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CONTROLLED-RELEASE VITREOUS FERTILIZERS FOR PRECISION AGRICULTURE

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Soil nutrients are essential in the efficient production of safe crops and foods to meet the needs of a growing population. Commercial fertilizers present problems, such as the need for successive doses due to their high solubility[1]. Therefore, it is necessary to develop alternative, biocompatible materials that contain the elements necessary for plant growth and have controlled release capacity[2]. Vitreous fertilizers (VF) have in their composition essential elements for plant development, such as phosphorus (P_2O_5) and silicon (SiO_2), which act as network formers, as well as modifiers, such as Ca^{2+} and K^+, responsible for the degree of connectivity network, reflecting chemical stability and dissolution processes. In this work, the glass composition P_2O_5-SiO_2-CaO-K_2O was investigated, varying the molar proportions of P_2O_5 and SiO_2. The VF was synthed via melt-quenching and characterized by Raman, DSC, XRF, SEM, and EDX. Structural characterizations revealed that variations in phosphorus and silica impact depolymerizing the glass network. The VFs were evaluated about their dissolution in an aqueous medium and citric acid/sodium citrate buffer solution (pH 4.7), accompanied by losses in mass, pH, and morphology after the test. The materials presented different mass loss profiles, with greater losses in the acid solution. In water, those with greater amounts of P_2O_5 acidified the medium. Morphological analyses demonstrated that the longer the contact time with the solutions, the greater the surface wear of the material. Thus, this work shows materials with distinct properties that have the potential to be applied in controlled release systems.

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