Multi-component Surrogate and Tracer Mixture Used to Evaluate Wastewater Treatment in Soil

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Abstract. A surrogate and tracer "cocktail" consisting of two bacteriophages (MS-2 and PRD-1), a conservative tracer (bromide) and an ice nucleating-active bacteria (Pseudomonas sp.) were introduced into four intermediate scale three-dimensional lysimeters and an individual home site. The sand filled 3-dimensional lysimeters were dosed with domestic wastewater and surrogates to investigate the hydraulic and purification performance of soil based systems during start up and early development of a clogging zone. A single family home, whose system was in operation for IO years and had evidence of ponding, was used to characterize purification of bacteria and virus in mature systems. Surrogate and tracer testing were conducted at weeks 8 and 45 in the lysimeters and breakthrough data were analyzed. After 48 weeks, soil cores were collected and analyzed for chemical and microbial properties. Lysimeter results show that purification processes were gradually established over four months or longer, after which there were increased removal efficiencies (>90%) for organic constituents, microorganisms and virus, while limited removal of nutrients were observed. Soil core analysis of both the field site and the lysimeters revealed increased biogeochemical activity at the infiltrative surface (from 0- 1 5 cm depth). Controlled laboratory experiments were also conducted to determine the relationship between microbial character estimated in percolate soil water as obtained from extraction of soil solids as compared to those measured directly in the percolate water. Preliminary results show that pore water densities calculated from soil cores are consistently higher than densities measured in percolate water collected at the same location. Therefore the soil core extract, which resulted in higher densities, is a more conservative measure compared to the concentration actually contained in the percolate/soil water.