

„Preparation of fertilizer formulations according to sustainable agriculture strategy”

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ABSTRACT

The paper presents innovative fertilizer technologies for sustainable agriculture. The research concepts presented include valorization of tannery waste as a renewable source of nitrogen, recovery of micronutrients from smelter slags and their use for fertilizer production, and production of a biopolymer hydrogel matrix for controlled release of nutrients. A hydrolysis process was used to convert tannery shavings. The process conditions were optimized by Response Surface Methodology (RSM). Seventeen amino acids were identified in the resulting hydrolysates, whose biostimulatory effects were confirmed in application tests on plants. For selective recovery of Cu(II), Fe(II) and Zn(II) from slags, the metallurgical material was subjected to chemical leaching. According to the circular economy strategy, post-extraction slag management methods that inhibit the mobility of toxic elements (As, Pb) were proposed. In *in vivo* tests, no phytotoxic effect was observed after application of fertilizer containing micronutrients extracted from slag. Natural polymers such as sodium alginate, carboxymethylcellulose and starch were used to produce the hydrogel matrix. The composites were enriched with micronutrients Cu(II), Mn(II) and Zn(II) by sorption. The mechanical strength of the structures, their swelling ability, and the functional groups responsible for the binding of micronutrient ions were investigated. The sprouts obtained in application tests can be biofortified foods with increased micronutrient content.