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Polydisperse Transport of Biosolids derived Dissolved Organic Matter

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Benefits of composted biosolid application to the top soil layer, is related to the high affinity of its solid phase to many organic chemicals (e.g.- pesticides, herbicides, emerging contaminants and heavy metals). This in turn, can create a natural buffer to prevent or delay their movement. On the other hand, the dissolved organic matter (DOM) fraction can enhance the apparent solubility and/or transport of some organic and/or inorganic contaminants from the top soil layer to the root zone and further to the groundwater and/or surface water bodies. Therefore, a quantitative understanding of DOM transport in soils is crucial for evaluating the bioavailability and mobility of the potential contaminants. The transport of DOM in soils is commonly evaluated from measurements of dissolved organic carbon (DOC). However, DOM is a polydisperse mixture of molecules with a wide range of molecular weights, chemical compositions, and functional group identities. Previous studies implied that polydispersity affected the transport of DOM in soil profile with respect to its origin, affinity to a given soil and the environmental conditions. The main objective of this study is to quantify the polydisperse transport of biosolids derived DOM in soils. To follow this objective a series of soil-column flow-through experiments were carried out. Two scenarios were examined (i) a pulse input of DOM into a DOM-free soil and (ii) and leaching a soil amended with biosolid (5% wt). The flow-through experiments conducted under steady-state saturated flow. The leachates were collected in fractions equivalent to 0.25 pore-volumes and analyzed for: DOC, TN, and optical density. The molecular weight distribution of each fraction was analyzed with Gel Permeation Chromatography (GPC). The GPC analysis enables as to quantify the polydispersity of the DOM, rather than average values of weight or number average molecular weight – as measured by other methods. We hypothesize that under saturated water flow conditions (i.e. no solid-air interface) the displacement of small and hydrophilic molecules follows by the larger ones with hydrophobic nature. The established breakthrough curves will be presented in conjunction with the molecular weight distribution as a function of time. The potential implications for the enhanced transport of heavy metals and hydrophobic pollutants will be discussed.