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Flow transfer modelling in vadose zone of a dredged sediment deposit: comparison of numerical solving methods.

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North of France has to deal with the environmental impact of a number of landfill deposits of dredged sediments (inherited from the past). One among them exhibit a highly contaminated subsurface layer (Cd: 1200 mg/kg ; Pb: 21000 mg/kg ; Zn: 15000 mg/kg) , so the consequences of the aqueous discharge from this layer due to the successive meteoric infiltrations on local groundwater quality have to be know. A lithologic and hydrogeologic characterisation of this site including water level and chemical monitoring was achieved (Lions, 2004). These first results showed that an effective risk assessment of this site had to consider modelling transport in the vadose zone. To predict migration of the heavy metals down to the groundwater (used for water supply), several numerical models of water flows and transport exist for vadose zone.

The aim of this work is to identify and compare three numerical tools: Hytec (van der Lee et al., 2003), Feflow (Diersch, 1998) and Porflow (Acri 1985-2004). These tools are dedicates to problems involving transient fluid flow and mass transport in variably saturated porous media. All these tools models use the Richard's equation expressed in matrix potential connected to the moisture content by the Van Genuchten mathematics model (Van Genuchten, 1981).

The simulations were realised in 1D. Parameters and initial and boundary conditions, used in this simulations, were the same for the three numeric tools. The pollutants aqueous concentrations were taken equal to the measured concentrations in the shal-

low groundwater from the highly contaminated subsurface layer. Site lithology and input parameters like initial condition, boundary conditions and saturated hydraulic conductivity come from the previous site field characterisation. Other parameters needed in the models, such as alpha, n, m with Mualem's condition, saturated and residual moisture content of Van Genuchten's mathematics model and total porosity were not directly measured. Therefore, estimates for these parameters were taken from the literature based on the textural classes defined for collected solid samples for each layers of the conceptual model (Guymon, 1994). Two of the models (Feflow and Porflow) use the Kd approach for the adsorption process and the third (Hytec) introduces geochemical mechanisms. In the case of studied site, previous work (Lions, 2004) highlights that the most likely geochemical processes include surface interaction, and precipitation when carbonates were present.

The results given by the different numerical solving methods were comparable. They reproduced globaly the observed phenomena, water table seasonal variations and migration of Pb, Zn and Cd. These first simulations allowed to test the reliability of numerical tools on a simplified case of the studied site. These simulations will be completed with a characterisation of the vadose zone based on in situ suction and moisture measurements as well as laboratory retention curves and hydraulic conductivities measurements. It will lead to a more realistic parameterisation of the site and a better comprehension of metals migration in the vadose zone. Then 2D and 3D simulating could be realised.