Modeling Variably Saturated Water Flow within Planned Covers of a Hypothetical Potash Tailings Pile

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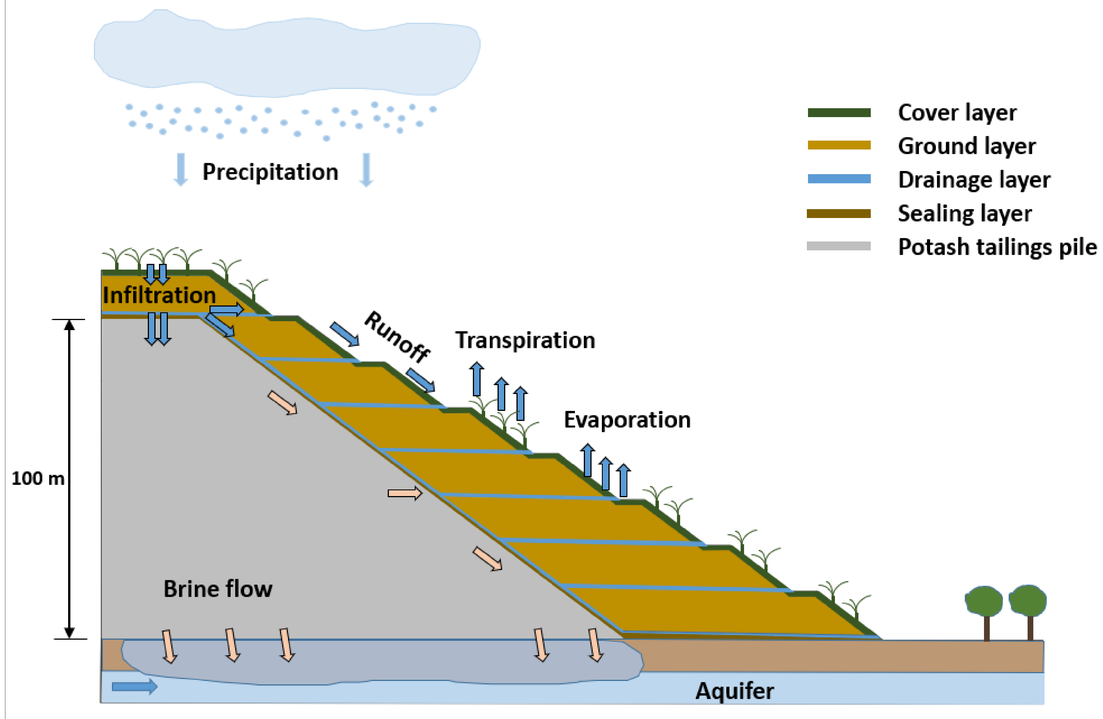
Abstract

Motivation

- Potash extraction produces solid residues consisting mainly of sodium chloride
- Impact of precipitation on the body of the tailings pile leads to leaching of salts with potential risk to surface- and groundwater

Fig. Potash Tailings Pile (Heringen, Germany)

Hypothetical Study Area



Research Questions

- Which processes have the greatest influence on the efficiency of a cover system for a potash tailings pile?
- How is the flow of water and salt inside the potash tailings pile and its interaction with the cover system and the groundwater?

Methodology

- Creation of model and establishment of suitable boundary conditions
- Creation of a water balance (surface runoff, infiltration into the cover body, evaporative loss to the atmosphere)
- Simulation of water flow with different cover layer configurations
- Estimation of brine flows through the tailings pile, through the cover body and into the groundwater

Governing Equations

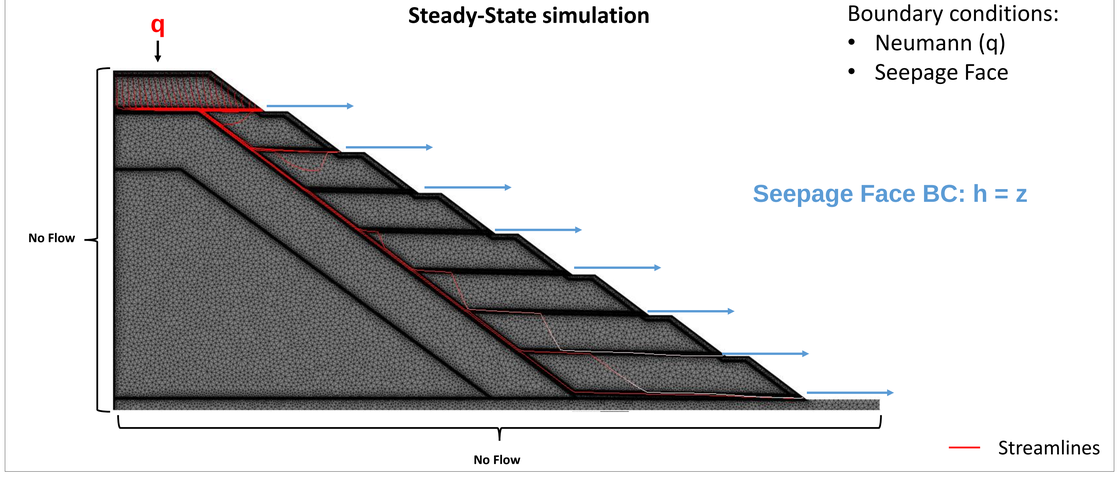
- Unsaturated-Saturated Flow

$$S_o \cdot s(\psi)\frac{\partial \psi}{\partial t} + \epsilon \frac{\partial s(\psi)}{\partial t} - \nabla \cdot \{K_r(s)\mathbf{K}[\nabla\psi + (1+\chi)\mathbf{e}]\} = Q_h$$

- Unsaturated – Saturated Mass Transport

$$s(\psi)R_d(C)\frac{\partial C}{\partial t} + \mathbf{q}\cdot\nabla C - \nabla\cdot[(\epsilon s(\psi)D_d\mathbf{I} + \mathbf{D})\cdot\nabla C] + \\ +[s(\psi)R(C)\vartheta + Q_h]C = s(\psi)Q_c$$

Preliminary Results: Testing BC



Numerical Software

- FEFLOW: Finite Element Modeling of Flow

Future Works

- Transient Flow Simulation
- Mass Transport Simulation