عنوان مقاله:

Process Optimization of Microbially Induced Calcite Precipitation by Ureolytic Yeast Spathospora sp. NN۰۴ using Box-Behnken Design: A Novel Approach towards Biocementation

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خلاصه مقاله:

Introduction: The present study was focused on the statistical optimization of growth parameters for enhancing the Microbially Induced Calcite Precipitation (MICP) using ureolytic yeast strain.Materials and Methods: Thirteen yeast strains were tested for the synthesis of urease enzyme by phenol-hypochlorite assay and were further evaluated for calcite precipitation test. The growth parameters were optimized using the best ureolytic strain by Box-Behnken Design (BBD) and the extracted MICP was characterized through instrumental analysis.Results: Among thirteen yeast strains, Candida tropicalis NN۴, Spathospora sp. NN۰۴, Wickerhamomyces anomalus VIT-NN۰۱ and Candida dubliniensis NN۰۳ showed positive results for the synthesis of urease enzyme. Spathospora sp. was found to be the most potent strain for MICP. A significant enhancement in MICP by Spathospora sp. was observed under optimized conditions viz. A-urea concentration (۸۰.۰ g/L), B-calcium chloride (۴۵.۰ g/L), C-pH (۹.۰) and D-inoculum dosage (۸%, v/v). The actual value (۳۴.۴±۰.۱۲ g/L) was in agreement with predicted value (۳۴.۷±۰.۰۱ g/L) with the R۲ value (۰.۹۹۰۰), confirming the validity of the model. The FTIR of MICP confirmed the fundamental bands of CO۳ stretching and bending vibrations, observed at ۱۳۹۴.۲۳ and ۸۷۴.۸۵ cm-۱. The Scanning Electron Microscope (SEM) images of biomotar revealed aggregated polymorphs of MICP interconnected with yeast mycelium and spores. The Energy Dispersive X-Ray Spectrometer (EDX) analysis indicated the presence of calcite in the biomotar. A remarkable improvement in the compressive strength (۲۸ to ۴۴ MPa) and morphological changes were observed in biocement mortar as compared to cement mortar.Conclusions: This result is the first report on the implementation of ureolytic Spathospora towards the application of biocementation through MICP using BBD.

کلمات کلیدی:

Biocementation, Box Behnken design, Compressive strength, Microbially Induced Calcite Precipitation, Ureolytic Yeast Spathospora sp. NN۰۴