which the concrete subsists have separate, but significant effects on the durability of cement concrete.