Conceptual interpretation of infiltration under sealing process by membrane fouling models

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**Abstract.** Membrane fouling models (Hernia, 1982) describe filtration membrane fouling which can occur by pore blocking, pore constriction, caking or a combination of the mechanisms (Bolton et al., 2006). In the paper, we are interested in the application of these models to the infiltration of overland flow into the soil porous media under sealing formation. The soil porous media is assumed to be the filter and the turbid runoff, flowing over an erodible slope, infiltrating into the soil porous media, is assimilated to the filtrating fluid. The mathematical models relate by explicit equations the pressure to time during constant flow process, and volume to time during constant pressure process. In particular the Complete Pore Blocking (CPB) assumes that each single particle participates to the blocking of the pores and that these do not settle on the previously deposited particles. Furthermore, each filtration deposit particle obstructs and blocks a single pore. The intermediate pore blocking IPB assumes a pore blocking and particles accumulation at the surface. Standard pore blocking SPB model assumes that particles accumulate inside membranes on the walls of straight cylindrical pores thus the pore volume decreases in proportion to the filtered volume. The pores are assumed to have a constant diameter and length. The cake filtration model (CF model) occurs when particles accumulate on the surface of a membrane in a permeable cake of increasing thickness that adds resistance to flow. The total resistance R is the sum of the membrane resistance and the cake resistance. In the paper, we study exchange fluxes between the pore water in the vadose zone and the free water body in the soil surface. The focus is on a post ponding phase, when the surface runoff occurs and a water layer flow on the soil surface slope, while the soil is saturated. The question is: assuming a rigid media, how much does the infiltration is impeded by the sealing layer and/or by the pore blocking? This is especially important for soil erosion processes and flooding formation. To this purpose, the individual Hermia models and the combined Bolton models were assessed through testing under constant pressure. We validated the models with experimental trials of runoff flow infiltration, measuring the infiltration rate by rainfall experiments in a silty-clay loam soil.

Hermia J., (1982), Constant pressure blocking filtration laws-application to power law non-newtonian fluids, Transaction of the Institution of Chemical Engineers, 60,183-187.

Bolton G., Kuriyel R., LaCasse D., (2006), Combined models of membrane fouling: development and application to microfiltration and ultrafiltration of biological fluids, Journal of Membrane Science, 277, pag. 75-84.