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OPTIMIZATION OF CARBONIC ANHYDRASE PRODUCED BY SOIL BACTERIAL ISOLATES FOR BIOCALCIFICATION OF CONCRETE

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ABSTRACT

Biocalcification, otherwise referred to as microbially induced calcium carbonate precipitation (MICCP) is an emerging area of research aimed at enhancing the strength properties of concrete. In this research study, two (2) bacterial isolates named GA(A) and GA(B) were isolated from concrete construction sites and screened for their carbonic anhydrase (CA) producing ability. Isolates GA(A) and GA(B) showed positive reaction to para-nitrophenylacetate (pNPA), producing yellow and peach/orange colour colonies respectively, and were used to produce the crude CA and the mean enzyme activity with standard error of mean for the CA from isolates GA(A) and GA(B) were 0.0321±0.0012 and 0.0351±0.0002 respectively. GA(B) was subsequently used for the large scale production of CA. Isolate GA(B) was identified as *Alcaligenes faecalis* subsp. *parafaecalis* Strain G, using cultural, biochemical and molecular characterizations. Optimum conditions for enzymatic activity were carried out to determine the optimum best conditions for CA activity. Optimum substrate concentration for the CA from isolate GA(A) was 5mM, with 50°C optimum temperature and an optimum pH of 8.5. While CA from *A. faecalis* subsp. *parafaecalis* Strain G had an optimum conditions of 7mM, 50°C, 9.5 respectively. The CA extract was used to reinforce concrete; the results showed an increase in crushing strength on days 7, 14 and 28 with mean crushing strength values of 11.54, 15.52 and 22.28 respectively. Scanning electron micrographs revealed distinctly visible precipitates of calcium carbonate crystals on the surfaces of the concrete treated with the CA. With the results obtained in the study, the CA could have huge potential applications in the biocalcification and healing of concrete.

Keywords: Concrete, Anhydrase, Bacteria, Soil, Optimization