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Abstract

Sustainable Pozzolan-Based Geomaterials for Slope Revegetation and Stabilization Applications †

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Slopes created alongside roads, embankments, as well as machine levelling operations for maintenance are a major source of disruption in ecosystems. In fact, several studies have shown that these slopes often fail to recover vegetation for long periods. In this research, several geomaterials formulations, intended for slope revegetation and stabilization, were developed and characterized. The main goal was to develop a sustainable geomaterial (eco-friendly and affordable) to be applied using projection technology, an accessible, affordable, and low-complexity process. A total of 14 formulations were developed for which the following were used as main raw materials: local pozzolanic minerals, lime, gypsum, agar-agar, and luffa fragments. A preliminary study was conducted, using lettuce seeds as a model, to select the formulations with higher compatibility with the germination process. The results showed that the presence of agar-agar, in small amounts, enhanced the germination and growth process. Additionally, the luffa's fibrous cellular components allowed the geomaterial to increase porosity, thus facilitating water drainage. Furthermore, a direct influence of the pH of the medium on the germination process was observed. From these results, two formulations (F10 and F13) were selected to carry out the complete characterization and germination studies with endogenous seeds (*Festuca petraea* (Bracel-da-rocha; *Crithmum maritimum* (Perrechil); and *Azorina vidalii* (Azorina)). Regarding the main technical properties, the setting time, workability, density, mechanical properties, water uptake, and degradation profile were evaluated. The results revealed that both formulations presented suitable workability and consistency properties, similar to those of mortars, confirming the possibility of application by projection. Significant differences in setting time, water uptake, mechanical properties, and degradation time were observed, mainly associated with the distinct compositions (F10: substratct/pozzolan/lime/gypsum/agar-agar; F13–substract/pozzolan/agar-agar). Regarding the endogenous seed germination study, conducted over a 6-week period, it was possible to verify the feasibility of seed germination for both formulations. Nevertheless, *Festuca petraea* presented a faster germination process (–16 days) and a higher germination rate (~60%). In conclusion, sustainable geomaterials were developed which fulfil the main technical requirements for projection technology, which may contribute to slope revegetation and stabilization, minimizing the disruption of the ecosystem.

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