

Hydroxyapatite formation in the presence of calcinated eggshells

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One of the challenges which a sustainable economy in respect of phosphorus (P) faces is an open cycle of P in an agricultural system. A pressure for food production accelerates P loading from farming catchments in receiving water bodies. Simultaneously natural resources of P are declining. From this perspective, we aim to develop a technique which allows us to remove P as a precipitated mineral from agricultural areas in bioreactors and to reuse precipitated P minerals as fertilizers.

We performed batch removal and adsorption experiments at the first stage using calcinated eggshell and woodchip bioreactors. Woodchips stimulate denitrifying microbes, impacting nitrogen removal. In our experience, calcined eggshells are an optimal substrate since, due to calcination, formed CaO increases porosity and the surface area and promotes adsorption. In our batch experiments, we observed hydroxyapatite formation due to the high surface reactivity of CaO. The eggshells removed up to 80% of dissolved P with as little as 2-3 total weight % in only 8 hours. At the upscaling stage, we performed flow-through benchtop experiments and treated natural agricultural runoff. The P removal data show that this technology is viable for upscaling field experiments.