Effect of biofilm on soil hydraulic properties: Laboratory studies using xanthan as surrogate

Hella Rosenkranz*, Sascha C. Iden, and Wolfgang Durner
TU Braunschweig | Institute of Geoecology | Braunschweig, Germany
*h.rosenkranz@tu-braunschweig.de | phone +49 (0) 531 391-5633

Introduction
Extracellular polymeric substances (EPS) are produced by many soil bacteria in the porous soil matrix and are attached to the bacterium cell and soil particles. The desiccation and rewetting behavior of EPS-influenced soils is changed in a way that the bacteria can better adapt to altered environmental conditions. For experimental purposes, xanthan can be used as a surrogate for the EPS because it has very similar physical characteristics.

The objective of this work is the quantification of the effect of xanthan on soil hydraulic properties. We determined the soil water retention and hydraulic conductivity curves of xanthan-affected soils with different experiments using small laboratory columns.

Materials and methods
The soil water retention and hydraulic conductivity functions of a biofilm-affected sandy soil material (Hamra) were determined by using xanthan as an EPS surrogate. The amount of added xanthan was varied in 3 stages, 0, 0.1, and 0.25 %.

Results: Evaporation

Results: Retention and conductivity

Conclusions
- The shape of the soil water retention curve is altered for all levels of xanthan addition because of the high water-holding capacity of the xanthan.
- The unsaturated hydraulic conductivity is reduced markedly by the added xanthan. The reason for this is the low permeability of the xanthan which blocks the pores.
- The reduction in unsaturated hydraulic conductivity is high enough to fully suppress stage-one evaporation for the soil-xanthan mixtures.

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