



MACRO 2022

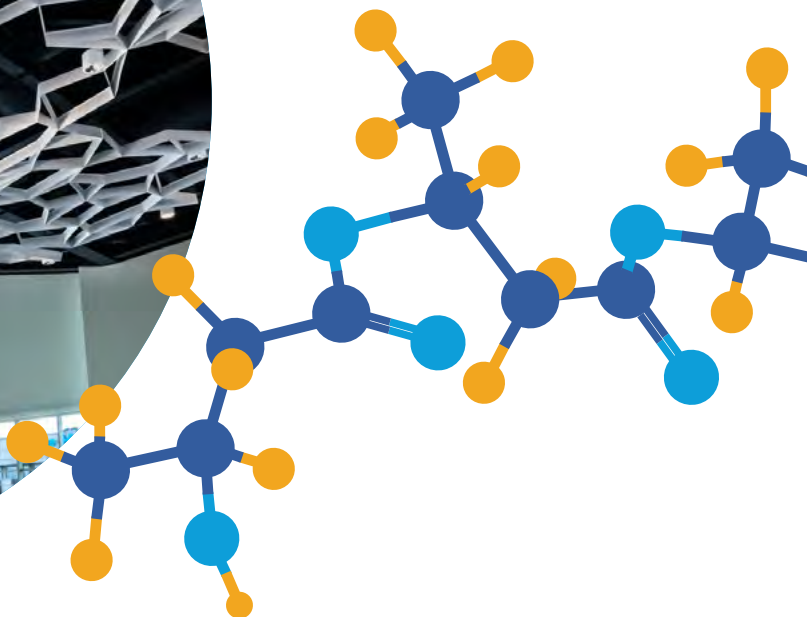
The 49th World Polymer Congress
July 17 – 21, 2022 Winnipeg, Canada

Book of Abstracts



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V-ORAL18: Application of Synthetic Hydrogels As Novel Multifunctional Soil Amendments

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Virtual Presentations, July 9, 2022, 8:00 AM - 9:00 AM

While using polyelectrolytes as soil ameliorants, there are two main directions. The first is the use of linear polymers in order to create a protective polymer-soil cover, which prevents erosion by wind/water flows and mechanical destruction of soils in general. The second direction is the use of hydrophilic crosslinked polymers with network structure, which form hydrogels in aqueous medium, capable of long-term moisture retention, and when mixed with soil, significantly increase soil moisture retention. At the same time, there are almost no descriptions of synthetic polymeric soil conditioners with both effects combined. This work presents the application of two cross-linked copolymers as promising soil conditioners with double effect.

The first material, presented here, is a microgel based on a crosslinked copolymer of polyacrylic acid and N-isopropylacrylamide. It was obtained by emulsion polymerization with an average diameter of beads of ~40 nm. The microgel was applied to sandy soil in a form of 1% solution by sprinkling it over the soil surface. As a result, a polymer-soil crust was formed. The formation of crust was possible due to the small size of separate microgel particles, which allowed them to bind separate soil particles. The crust was demonstrated to be stable against strong wind (up to 54 m/s velocity) and water flows. At the same time, the treatment of soil samples with the polymer greatly enhanced water retention properties compared to an untreated control sample, due to the network structure. For example, treatment of sandy soil increased the available water range (AWR) from ~3% to ~16%. The second material is a hydrogel based on a crosslinked copolymer of acrylamide, potassium acrylate and starch. The mass content of crosslinking agent was ~0.04%. It was so low on purpose to make the hydrogel mechanically weak so that it is easily deformable and spreadable over the soil surface. The polymer was obtained by graft polymerization in block, then it was crushed to 0.25-0.5 mm-sized granules. The swollen hydrogel with 1% polymer content was applied to the soil surface by sprinkling. Likewise, a polymer-soil crust was obtained. This time, it was created due to the fact that the swollen hydrogel was able to spread over the surface of the soil and cover all soil particles with a uniform film. The crust also withstood strong wind/water streams. Simultaneously, treatment of sandy soil with polymer increased the AWR from 3% to 21%.

We compared the presented materials with conventional polymeric soil amendments. First, a linear polymer, polyacrylic acid, also created a mechanically stable polymer-soil crust but it had no impactful water retention. Second, we tested a commercial hydrogel, cross-linked copolymer of acrylamide and potassium acrylate with ~0.2% crosslinking density. In turn, it enhanced the water regime of sandy soil (increased AWR from 3% to 19%), but did not form any mechanically stable structure. This way, the novel polymeric soil amendments, presented here, combine properties of conventional materials.

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