Phase I /2020

Obtainment of bacterial strains compatible with the cement/mortar mixture and preparing agro-industrial by-products as ingredients to support the viability of bacterial cells

Abstract

The Phase I/2020 comprised the following activities: A.1.1. Elaboration of the experimental model for the selection of bacterial strains specialized in carbonatogenesis; A.1.2. Selection of bacterial strains specialized in carbonatogenesis (Part 1); A.1.3. Elaboration of the experimental model for the selection of agro-industrial by-products destined to improve the viability of bacterial cells in constructive materials; A.1.4. Elaboration of procedures/methods for realization and characterization of construction materials containing bacterial cells (Part 1); A.1.5. Dissemination of project results, construction of the project web site.

In order to fulfill the assumed activities an extensive bibliographic material was studied that would allow the elaboration of the conceptual and experimental models. Biomineralization is the process by which living organisms are able to form minerals, the phenomenon taking place through different mechanisms, active and passive. Exploiting biomineralization through practical applications is an environmentally friendly way, with significant implications for reducing energy consumption.

The research was focused on the selection of microorganisms, significantly involved in the global carbon cycle, inducing the precipitation of calcium carbonate. The key factors of bioprecipitation phenomenon are: pH values, the concentration of calcium ion Ca^{+2}, the concentration of dissolved inorganic carbon, and the accessibility of crystallization sites. Preliminary selection tests were performed with bacterial strains from the ICECHIM Microbial Collection, capable of precipitating calcium carbonate under specific culture conditions. In a first stage of the selection process, 4 bacterial strains were tested, namely *Bacillus subtilis, Bacillus amyloliquefaciens, B licheniformis* and *Pseudomonas sp*. Highlighting of precipitated calcium carbonate was done with various dyes that act by forming calcium chelated complexes. Among them, alizarin red S offers more reliable results even at small deposits. A purple staining of the samples was obtained, with an increased intensity in the *B. subtilis* and *B. licheniformis* strains. Optical microscopy images taken on the filtered culture broth and staining with red alizarin S, indicate the appearance of crystals in bacterial biomass. Various agro-industrial by-products with potential in supporting and improving the viability of bacterial cells in building materials were analyzed. The viability of bacterial cells in building materials is fundamental to the bioprecipitation process. Among by products is defined vinasse resulted from the fermentation of molasses. The necessary methods have been established for the characterization of construction materials containing bacterial cells, and this study will be completed in the next stage.

The dissemination of the project results was done as follows: realization of the project website www.icechim.ro https://icechim.ro/project/bioconstrmater/ (Romanian and English language) and registration for participation to the Proceedings of the International Conference "Agriculture for Life, Life for Agriculture", X Edition, organized by the USAMV, June 3-5, 2021, Bucharest.

The following results were obtained: i) experimental model for the selection of bacterial strains specialized in carbonatogenesis; ii) experimental model for the selection of agro-industrial by-products to improve the viability of bacterial cells in construction materials; iii) experimental model of procedures/methods to characterize the construction materials containing bacterial cells (Part 1); iv) construction of project web-site.

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