Bioremediation of herbicides MCPA and glyphosate using zeolite/microbial film biocomposite

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Pesticides are one of the major environmental pollutants linked not only to environmental issues but also to human health problems. Most of the pesticides do not degrade completely in natural environment or kinetic of their degradation is too slow, resulting in pesticides accumulation in soil and surface waters. Consequences are perturbations in soil and water's ecosystems and impacts on human health, as groundwater is one of the main sources of drinking water.

The aim of this study was to obtain zeolite/microbial film biocomposites that degrade MCPA and Glyphosate with the further objective to introduce them in agricultural fields, thus avoiding pesticides migration in groundwater. The microbial communities were selected and enriched from agricultural field with a history of intensive pesticide usage on basis of their ability to degrade MCPA or glyphosate (1-10 mg/L). Natural mineral zeolite was used as support material for biofilm growth. To promote biofilm formation and improve performance of the final biocomposite in general, the natural zeolite was modified by nontoxic environmentally friendly cations (Li^+, Na^+, K^+, NH_4^+, H^+, Mg^{2+}, Ca^{2+}, Fe^{3+}). The modification approaches that maintain crystalline structure of natural zeolite were selected.

The biocomposite was characterised using SEM and DNA sequencing for biodiversity analysis. Support material was characterised using powder XRD, surface area measurement and chemical composition analysis. Kinetic of degradation of pesticides by biocomposite in liquid media and in pots with sand was studied.

It has been shown that according to zeolite modifications, the microbial activity and biodiversity changed. The best results showed biodegradation of pesticides in less than 2 days in water and 6 days in sand. DNA sequencing of biofilm communities showed the presence of bacteria and fungi genera known to degrade MCPA and/or Glyphosate.